

# Hospital Waste Management in Four Major Cities

*A synthesis report*



*UWEP Working Document 8*

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Cover photo: Accumulated blood bags, plastic needles, syringes, catheters, used medicine bottles at a government hospital in Karachi

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## EXECUTIVE SUMMARY

This Report draws together the findings of researchers in Bogota, Colombia; Hanoi, Vietnam; Karachi, Pakistan; and Manila, Philippines. They studied the techniques and systems applied for the segregation, storage, collection, disposal and recycling of wastes generated in hospitals and other health care institutions in these four cities and focussed particularly on the role of micro and small enterprises (MSEs). The terms of reference for the research studies were interpreted in different ways by the researchers and the studies reported in the Consultants' reports reflected the local conditions prevailing.

It is clear that the management of health care wastes is not satisfactory in any of the cities studied. Existing systems, especially in Government hospitals, are unsuitable, unhygienic and unacceptable. The general awareness of the health and environmental risks resulting from poor health care waste management practices is limited at all levels of management, except at private hospitals in Karachi and Manila. A lack of knowledge about and concern for the handling, fate and effects of infectious and hazardous health care wastes by administrators, doctors, nurses, cleaners, waste handlers, recyclers and waste pickers gives rise to serious problems in these cities.

The report details the sources, generation rates, segregation approaches, storage arrangements, collection and disposal systems and recycling conditions for health care wastes in the four cities. While there is an attempt to segregate infectious and hazardous waste in some hospitals the subsequent handling of segregated materials is uncontrolled and exposes hospital workers, municipal workers, waste pickers and recyclers to serious health risks. Inappropriate recycling of some components of health care wastes is taking place in all the cities studied and, in general, no special arrangements are made to handle infectious and hazardous materials once they leave the source. Some hospitals have incinerators for infectious waste but many are not operating continuously and emission control systems are non-existent.

A more organised approach to health care waste management is recommended by all the researchers and a National Plan, supported by legislation, is seen as a mechanism for achieving common sustainable levels of service in any country. Exploitation of low-paid workers and waste pickers occurs in all four cities and needs to stop. Proper planning with adequate resources being allocated for health care waste management is necessary to improve the conditions of all workers and players in the recycling system. Training of health care administrators, medical staff and workers is recommended as an important component of national planning for health care waste management. Whilst segregation with standard colour-coded containers for hazardous materials is seen as essential in the management of health care wastes, the current practice of allowing the recycling of any component for which there is a local market must be terminated in the interests of health.

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## **1. INTRODUCTION**

### **1.1 Background to the Report**

This Report attempts to synthesize and analyze six reports on research studies carried out by consultants in four major cities: Bogota, Colombia; Hanoi, Vietnam; Karachi, Pakistan; and Manila, Philippines. The six reports forming the basis for this Report are:

Hospital Waste Management and Recycling in Bogota: A Case Study, by Andrea Lampis (MSc), Institute for Environmental Studies (IDEA), National University of Colombia and Research Programme on Solid Waste (PIRS), National University of Colombia, Bogota, September 1997.

Health Care Waste Management at Karachi, Pakistan: Final Report by Rehan Ahmed, Environmental and Sanitary Engineer, Karachi, August 1997.

Health Care Waste and Small Enterprises in Hanoi, Vietnam, by Nguyen Thanh Binh, Dang Thi Sy, Michael DiGregorio with Nguyen Thi Huong Giang, Nguyen Thi Thanh Hoa and Bui Cao Son, Center for Natural Resources and Environmental Studies, Vietnam National University, Hanoi, February 1997.

Linking Community and Small Enterprise Activities with Urban Waste Management: Hanoi Case Study, by Michael DiGregorio, Trinh Thi Tien, Nguyen Thi Hoang Lau and Nguyen Thu Ha, Center for Natural Resources and Environmental Studies, Vietnam National University, Hanoi, August 1997.

Hospital Solid Waste Management: Two Case Studies in Metro Manila, Philippines, by Rolando T. Soncuya, Loida D. Matias and Danilo G. Lapid, Center for Advanced Philippine Studies, Quezon City, Philippines, September 1997.

Exploratory Study of Waste Management of Minor Health Care Institutions and Funeral Establishments in Metro Manila, Philippines, by Rolando T. Soncuya, Loida B. Matias and Danilo G. Lapid, Centre for Advanced Philippine Studies, Quezon City, Metro Manila, Philippines, July 1997.

All six reports were sponsored by WASTE using support from the Netherlands Ministry for Development Cooperation (DGIS). The authors of this Report were contracted by WASTE under the Urban Waste Expertise Programme (UWEP).

The Consultants from the four cities participated in an International Workshop on Hospital and Municipal Solid Waste Management sponsored by WASTE and held in Quezon City, Metro Manila, Philippines in February 1997. A report on this Workshop was also available to the authors of this Report; the summary recommendations from the Workshop Report are reproduced in Box 1.

### **1.2 Health Care Institutions Covered in the Report**

The terms of reference adopted by the Consultants in the four cities were not the same and this, together with differing local conditions, gave rise to the six reports covering waste

**BOX 1 - RECOMMENDATIONS OF THE INTERNATIONAL WORKSHOP ON HOSPITAL AND MUNICIPAL SOLID WASTE MANAGEMENT 17-21 February 1997, Quezon City, Metro Manila, Philippines.**

*Based on the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis and discussions on hospital waste management, the following recommendations were made:*

- a. Provide training for waste handlers in hospitals;*
- b. Track the waste source*
- c. Sell the waste per weight*
- d. Maximize separation of hazardous and non-hazardous waste*
- e. Separate the non-hazardous waste*
- f. Avoid/reduce use of use / disposable items*
- g. Separate close to the source to avoid mixing or contamination*
- h. Set attainable standards*
- i. Discourage in-house handling without separation*
- j. Discourage of tampering hazardous waste*
- k. Contracting SMEs for non hazardous waste*

management in different combinations of health care institutions. However, four of the reports included data on waste management in major hospitals, with the Bogota report and one of the Manila reports providing greater depth case studies of three and two major hospitals, respectively.

The Hanoi report concentrating on health care wastes covered, in addition to hospitals, district health service centers, a village infirmary, a birthing center and a TB clinic. The Karachi report covered the broadest scope of health care institution and, in addition to major hospitals, also included data from pathological laboratories, X-ray clinics/radiological laboratories, dentists, clinics, dispensaries, consulting clinics, basic health centres, maternity homes and blood banks. Clinics, health centers and funeral establishments were included in the second report from Manila.

Apart from the Hanoi report on health care waste management, all the other reports discussed recycling of health care waste components. One of the Hanoi reports was concerned with solid waste recycling in general but did not single out health care waste recycling in particular. The major health care institutions covered by the Consultants' reports are detailed in Box 2.

### **1.3 Study Methods**

Case study techniques were adopted for the hospital waste research studies in Colombia and the Philippines. In Pakistan and Vietnam, extant data on and visits to a large number of health care institutions were used to assess waste management practices. The same approach was adopted in the exploratory study of minor health care institutions and funeral establishments in Manila. In all cases, interviews with the various 'players' in health care waste management and recycling were adopted to elicit 'actual', rather than 'theoretical', information.

**BOX 2 - MAJOR HEALTH CARE INSTITUTIONS COVERED BY THE SOURCE REPORTS**

**COLOMBIA, BOGOTA**

San Ignacio Hospital  
San Juan de Dios Hospital  
La Misericordia Hospital  
Shaio Clinic  
San Antonio Clinic

**PAKISTAN, KARACHI**

Civil Hospital  
Jinnah Post Graduate Health Care Centre  
Abbasi Shaheed Hospital  
Liaquat National Hospital  
The Aga Khan University Hospital

**PHILIPPINES, MANILA**

Capitol Medical Center  
East Avenue Medical Center

**VIETNAM, HANOI**

St. Paul Hospital	Railway Hospital
Bach Mai Hospital	Thanh Tri District Hospital
Army Hospital 108	Women's Hospital
Birthing Hospital B	Viet Xo Hospital
Hai Ba Trung Hospital	Swedish Children's Hospital
Hoa Nhai Hospital	Army Hospital 154

**2. LEGISLATION GOVERNING HEALTH CARE WASTE MANAGEMENT**

In all four countries, Colombia, Pakistan, Philippines and Vietnam, there are laws, regulations and/or guidelines relating to the management of hazardous wastes, including health care wastes. An elaborate legislative framework, incorporating laws and decrees issued over the period 1979-93 by the Ministry of Health, Ministry of Environment, Ministry of Works and Social Security, Department of Health and the District Secretariat of Health, regulates health care waste management in Colombia to international standards. The Pakistan Environmental Protection Ordinance (PEPO), 1983 provides the legislation to control environmental pollution in Pakistan but does not specifically mention health care wastes, whereas PEPO, 1997, which supersedes PEPO, 1983, defines hospital waste and deals with the handling of hazardous substances. In the Philippines, hospital waste is primarily regulated by an act issued by the Government in 1990 and a comprehensive ordinance issued by the Metropolitan Manila Authority in 1991. The Ministry of Health in Vietnam has issued guidelines for managing health care wastes and 1996 circulars have drawn attention to the poor practice in storing, transporting and disposing of health care wastes and made recommendations for improvement.

Although there appears to be a lack of detailed laws and regulations governing health care waste management in Vietnam, the practice of managing these wastes there is very similar to that in Colombia, Pakistan and the Philippines. The implementation and enforcement of detailed laws and regulations on health care waste management is yet to be achieved in all four countries and monitoring of compliance with existing legislation is not yet carried out in any of these countries. Failure of existing legislation in these four countries, which seem to be typical of many developing countries, gives rise to serious concerns about the environmental and public health impacts of poor storage, handling, collection, recycling and disposal of health care wastes. Recent studies in Colombia and Vietnam have drawn attention to the inadequacy of existing health care waste management in those countries.

In none of these four countries is there legislation to favour or restrict recycling of waste components. Only in Colombia does there seem to be moves to facilitate recycling through the favouring of Community-based Organizations (CBOs) or cooperatives in awarding solid waste contracts by municipalities.

### **3. SEGREGATION AND PRIMARY STORAGE OF HEALTH CARE WASTE**

#### **3.1 Hospital Wastes**

Hospital staff in all four countries are not disciplined in the handling of health care wastes. This leads to poor or no segregation of different types of hospital waste, with general and infectious wastes often being mixed in the same primary container at source. In Government and Municipal Hospitals in Karachi there are no colour-coded containers for different types of waste and all waste materials are mixed in baskets or pots placed under patients' beds. The same applies at one hospital in Bogota, where only black bags are supplied to the wards. In Hanoi, standard covered plastic containers are used for all wastes.

In Manila, the two hospitals studied utilized black, green and yellow plastic bags to line cans in the wards, for general waste, biodegradable and infectious (including sharps) wastes, respectively. Box 3 gives the details of segregation as practised at the Capitol Medical Center in Manila. Black and red bags are used in four of the Bogota hospitals studied and green and red bags used in the other. In one of Bogota's hospitals, white bags are used for recyclable materials. The private hospital in Karachi uses green and red bags. However, nowhere is there any confidence in the different containers or bags holding only the type of waste for which they were intended.

Pathological wastes are typically given special treatment in most hospitals. In Hanoi, this might be burial on or off-site or on-site incineration and in Karachi, on-site incineration is intended. Hospitals in Bogota and Manila tend to treat pathological wastes with formalin or sodium hypochlorite before containment in red bags prior to disposal. Even so, in all four cities, some infectious wastes and even pathological wastes find their way into containers and bags holding general hospital waste. Placentas are frequently returned to families for burial on their premises in Manila while in Hanoi they are sold to fish or pig farmers. In the Karachi hospitals, all placentas are held in cold storage before being exported to France. There is generally no special attention given to waste from radiological laboratories, which is typically mixed with general waste.

### **BOX 3 - SEGREGATION AT THE CAPITOL MEDICAL CENTER (CMC) MANILA**

*CMC requires the use of three waste cans lined with three (3) colored plastic bags for every patient room, emergency room-out patient department, operating room-recovery room, delivery room-nursery, intensive care unit-coronary care unit, floor nurses station, x-ray and CT scan areas to separate infectious, non-infectious and biodegradable wastes.*

*Waste cans (8"x10"x12") lined with black plastic bags are for non-biodegradable and non-infectious wastes such as cans, bottles, tetrabrick containers, styropor, straw, plastic, boxes, wrappers, newspapers.*

*Waste cans lined with green plastic bags are biodegradable wastes such as fruits and vegetables' peelings, leftover food, flowers, leaves, and twigs.*

*Waste cans lined with yellow plastic bags are for infectious waste such as disposable materials used for collection of blood and body fluids like diapers, sanitary pads, incontinent pads, materials (like tissue paper) with blood secretions and other exudates, dressings, bandages, used cotton balls, gauze, IV tubings, used syringes, Foleys catheter/tubings, gloves and drains.*

*In the Department of Pathology, there are three types of wastes that are segregated namely, dry non-infectious waste, blood, serum and plasma and urine and feces.*

*Dry non-infectious waste such as paper, plastics and other non-infectious ordinary wastes are placed in separate black plastic bags and are collected daily by the housekeeping personnel for disposal.*

*Excess blood, serum and plasma specimens from different sections of the laboratory are collected in a glass container or flask (9"x5" dia.) and sterilized by autoclaving (pressure cooker) for thirty minutes at 121 degrees centigrade. Unused and expired blood bags are packed together and disposed by incineration.*

*Pipettes, test tubes, and other glassware used in testing infectious specimen (hepatitis, AIDS, typhoid fever, etc.) are soaked in 0.5% sodium hypochlorite for at least 30 minutes before disposal.*

*Sharps like disposable syringes are collected in bags and bought down for incineration. Needles and sharps are collected immediately after use in cans or puncture free containers (8" x 4" dia. Hard plastic) for incineration.*

*Pathological waste such as tissues, organs, fetuses and body parts are disinfected and/or preserved in covered plastic or bottle containers with 10% formalin. These are disposed by incineration.*

*For other hospital sections not included in the previous discussions such as dietary and canteen, administrative offices and doctors' offices, two waste cans lined with plastic bags shall be maintained. The black plastic lined cans are for non-biodegradable while the green plastic lined cans are for biodegradable wastes.*

### **3.2 Wastes in Minor Health Care Institutions**

Only the research studies in Hanoi and Karachi report on waste management in minor health care institutions such as clinics, dispensaries and basic health care units. From the information collected, it is clear that common waste bins are used in such establishments and no segregation of different types of waste is attempted, apart from readily recyclable materials.

## 4. GENERATION OF HEALTH CARE WASTES

### 4.1 Hospital Waste Sources

Although the four reports giving data on hospital waste generation present information in different forms, the following sources of waste were identified in the locations indicated:

Surgery (Operating Rooms)	- Bogota, Hanoi, Karachi, Manila	First Aid	- Bogota
Intensive Care Unit	- Bogota, Manila	Wards (Patient Rooms)	- Bogota, Hanoi, Karachi, Manila
Obstetrics (Gynaecology)	- Hanoi, Karachi, Manila	Outpatients	- Bogota, Manila
Coronary (Cardiology) Unit	- Bogota, Karachi, Manila	Sterilization	- Bogota
Neurology	- Bogota, Karachi	Burns Unit	- Bogota, Karachi
Nuclear Medicine (Radiotherapy)	- Bogota, Karachi, Manila	Blood Bank	- Bogota
Haemodynamic Unit	- Bogota	Infectious Diseases (Isolation) Unit	- Bogota, Karachi
Nutritional Unit	- Bogota	Orthopaedics Unit	- Bogota, Karachi
Lactating Unit	- Bogota	Odontology (Dental)	- Bogota, Karachi
Kitchens	- Bogota, Hanoi	Laundry	- Bogota
Doctors' Private Area	- Bogota	Otology	- Karachi
Cafeteria	- Bogota	E.N.T.	- Karachi, Manila
Laboratory (Pathology)	- Bogota, Manila	Eye (Ophthalmology)	- Karachi, Manila
Emergencies (Casualty)	- Bogota, Karachi, Manila	Paediatric Unit	- Karachi, Manila
Non-invasive Tests	- Bogota	Psychology	- Karachi
		Skin (Dermatology)	- Karachi
		Physiotherapy	- Karachi
		Urology	- Karachi
		Thoracic Medicine	- Karachi

Several of the reports provided data for different floors of the hospitals, where each floor contained different departments, wards and ancillary services.

### 4.2 Types of Hospital Waste

In terms of hospital waste types, the four reports provided information in different forms. The Bogota report showed a breakdown of wastes in one hospital only as black and red bags whereas, for two other hospitals, several types of waste were identified, including non-hazardous, hazardous, cardboard, paper and kraft and glass. In Hanoi, the majority of hospitals separate hazardous and non-hazardous types of waste at source but these are mixed in common containers before eventual transport to disposal. The Karachi report provides estimates of hospital waste types only in terms of general waste and infected waste. At Manila hospitals, waste is segregated into non-infectious dry waste (black bags), non-infectious wet waste (green bags) and infectious waste (yellow bags). Pathological wastes, as indicated in Section 3.1, usually receive special treatment in all four cities. Sharps are segregated in Bogota, Hanoi and Manila hospitals but only in Manila do they receive incineration before disposal. In some Hanoi hospitals disposable plastic syringes are recycled, without any special treatment.

### 4.3 Hospital Waste Quantities

The report on Manila hospitals contains no definitive information on waste quantities whereas the Bogota report provides data on waste quantities at one hospital by floor and by day of the week broken down for red and black bag wastes. For the other two major hospitals covered by the Bogota report, the total waste produced varied from 1-3.5 kg/day per bed of which 0.3-0.9 kg/day per bed was hazardous. The breakdown of type of waste generated at the various sources in Shaio Clinic is given, as an example, in Table 1.

**TABLE 1. Shaio Clinic, Bogota: Proportions of Different Types of Waste at Various Sources**

Source	Non Hazardous	Hazardous	Cardboard	Paper	Glass	Sub-total by Area
Surgery theatres	9.29%	22.70%	0.00%	0.0%	0.0%	12.57%
Intensive Care Unit	6.33%	39.96%	0.00%	0.00%	0.00%	16.42%
Coronary Care Unit	2.00%	5.88%	0.00%	3.30%	0.00%	3.10%
3rd Floor Patients' Rooms	3.13%	0.59%	0.00%	0.00%	0.00%	1.98%
2nd Floor Patients' Rooms	3.33%	0.05%	0.00%	5.94%	0.00%	2.06%
1st Floor Central Block	12.23%	0.79%	0.00%	3.96%	0.00%	7.33%
1st Floor Northern Block	4.16%	0.35%	0.00%	7.92%	0.00%	2.67%
Nuclear Medicine Unit	3.67%	0.49%	0.00%	6.60%	0.00%	2.41%
Haemodynamic Unit	2.52%	16.84%	0.00%	0.66%	100.0%	6.88%
Nutritional Unit	1.14%	0.00%	0.94%	0.00%	0.00%	0.73%
Kitchen	23.44%	0.00%	0.94%	8.91%	0.00%	13.67%
Doctor's Private Area	0.50%	0.00%	0.00%	2.64%	0.00%	0.35%
Cafeteria	10.15%	0.00%	0.75%	0.00%	0.00%	5.85%
Laboratory	0.76%	8.77%	1.78%	24.42	0.00%	3.98%
Emergencies	2.65%	3.09%	0.37%	0.00%	0.00%	2.53%
Non-invasive tests	0.64%	0.00%	0.00%	0.00%	0.00%	0.36%
First Aid	1.97%	0.30%	0.00%	0.00%	0.00%	1.22%
Others	12.10%	0.20%	95.23%	35.64%	0.00%	15.88%
<b>SUB-TOTAL BY TYPE</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>

Based on interviews at 18 hospitals in Hanoi, total waste generation varied between 0.6 and 4.6 kg/day per bed, depending on the 'relative wealth of the hospital and patients'. For the hospitals in Karachi, the total waste produced varied from 1.63-3.69 kg/day per bed for Government hospitals, with an estimate of 61-70 per cent of the total being infectious waste. At the only private hospital studied, the total waste generation was 0.99 kg/day per bed with an estimated 38 per cent being infectious waste. Table 2 provides data on the generation of waste at the various sources in four Karachi hospitals.

### 4.4 Waste Generation in Other Health Care Establishments

The report on Bogota health care wastes covers only one clinic but gives no information on waste types or quantities at that establishment. Likewise, the Hanoi report contains no information on wastes types or quantities at health care institutions other than hospitals. Health care establishments other than hospitals are included in the Karachi report and estimates of total waste generated and the types (general or infected waste) were given as follows:

Clinics and Dispensaries - 75g/day per patient (80 per cent infected)

Basic Health Units	- 40g/day per patient (80 per cent infected)
Consulting Clinics	- 25g/day per patient (10 per cent infected)
Nursing Homes	- 300g/day per person (100 per cent general waste)
Maternity Homes	- 4.1kg/day per bed (70 per cent infected)

It is clear that the quantities of waste generated in most of these health care establishments in Karachi are small but some contain high proportions of infected waste.

**TABLE 2. Waste Generation at Various Sources in Four Karachi Hospitals**

Wards/ Departments Sources	Generation Rates (Kg/bed per day)			
	Civil Hospital	JPMC	Abbasi Shaheed Hospital	LNH
Medical	3.228	1.320	2.860	0.990
Surgical	3.346	1.270	1.575	1.150
Gynae. & Obstt.	3.810	1.780	3.250	1.540
Orthopaedic	3.442	1.560	1.920	1.080
Cardiac	3.490	-	1.580	1.460
C.C.U.	5.500	-	2.500	1.560
Neurology	2.600	2.730	1.220	-
Urology	3.520	-	-	-
E.N.T.	3.400	2.320	1.470	-
Eye	2.700	0.430	1.180	-
Paediatric	3.096	-	1.380	1.360
Nephrology	-	3.250	1.290	-
Plastic Surgery	3.710	1.670	-	-
Skin	3.500	-	-	-
Burns	6.800	-	1.910	-
Accidental	-	1.560	-	-
Psychiatry/Psychia	2.750	0.680	-	1.070
<b>TOTAL</b>	<b>3.470</b>	<b>1.510</b>	<b>2.030</b>	<b>1.280</b>

The report on minor health care institutions and general establishments in Metro Manila provides the information on hazardous and infectious waste generation contained in Table 3. It was observed that much of the waste generated in these establishments is mixed with general waste and this accounts for the relatively small quantities of hazardous waste reported. In maternity and lying-in clinics and in Barangay health centers, sharps are segregated, whereas many other infectious wastes are mixed with general waste. Funeral establishments typically generate more waste than the other types of establishment included in Table 3.

## **5. PRIMARY COLLECTION OF HEALTH CARE WASTES**

### **5.1 Hospital Wastes**

Within hospitals, the wastes stored in primary containers and bags at source are collected by in-house nurses' aides, cleaners or janitors in Hanoi, Karachi and Manila but contracted cleaners are used in Bogota. In the three major hospitals studied in Bogota, waste generated in the wards is collected by a contracted cooperative (El Porvenir) and placed in storage

rooms designated, but not designed specifically, for waste storage and located on each floor. Different coloured bags are mixed indiscriminately in these storage rooms and, at several times during each day, the collected wastes are transported through the hospital, often by hand cart, to a central storage area outside the hospital buildings. In this process, little attention is given to the safety of the system and the workers of El Porvenir are more motivated by time- and effort-saving than by health and security. The report identified open red bags, needles in unsafe containers, overloading of containers and leakage from containers as typical deficiencies of the system which give rise to risk to the workers and the public.

**TABLE 3. Generation of Hazardous and Infectious Waste in Minor Health Care Establishments in Metro Manila**

Waste per Week	Consultation Diagnostic Clinic		Maternity Clinic		Lying-in Clinic		Barangay Health Center		Funeral Establishment	
	%	No	%	No	%	No	%	No	%	No
Less than 1 kg	80%	16			25%	1	11.11%	1		
1 kg less 2 kg	10%	2					22.2%	2		
2 kg less 3 kg	5%	1	33.3%	1	25%	1	33.33%	3	25%	1
3 kg less 4 kg	5%	1					11.11%	1		
4 kg less 5 kg			33.3%	1	25%	1	22.22%	2	25%	1
5 kg less 6 kg										
6 kg less 7 kg										
7 kg less 8 kg			33.3%	1					25%	1
8 kg less 9 kg										
9 kg less 10 kg					25%					
10 kg and more									25%	1
<b>TOTAL</b>	<b>100%</b>	<b>20</b>	<b>100%</b>	<b>3</b>	<b>100%</b>	<b>4</b>	<b>100%</b>	<b>9</b>	<b>100%</b>	<b>4</b>

In Hanoi, nurses' aides are charged with the collection of waste from wards, etc. and transport it to common waste bins, where the contents of the segregated- waste containers are mixed. 'Sweepers' (sanitary staff) employed by the hospitals in Karachi collect waste from the wards at the end of each of three shifts per day in 100 litre drums provided in each ward. These drums are then transported on trolleys or, often, on the shoulders or heads of the sweepers to a central storage area outside the hospital buildings. The sweepers are not aware of the hazardous nature of the material they are handling and no special precautions are taken to protect themselves or the public. One supervisor for each shift is responsible for hospital cleaning and waste collection and disposal. A comparison of waste handling in two Karachi Hospitals is given in Box 4.

In Manila hospitals, janitors collect waste on every floor at the end of every work shift and transfer the different coloured bags to a temporary storage room (awaiting the scheduled time for use of the elevator) or place them in larger black and green plastic bags before transporting them to the central storage area outside the hospital buildings. Some segregation of recyclable materials is carried out by the janitors, principally paper and cartons. A supervisor controls the janitors. The system of hospital waste management at the East Avenue Medical Center is outlined in Figure 1.

## **BOX 4 – COMPARISON OF WASTE HANDLING IN TWO KARACHI HOSPITALS**

### **ABBASI SHAHEED HOSPITAL (Metropolitan Government and General Hospital)**

*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.*

### **AGA KHAN UNIVERSITY HOSPITAL (Private Hospital)**

*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.*

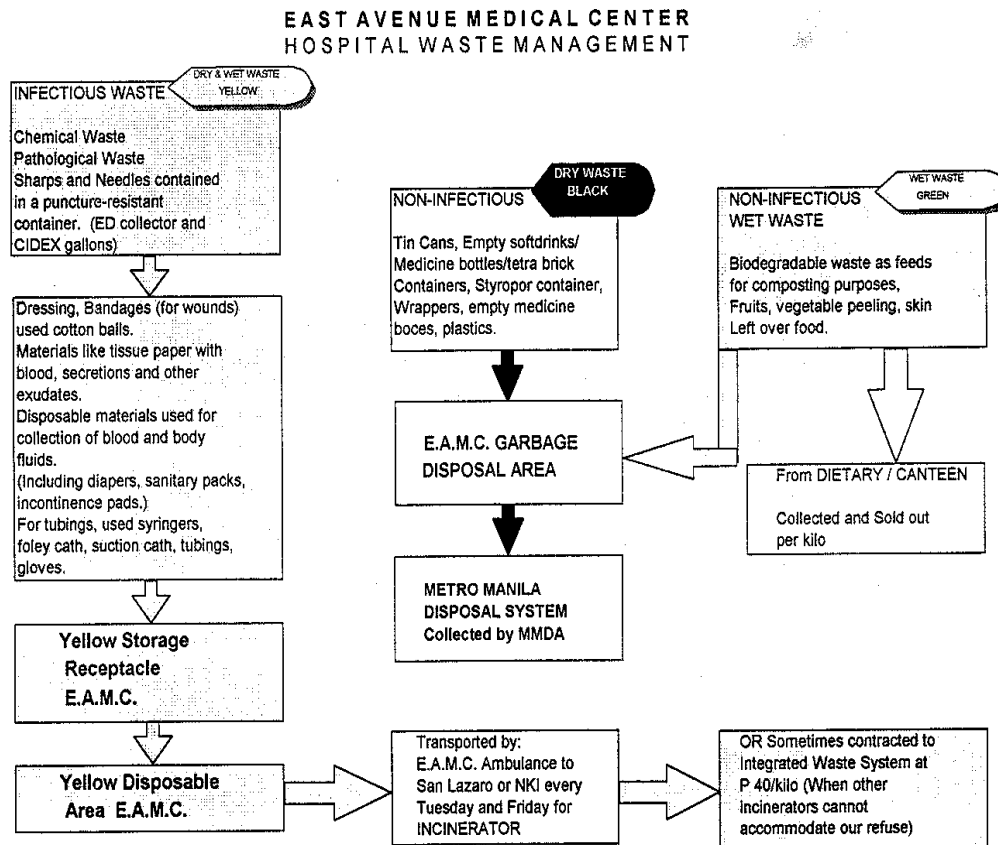
*Infectious waste is kept in red colour bags which includes sharp containers, tissues, animal carcasses, blood, body fluid, cotton, bandages, expired medicines and other hazardous items. The red bags are carried by a special team of personnel with appropriate personal protection gears, equipment and 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 autoclaved and sterilized before reuse or disposal.*

*The infectious waste packed 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.*

## **5.2 Other Health Care Establishments**

At minor clinics and health centres, etc. the primary collection of wastes is informal and usually left to the cleaners of the premises, who are not made aware of the risks involved. Some minor segregation of waste materials is carried out for recycling purposes.



**Figure 1. East Avenue Medical Center Hospital Waste Management**

## 6. SECONDARY STORAGE OF HOSPITAL WASTES AND RECYCLING

### 6.1 Central Storage of Wastes at Hospitals

In all four cities, most hospitals have a central area outdoors on the hospital site where waste is stored for days before disposal. In some cases the storage area is roofed and, in others, skips are used for the temporary storage of waste. The storage areas for waste in the two Manila hospitals are relatively small, giving rise to problems due to unreliable waste collection. In Karachi, hospital waste stored temporarily on site is regularly transferred by the hospital sweepers to communal storage bins located in nearby communities and mixed with general household solid waste. In Bogota hospitals, the most hazardous and infectious wastes are incinerated but the general waste is contaminated as a result of poor segregation practices.

Storage of hospital waste on site is not well managed in most cases and access to waste pickers, vermin, feral dogs, etc. is not always prevented. With open and leaking bags being common, these storage areas are hazardous, particularly to workers handling the wastes, and few precautions are taken to protect them against health risks. Hospital management generally attaches little importance to waste management and regulations and guidelines are ignored.

## **6.2 Central Storage of Wastes at Other Health Care Establishments**

The relatively small total quantities of wastes generated at minor health care establishments do not cause problems of central storage. Some clinics and health centres bury a proportion of their waste on site and burn part of the remainder. Funeral establishments in Manila burn about 25 per cent of their waste on site.

## **7. COLLECTION OF WASTES FROM HEALTH CARE ESTABLISHMENTS**

Apart from those wastes which are buried or incinerated on site, the health care wastes generated in hospitals, clinics and health centres, etc. are generally collected by the municipal solid waste service. No special vehicles are provided for health care wastes, although dedicated vehicles are sometimes allocated, and no special precautions are taken by the municipal workers in handling the hazardous or infectious wastes. Red or yellow bagged wastes are typically mixed indiscriminately with black bagged waste and these combined with general municipal waste. In one Manila hospital, yellow-bagged wastes are transported separately by ambulance to be incinerated at another hospital or in a commercial incinerator. Hazardous waste in Bogota is collected by a separate vehicle marked "Attention, hazardous waste" but no special measures are provided and contaminated leakage frequently occurs.

## **8. DISPOSAL OF HEALTH CARE WASTES**

### **8.1 On-site Burial**

Most of the hospitals covered by the four studies did not use on-site burial as a disposal method but some hospitals in Hanoi bury body parts and tissues and some sharps on hospital premises. Many minor health care establishments bury a significant proportion of their waste on site.

### **8.2 Incineration**

Many minor health care establishments burn a proportion of their waste on site but this practice is not controlled and causes air pollution. However, it reduces the quantity of hazardous, infectious waste for disposal elsewhere.

In Bogota hospitals, hazardous and infectious wastes, are incinerated on site in incinerators of doubtful efficiency. These incinerators are not properly designed for the disposal of clinical waste and are not operated to high standards. At one hospital, infectious waste has to be transported to another hospital's incinerator for disposal. Some of the hospitals in Karachi have on-site incinerators to burn pathological and infectious waste but not all operate

satisfactorily or regularly. Only in the private hospital, where waste is managed by an experienced international company, is the on-site incinerator properly designed, well maintained and efficiently operated in handling all infectious waste. The hospitals studied in Manila adopt incineration for disposal of infectious waste, one in a very old incinerator on site (due to be replaced) and the other in an incinerator located at a nearby hospital.

Incineration has been selected as the preferred system for disposal of health care wastes in Hanoi but a centralized modern incinerator has not yet been installed. In the meantime, many inefficient on-site incinerators are used to dispose of body parts and tissues.

### **8.3 Municipal Landfilling**

In all four cities, by far the largest proportion of health care wastes is disposed of in municipal landfills. Modern sanitary landfilling techniques are not adopted at any of the landfills and so health care wastes are dumped indiscriminately with general municipal solid wastes. No special management of these wastes is carried out and there is universal scavenging of the dump sites by people surviving solely on recycling materials extracted from the municipal and health care wastes. They take no special precautions with health care wastes and treat all wastes in the same way. In some cases, for example in Karachi, some waste is burnt at municipal dump sites.

### **8.4 Guidelines**

A summary of guidelines for hospital waste management prepared by the District Secretariat of Health of Bogota (DSHB) is provided in Box. 5.

## **9. RECYCLING ACTIVITIES IN RESPECT OF HEALTH CARE WASTES**

### **9.1 Segregation for Recycling at Hospitals**

Varying degrees of segregation of recyclable components of hospital wastes occur at hospitals in the four cities. In general, these activities are not organized by the hospital management and have grown out of opportunities available to the workers involved in handling the hospital wastes.

In Bogota hospitals, the 'El Porvenir' cooperative workers segregate paper, cardboard and glass for recycling at any stage of waste handling. In doing so, they are not careful and recyclable materials are generally contaminated with blood and infectious fluids leaking from red bags. The Consultant carrying out the study in Bogota believes that more and less - contaminated recyclable materials could be produced by El Porvenir if the handling of hospital waste was better coordinated and planned. It was also stressed that the health risks to these poorly-paid workers could be reduced with better and more responsible management. In one of the Bogota hospitals, a recycling policy exists aimed at making a profit from the sale of recyclable materials, including cardboard, scrap metals, wood and serological bags.

In Hanoi, most of the hospitals studied practised some form of waste segregation of recyclable materials. This was achieved in more than half of the hospitals by itinerant junk

buyers and collectors taking materials freely from waste bins. In other cases, such individuals gained

**BOX 5 – SUMMARY OF GUIDELINES FOR HOSPITAL WASTE MANAGEMENT OF THE DSHB**

Classification	Element	Treatment	Final destination
Solid waste containing biological contaminants	Sharps <ul style="list-style-type: none"> <li>• Needles</li> <li>• Bisturi</li> <li>• Glass</li> </ul>	<ol style="list-style-type: none"> <li>1. Dispose in a resistant container with a small opening.</li> <li>2. Inactivate germs with sodium hypochlorite at 5000 PPM for 30 mins.</li> <li>3. Dispose of in a double red bag without taking waste out of its container.</li> </ol>	<ul style="list-style-type: none"> <li>• Sterilise</li> <li>• Incinerate</li> <li>• Reduce into small pieces</li> </ul>
	Probes, tubes, catheters and syringes.	<ol style="list-style-type: none"> <li>1. Inactivate germs with sodium hypochlorite at 5000 PPM for 30 mins.</li> <li>2. Dispose of in a double red bag.</li> </ol>	<ul style="list-style-type: none"> <li>• Incinerate</li> <li>• Reduce into small pieces</li> </ul>
	Medical materials used in patient care (bandages, gloves, etc.)	<ol style="list-style-type: none"> <li>1. Dispose of in a double red bag.</li> </ol>	<ul style="list-style-type: none"> <li>• Incinerate</li> </ul>
	Laboratory material used in cultivation	<ol style="list-style-type: none"> <li>1. Sterilise</li> <li>2. Dispose of in a double red bag.</li> </ol>	<ul style="list-style-type: none"> <li>• Incinerate</li> </ul>
	Anthropomorphic parts	<ol style="list-style-type: none"> <li>1. Fix in formalin</li> <li>2. Dispose of in a double red bag.</li> </ol>	<ul style="list-style-type: none"> <li>• Incinerate</li> </ul>
	Food waste <ul style="list-style-type: none"> <li>• Processed</li> <li>• Left overs</li> </ul>	<ol style="list-style-type: none"> <li>1. Inactivate germs with sodium hypochlorite at 5000 PPM for 30 mins.</li> </ol>	<ul style="list-style-type: none"> <li>• Incinerate</li> <li>• Reduce into small pieces</li> </ul>
Solid waste not containing biological contaminants	Ordinary waste <ul style="list-style-type: none"> <li>• Dust, soil.</li> <li>• Butts, cigarettes, paper.</li> </ul>	<ol style="list-style-type: none"> <li>1. Sweep with wet broom</li> <li>2. Dispose of in black bag</li> </ol>	<ul style="list-style-type: none"> <li>• Sanitary landfill</li> </ul>
	Recyclable material <ul style="list-style-type: none"> <li>• Glass, X-ray films</li> <li>• Plastic, paper, scrap metal and industrial derivatives.</li> </ul>	<ol style="list-style-type: none"> <li>1. Classify at source</li> <li>2. Dispose of in white bag</li> </ol>	<ul style="list-style-type: none"> <li>• Reduce into small pieces.</li> <li>• Sale to thirds.</li> </ul>
Liquid waste containing biological contaminants	Blood components Blood Haemoderivatives	<ol style="list-style-type: none"> <li>1. Dispose of in a double red bag</li> </ol>	<ul style="list-style-type: none"> <li>• Incinerate with elaboration of acts.</li> </ul>
	Other bodily fluids	<ol style="list-style-type: none"> <li>2. Inactivate germs with sodium hypochlorite at 5000 PPM for 30 mins.</li> </ol>	<ul style="list-style-type: none"> <li>• Discharge to sewer</li> </ul>

permission to access hospital waste from the municipal waste collection workers, who they paid, or received recyclable materials (such as transfusion bottles) by direct purchase from hospital staff. In several cases, the nurses' aides were also involved in this activity, allowing the mainly women junk buyers to assist them in collecting waste in the hospitals in exchange for the recyclable fraction. The majority of hospitals in Hanoi sell placentas to fish and pig farms. Over the past two years, plastic waste, especially transfusion bottles and syringes, has been highly sought after by junk buyers although the amount generated in Vietnam is not great by comparison with the norm in other countries in Southeast Asia. Plastic syringes are collected by nurses' aides and sold to junk buyers or collected directly from the waste by the junk buyers. At a few hospitals in Hanoi, waste pickers collect plastic waste materials from the waste storage areas because no segregation has occurred earlier in the waste handling system. Glass transfusion bottles are washed and steamed for reuse in the hospital and some plastic transfusion bottles are used to store bodily fluids. Medicine bottles are washed and

used as containers for swabs or storage of body tissues at some hospitals and sold to junk buyers at others. Glass syringes are boiled or steamed for reuse in hospitals and even plastic syringes are, illegally, boiled for reuse in a few hospitals. Paper and cardboard are recycled from most hospitals in Hanoi. Three hospitals sell old X-ray films to jewellers for electrolytic extraction of silver.

In Karachi hospitals, most of the infectious waste is not recycled since it contains little recyclable material. Only placentas are recycled, to France as discussed in Section 3.1. The main component of health care wastes generated in Karachi is plastic waste and most of this is recycled. Transfusion bags and accessories are segregated from waste by the sanitary workers and sold to hawkers. Likewise, syringes are removed from hospital waste by the sanitary workers and sold to hawkers. Glass bottles are retrieved by sanitation workers, to be cleaned, washed and reused. Paper is generally not segregated within hospitals in Karachi but is scavenged from the main waste storage area outside each hospital. Major items of metal waste are collected by the sanitary workers and sold to street hawkers. In addition to the internal segregation of recyclable materials at Karachi hospitals, hospital wastes are scavenged when placed in communal bins with municipal solid waste from nearby communities. The exposure of waste pickers to dangerous hospital wastes is extremely hazardous yet no controls are applied.

In Manila, the rules covering government entities in selling property has limited the opportunities for recycling of materials in hospital waste. Officially, recyclable materials cannot be sold without formal tendering by three bidders. Nevertheless, at the two hospitals studied, segregation of recyclable materials occurs informally. For example, at both hospitals biodegradable waste from kitchens, etc. are segregated and sold to pig farmers with the proceeds going to key personnel in the kitchens. Paper, cardboard and glass are segregated in the hospitals and either sold to itinerant buyers or given to the municipal waste collection workers as an incentive to collect the waste more frequently. In one hospital, the administration is involved in recycling paper and cardboard and, in this case, the proceeds benefit the hospital. More often, recycling is carried out informally by hospital sanitary workers and information was not given freely to the Consultant. Municipal waste collection workers also scavenge recyclable materials from the hospital waste collected and sell them on to junk shop specialists. A summary of waste segregation at the Capitol Medical Center in Manila is shown in Figure 2.

## **9.2 Segregation for Recycling at Other Health Care Establishments**

The quantities of recyclable materials in waste from minor health care establishments are small. In general, any segregation for recycling will be carried out by the workers handling the waste in clinics and health centres, etc. but the minimal quantities generated limit the opportunities for sale. In Karachi and Manila, the level of recycling activities in minor health care establishments is reported by the Consultants to be negligible.

## **9.3 Segregation for Recycling at Municipal Landfills**

At all landfills serving the four cities covered by the study, a large number of waste pickers rely on recycling for their survival. As already mentioned, they do not differentiate between general solid waste and hazardous health care waste and go through all wastes looking for recyclable materials. In Hanoi, 20-25 per cent of the total municipal solid waste generated is

recycled, about one third of which is paper and one third metals. Most of the recycling is achieved by urban recyclers, and at the landfills only relatively small quantities of bone, paper, plastics and glass are retrieved. Health care wastes in Hanoi, and in the other three cities of the study, are likely to contribute only a small amount of such recyclable materials at landfills because of the at-source segregation of the most valuable components.

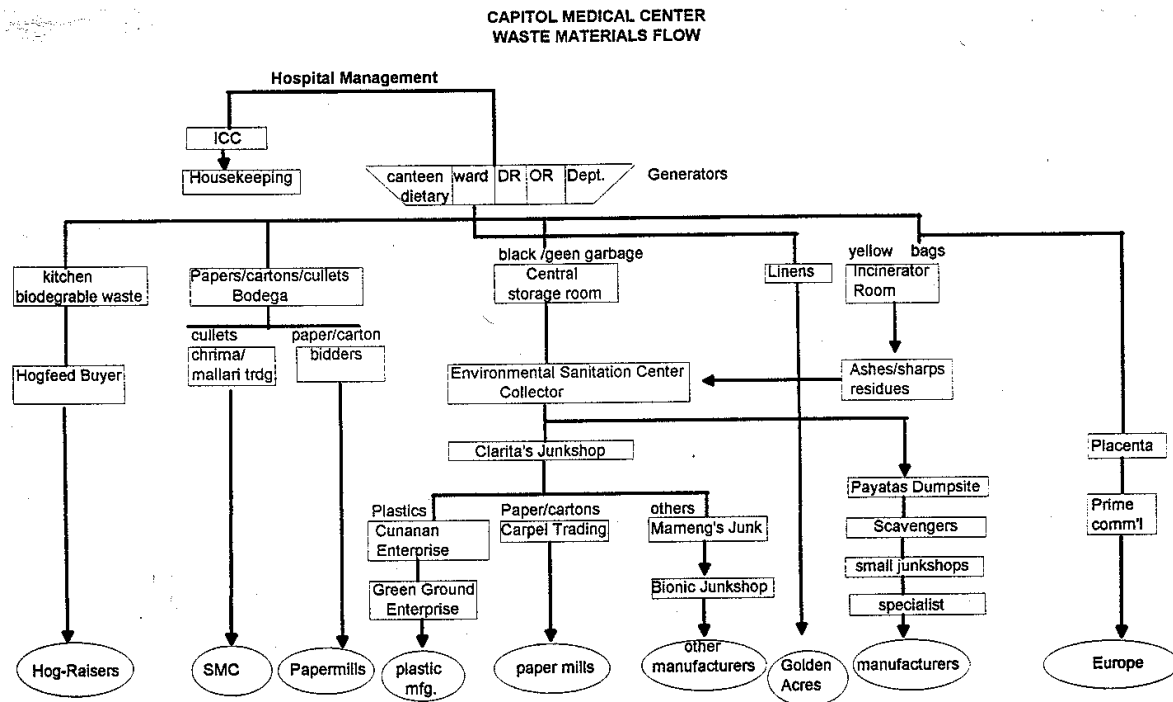


Figure 2. Capitol Medical Center Waste Materials Flow

## 10. THE RECYCLERS

### 10.1 The Initial Players in Hospital Waste Recycling

The initial players in hospital waste recycling are the workers responsible for handling waste in the hospitals. In Hanoi, Karachi and Manila, the nurses' aides, sweepers and janitors are employed by the hospitals and are controlled by hospital supervisors with little support or advice from senior management. Much of their recycling activity is informal and benefits only the workers involved.

In Bogota, this initial role is played by workers employed by the cooperative 'El Porvenir', which has contractual arrangements with the hospitals. El Porvenir is affiliated to the National Association of Recyclers (ANR) formed in 1989 with the help of the Social Foundation to legitimise the activities of recyclers as beneficial in reducing the environmental impact and financial cost of solid waste management. Over the past seven years, El Porvenir has been involved in recycling both in the streets and in three hospitals. The cooperative is structured as a micro-enterprise and as such has achieved better dealing and sale conditions with junk shops and SMEs and provided more security and dignity for its

employees. The contractual terms with the three hospitals do not include a specific clause spelling out the obligation to segregate recyclable materials but containers and stores for recyclable materials are mentioned

Women are often employed to carry out this initial responsibility in hospital waste management and sometimes there is a prevalence of women handling certain responsibilities, for example in charge of cleaning work and serving in maternity wards.

## **10.2 The Second Tier of Hospital Waste Recyclers**

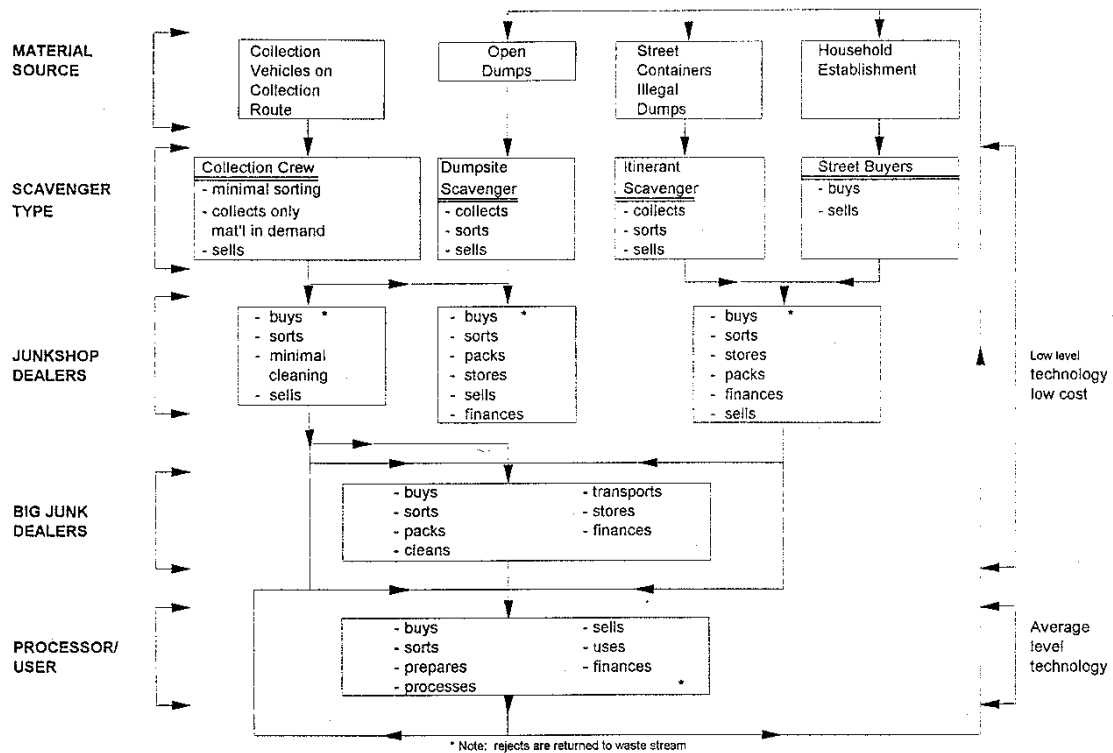
Municipal waste collection workers often serve as the second tier of hospital waste recyclers. They frequently receive recyclable materials segregated by the hospital waste handlers and sell them on. In addition, they scavenge the waste collected at hospitals before dumping it at the landfill site. This is the main system in Manila but, in Bogota hospitals, El Porvenir tends to play both the initial and second tier roles in waste recycling.

In Hanoi and Karachi, itinerant junk buyers and street hawkers serve as intermediaries between hospital waste handlers and recycling junk shops. A large number (c. 7,000 in 1996) of itinerant junk buyers work in Hanoi; most of them are farmers from rural provinces and women make up 66 per cent of the total. In Karachi, street hawkers buy recyclables from households and institutions, including hospitals and other health care establishments.

## **10.3 The Third Tier of Hospital Waste Recyclers**

Municipal waste collection workers and itinerant junk buyers sell on the recyclable materials segregated from health care wastes to middle dealers in the form of junk shops and, in Hanoi, depot operators. Middle dealers serve the purpose of storing and, sometimes, further separating recyclable materials until a sufficient quantity has accumulated to make it worthwhile selling it on to main dealers. El Porvenir serves as a middle dealer in Bogota with centralized organization of solid waste recycling, of which hospital waste recycling is only a small part. In Karachi, many junk shops illegally located on public land serve as middle dealers and often have to pay protection money to the police. The owners manage and control all the dealings and make all decisions regarding the business.

The place and function of middle dealers in waste recycling in Metro Manila are indicated in Figure 1. A junk shop located near the municipal landfill specializes in hospital waste recyclables, including those from the two hospitals included in the Consultant's study. The owner operates without a permit from the city authorities because she is squatting on the property rather than owning it. Her son is the municipal worker collecting waste from the hospitals included in the study. On arrival at her premises the waste is further segregated into aluminium, paper, bottles, plastics and metals, with sharps and blades placed in a separate container and returned to the collection vehicle for disposal at the landfill. The waste collection workers, primarily her son's group, are paid the prevailing prices for that day. Lack of registration makes the owner of the junk shop susceptible to extortion and harassment by the police and other government officials. Shortage of capital limits her buying capacity and at present she employs no staff. Another female junk shop owner in Metro Manila employs six male workers working ten hours per day for the minimum wage applicable to the National Capital Region.



**FIGURE 3. Materials Waste Flow in Metro Manila**

In Hanoi, many second tier junk buyers (termed depots) are simply individuals (usually women) located on a city street who purchase from the itinerant junk buyers. The junk shops in fixed locations are also middle level dealers. Depot operators are located both within the city and at the landfill site, the latter purchasing primarily from waste pickers working there. The mainly women Depot operators report paying money to local police for the right to work in the same neighbourhood. Sorting, washing and grading of recyclable materials is usually carried out at the operator's home by her children. Box 6 is an excerpt from The Hanoi Consultant's report dealing with junk dealers.

#### 10.4 Main Dealers in Hospital Waste Recycling

In Bogota, the middle dealing 'El Porvenir' cooperative sells recyclable materials to 'industry' (specific main dealers are not detailed in the Consultant's report). However, the Social Foundation is attempting to persuade such cooperatives as El Porvenir to create stronger links with industry and introduce schemes geared to adding value, for example by the production of consumer goods, such as toys and kitchen accessories, from recycled plastics. In one instance quoted (Barranquilla), a cooperative already exists to recycle plastics in the form of tiles. There is the longer-term objective among recyclers in Bogota to upgrade their capacity to compete with high-tech firms.

## **BOX 6 – JUNK DEALERS IN HANOI**

*Junk dealers serve as intermediaries in the recycling industry. Most are small shop owners and sidewalk depot operators though a few operate larger shops as dealers and agents of factories.*

*Small and medium junk dealers have fixed locations on the sidewalk or in shops. Most dealers come from villages near the center of the city and are female. Back in their home villages, selection and classification are done by other members of the family (their husband, children, old people etc.). Husbands or male members usually transport junk by bicycle, tricycle or motorized pedicab back home, to other buyers or dealers within the city or directly to recycling workshops.*

*Larger shops are generally managed by Hanoi residents who have advantages in location and investment capital as well as business acumen. These larger businesses require broader occupational networks, are very competitive, and require some skill in handling venture capitals. As a result, large shops are generally managed by men, though wives and daughters may handle much of the day to day transactions. Their goods are usually sold directly to manufacturers (paper and scrap metals, for example) and are transported by them to the factory. Agents frequently establish delivery contracts with purchasers which should be fulfilled by certain dates and supply a certain amount of goods.*

Vietnam has a long history of recycling waste materials and, in Hanoi's case, many villages in the suburbs and in nearby Provinces have developed skills which now make them main dealers in the solid waste recycling system. Where there is a material to exploit, there is a village that has developed the trade. 'Industrial' villages have evolved wherein the specific community undertakes a particular aspect of recycling and, from time to time, hires workers from nearby agricultural communities, thus contributing to the rural economy. These 'industrial' villages recycle their products both to the city, to large-scale industries such as paper companies and steel mills, and to rural areas, where specialized villages transform materials such as plastics into saleable goods. Increasingly, recycling factories with higher scale and greater diversity of products are developing in rural areas around Hanoi.

Over time, the main recycling dealers in Karachi have decentralized due to 'pressure on space and working environment'. The main dealers usually deal in one single waste item only and have personal contacts with middle dealers. One of the main locations for main dealers is close to an industrial trading estate, making it convenient to access end-users. Bulk quantities of recyclable materials are collected, prepared and sold on. Even though the premises of such main dealers have a legal status the operators are not registered and have to pay protection money to enforcing agencies. The ultimate industrial receivers of recycled materials in Karachi tend to be located near the main dealers and produce end-products for which there is a market. An example of a recycled end-product is 'dana', which are the plastic pellets produced after molten waste plastic extrusion, cooling and cutting. Waste glass and paper are likewise converted into useful products in specialist enterprises.

In the Consultant's report on Manila, two main dealers are identified as receiving, cleaning and accumulating glass cullet, especially from hospital waste. When sufficient quantity (one truckload) is available, the cullet is delivered to a glass bottle-making plant associated with a

major brewery. Another enterprise is identified as specializing in paper and cardboard segregation for delivery to paper mills. A major enterprise, employing approximately sixty workers, produces plastic pellets for sale to the manufacturers of plastic products.

## **11. ECONOMIC ASPECTS OF HANDLING HEALTH CARE WASTES**

### **11.1 Hospital Waste Collection Costs**

In the Bogota hospitals covered by the study, El Porvenir is contracted to provide cleaning and waste collection services for an annual total of Colombian Pesos (\$)233,540,068 (Colombian \$ 1000 = US\$1). One of the hospitals provides more than Colombian \$ 200,000,000 per year in revenue, with the other two providing approximately Colombian \$ 17,000,000 and 15,000,000 per year, relatively minor amounts. In addition, the three hospitals were charged a total of between Colombian \$ 250,000 and 500,000 per annum (1994 prices) for waste collection by the municipality. Hence, the total cost of cleaning and waste collection services in three hospitals in Bogota is probably between US\$ 500,000 and 750,000, reflecting the low wages paid to the workers of El Porvenir and the municipality. These workers do not enjoy a good standard of living or quality of life.

No information on the costs of collecting hospital waste in Hanoi is given in the Consultant's report. The Karachi Consultant's report likewise omits the costs of hospital waste collection but gives the wages of sanitation staff in health care establishments as Pakistan Rupees (Rs) 1000-1600 (US\$ 25-40) per month. Municipal staff also receive other benefits, such as health care treatment and overtime. Health care establishment staff also receive health care treatment for themselves and their families and receive gifts from recovered patients. They also receive the income from sale of segregated recyclable materials, estimated at US\$ 2-5 per month per worker.

The Manila report on hospital waste gives little information on collection costs, apart from suggesting that one hospital pays the garbage collector Philippine Pesos (P) 700 per week as an 'incentive' (P 2.5 = US\$ 1). In addition, one of the dump site operators is said to charge a fee of P 200 for each load of waste delivered, compared with P 40/kg charged by the private incinerator.

It is clear from the Consultants' reports that in none of the four cities are hospital wastes collection and segregation carried out efficiently and, as a result, economic costs are not being charged. Workers involved in health care waste collection are poorly paid and the costs associated with this service in no way reflect the real costs to society in terms of social, health and environmental damages.

### **11.2 Economics of Hospital Waste Recycling**

The report on Bogota hospital waste management includes figures for the revenue generated by recycling of materials from hospital waste. For all three hospitals included in the study, the annual total income from sale of materials recycled by El Porvenir is Colombian \$ 10,600,000. This figure is almost negligible compared with even the minimal costs reported for the annual cost of cleaning and waste collection at these three hospitals. The economic benefits of the current level of recycling in Bogota hospitals would appear to be irrelevant in

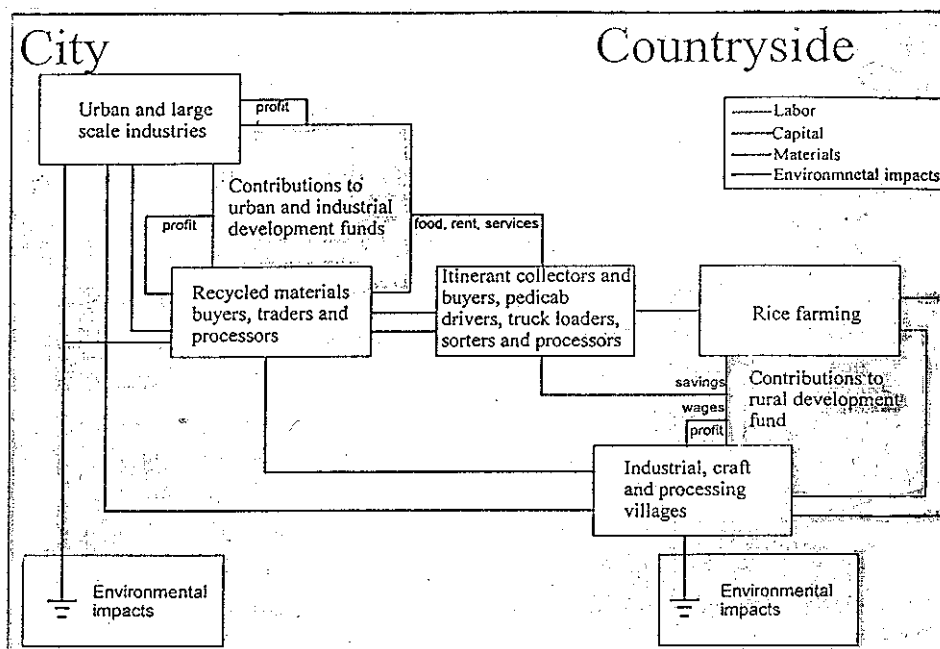
terms of the general economy but the wider recycling activities associated with solid waste management is quite important in social and economic terms, considering the thousands of otherwise destitute people associated with the activity through the National Association of Recyclers.

The Hanoi report on ‘Linking Community and Small Enterprise Activities with Urban Waste Management’ provides a survey of the income of waste recyclers as shown in Table 4. This indicates the importance of women in the recycling industry although it was also found that males earned more, on average, than females. Junk collectors’ income is lowest, with 63 per cent of them earning less than US\$ 0.91 per day compared with 33.5 per cent of junk buyers earning at that level. The importance of waste recycling in the economy of Vietnam is illustrated by Figure 2 taken from the mentioned report.

**TABLE 4. Average Income Per Day, All Urban Recyclers By Gender**

Income Group	Male		Female		Grand Number	Total Percent Column
	Number	Percent Column	Number	Percent Column		
<.91 USD	23	23.0%	88	45.4%	111	37.8%
1-1.40 USD	22	22.0%	58	29.9%	80	27.2%
1.45-1.82 USD	28	28.0%	31	16.0%	59	20.1%
>1.82 USD	25	25.0%	14	7.2%	39	13.3%
(Blank)	2	2.0%	3	1.5%	5	1.7%
<b>GRAND TOTAL</b>	<b>100</b>	<b>100.0%</b>	<b>194</b>	<b>100.0%</b>	<b>294</b>	<b>100.0%</b>

Source: survey data



**FIGURE 4 Urban-rural Relationships in Hanoi's Recycling Industry**

The Karachi report provides information on the market prices for recyclable materials and the total recycling income from all health care wastes, as shown in Table 5. A total turnover of less than US\$ 1000/day indicates that hospital health care waste recycling is not important in the general economy but this represents only a small proportion of the total waste recycling industry, which is socially and economically significant.

**TABLE 5. Market Prices of Hospital Waste Recyclables in Karachi**

Waste Material	Quantity in kg/day	Middle Dealers		Main Dealers	
		Prices Rs	Total Rs	Prices Rs	Total Rs
Swabs/Dressings	1300.5	5	6502	7	9103.5
Placenta	120.00	-	-	-	-
Plastic bags and Accessories	1175.5	8	9404	10	11755.5
Urine bags	80.0	6	480	7	560
Syringes	630.4	5	3152	7	4412.8
Glassware	411.8	6	2470	8	3294
Plastic and Polythene	592.6	4	2370	5	2963.0
Paper	749.3	6	4495	8	5994.4
Metals	191.1	8	1528	9	1719.9
<b>TOTAL</b>	<b>5311.2</b>		<b>30,404 (US\$ 760)</b>		<b>39,803 (US\$ 995)</b>

In the Manila report, the female owner of the junk shop described earlier is said to gross P4000 per week from recycling mainly from her son's deliveries. Her mark up is 50 per cent on plastics, 25 per cent on aluminium cans, cartons and paper and 20 per cent on medicine bottles. Workers in the recycling industry in Manila are poorly rewarded (P150 per day) for long hours (10h per day) and most live in squatter communities. One main dealer in paper delivers approximately 400 tonnes per month to paper mills and is paid with post-dated cheques. This dealer is concerned about the unrestricted importation of scrap paper, which depresses local market prices. The large main dealer in plastics was set up with initial capital of P 2 million; clean plastics are bought from middle dealers for P10/kg and the output plastic pellets are sold for P15/kg. Many middle dealers have been encouraged to enter waste recycling in Manila by the ease of entry and the low capital requirement to set up. Once businesses grow, main dealers will often provide capital and advance payments to middle dealers to secure the supply of recyclables. The prices offered by main dealers are influenced by the quality of the recycled material (accurate classification) and whether or not transport has to be provided. Prices also fluctuate on a seasonal basis and are affected by the arrival

times of imported waste materials. The unpredictability of market prices for recyclable materials is an important factor in maintaining the sector, with many junk shops having gone into bankruptcy. Extortion is also a serious concern of junk shop owners.

## **12. HEALTH AND ENVIRONMENTAL IMPACTS OF HOSPITAL WASTE RECYCLING**

It is brought out in the case studies of hospital waste management in Bogota that many accidents have happened in the three hospitals in which El Porvenir workers handle the wastes. In the past year at one hospital, eighty incidents have occurred which have resulted in medical follow-up costs of Colombian \$ 17 million. Workers are immunized against tetanus and hepatitis B and undergo a medical examination before starting work at a clinic or hospital. They are also due a check up every six months but, in spite of the Law requiring health care provision as a right, there have been instances where the workers have even been denied emergency assistance by a hospital. Inadequately designed and poorly maintained and operated incinerators at hospitals in Bogota create environmental air pollution. Leakage from vehicles transporting health care wastes to disposal landfill sites causes environmental pollution on the roads and gives rise to public health risk. Waste pickers at dump sites are exposed to serious health risks from infectious health care waste, sharps and chemicals.

The Hanoi report on urban waste management identifies the health risk to junk collectors and buyers who service health care establishments, from exposure to pathogens or toxic chemicals. Waste pickers at landfill sites are also singled out as being vulnerable to flies, mosquitoes and air-borne dust. Leachate from landfills is claimed to pollute surface and ground waters. Work as a recycler in Hanoi is said to be arduous and to pose risks to health through traffic accidents and contact with waste.

The Karachi report reviews the impacts of health care waste management on land, air and water. In health care establishments, particularly in government hospitals, the storage and transport of waste give rise to serious concern about pollution of wards and storage areas and the potential for spread of communicable diseases. During transport to disposal sites, health care wastes are often blown onto streets, creating environmental pollution and health risk. Burning of waste at dumps causes severe air pollution and exposure of waste pickers to infectious material and sharps is a serious threat to health. The Karachi consultant also identified health care wastes being disposed of into river systems, drains, channels and the harbour. Decomposing wastes in these waterways create obnoxious odours and look aesthetically unattractive, as well as having an adverse effect on fisheries. The attitudes of health care workers in Karachi are illustrated by the excerpt from the Consultant's report in Box 7.

Although the Manila report does not discuss the health and environmental impacts of health care waste management, it is obvious that the same concerns apply as in the other three cities. At present, little attention is given to these impacts by health care managers and workers and the general public is at risk.

## **BOX 7 – ATTITUDES OF HEALTH CARE WORKERS IN KARACHI**

*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 probably 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.*

## **13. CONCLUSIONS**

### **13.1 Health Care Waste Sources**

In the four cities included in this study (Bogota, Hanoi, Karachi and Manila), hospitals were the major source of health care wastes, whereas minor health care establishments such as clinics and health centres produced relatively small quantities. In the case studies on hospitals, a wide range of sources of waste generation have been identified, including patients' wards and specialist departments.

## **13.2 Health Care Waste Management**

In none of the four cities is the management of health care wastes satisfactory and in most hospitals, especially Government hospitals, existing systems are unsuitable, unhygienic and unacceptable. General awareness of the health and environmental risks created by poor waste management practices is limited at all levels of management, although private hospitals in Karachi and Manila appear to be the exceptions to this situation. A lack of concern for the handling, fate and effects of infectious and hazardous health care wastes on the part of administrators, doctors, nurses, cleaners, waste handlers and recyclers gives rise to the serious problems now facing the sector in these cities.

As a result of the poor awareness of and limited concern for proper waste management on the part of health care administrators and medical staff there is low institutional capacity in the sector and little political interest in making improvements. Scarce resources for public services in general in the four cities give rise to a low priority being attached to health care waste management, in spite of the high health risk to waste handlers, recyclers and the public. In most locations, health care wastes are not given special care and attention but are generally handled along with and in admixture with municipal solid waste.

Manila hospitals would seem to have the managerial capacity to control health care wastes in an appropriate manner but the lack of monitoring and enforcement of regulations has led to laxity in waste management. In Hanoi, the authorities are now attempting to improve health care waste management but have not yet achieved the systems outlined in their guidelines. The environmental conditions in Bogota, including the high level of violence and sense of personal insecurity, have relegated health care waste management to a low priority and the Consultant there found it difficult to obtain reliable information from hospital management and the waste handling cooperative. In Karachi Government hospitals, the poor management of wastes is creating undesirable environmental conditions and high health risks to unaware waste handlers and the public.

## **13.3 Legislation**

A range of legislative regulations governing the management of health care wastes exists in the four countries represented in the study. The most comprehensive and demanding framework of legislation regulating health care waste management to international standards has been promulgated in Colombia but is not implemented. The many ministries and agencies issuing this legislation have not shown any interest or initiative in enforcing the regulations. In the Philippines, National and regional legislation apply to the management of health care wastes but there has been no attempt to enforce the wide ranging regulations. The National Environmental Protection Ordinance in Pakistan now mentions hospital wastes but provides no specific guidance for their management, apart from general guidance on the handling of hazardous substances. Again, the implementation and enforcement of regulations have not been achieved in Karachi. The absence of legislation governing health care wastes in Vietnam does not seem to have created worse conditions in health care waste management there than in the other three countries. Recent guidelines issued by the Ministry of Health appear to serve the purpose of legislation but have not yet been implemented.

In none of the four countries is there any legislation dealing with recycling from solid waste, neither to encourage nor prevent it. Recycling activities in the four cities of the study are

entirely informal and many of the active participants operate illegally and without any form of registration or official recognition.

### **13.4 Segregation and Primary Storage**

It is clear from the Consultants' reports that, even where there are different containers and different coloured plastic bags for storage of different types of waste at source, there is little segregation of waste components in health care establishments in the four cities. Medical staff are either not informed on the need for segregation or apathetic to the consequences of not segregating different types of waste and, as a result, infectious and hazardous materials are typically mixed with general waste. This leads to contamination of potentially recyclable components of the general waste and to high risk of infection of workers subsequently attempting to segregate such components.

Although a major problem arising from the lack of segregation at source is the widespread contamination of general waste, and hence a greater quantity of contaminated waste than otherwise would arise, the fact that health care waste is generally mixed with municipal waste during the collection process and at disposal negates the value of such segregation. However, failure to segregate recyclable components at source reduces the quantity of reusable materials reclaimed, even allowing for downstream scavenging of the mixed waste. Perhaps a greater awareness of recyclable materials by medical staff would encourage them to be more diligent in segregation. Prohibiting the recycling of components of infectious wastes and sharps is necessary in all four cities.

In Hanoi, most hospitals practice some form of segregation and classification of recyclables but there is no standardised system. The informality of recycling activities limits the extent of segregation at source. None of the hospitals studied in Bogota implement segregation of wastes at source even though different coloured plastic bags are supplied in some institutions. In Government hospitals in Karachi, a single container seems to be used for all waste types, apart from pathological waste, and no segregation is possible. The private hospital in Karachi, serviced by an international hospital waste management company, segregates infectious waste from general waste but does not appear to separate out recyclable materials. The Manila hospitals studied separate infectious, biodegradable and general waste at source in different coloured bags. Biodegradable waste is recycled but other recyclable components of mixed waste are not segregated at source. In almost all hospitals included in the study, pathological wastes are segregated and receive special treatment on site.

The waste containers used to receive and store waste in health care establishments in Hanoi and Karachi are not specially designed for the purpose and result in the mixing of infectious and general wastes and a lack of segregation of recyclable components. In Bogota hospitals, there is no standardisation of waste containers or plastic bags, although different coloured bags are provided for different types of waste in some institutions. In one hospital, white bags are used for recyclable materials. The Manila hospitals covered by the study used black, green and yellow bags for general, biodegradable and infectious (including sharps) wastes, respectively. Minor health care establishments in Hanoi and Karachi use common waste bins for all types of waste and only segregate obviously recyclable materials in the local context.

### **13.5 Waste Generation**

By comparison with municipal solid waste, the arisings of health care wastes in the four cities is relatively small. In the hospitals where waste quantities were measured or estimated, a total generation rate of approximately 1-4 kg/day per bed was obtained, with the infectious component being 30-70 per cent of the total, depending on the degree of segregation. Minor health care establishments generate very low quantities of waste on an individual basis. The Karachi Consultant's report estimated that all health care establishments in Karachi would generate a total of 113 tonnes/day of waste with only 5 tonnes/day (less than 5 per cent) being retrieved and recycled. The Hanoi report on Solid Waste Management indicated a much higher level of recycling (20-25 per cent) from municipal solid waste, but did not give any estimate of recycling from health care waste.

From the data available, it would appear that health care waste will not serve as a major source of recyclables and would be unlikely, in itself, to support a significant recycling industry. Nevertheless, since a sizeable recycling industry exists in all four cities covered by this study, more efficient segregation and recycling of health care wastes will benefit from the active markets available for waste components. In each city, there is a market awareness of the valuable components contained in health care waste and this has given rise to the informal system of recycling which has arisen at each establishment. Unfortunately, this gives rise to high health risks among recyclers and the recycling of many undesirable components from the health point of view.

### **13.6 Primary Collection**

In Hanoi, Karachi and Manila, wastes, segregated or not, are collected by workers employed by the health care establishment. These waste handlers are usually the cleaners or janitors of the premises and are aware of local opportunities for recycling of components of the waste. However, they are either unaware of, or insensitive to, the hazards associated with handling health care waste and generally take no precautions in handling, transporting and separating the waste. They are not supplied with protective clothing or special equipment and are thus vulnerable to the high risk of handling infectious waste and sharps.

In Bogota, a cooperative enterprise ('El Porvenir') has been developed as a result of a concerted attempt to encourage waste recycling and employ otherwise destitute people. El Porvenir workers serve as cleaners and waste handlers in the Bogota hospitals included in the study. Although they have been trained in the handling of health care waste, the Consultant saw no evidence of such training in the systems adopted for handling wastes in Bogota hospitals. El Porvenir is involved in the wider market of recycling from municipal solid waste and so hospital waste handlers also segregate recyclables from mixed waste, with little concern for the health risk involved. They are poorly paid and represent the lower rank of society, suffering social discrimination.

Waste collected from the wards and departments in hospitals is typically stored temporarily in a room of the floor on which it was generated. This temporary storage area has not normally been designed for waste storage and, even where separate coloured bags are used for segregated waste components, all wastes are indiscriminately mixed together. Usually at the end of a work shift, the mixed wastes from the various floors of a hospital are transported on trolleys (or, in Karachi, in containers on the head or shoulders of the handlers) to a central

storage area outside the hospital buildings. Plastic bags containing infectious waste frequently split during this handling process and contaminated fluids, sharps and infectious solids are often a hazard in the storage areas and along hospital corridors during transit.

### **13.7 Secondary Storage and Segregation**

In some hospitals the most infectious wastes and pathological wastes are incinerated on site, often in outdated and poorly maintained and operated incinerators. It is the practice in some health care establishments to bury some waste on-site. In many hospitals, pathological wastes are treated with formalin or sodium hypochlorite before being sent for disposal. Otherwise, wastes are dumped in a central area, usually outdoors but sometimes with a cover. The central storage areas in Karachi hospitals are frequently not adequate for the waste generated and the waste handlers regularly dump hospital waste, including infectious waste, in nearby community bins provided for general domestic waste. These bins are scavenged by itinerant recyclers and, sometimes, burning of the waste occurs in the bins. At most hospitals covered by the study, the central waste storage area is poorly managed and is scavenged by the waste handlers, itinerant waste pickers and feral dogs, as well as being an unsightly and unhygienic site.

### **13.8 Collection**

In all four cities, health care wastes are collected by the municipal waste collection service and transported for disposal with municipal waste. Apart from those wastes which are incinerated or buried on site at some hospitals, all types of wastes are mixed and transported, often along with municipal solid waste, to municipal landfills. The municipal waste collection workers are often involved in the recycling chain and, in Manila, the recyclables are delivered to a junk shop before the remaining waste is taken to the municipal dump.

Although dedicated collection is often arranged for health care waste, no special vehicles are used in any of the cities. Collections are generally unreliable and this gives rise to problems in the central storage areas of hospitals. Leakage of contaminated fluids and blown debris from collection vehicles create health and environmental problems along the routes. Scavenging of health care waste loads by the municipal workers en-route is not uncommon. In many cases, the health care wastes are mixed with municipal solid waste in a common collection vehicle.

### **13.9 Disposal**

Apart from those health care wastes which are incinerated or buried on site, most waste generated in health care establishments is disposed of in municipal waste dumps along with municipal solid waste. Controlled sanitary landfilling does not exist in any of the cities so there is no special placement of health care waste in these dumps. Furthermore, the municipal dumps in all four cities are universally scavenged by large numbers of very poor people surviving entirely through their recycling activities. These waste pickers are not legal and no special arrangements are made for their health and safety. They live on or near the dump sites and they and their families are exposed to a wide range of infections.

### **13.10 Recycling**

The main recycled components of health care wastes are paper, cardboard, glass and plastics. At the health care establishment, such materials are segregated by the waste handlers at source when they are aware of a local market for the separated materials. The proceeds from such recycling activities benefit the person or persons involved, and only rarely the hospital. In Bogota, El Porvenir credits the hospitals with the proceeds of recycling but, in Manila, Government policy on the sale of property makes it impossible for Government hospitals to benefit from official recycling. Nevertheless, the trade in recycling from health care wastes is very small compared with that from municipal solid waste recycling.

### **13.11 The Recyclers**

In three of the cities of the study, Hanoi, Karachi and Manila, the tier of recyclers beyond the waste handlers in health care establishments, the municipal waste collectors and the dump site waste pickers are junk shops and itinerant junk buyers. El Porvenir serves as the tier of recycler between the initial waste handler (in which capacity they also serve) and the industries finally receiving recycled materials.

The intermediate junk shops and itinerant junk buyers (and El Porvenir in the case of Bogota) serve to classify and clean waste components and accumulate sufficient quantities to sell on to specialist junk dealers (SMEs) or end-user industries. Specialist main dealers are active in Karachi, Manila and Hanoi, where industrial villages on the outskirts of the city have developed as a result of waste recycling activities. Women make up a significant proportion of recyclers in most of the cities and are the majority in Vietnam.

Market prices for recycled waste components fluctuate with market demand and season but imported junk from overseas also has a major impact in Manila. The trade in recycling is very active in all four cities but seems to be more risky for middle dealers in Manila. In all four cities, large numbers of recyclers are supported solely by these activities and, in Vietnam, the rural economy benefits significantly from them. However, the small quantities of health care waste recyclables contribute only a small proportion of the market turnover and the benefit to poor people in economic terms.

Deficiencies in the SMEs involved in recycling identified by the Consultants are shortage of investment, a low level of technological capacity and over-reliance on basic manual labour. The Bogota Consultant has mentioned the possibility of the cooperative 'El Porvenir' being superseded by commercial companies offering more professional services to hospital administrators in the current free market environment. Such a move would be counter-productive in terms of social support for the poor people now employed in the cooperative but reflects on the level of service now provided. The deep involvement of the rural community in recycling in Vietnam is important in terms of the rural economy and the Consultants in Hanoi have mentioned the improving investment in better technologies by some of the specialised industrial villages. SMEs involved in recycling in Manila seem to be in a precarious position in relation to fluctuating market prices and rely on low cost labour from squatter communities to survive. The Afghan refugees, Hindus and Christians who make up the itinerant waste pickers in Karachi now provide the low cost inputs to recycling SMEs in that city, creating a relatively stable market situation.

### **13.12 Strengths and Weaknesses of the Existing Systems**

The Manila Workshop attended by the researchers discussed the strengths and weaknesses of the health care waste management systems in the four cities. In all cases, waste handling and disposal was acknowledged as being achieved at low cost and involving small and micro-enterprises (SMEs). This allowed flexibility in operation and employment and provided an opportunity for the recognition and solidarity of low-income groups. The handling and recycling of health care waste supported groups of poor people who would find it difficult to survive without this source of income. At the present time and with the current awareness of health risks, it will be difficult to change existing entrenched systems.

These systems generally have a low level of technological capacity and expose manual workers to unacceptable health risk. More sophisticated systems are restricted by the lack of resources available in health care establishments. Recyclers are vulnerable to market price fluctuations for recycled components and find it difficult to build up the capital resources required to upgrade the technology applied. Governments have typically accepted the recycling of waste as an informal sector activity and have not attempted to provide a more organized environment in which health and environmental improvements could be achieved. On the other hand, national planning for health care waste management might place at risk those SMEs which survive under existing conditions.

In each country studied, the main strengths identified by the researchers should be exploited in any development of health care waste management. The evolution of worthwhile practices and organizations in the four cities has resulted from adaptation to local conditions, opportunities and skills and should not be lost in any reorganization but should be seen as opportunities for developing a socially, technically and economically effective system adapted to local conditions.

## **14. RECOMMENDATIONS**

### **14.1 National Plan**

The poor management of health care wastes in all four cities covered by the study suggests a more organised approach is necessary. This is recommended by all Consultants and developing a National Plan for health care wastes is seen as a mechanism for achieving common, sustainable levels of service in all four countries. Appropriate legislation must be introduced to support such a National Plan of action and the current dilution of responsibility through the involvement of many Ministries and agencies must be overcome. It will normally be preferable to have a single institution responsible for health care waste management and for that institution to be given the resources to achieve its monitoring and enforcement functions.

### **14.2 Resources**

Health care establishment administrators and Governments in Colombia, Vietnam, Pakistan and the Philippines have to recognise that the exploitation of poor workers in waste handling and recycling has to stop. The serious health and environmental risks now being taken in waste handling, transport and disposal must be prevented and reasonable levels of investment

for properly planned and executed strategies should be made available. Poorly paid workers now involved in health care waste management should have the expectation of reasonable employment conditions with an increase in investment in the sector in the future. Formalising and organizing the recycling of components from health care wastes will also improve the conditions of players at all stages of the recycling system. Acknowledgement by Governments of the reality of recycling from wastes and its social benefits could lead to more stable market conditions and an upgrading of the technologies applied. Better health and environmental conditions for waste handlers, waste pickers and recyclers should not be overlooked in planning the resources for health care waste management.

### **14.3 Awareness and Training**

The universal lack of awareness of the need for efficient health care waste handling and disposal at all levels of management is a cause for serious concern. Administrators, doctors, nurses and health care workers must be given adequate training so that they understand the risks involved, proper management of wastes and the consequences of poor practices. They must be made aware of the possibilities for and importance of waste segregation at source. In addition, although more difficult to achieve, they must be influenced so as to pay due respect to waste handlers and recyclers as providing a necessary and beneficial service to society.

It is clear from the case studies in the hospitals that waste handlers are not following approved practices, even though some (for example El Porvenir workers in Bogota) claim to have received training. A thorough programme of training for those responsible for waste handling in health care establishments, and for municipal workers collecting waste from health care establishments, to ensure that they adopt professional attitudes to waste management and apply approved practices. They must also be instructed in effective segregation at source and informed of the policy for recycling. Their training must include the use of protective clothing and specialist equipment to allow them to carry out their responsibilities in a manner which ensures their own safety as well as that of the public. It is essential that low-grade workers understand that their future depends on them providing a high level of service, in the face of free market competition.

Some instruction of waste pickers and recyclers of health care wastes on the risks involved and the precautions which could be taken would also be advisable. Better health care provision for waste pickers and recyclers is urgently needed.

### **14.4 Waste Management System Improvements**

The Karachi Consultant made detailed recommendations for improvement of health care waste management and included the broad suggestions shown in Table 6. He advocated the use of properly designed waste storage containers, with standard colour-coded plastic bags, and adequate, secure and hygienic waste storage areas both within and outwith hospitals. Segregation of waste components at source, using coloured plastic bags, was seen as essential and the importance of organized recycling was stressed. Nevertheless, although health care wastes provide opportunities for recycling segregated materials, many components, such as infectious waste and sharps, should not be recycled. The current practice of recycling any component for which there is a local market, however hazardous, must be terminated in all four cities and only those recyclables which can be safely segregated and recycled permitted to be separated out.

The Hanoi Consultants recommended proper implementation of waste classification at source according to Figure 3. To achieve this, segregation in colour-coded plastic bags was proposed and, for tracking, the marking of bags with the hospital name. They also suggested that all hazardous waste should be disinfected before release, to protect waste pickers, recyclers, junk buyers and municipal collection workers. The recycling and reuse of non-hazardous health care waste (such as transfusion bottles and disinfected used syringes) was supported. At a later stage, with additional investment, the construction of properly designed waste storage areas at all hospitals was recommended. As a longer term objective, separate collection of hazardous and non-hazardous wastes was proposed, with landfill disposal of only non-hazardous waste. A final recommendation was that 'hospitals should be encouraged to reduce the amount of waste needing disposal through reuse and the sale of recyclable materials to junk buyers'.

**TABLE 6. Management Alternatives for Hospital Wastes in Karachi**

<b>Technology</b>	<b>Recommended Approach</b>	<b>Applicability</b>
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 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	multiple chamber incinerator	general applicability
Landfill	sanitary landfill designed to prevent contamination of ground-water or land	less preferred than incineration, applicable to general waste and properly treated infectious waste
Sewerage system	Sterilised liquids	applicable to small quantities of liquid wastes only after sterilisation

For the disposal of hazardous and infectious health care wastes, several of the Consultants recommended the installation of modern clinical waste incinerators with carefully controlled operation and emission clean-up. For larger hospitals, these could be located on site and might serve several other hospitals and minor health care establishments. A centralized incinerator facility was suggested as a possible solution for Hanoi and Manila but the question of fee structure would need to be addressed. Continuing use of small inefficient

incinerators at hospitals was not recommended. In the absence of proper incineration facilities, pretreatment (disinfection, autoclaving) of infectious wastes was suggested before controlled sanitary landfill disposal, adopting trenching and secure covering.

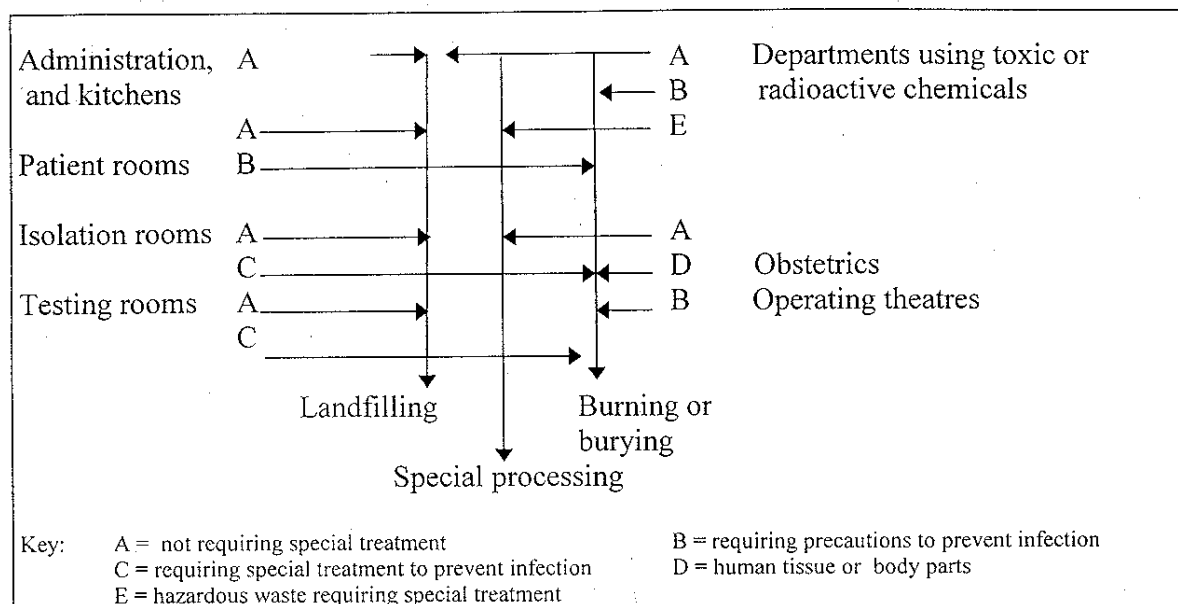


Figure 5. Proposed Flow of Health Care Waste in Hanoi

#### 14.5 SMEs Involved in Recycling

The difficulties of involving the community in health care waste management were stressed for the case of Bogota. Even El Porvenir, a cooperative serving as a SME, was running into difficulties in maintaining standards and would most likely be adversely affected by commercial competition in the future. In Manila, the lack of legal recognition of SMEs involved in recycling is a problem and leads to extortion. Formalizing the recycling of components from health care wastes will assist junk shops to access this source and lead to a more stable market and revenue for the hospitals. For Vietnam, SMEs were encouraged to improve the technology applied in recycling and to produce more end-products for the consumer market rather than sell on materials to formal industry.

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