



# MANAGING HOSPITAL waste

A guide for health care facilities

MEGHA KELA • SAMIR NAZARETH • RAVI AGARWAL



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**SRISHTI**

SEPTEMBER, 1998

MEGHA KELA ◆ SAMIR NAZARETH ◆ RAVI AGARWAL

**Srishti** is an environmental group, registered as a society, and involved in the issue of medical waste. In March 1996, when the Supreme Court of India directed all hospitals in Delhi over 50 beds to install incinerators, Srishti approached the Hon'ble Court asking for alternative technologies and standards for them, both of which were agreed to. Subsequently Srishti was involved by the Central Pollution Control Board to help evolve national standards for medical waste. These are due for release by the Ministry of Environment and Forests, Government of India.

**Srishti** is keen to see responsible health care practices being adopted in the country and remains committed to a cleaner and safer environment.

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# Foreword

Hospitals are meant to ensure community health. It is thus surprising that till recently not enough attention has been paid to the disposal of medical waste. Infectious waste can transmit numerous diseases in the community and put those who handle waste, and live in its proximity, at risk. However, what is not commonly known is that only a small percentage (less than 10%) of the hospital waste stream is infectious, while another 5% is non - infectious but hazardous.

Most medical administrations have focused on installing disposal technologies such as incinerators and not on implementing a 'practice' of waste management within the hospital. As is well known now, after much information dissemination by medical bodies and NGOs and as proposed in the national standards for medical waste, no single disposal technology can take care of all types of medical waste. For example contaminated plastics need to be shredded and disinfected, while pathological waste may need to be incinerated.

Comprehensive solutions to medical waste management lie solely in implementing systems of waste segregation, disinfection and treatment through the co-operation of hospital staff, and the medical personnel. Often, such solutions are resisted by hospitals, since they either think the issue is not important enough, or too difficult. All that is needed is some guidance, and the will to manage medical waste responsibly. Areas of interventions include training, segregation, disinfection, and raising awareness, all co-ordinated within a reporting and monitoring program involving a senior person.

It was to prove this possible that Srishti on the invitation of Orthonova hospital, undertook the task of actually implementing a responsible medical waste system. This document, based on hands- on experience, as well as an understanding Srishti has acquired of the issue through years of research, is the outcome of this effort.

It is meant to be used as resource material by NGOs, medical personnel, regulatory bodies, and anyone else wishing to implement a safe waste management system in a health care facility. This document is meant to evolve and change with experience. We welcome suggestions and recommendations to improve it.

**Ravi Agarwal,**  
**Chief Co-ordinator**

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## Chapter 1

# Planning the Program

As with all programs, waste management must also follow a plan. To begin with, the basic steps to be considered in the health care institution are<sup>1</sup>:

### **1. A willingness on the part of the health care institution to participate:**

A willingness on the part of the hospital to work with the community to develop a mutually beneficial set of waste management practices is imperative to ensure proper implementation and follow up. A waste management program will work only if the entire staff of the hospital works together to develop an effective waste management scheme.

### **2. Self motivation:**

The zeal to work for the betterment of the hospital environment should come from within the people. Such persons ought to be identified and made the project leaders from within the hospital staff. These people must be enthusiastic, and ideally have good communication skills. They should either be decision makers or have the full public support of top management in the hospital. The remaining staff needs to be galvanised into action through seminars and training sessions.

### **3. Investments:**

The health care institution must be ready to invest resources for bringing about the required changes to implement the waste management program. These include:

- a) **Personnel:** People who will have to devote considerable time to the scheme in the initial stages.
- b) **Space:** Each location such as nursing stations etc., need to provide additional space for the accommodation of bins, needle cutters, leak-proof containers for sharps containment, in place of a single bin. Some space is also needed for the composting of kitchen waste. Ideally, this space should be located outside the hospital.
- c) **Equipment:** Certain purchases may have to be made; e.g., the needle cutters/destroyers, bleaching powder, polyethylene bags and different types of bins, or even major investment in autoclaves, microwaves or regional incinerators mainly for wastes which are safe to incinerate.

### **4. Choosing a hospital to serve as a Model:**

In case a suitable hospital is being selected to implement a model program by an outside agency, then the following can also be kept in mind:

The pilot hospital should look as much like an average hospital as possible so that other facilities can identify with it and follow the lead. Alternatively, it is best to choose the

<sup>1</sup> McRae Glenn: Selection of pilot hospitals : CGH Environmental Strategies Inc.

hardest case to work on, so that when change happens, others will look and say, " if they can do it there, we can certainly do it here." A typical hospital may be a teaching hospital, a hospital with a large research facility etc.

A) THE PLAN

**Objectives**

The hospital's aim has to be to contain infectious waste, without adding to other forms of pollution. This needs a system of identifying and segregating waste at the point of generation. Treatment, can be at source, on-site, off-site in a centralised facility, or at various points of generation depending on the type of waste and the facility available.



Proper waste containment and disinfection can be done only when the type of waste and the point of generation is known. A *waste survey* provides such information. Not only does it quantify the different types of wastes such as plastics, glass, cotton wool and bandages, but also helps to determine the location of its source within the hospital.



One has to identify the key locations, such as nursing stations, the operation theatre, laboratories, the intensive care unit., in the hospitals where waste management interventions are needed. These key areas must be equipped with basic equipment such as needle cutters/ destroyer, coloured bags for segregation, chemical disinfection units or autoclaves if needed, also the personnel in these areas need to be trained for their handling.



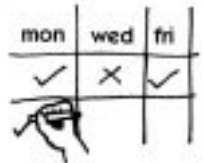
In the context of the prevalent disposal culture, it is critical to examine the purchase policy of the hospital. Here conscious decisions can be taken to help reduce those items which may lead to the creation of unnecessary wastes, or of wastes which may need special treatment, or be expensive to dispose.



Simultaneously, a training program on all aspects of waste management, for all hospital personnel including the hospital administration, needs to be conducted. Training has to be integrated in the implementation process of the program to make it sustainable. Many hospitals have visiting doctors, and they also have to be included in the scheme. Training has to also address the concerns of all those involved.



An awareness program will make the system visible and help in its implementation, serving as a constant reminder and a motivation medium. Posters, and signs help in giving a sense of urgency. A mission statement can help focus the efforts.



Finally there is the need to incorporate a Reporting Format to make the system `a routine affair', as any other working system within the hospital. A senior person has to be in-charge of monitoring the system.

The following is the scheme:

**STAGE I**

- 1. Identifying a Nodal Person:** This person will be the key to implement the overall plan in the hospital. In case outside assistance is sought then this person can be the co-ordinator. The person can also serve as a central point for information dissemination.

2. **Waste Survey:** This includes a waste survey to perform a qualitative and quantitative assessment of the waste, and an inventory of the pharmacy etc. The survey of the pharmacy will give an estimate of the type and quantity of disposables and non-disposables used in the hospital. It is necessary that the survey be representative of the waste generated, and should be carried out over a period of two weeks.
3. **Evaluation of existing practices:** Through the evaluation of the existing waste management scheme, interventions and change required will be identified. Accordingly, measures have to be introduced to evolve a need-based waste management scheme.
4. **Location Identification:** Survey of the hospital to determine suitable positions for the placement of waste disinfection and disposal equipment within the hospital.
5. **Ordering equipment:** It is a good idea to evaluate the equipment needed and to order it, so that it is in place before the plan is implemented.

## STAGE II

1. **Training:** This is critical to sensitise hospital staff on the issue of hospital waste and to guide them in ways of safer waste management.  
The training may be conducted in various stages based on the work requirements. Awareness of the program should be spread through posters and other visible material displayed in the hospital. The training of the staff needs to be time specific but usually takes longer at the beginning of the program, turning more focused and need-based as familiarity with the program increases.
2. **Implementing Segregation:** The practice of waste segregation has to be initiated simultaneously with training in the hospital. Segregation has to occur at the point of generation of the waste in the locations identified.
3. **Equipping:** Needle cutters and other equipment for the handling and disposal of the waste should be installed in the hospital and personnel handling them made familiar with their use.
4. **Basic Implementation:** After the installation of the equipment and initiation of segregation, chemical disinfection of the infectious disposable items and destruction of the needles can be started in the hospital.
5. **Composting:** The hospital kitchen waste can also be composited into useful manure.
6. **Reporting and Feedback:** After the scheme has been set up, there should be follow up by the entire staff. A method of accounting for the various steps in the scheme has to be evolved.

### The Objectives of a waste management scheme should be:

1. Changing a mind set through training.
2. Segregating waste so that each type is treated in a suitable manner according to the rules.
3. Using proper containment/ disinfection technology depending on the type of waste.
4. Creating a system where all personnel in the hospital are responsible and accountable for proper waste management.
5. Changing use patterns from single usage to multiple usage.
6. Attempting to find safe, non-toxic and /or easily disposable alternatives to medical kits.



## Chapter 2

# Getting to Know the Waste

Waste survey is an important part of the waste management scheme. A survey helps in evaluating both the type and quantity of waste being generated in the hospital.

### A survey aims to:

1. Differentiate the types of waste.
2. Quantify the waste generated.
3. Determine the points of generation and the type of waste generated at each point.
4. Determine the level of segregation and disinfection within the hospital.
5. Find out the type of disposal carried out.
6. Get familiar with the personnel at all levels.

### With this information it will be easy to:

1. Provide specific receptacles for different wastes at different levels of output (depending on the ward).
2. Determine the type of disinfection needed and the point at which it should be carried out in the waste stream.
3. Use the information in hospital-specific training.

## 2.1 CLASSIFICATION OF WASTE

Categorisation or classification of waste is important. There are different types of classification used. Usually regulatory authorities determine the classification depending upon how a particular class of waste is to be handled, treated and finally disposed. The Ministry of Environment and Forests has a classification which is notified in the Bio-Medical Handling and Management Rules. These have been appended in Table 1.

Broadly, Srishti used the following classification for the survey.

### i) Non-infectious waste

Non-infectious waste constitutes a major portion — nearly 90%<sup>2</sup> of the entire hospital waste generated. It is similar to house hold waste as it does not contain infection spreading microbes as it is not in contact with any body fluids.



Non-infectious waste is broadly classified into:

- i. **General office waste:** Comprising wrapping paper, office paper, cartons, packaging material including plastic sheets, news paper and bouquets etc.

<sup>2</sup> WHO: Managing medical waste in Developing Countries: 1994, pg 2.

TABLE 1: CATEGORIES OF BIO MEDICAL WASTE: (AS PER MOEF RULES)

	Waste Category	Treatment and Disposal Option
Category No.1	<b>Human Anatomical waste</b> (Human tissues, organs, body parts)	Incineration@ / Deep Burial.*
Category No.2	<b>Animal wastes</b> (Animal tissues, organs, body parts, carcasses, bleeding part, fluid, blood and experimental animals used in research, waste generate by veterinary hospitals)	Incineration @/ Deep burial
Category No.3	<b>Microbiology and Bio- Technology Wastes</b> (Waste from laboratory cultures, stocks or specimens of micro-organisms, live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biological, toxins, dishes and devices used to transfer of cultures)	local Autoclaving/ Microwaving/ Incineration@
Category No.4 #	<b>Waste Sharps</b> (Needles syringes, scalpels, blades, glass, etc. that are capable of causing puncture and cuts. This includes both used and unused sharps)	Disinfection (Chemical @@/ Autoclaving/ Microwaving and mutilation/ shredding ##
Category No.5	<b>Discarded Medicines and Cytotoxic drugs</b> (Waste comprising of outdated, contaminated and discarded drugs and medicines)	Incineration@/ destruction and disposal in landfills.
Category No.6	<b>Soiled Wastes</b> ( Items contaminated with blood and body fluids including cotton, dressings, soiled plaster casts, linens, beddings, other materials contaminated with blood)	Incineration @/ Autoclaving/ Microwaving
Category No.7	<b>Solid Wastes</b> ( Waste generated from disposable items other than the waste sharps such as tubing, catheters, IV Sets etc.)	Disinfection by chemical treatment @@/ Autoclaving/ Microwaving and mutilation/ shredding ##.
Category No.8	<b>Liquid Wastes</b> ( Waste generated from laboratory and washing, cleaning, house- keeping and disinfection activities)	Disinfection by chemical treatment and discharge into drains.
Category No.9	<b>Incineration Ash</b> (Ash from incineration of any Bio Medical wastes)	Disposal in municipal land fill.
Category No.10	<b>Chemical Wastes</b> (Chemicals used in production of biologicals, chemicals used in disinfection, as insecticides, etc.)	Chemical@@ treatment and discharge in drain for liquids and liquids and or secured landfill for solids.

## NOTE:

# Chemical treatment using at least 1% hypochloride solution or any other equipment chemical reagent.

@@ It must be ensured that chemical treatment assures disinfection.

## Mutilation/ Shredding must be such to prevent unauthorised reuse.

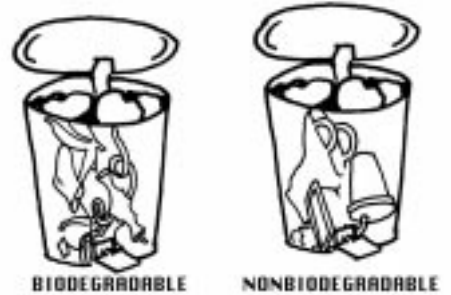
@ No chemical plastics shall not to be incinerated. @ Chlorinated plastics shall not to be incinerated.

\* Deep burial shall be an option available in towns with population less than 5 lakhs in rural areas.

SRISHTI NOTE: Srishiti believes that the categories may need to be fine tuned and modified as practices evolve with experience.

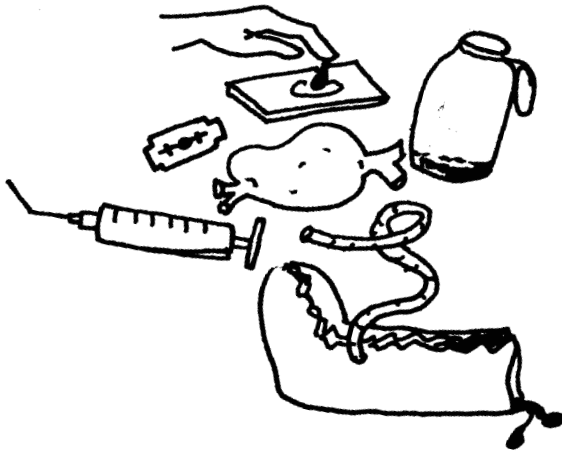
ii. **Kitchen waste:** Includes left over food, swill, peels and dirty water (which is drained) generated from the hospital kitchen<sup>3</sup>. Kitchen waste is further divided into two categories:

- i. *Biodegradable kitchen waste*- which includes peels of fruit and vegetable skins, left over food, tea dregs and other natural kitchen waste.
- ii. *Non biodegradable waste* - This waste includes wrappings, foil, plastic, paper and other material which is essentially man made.



**ii) Infectious waste**

1. Used sharps and items that could cause a cut or puncture.
2. Pathological waste including tissues, organs, blood and body fluids.
3. Syringes, IV tubing, blood bags, and other items contaminated with blood and body fluids.
4. Items such as plaster casts etc. which may be defined as infectious waste only when contaminated with blood or pus. These are non-infectious waste, when they have had no contact with body fluids.



**2.2 THE WASTE SURVEY**

(See Form 1 & 2 for waste survey forms)

While conducting a waste survey the following points should be taken care of:-

1. *Place* : The waste survey should be conducted in all the Wards, Operation Theatres (OT), Out Patient Departments (OPD), Emergency, Intensive Care Units (ICU), Laboratories, Administrative Sections, Kitchen and the main bin of the hospital.
  2. *Time*: The waste survey should be carried out at the end of each shift or at the time the waste is being disposed. This should be done continuously for 2 weeks or more depending on the size of the hospital.
3. *Segregation*: The waste has to be segregated into its different categories for quantification during the survey.
  4. *Protective Clothing*: One should always wear aprons, face masks and gloves while handling waste during a survey.
  5. *Inspection of the present system*:
    - a) Is the waste being segregated?
    - b) Is the waste being disinfected?
    - c) Location, size and number of bins in the hospital.
    - d) Frequency of disposal from points of generation.
    - e) Frequency and mode of disposal of waste from the main bin.



<sup>3</sup> Hospital waste management workshop 26<sup>th</sup> & 27<sup>th</sup> Dec '96: Centre for Environment Education (C EE) South.

The survey can be recorded on Survey Form 1 & 2.

The information generated is used to define the size of bins required for the storage of each type of waste and to determine points and types of interventions.

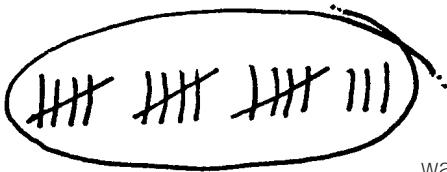
Inclusion of hospital personnel during the survey provides a first-hand experience to them on waste classification and segregation. As the personnel assist in the survey they understand the importance of waste classification and segregation.

### ii) Measurement Variations

Certain variations will be found in the quantity of waste generated during the survey. The variations are due to the fluctuations in the number of patients and types of ailments being treated.

Variations also occur with each shift. It is therefore suggested that the quantification be done for at least two weeks, over various shifts. The average of all the readings, should then be used for a more reliable final survey result.

To find out the waste generated per bed, the total waste is divided by the number of beds. Ideally the waste survey should be carried out periodically over different occupancy rates, and should be a periodic affair in the hospital to evaluate the change in the waste stream over time.



### iii) Pharmacy Inventory

An inventory of pharmacy must be made to determine the type of products being used and the number of disposables or non disposables. It is also important to know what they are made of, and how critical is their use. An inventory here also cross checks the waste generated, since most of the items listed eventually land up in the waste stream.

The material of the disposable item will decide the type of disinfection and disposal needed. For example chlorinated plastics such as - PVC should not be burnt.



A pharmacy inventory is also a key information base to be used for a waste reduction and recycling program which may be initiated subsequently. It can help reduce wasteful packaging at the outset and also help in substituting certain items for more environmentally friendly alternatives.



**Precautions while doing a waste survey:** *Handling wastes can be unsafe. It is imperative that the staff carrying out the survey follow safe practices.*

1. Gloves must be worn at all times.
2. A simple semi rigid plastic sheet/ glasses can be used to protect the face.
3. Often ordinary tongs can be used for waste segregation.
4. The bags being weighed should not be more than  $\frac{3}{4}$  full at any time, else handling becomes difficult.
5. The bags must be sealed or tied after being filled.
6. Direct body contact with the bags should be avoided while measuring waste.

**HOSPITAL WASTE BIN SURVEY SHEET**

Hospital Name : \_\_\_\_\_

OUTSIDE BIN

Date : \_\_\_\_\_

Time/Shift : \_\_\_\_\_

Is waste still segregated : \_\_\_\_\_

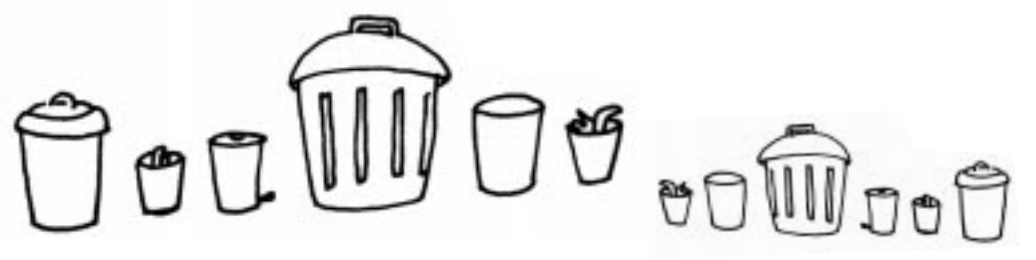
Method of collection / disposal : \_\_\_\_\_

Other comments : \_\_\_\_\_

S.No	Type of waste	Quantity/ Number

Signed  
(Designation)

**FORM 1** photostat and use



### HOSPITAL AREA WASTE SURVEY SHEET

Hospital Name : \_\_\_\_\_

**WITHIN THE HOSPITAL**

Date : \_\_\_\_\_

Time/Shift : \_\_\_\_\_

Hospital Area : \_\_\_\_\_

Type of segregation : \_\_\_\_\_

Type of disinfection : \_\_\_\_\_

Method of collection : \_\_\_\_\_

Other comments : \_\_\_\_\_

S.No	Type of waste	Quantity/ Number

Signed  
(Designation)

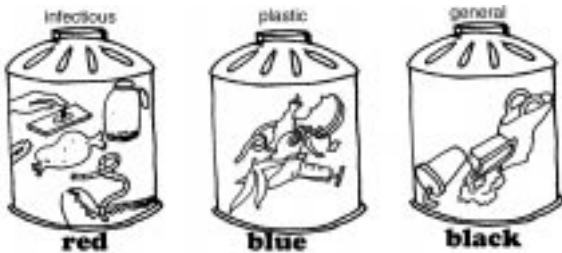
**FORM 1** photostat and use

## Chapter 3

# Dealing with the Waste

### 3.1 WASTE SEGREGATION

Segregation is the key to any waste management scheme. Through segregation, different categories of wastes are sorted and placed in different containers or bags. Segregation should be carried out at the point of generation, to keep general wastes from becoming infectious. If the infectious waste, which forms a small part of hospital waste, is mixed with the other hospital waste the entire waste will have to be treated as infectious waste.



To treat entire waste as infections is an expensive option and is also a dangerous practice especially if the waste is being dumped without any prior treatment.

With segregation a hospital can:

- Reduce total treatment costs
- Reduce the impacts of this waste on the community
- Reduce the chances of infecting workers.

Segregation comprises of separation of different waste streams based on the type of treatment and disposal practice. The waste of each category specified will be disposed off into separate receptacles. The best way of segregation is a colour coded system, where each receptacle has its own colour (see Table 2). However, too many categories of waste may lead to trouble in storage, treatment as well as its disposal. The easiest system for segregation is to use different colour receptacles with labels for different types of waste streams. The bins should be lined with plastic bags (non-chlorinated) with colours matching that of the bins, as per recommendations. (Table 2)

Segregation has to be conducted at the point of generation.

Proper segregation should:

- Identify waste according to source and type of disposal/disinfection
- Provide receptacles specifically suited for each waste

Each hospital must ensure that there exists a:

- list of items and materials that will always be considered infectious - hazardous waste, such as needles and syringes.
- list of items and materials classified as infectious-hazardous waste only under certain conditions such as plaster cast with blood.



- Supply of coloured bags of recommended colour code and material.
- Recommended system of labelling, including the international bio-hazard symbol.
- Supply of proper containers for transportation of waste, in case this is needed to be done, on-site or off-site.

TABLE : 2 COLOUR CODING AND CONTAINER FOR DISPOSAL OF BIO-MEDICAL WASTES (AS PER MOEF RULES)

Colour Code	Types of Container	Waste Category	Treatment Options as per Schedule I
Yellow	Plastic bags.	Cat.1, Cat. 2, Cat. 3, and Cat. 6	Incineration/ deep burial
Red	Disinfected container/ plastic bag	Cat.3, Cat.6 and Cat.7	Autoclaving/ Microwaving/ Chemical Treatment
Blue/White Translucent	Plastic bag/ Puncture proof container	Cat.4 and Cat.7	Autoclaving/ Microwaving/ Chemical treatment and destruction and shredding.
Black	Plastic bag	Cat.5, Cat.9 and Cat.10 (Solid)	Disposal in secured landfill

NOTES:

1. Colour coding with waste categories with multiple treatment options as defined in Schedule 1, shall be selected depending on treatment options chosen, which shall be as specified in Schedule 1.
2. Waste collection bags for waste types needing incineration shall not be made of chlorinated plastics.
3. Categories 8 and 10 (liquid) do not require containers/ bags.
4. Category 3 if disinfected locally need not be put in containers/ bags.

SRISHTI NOTE: Srishti believes that the categories may need to be fine tuned and modified as practices evolve with experience.

## 3.2 HANDLING AND TREATING

### i) Infectious waste

The followings should be kept in mind while dealing with infectious wastes. (Infectious waste is generated from all the in-patients and out-patients departments of the hospital):



generated from all the in-patients and out-patients departments of the hospital):

1. Infectious waste must be separated at the point of generation itself.
2. Bins with lids lined with polythene bags, or with inner chambers for bleach should be used.
3. A lidded bin will discourage inadvertent use by others.
4. The bins and bags should have a colour code- yellow or red (see Table 2). Bins should also be labelled with the bio-hazard symbol and if required, for the types of waste they have to be used for.
5. Personnel involved in infectious waste handling should be provided with suitable protective gear. Instructions on proper waste handling should be circulated to them during the training sessions.



6. Polyethylene bags placed in the bins have to be changed with each shift or when they are  $\frac{3}{4}$ th full. Excess waste in the bag would increase the risks of spillage around the bin.
7. Polyethylene bags carrying waste have to be sealed/ tied at the top whenever the waste is being transported within or outside the hospital.
8. Infectious waste from the wards, ICU, OPD, O.T and the labs should have a common specific bin allotted for them at the final point of disposal. This bin should be covered and protected from the public at all times.
9. If the hospital does not have a facility to treat the waste (not chemically treated) it has to be sent from its final disposal point to a common facility. Transportation of such waste can only be in authorised carriers, under the Hazardous Waste Transportation Rules, to such common facilities which are now being proposed.

Infectious waste needs to be destroyed or disinfected. The recommended methods for the disinfection and destruction of the biologically infectious waste are autoclaving and microwaving. Incineration is also an option, but only for certain types of wastes.

Microwave and autoclave and other alternatives to incineration are safer since they have minimal environmental impacts, besides being easier and cheaper to run.

**Precautions for infectious waste disposal:**

1. Infectious waste has to be kept separately in lidded bins lined with polyethylene bags wherever needed.
2. Under no circumstances should the infectious waste be mixed with the non-infectious waste.
3. The bag lining the bin should be only  $\frac{3}{4}$ th full to ensure that the waste does not spill out.
4. While carrying the bag containing infectious waste it has to be sealed/tied.
5. Bags containing infectious waste have to be disposed off through incineration, autoclaving or microwaving, as per recommendations.
6. Properly labelled waste containers minimise confusion in handling and disposal of waste.



**ii) Disposable items**

Disposable items include single use products syringes, IV bottles, catheters, sharps (sharps have to be treated separately) and rubber gloves. As such items are often recycled and have the risk of being reused illegally, it is imperative that chemical disinfection be followed for them. (Table 3)

Disposables have to be dipped for a minimum duration of  $\frac{1}{2}$  to 1 hour in the chemical disinfectant depending on its potency or autoclaved or microwaved. Bins which can be used for chemical disinfection are a set of twin bins, one inside the other, with the inner one being perforated and easily extractable. This helps ensure, that the bleach solution in the outside bin permeates the inner bin containing the disposable items and minimises contact when the contents are being removed.

**Handling of disposable items:**

1. Disposable items like the gloves, syringes, IV bottles, catheters etc. have to be shredded, cut or mutilated. This ensures that they are not reused under any circumstance. For instance the fin-

TABLE 3 : CHEMICAL DISINFECTION

Chemical disinfection can have a wide application in small healthcare facilities. It ensures at least Level II disinfection for certain categories of wastes, such as disposables etc., and for many applications can be a cheap way of treating medical wastes..

A good disinfectant is bleach. For chemically treating the waste a optimum concentration of bleach has to be prepared. The concentration prescribed by the World Health Organisation (WHO) is 10gms of bleach in 1 litre water. However it must be cautioned that medical wastes that

have been chemically disinfected should continue to be treated as hazardous, unless careful bacteriological testing has shown disinfection to be complete.<sup>4</sup>

The bleach solution should be prepared at the beginning of the shift. At the end of the shift or after the bin is full and the waste has been treated with the chemical disinfectant, it has to be disposed. The waste should be collected in plastic bags from all the wards and other stations of the hospital to the final disposal site. This can be collected by the concerned personnel at specific intervals.

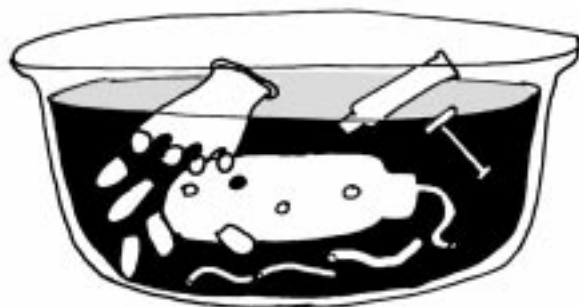
#### Recommended dilution of chlorine- releasing compounds<sup>5</sup>

	“Clean” conditions <sup>†</sup>	“Dirty”conditions <sup>‡</sup>
Available chlorine required	0.1% (1g/litre)	0.5% (5g/litre)
Sodium hypochlorite solution (5% available chlorine)	20ml/ litre	100ml/litre
Calcium hypochlorite (70% available chlorine)	1.4g/litre	7.0g/litre
NaDCCÆ powder (60% available chlorine)	1.7g/litre	8.5g/litre
NaDCC tablets (1.5g available chlorine per tablet)	1 tablet/litre	4 tablets/litre
Chloramine (25% available chlorine) Ø	20g/litre	20g/litre

<sup>†</sup> After removal of bulk material. <sup>‡</sup> For flooding, e.g., on blood or before removal of bulk material. <sup>Æ</sup> Sodium dicloroisocyanurate Ø As it releases chlorine at a slower rate than hypochlorites, a higher initial concentration is required.

gers of the gloves should be cut, IV bottles can be punctured and the same can be done for other disposable items.

2. Extreme care has to be taken while handling the needles and the syringes, since most sharp injuries occur between the point of use and disposal. It is also recommended that blood bags/sharps be handled with proper protection.
3. Once the disposable items have been snipped they have to be dipped in a effective chemical disinfectant for a sufficient time or autoclaved or microwaved so that they are disinfected.



<sup>4</sup> World Health Organisation. 1994: Managing Medical Wastes in Developing Countries. WHO/PEP/RUD/94.1.

<sup>5</sup> World Health Organisation. Laboratory Biosafety Manual 1993, Geneva

**Precautions for disposal of disposables:**

1. All the items have to be dipped in the chemical disinfectant after being snipped.
2. Blood bags should not be handled.
3. Syringes and sharps should be handled with extreme care.
4. The concentration of the bleach solution has to be 10gms of bleach in 1 litre water.
5. The disposable items must be dipped in the bleach for at least an 1/2 hour to make sure that they are disinfected.
6. The bleach solution has to be changed after each shift.
7. Always separate the syringe barrel from its plunger before disinfecting it.

**iii) Sharps**

Handling of sharps is extremely critical. Sharps are probably responsible for a majority of injuries. Sharps need separate attention from other disposables in a waste management scheme.

**What are Sharps?:** As defined by the Central Pollution Control Board (CPCB) guidelines sharps consist of needles, syringes, scalpels, blade, glass etc., that are capable of causing puncture and cuts. This includes both used and unused sharps.<sup>6</sup>

**Types of Sharps:** The most commonly used sharps include single use hypodermic needles, syringes, pasture pipettes, scalpel blades, blood vials, test tubes, needles with attached tubing, and culture dishes (regardless of presence of the infectious agents). Also included are other types of broken or unbroken glass ware, that were in contact with infectious agents, such as used slides and cover slips. The major percentage of the sharps include needles and syringes.

**Where is Sharp waste generated:** The prime area of sharp generation is in the Operation Theatre which contributes to a major portion of the sharps generated in the hospital. The O.T.'s generate a whole lot of blades, lancets, scalpels along with the needles. The other areas of the hospital are all the wards, OPD and laboratories which contribute mainly to the needles and the syringes.

Major portion of the sharp waste are the needles which can be cut by a needle cutter and contained in bleaching powder solution, or autoclaved or and shredded or be destroyed by a needle destroyer. Other than needles, a small amount of sharps waste is generated which may also be contained in a separate bin meant for sharps or in the needle cutter itself depending on the quantity.



<sup>6</sup> Central Pollution Control Board (CPCB) environmental standards and guidelines for the management of hospital waste, June 1996.

**Present system of handling sharps:**

Most health institutions do not have specific treatment for sharps since segregation has not been in practice.

**Dangers associated with sharps:** The main danger of sharps is their inherent ability to cause puncture wounds and/ or lacerations. Once sharps mix with municipal waste, ragpickers collect and resell them, endangering not only themselves, but also all those who trade in them and buy them. Body fluid carrying diseases have a increased possibility of being transmitted through injuries caused by these sharps to all those handling them, including hospital employees.

**Proper system of sharp collection and disposal:**

To keep away 'needle stick' injuries it is important that sharps be handled with special care:

1. While handling sharps, gloves must always be put on.
2. Segregate sharps from rest of the waste at the point of generation.
3. Clipping, bending or breaking of needles to make them non usable must not be practiced as this may cause accidental inoculation.
4. Needles and syringes generated should be destroyed by a needle destroyer/ cutter and disinfected/sterilised and shredded.
5. Syringes and sharps must be dipped in a strong disinfectant (like bleach) of recommended concentration for a definite period of time or autoclaved before final disposal/ shredding.
6. Place the sharps in a puncture proof container.

These containers must be conspicuously labelled by the universal biohazard symbol.

**Precautions in handling sharps:** *As most injuries are caused by sharps, their proper handling need not be overemphasised:*

1. All the employees working in/ out side the hospital must be vaccinated against Hepatitis B.
2. All the workers should put on gloves while dealing with infectious waste especially sharps.
3. Sharps should not be left casually on counter tops, food trays, on beds as grievous injuries can result.

**iv) Liquid waste**

Hospitals generate liquid waste which is either infectious or chemical in nature. To avoid risk of exposure

TABLE 4 : THE SUGGESTED PARAMETERS FOR THE TREATMENT OF LIQUID WASTE BY THE CPCB

Parameters	Permissible Limits
pH	6.5 - 9.0
Suspended Solids	100 mg/l
Oil and grease	10 mg/l
BOD	30 mg/l
COD	250 mg/l
Bio-assay test	*90% survival of fish after 96 hours in 100% effluent

Note: The limits are applicable to those hospitals which are connected with sewers without terminal sewage treatment plant or not connected to public sewers. For discharge into public sewers having terminal facility the general standards as notified under the Environmental ( Protection ) Rules, 1986 shall be applicable.

\* It is strictly recommended that the hospitals/ nursing homes/poly-clinics/private clinics, specialised centres, pathological laboratories, veterinary hospitals, medical colleges etc., shall not dispose of the solid wastes on open land and municipal dustbin, and let out the untreated liquid waste into sewers.



to the general public it is necessary that the waste be properly treated.

Liquid chemical waste should first be neutralised with reagents and then flushed into the sewer system. The liquid pathological waste should be treated with a chemical disinfectant. The solution should then be treated with a reagent to neutralise it, this can be flushed into the sewer (see Table 4).

**V) Non-infectious Waste**

- Non-infectious waste may be treated as normal house hold waste and thus it does not require any special treatment.
- The general office waste comprising of the waste papers can be clubbed with other recyclable materials to be sent in for recycling.
- Kitchen waste can be utilised in many different ways according to the quantity of the waste. In large hospitals, technologies like bio-digesters can be installed. Such conversion uses the waste as a resource producing both compost as well as gas. The gas can be piped for cooking etc. In smaller establishments kitchen waste can be composted.



There are different methods to manage these types of waste:

Biodegradable waste can be converted into manure, through composting. There are essentially two types of composting, as described in Box 1.

Non bio-degradable can be disposed of in municipal bins. Reduction is a good strategy to adopt in this case. Some areas where waste may be reduced are :

1. Minimising the use of aluminium wrappings to keep food fresh in hospitals and using casseroles instead.
2. Items used frequently in the kitchen like tea spices could be bought in bulk. This reduces the quantity of packaging material and is also cheaper for the hospital in the long run.
3. Hot beverages could be provided in unbreakable melo-ware instead of disposable plastic cups or styrofoam. Also traditional clay 'khullads' could be a possibility.



Precautions for non-infectious wastes:

1. Segregation of hospital waste is the key to ensure that 90% of the waste which is non-infectious is treated easily. At no stage should infectious waste come in contact with non-infectious waste. If mixed, with the infectious waste, non-infectious waste has to be treated as infectious waste.



## BOX 1 : COMPOSTING AND BIO-METHANATION

**VERMI COMPOSTING**

Vermi composting uses earth worms to compost kitchen waste. These worms consume the garbage fed to them and convert it into manure

**Requirements:** Land, matured cow dung (khad), Coconut husk, Earth Worms ( *Eisenia foetida* )

**Initial steps:** Make a shallow trench, no wider than 3 feet and 6-8 inches deep. The length can be extended to requirements Put a layer, 1 inch thick of rubble in the pit. This is put so that the earth worms will not escape into the soil. Then put a layer of coconut husk over the rubble. This will retain moisture. Spread gobar, fresh or otherwise on this. The layer should be 6 inches thick. Water the pit for a few days. Next add the worms. The weight of the worms added should be approximately half the weight of the garbage that will be fed daily. Water the pit lightly once again for a few days. It is now ready to be fed.

**Feeding the pits:** Take care not to feed plastics, metal or any other non-biodegradable waste. Divide the pit into segments depending on the length of the pits and the quantity of garbage being fed daily. For example a pit may be divided into 7 segments each to be fed once a week. At the end of the week the first segment will be fed again since the earlier garbage would have disappeared. The pit has to be kept moist.

**Harvesting the manure:** After six weeks stop watering and feeding the pit. Pile the khad into mounds in direct sunlight. The earth worms dislike sunlight and will scurry to the bottom of the mound. Scoop the top of the mounds and use as vermi-compost. The bottom is full of worms and is spread along the pit. Fill the pit with dry leaves and once again start the feeding process.

**PIT COMPOSTING**

For this method pits have to be dug. Pits can either be circular in shape or rectangular. Pits should not be over 6 ft

deep. It is important to note that the mouth of the pits should have a slope with a gradient facing outwards.

Once the garbage is brought to the site-Feed the garbage to the pit after removing all non biodegradable. Pour a slurry of fresh cow dung and water in the pit and mix the constituents with a rake. Slurry should be poured every third day for the next 10 days.

During the next 10 days the slurry should be poured every 7 days. On the 15th day of garbage feeding the contents should be mixed with rake. The gobar slurry should be added on the 20th, 25th and so on till the pit is full. Once the pit is full its contents should be turned on the 20th day after filling. The pit can be covered with a mixture of mud and gobar. The contents should lie like this for 2 months. After this period the contents are removed from the pit and the particles not fully decomposed separated. The khad so produced should have the smell like fresh soil.

Leaves and other yard trimmings can be composited in the same way in a separate pit. There is no need to add a slurry of gobar. However it is necessary to keep the contents in the pit damp/wet. The contents can come out of the pit in a conical shape which has to be covered with dung and mud.

The pit should lie in this state for 5 months. Another important thing to be kept in mind is that all branches should be shredded before putting in the pit

**BIO DIGESTION**

The technology is based on the gobar gas system. However instead of cow dung biodegradable kitchen waste is fed on a daily basis and an equal volume of slurry is released into the slurry pits. This slurry makes a very good manure. Initially, however, the bio-digester has to be fed with fresh cow dung. Also with the degradation of the waste, methane gas is formed which is trapped in the dome of the system. This gas can be used as a cooking fuel.

**vi) Radioactive Medical Waste**

(see Box 2)

The use of nuclear technology in medicine can be broken into two parts—detection and treatment. In detection, rays such as X rays, chemical dyes are frequently used. In treatment, isotopes of various elements are used.

Hospitals providing Nuclear Medicine have not only



## BOX 2 : RADIOACTIVE HOSPITAL WASTE RULES

The use, transportation and disposal of nuclear waste which includes nuclear medical waste comes under the Atomic Energy (Safe Disposal of Radioactive Wastes Rules 1995). Thus the disposal of this waste does not come under the specifications or recommendations made by the Ministry of Environment and Forests.

**According to these rules:<sup>7</sup>**

1. An authorization has to be obtained by the users of radioactive material to dispose of radioactive wastes and decayed/unused waste.
2. According to 15 (1) of these Rules disposal of unsealed sources is permitted locally by land burial route ( for solids) or sewage/soak pit discharge for liquids.
3. Further disposal of sealed sources is permitted only by the transfer to an authorized waste management agency for eventual disposal at specially designed facilities.

There is a Waste Immobilization Plant (WIP) at Tarapore in

Bombay. Even though the government has specified rules for the use of such materials and the disposal of their waste there are methods to decrease the risk of exposure to the personnel and the patient.<sup>8</sup>

**Some of the suggested measures which hospitals can adopt are:<sup>9</sup>**

1. Strict attention to the patients environment and person.
2. Gowning of all personnel entering the patients room.
3. Sterilising equipment to be used on the patient and by the patient. This would include the crockery and cutlery too.
4. Proper food preparation of food to ensure that it is bacteria free.
5. There should be proper dusting of the room.
6. Masks are a source of infection as they become warm and damp creating perfect conditions for bacterial growth. It should be changed or disposed at regular intervals.

to check for radiation but also ensure that instruments are properly maintained, proper protective gear is provided not only to the practitioners but also to the patients. There should be specific drills for spills of nuclear waste and prolonged exposure to radiation.

Certain basic necessities for an institution providing Nuclear Medicine are

1. Proper room with Lead lined walls
2. Machines that are regularly checked
3. Protective gear for the personnel and the patient.
4. Separate special containers for the different types of waste generated.
5. Easily recognisable symbols for notifying the area and the type of waste.
6. Proper training for all personnel and regular refresher courses.

**vii) Chemical Hazardous Waste**

(see Table 5)

Hospitals also generate a wide range of chemical hazardous waste which must be segregated and properly managed. These include–

- Solvents
- Chemotherapy waste
- Photographic chemicals
- Formaldehyde waste
- Radioactive waste
- Heavy metals like Mercury used in instruments
- Other toxics and corrosives
- Waste anaesthetic gases.

Hospitals must emphasise safe use of the materials that produce these wastes. Minimisation of the



<sup>7,8</sup>Atomic Energy Regulatory Board : Annual Report 1993-94.

<sup>9</sup>Lochead Joyce, N.M: Care of the Patient in Radio Therapy: Blackwell Scientific Publications.

TABLE 5 : CHEMICAL HAZARDOUS WASTES

Waste Minimization Methods for General Medical and Surgical Hospitals <sup>10</sup>		
S. No.	Waste Category	Waste Minimization Method
1.	Chemotherapy and Antineoplastics	<ul style="list-style-type: none"> <li>• Reduce volumes used</li> <li>• Optimize drug container sizes in purchasing</li> <li>• Return outdated drugs to the manufacturer</li> <li>• Centralise chemotherapy compounding location.</li> <li>• Minimize waste from compounding hood cleaning</li> <li>• Provide spill clean ups</li> <li>• Segregate wastes.</li> </ul>
2.	Formaldehyde	<ul style="list-style-type: none"> <li>• Minimize strength of formaldehyde solutions</li> <li>• Minimize wastes from cleaning dialysis machines and RO units</li> <li>• Use reverse osmosis water treatment to reduce dialysis cleaning demand</li> <li>• Capture waste formaldehyde</li> <li>• Investigate reuse in pathology, autopsy laboratories</li> </ul>
3.	Photographic Chemicals	<ul style="list-style-type: none"> <li>• Return off-spec developer to manufacturer</li> <li>• Cover developer and fixer cans to reduce evaporation</li> <li>• recover silver efficiently</li> <li>• Recycle waste film and paper</li> <li>• Use sponges (squeegees) to reduce bath loss</li> </ul>
4.	Radionucleids	<ul style="list-style-type: none"> <li>• Use counter current washing</li> <li>• Use less hazardous isotopes whenever possible</li> <li>• Segregate and properly label radioactive wastes and store short lived wastes in isolation until decay permits disposal in trash.</li> </ul>
5.	Radionucleids	<ul style="list-style-type: none"> <li>• Use less hazardous isotopes whenever possible</li> <li>• Segregate and properly label radioactive wastes and store short lived wastes in isolation until decay permits disposal in trash.</li> <li>• Substitute less hazardous cleaning agents, methods for solvents cleaners.</li> </ul>
6.	Solvents	<ul style="list-style-type: none"> <li>• Reduce analyte volume requirements</li> <li>• Use premixed kits for tests involving solvent fixation</li> <li>• Use calibrated solvent dispensers for routine tests</li> <li>• Segregate solvent wastes</li> <li>• Recover reuse solvents through distillation.</li> </ul>
7.	Mercury	<ul style="list-style-type: none"> <li>• Substitute electronic sensing devices for mercury containing devices</li> <li>• Provide Mercury spill cleanup kits and train personnel</li> <li>• recycle uncontaminated mercury wastes using proper safety control</li> </ul>
8.	Waste Anaesthetic Gases	<ul style="list-style-type: none"> <li>• Employ low leakage work practises, Purchase low-leakage equipment</li> <li>• maintain equipment to avoid leakage</li> </ul>
9.	Toxics, Corrosives and Miscellaneous Chemicals	<ul style="list-style-type: none"> <li>• Inspection and proper equipment maintenance for ethylene oxide sterilizers.</li> <li>• Substitute less toxic compounds, cleaning agents.</li> <li>• Reduce volumes used in experiments.</li> <li>• return containers for reuse, use recyclable drums.</li> <li>• Neutralise acid waste with basic waste.</li> <li>• Use mechanical handling aids for drums to reduce spills.</li> <li>• Use automated systems for laundry chemicals.</li> <li>• Use physical instead of chemical cleaning methods.</li> </ul>

<sup>10</sup> EPA Guides to Pollution Prevention: Selected Hospital Waste Streams.



wastes, careful segregation of these wastes, exploring opportunities of recycling these wastes and safe disposal for those wastes which cannot be recycled.

### 3.3 ON-SITE TRANSPORTATION

Segregated wastes have to be transported within the facility from the point of generation to the final waste disposal site. All bags should be fastened, small trolleys can be used in larger facilities, or the bin themselves carried in smaller hospitals. Care must be taken to avoid spills. Non-infectious should not be transported with infectious waste.



### 3.4 STORAGE

In case off-site facilities are being used, short-term storage becomes unavoidable. Separate areas have to be earmarked within the facility, with warning signs, ensuring no-access to unauthorised personnel, stray animals etc. In case an on-site treatment method is used, such as an autoclave, then the storage should preferably be next to it.



**TABLE 6 : MERCURY SPILL MANAGEMENT**

#### During a mercury spill

- Never touch mercury with bare hands as mercury absorbs quickly through the skin.
- Remove all jewellery when dealing with mercury as mercury combines with metals.
- Clean the area around the spill
- Wear all the protective gears -nitrile gloves/ two pairs of latex gloves
- Contain the spread of mercury
- Use a regular syringe to suck all the mercury- Minor spills are managed by gathering mercury by stiff paper to scoop it or the sticky end of a scotch. Large droplets can be sucked into the syringe.
- Pour the collected mercury into a plastic container with 5 to 10ml of water.
- Seal the container containing mercury with scotch tap.
- Put the used syringe in a separate plastic container for further use.
- The used gloves should be disposed off.

## Chapter 4

# Focusing on Specific Locations

A waste management system should endeavour to contain the waste at the point of generation. Therefore nodal points like Wards, Operation Theatres, Out Patient Departments, Laboratories and the Emergency should be focused on.

### 4.1 IN-PATIENTS DEPARTMENT

The in-patients departments generate all types of waste which have to be segregated at the point of generation itself for an effective waste management practice in the hospital. For which bins for both infectious and non-infectious waste have to be placed in all the wards.



The bedside of each patient should have a bin meant for carrying only non-infectious waste like fruit peels, papers etc. unless the patient is classified as infectious. Bins for the infectious wastes should be kept in a specific location

(e.g. the nursing station) within each in-patient department so that it is easy to carry them to the patient where the dressing is being done or the soiled dressings generated from the patients be carried to the infectious waste bin in a tray from the point of generation.

Intensive Care Units (ICU) have patients who are in a critical state and require support of a vital function until the disease process is arrested. Such patients are likely to have poor resistance to infection and are often unable to do things on their own and have full time attendants. Due to this they are susceptible to greater hazards of cross infection than ordinary wards. To prevent the spread of infection further we have to ensure that the waste generated in the ICU is not contained near the patients. The bins for infectious and non-infectious waste shall be located near the nurses duty room in the ICU to prevent the spread of infection amongst the patients.

The IV tubing, catheters and used syringes should be kept separately in a container from where they can be disinfected chemically or autoclaved before their final disposal.



All the sharps and glass ampoules should also be placed in separate puncture proof containers. The syringes and the needles should be destroyed by a needle destroyers/ cutters.

All these bins should be cleaned after every shift or at the moment these bins become three quarters full.

**The scheme in this area should:**

1. Segregate the waste into different categories.
2. Each category should have a specific type of disposal method.
3. The number of bins should be distinct and their numbers and size should be proportional to the density of the wards and the medical procedures in the wards.
4. Depending on the type of containment the bin design should vary.

**4.2 OPERATION THEATRE**

The Operation Theatre (OT) follows a set of rules so designed to minimise time loss and risk to the patient during the operation. Also there are standard procedures within the OT such as counting the number of instruments used, autoclaving reusables and fumigating the theatre.

The waste management strategy for the OT should be designed not to impede an operation but to ensure that waste reaches the main bin after being decontaminated and all disposables properly disinfected and destroyed.

As in all other areas, programmes should be initiated after meetings with the staff. Management strategies based on these meetings have to be formulated so that the OT staff can work smoothly without feeling any 'extra burden'.

The O.T area can be segregated into two major areas - the preparation room and the theatre itself.

While doing the waste management in the O.T, bins for infectious waste have to be lined with yellow/ red bags. These bins will contain contaminated swabs, soiled bandages and amputated body parts (if autoclaves or microwaves are used then body parts should be stored separately). The bags with waste should be sealed and stored outside the O.T to prevent liberation of bacteria during handling.

Used instruments and sharps shall be placed in a tray, counted and sealed in bags and sent for autoclaving.

A separate container for IV sets, catheters, gloves and syringes should be provided in O.T. These disposables have to be treated with a chemical disinfectant for at least an hour or sent for treatment to the autoclaves or other alternative technology and for their final disposal.

As lots of medical kits are opened prior to the operation. There is a lot of general waste generated, there should be a bin for general waste kept in the O.T for all the general waste. All the packaging waste should be kept in the bin. Provision can also be made for a small bin in case there is any packaging waste generated during the operation.

In the changing room contaminated laundry should be placed in the laundry bag which should be sealed in water proof bags and sent to the laundry for cleaning.



Posters put up in the O.T help in reminding the staff of the waste program.



**The scheme in this area should:**

1. Not impede the work during the operation.
2. Be able to throw general waste prior to commencement of operation.

**4.3 OUT PATIENTS DEPARTMENT**

The OPD may also include a casualty/emergency ward. Each room in the OPD should have three bins. The bins are for the infectious waste which includes soiled bandages. The other bin is for general waste and the third container for the disposable items and used gloves which can be mutilated and disinfected at regular intervals by a ward boy. The used needles and syringes should be placed separately and destroyed by the needle cutter/destroyer which has to be present in each department.

The casualty/ emergency room should have bins for infectious waste, general waste and plastic waste. The number of bins for the infectious waste will depend on the number of beds in that room preferably each bed should have this bin or if the infectious waste bins are not available then the sisters should carry the tray containing the soiled bandages to the nearest bin meant for infectious waste. Bins for plastic waste and general waste should also be installed in each emergency. The plastic waste should be mutilated and chemically disinfected. There should be a tray for needles and other sharps. A needle cutter should also be installed.

While treating a patient in the emergency the hospital staff should always wear protective dressings as the patient could be a carrier of any infectious disease.



**The scheme in this area should:**

1. Segregate the waste into different categories.
2. Provide specific collection and disinfection systems for each type of waste generated.
3. Distinct containers for different types of waste.
4. The design of containers should depend on the type of waste and disinfection method.
5. The number of bins should be proportional to the waste generated in the casualty.

**4.4 THE LABORATORY**

Laboratory deals with all the pathological, biochemical, and microbiological diagnostic tests. These tests are performed on various body fluids and tissues using certain reagents. These tests generate both infectious and hazardous waste due to the presence of chemicals and pathogens making it a source for infection. Thus special care has to be taken while dealing with laboratory waste.

The waste generated in the laboratory should be segregated into different classes according to

the Waste Classification. The infectious waste can be further subcategorized as:

- sharps
- media and culture plates
- reagents and swabs.

This sub-categorisation is necessary for proper waste disinfection and disposal. While dealing with the waste management of the laboratory, a few basic things have to be taken care of like:

1. All personnel in the laboratory should wear gloves during testing procedures and disposal.
2. All the seats are to be provided with a bin to contain general waste while the infectious waste comprising of the sharps, used reagents and the media plates should be carried to a designated area in the laboratory and treated.

Needles constitute a major part of the waste generated from pathological laboratory. It is therefore necessary to have a needle cutter/destroyer in these areas. All the needles should be cut with the needle cutter and immersed into chemical disinfectant for the required duration.

Scalpel, lancets and broken glass pieces also form part of the waste in a laboratory. These used instruments and glass pieces are put into a separate container containing a disinfectant.

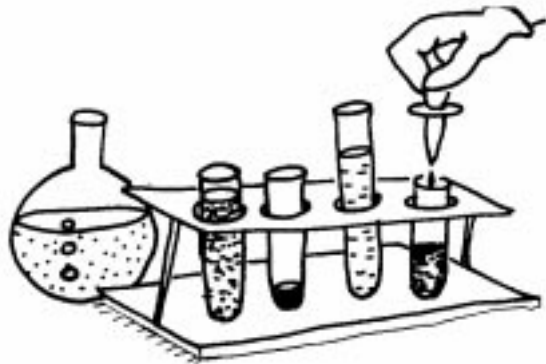
Glass slides and test tubes which are frequently reused have to be cleaned, disinfected and heated at a high temperature to make them infection free.

The sharps including broken glasses, destroyed needles and other sharps are collected in a separate puncture proof container which has to be sealed from all the sides to prevent spillage, and be autoclaved/ microwaved/ or send for chemical treatment before final disposal/ shredding. The procedure of handling and disposal of the sharps is the same as that practised in other parts of the hospital.

Media and Culture plates are wastes generated only in the laboratories. These plates are to be autoclaved /microwaved or disinfected using high temperature heating in oven after being chemically disinfected within the laboratory as

these plates can be infected through cultures which may carry infectious pathogens.

Some of the reagents used in the laboratory are hazardous in nature and may cause skin allergies burns, etc. Thus these must be handled with special precautions. In most of the cases the reagents and the chemicals are poured down the drain but the correct method suggested for the disposal of the liquid waste is to neutralise the pH of the solution before draining it into the sewer lines.



**Precautions:**

1. In case of a spill or a leak, the surface containing the spill should be cleaned with a swab soaked in a chemical disinfectant and then the swab should be put into infectious waste bin.
2. No reagents must be sucked into the pipette with the mouth.
3. Other precautions to be kept in mind are same as those followed in rest of the hospital.
4. Laboratories should be ventilated so as to ensure that the personnel do not breathe in contaminated air. Also precautions should be taken to ensure that the general public is not exposed to this air.

**The scheme at this location should:**

1. Reduce the risk for all personnel.
2. Disinfect/destroy waste according to their types.
3. Keep separate bins for different wastes.

**All of these locations should ensure :**

1. Proper segregation of waste.
2. Disinfection and disposal according to waste type.
3. Minimisation of risk for all personnel.



## Chapter 5

# Involving Personnel, through Training and Awareness

### 5.1 GOALS

Training is a vital step in the process of implementing a waste management system. In this step, existing mind sets are changed or broadened. Proper training will make the transition to the new scheme a lot more easier.

**The goals of a training programmes are:**

1. Establish contact with personnel
2. Define problem at the macro and at the level the target audience is working in
3. Suggest remedies to the audience
4. Obtain feed back from the audience
5. Alter scheme if desired/suggested
6. Initiate dialogue between various departments within the hospital

**The training programme should be divided into segments that cover:**

1. Teaching
2. Discussions
3. Feedback

As the idea behind the whole training programme is to train and promote a new concept to hospital personnel, it is necessary to first identify key personnel from each department and explain the entire system to the person so that the person can work with the people of the department at any occasion. The persons' presence during these programmes will go a long way in making the programme a success.

The contents to be taught and the method of instruction will differ for different personnel. Also the time period and the duration of these teaching modules will differ for each department.



#### **Requisites of a trainer:**

The trainer must be an expert in the field of hospital waste management. This person should be a good communicator and be able to explain a topic in layman terms. The trainer could be brought from an outside agency or be someone from within the hospital who has undergone a course in hospital waste management. It is necessary that this person be able to communicate and spread the new waste management scheme to all the personnel in the hospital.

## 5.2 TRAINING MODULES

### i) Training Nurses

When dealing with nurses it is important to understand that their presence in a hospital is for the patients. Waste management is just a part of their duty therefore it is necessary to reinforce their learning on the deleterious health effects of improper disinfection and waste storage. The next step would be to explain the waste management steps to them and to discuss their very important roll in the scheme. The third session should be a question and answer round. Once the cycle is completed the second step should be repeated.

#### Lesson 1: Suggested duration approx. 45 minutes

In the introductory class the nurses could be asked about the current waste management practices going on in their hospital. What they know about effects of improper waste management practices and improper disinfection of linen on patients. Part of the introduction could also deal with the impacts of untreated waste on the general community.

#### Instruction tools and other resources:

1. Slides showing how waste is being disposed off currently in hospital.
2. Slides showing how some of the waste is being wrongly reused (if possible)
3. Slides of hospital waste in the municipal bin.

#### Goals:

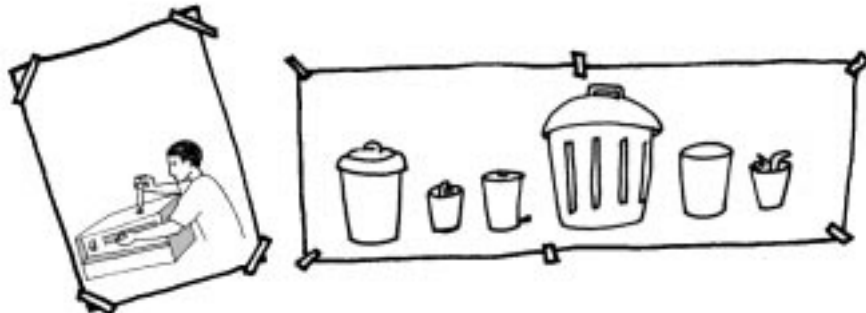
At the end of this session the nurses should know:

1. That improper waste management is not only detrimental to their health, patient's health but can also develop into a social problem.
2. They should realise that they are responsible for the waste generated in their department.

#### Lesson 2: Suggested duration approx. 60 minutes

In this session nurses should be taught how the waste should be segregated. And how different types of waste need different types of disposal and disinfection. They should be made to understand that they have to ensure that the ward boys in their ward are to segregate the waste and disinfect the waste accordingly. However if the ward boys are busy elsewhere they have to put the waste in the respective bins.

Nurses should be taught how to make a chemical disinfectant (bleach solution), what are the types





of waste that will be put into bleach, how will sharps be disposed and disinfected, what kinds of waste need to be mutilated.

**Goals:**

1. Know how the waste is being segregated.
2. Know the types of disinfection for different waste.
3. Understand that they are responsible for the ward boys actions and segregation of waste in their wards.
4. Understand operations of different waste management instruments.

**Instruction tools and other resources:**

1. Slides with flow charts so that the nurses know the point at which they have to intervene.
2. Equipment like Needle cutter/ destroyer.
3. Different coloured bins and plastic bags.
4. Chemical disinfectant like bleaching powder solution.
5. Nurse from a hospital where the scheme is already in place.
6. Audio visual on the subject.

**Lesson 3: Suggested duration approx. 30 minutes**

In this session feedback is obtained on the set-up waste management system. The session should start with a question and answer round to see whether the nurses have understood the scheme.

They then could be asked if they have any problems with the new set-up and if they have any solutions for the problems or made to understand why some of the steps are important.

**Goals:**

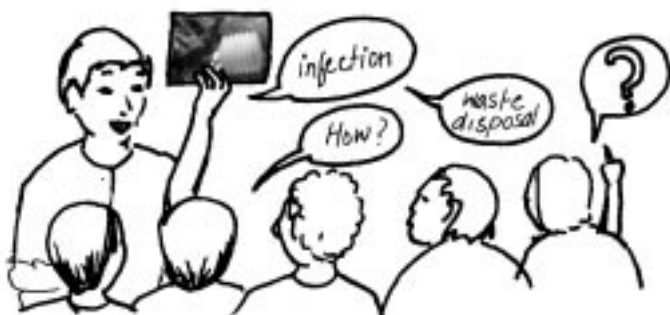
1. Reinforce the system and the responsibility of the work.
2. Should clear out any doubts.
3. Find alternatives, if any.

**Instruction Tools and Other Resources:**

Same as in Session 2 except for the invited person

**ii) Training Ward Boys**

During the training sessions it is necessary that the ward boys understand the waste management scheme to be part of the work which they are supposed to do and not perceive it as additional tasks.



**Lesson 1: Suggested duration approx. 60 minutes**

In the first session the ward boys have to be told about the problems of improper waste management and how it can lead to infection within the hospital and to its handlers. They could then be asked to explain about the waste management practices in the hospital.

**Goal:**

1. The ward boys should realise that proper waste management is beneficial to them and the community.
2. To understand the difficulties faced by them while dealing with the system..

**Instruction tools and other resources:**

1. Slides are the most important tool in this session. Photographs depicting waste handling should accompany a commentary.
2. Films showing the hazards associated with medical waste.

**Lesson 2: Suggested duration approx. 60 minutes**

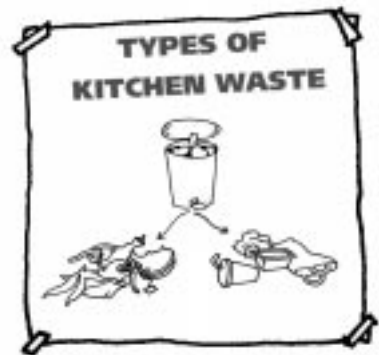
The second session should introduce the scheme to the ward boys. They should be told how they are to segregate the waste. Also, the types of disinfection to be used are to be explained to them. Methods to deal with spills and cleaning floors, proper mutilation, protective clothing and preparation of chemical disinfectant solution are some of the main topics which are included in this section.

**Goals:**

1. The ward boys should be able to identify all types of waste according to the type of disposal practice required.
2. The ward boy should know how to prepare chemical disinfectant solution and the time the waste should be dipped in it.
3. Ward boys should know what protective measures to take when they are handling the waste.
4. Ward boys should understand that the nurses will be helping them implement and follow the waste management scheme.

**Instruction tools and other resources:**

1. Pictograph slides explaining what should be done with the waste.
2. Equipments like Needle cutter/ destroyer.
3. Different coloured bins/ plastic bags.
4. Chemical disinfectant like bleaching powder solution.
5. Examples of different types of waste for segregation.
6. Implements to mutilate the waste.
7. Protective gear.
8. Ward boy from a hospital where the scheme is in place.
9. Documentary/ film from a hospital which has a waste management system functioning.



*A special mention for the types of segregation in the kitchen should also be made in this session. The dietician/ kitchen in-charge should be met separately and the waste management steps to be ensured by the person should be detailed. The kitchen in- charge has to ensure that the waste is being separated into biodegradables and non-biodegradables.*

**Lesson 3: Suggested duration approx. 45 minutes**

This will be similar to capsule 3 for the nurses and seeks to further improve the system. One point to note here is that the ward boys are often very innovative and with several ideas, and must be

made a part of every solution involving them.

**Goals:**

1. Reinforce the system and the responsibility of the work.
2. Should clear out any doubts.
3. Find alternatives to the existing purchases if any.

**Instruction tools and resource persons:**

Same as in Session 2 except for the invited person.

**iii) Training Safai Karamcharis / Janitors**

*Safai karamcharis* are the people who sweep, collect waste from each ward and take it to the final disposal site in the hospital. They are mostly not involved in the waste generation and segregation being carried out within the hospital. For them, a 3 staged programme can be followed

**Lesson 1: Suggested duration approx. 60 minutes**

As these personnel collect the waste from all departments and sweep the hospital they should be told about the health effects of improper collection and disposal system. They should also be given an opportunity to voice their concerns.

**Goals:**

1. The Safai Karamcharis should know that they are at risk if waste is not managed properly.
2. They should understand the use of protective gears.

**Instruction tools and other resources:**

Slides showing the ways they can contract infection and the effects of improper waste disposal should be screened along with a commentary.

**Lesson 2: Suggested duration approx. 45 minutes**

In this session the Safai Karamcharis should be taught how to collect waste from the wards, according to the waste type. They should also be told about the use of protective gears and their personal protection.

In this session they should be told of the final disposal points for the various types of waste and how to deal with the biodegradable waste. It is also important to emphasise that different kinds of waste should not be mixed.

While training the employees the nodal person incharge of the scheme in the hospital should be present so that the employees get familiar with him/her and get back when there is a problem, like waste in the wards not being properly segregated.

**Goals:**

1. The Safai Karamchari should understand the importance of segregation of waste.
2. These personnel should be able to identify the waste and know where to dump each kind of waste.
3. They should meet the nodal person in



case of any problem faced by them while dealing with the waste.

4. They should know the kind of protective gear to wear.
5. They should know how to collect the waste properly from the wards.

#### Instruction tools and other resources:

1. Pictograph slides explaining how waste should be collected.
2. Different coloured bins/ plastic bags.
3. Examples of different types of waste.
4. Protective gear.
5. Safai Karamchari from a hospital with such a scheme.
6. Documentary/ film from a hospital which has a waste management system functioning.



### Lesson 3: Suggested duration approx. 45 minutes

This will be similar to capsule 3 for the nurses and seeks to further improve the system. One point to note here is that the safai karmcharies are often very innovative and with several ideas, and must be made a part of every solution involving them.

#### Goals:

1. Reinforce the system and the responsibility of the work.
2. Address any concerns of the participants.
3. Discuss alternatives, if any.

#### Instruction tools and other resources:-

Same as in Session 2

#### iv) Training Doctors:

The training programme for the doctors should emphasise what the doctors do to ensure a proper waste management system.

### Lesson 1: Suggested duration approx. 45 minutes

The goal behind the scheme should be explained to the doctors after which suggestions can be given to them as to how the waste can be managed by their initiatives within the nursing stations, OPD and the OT. It should also be suggested that they check the waste management scheme in the wards they visit.

#### Goals:

1. Complete understanding of the scheme.
2. Basic segregation of waste in the emergencies and other nursing stations.
3. Checking of the waste management system in their individual nursing stations and operation theatre.



**Instruction tools and other resources:**

1. Slides giving flow charts, showing where the doctors can intervene.
2. Equipments like Needle cutter/ destroyer.
3. Different coloured bins and plastic bags.

This session can be repeated after the entire scheme has been in place.

**v) Training for Administrators**

The people in administration are not directly involved in waste management. However they are the decision making body and a lot of their decisions can affect the waste system.

**Lesson 1: Suggested duration approx. 45 minutes**

Discussion with the administrators is required once a tentative plan is developed. The idea would be to involve various people in the administration in the scheme who are also in a position to co-ordinate any purchase or any other activity as required. It is also important that one single person responsible for the waste programme is clearly identified. Such a person could be selected by the administration. The administration could also be involved in the checking and monitoring of the program. It is therefore very important to involve the administration by explaining the plan to them and modifying it as required in this single session. Administrators will thus be an intrinsic part of the system.

**Goals:**

1. Make them understand the importance of the scheme.
2. They should know what kind of materials to purchase for the scheme.
3. They should be able to identify the different responsibilities given to different personnel.

**Instruction tools and other resources:**

1. Pamphlets giving details of the types of purchases required.
2. List of personnel and their responsibilities.
3. Talk by administrator from another hospital with such a scheme.

The waste management system should be set up after the second session is completed for all the personnel. During the setting up of the system the scheme can be explained at each point to the personnel at different places in the hospital.

Once the entire cycle has been completed the second capsule for the nurses, ward boys and safai karamcharis should be held at intervals of a week for a month.

The third capsule should be started after at least 2 weeks of the commencement of the scheme.

After the entire training programme there should be a meeting of the heads of the various departments so that a performa can be made to check if the waste management system is going on smoothly.

Also, all new personnel should be informed of the scheme by the head of that department. The head of each department should carry out refresher courses every three months.



**Important:**

1. Notes on waste management for new personnel joining to various sectors must be made available with explanations .
2. As far as possible, such sessions should be interactive.
3. These sessions can be conducted either by or along with the head of the departments.

**5.3 AWARENESS**

(see samples of posters on pg 52-55)

The concept of awareness is to educate personnel regularly about the scheme and to inform others about the scheme in a concise manner. Awareness is carried out for

1. **Only the hospital personnel:** In this case the modes used for awareness include *audio* visuals, videos and slides for a group meeting to explain a concept. Through meetings, seminars and workshops which are a method of renewing the concept. The other ways of spreading the message is through street plays, skits, poster making competitions.



To continue the process it is important to add it to the curriculum of all the medical and para medical students.

2. **Both hospital personnel and visitors:** For making the system more visible a recommended medium for information dissemination is posters. Some of the points that should be kept in mind are:
  - a. Posters should be placed in locations which are frequented by personnel.
  - b. They should be area specific.
  - c. They should be concise.
  - d. The contents should be large enough to read.

*Some of the areas where posters should be put are:*

- |                  |  |                         |
|------------------|--|-------------------------|
| i. main entrance | ii. reception                            | iii. lift               |
| iv. waiting hall | v. doctors room                          | vi. administrators room |
| vii. OPD         | viii. OT                                 | ix. Laboratory          |
| x. Wards         | xi. lobby and the rooms of the patients. |                         |

It is important that a poster with a short mission statement - summarising the efforts of the hospital, is prominently displayed. This phrase will be another form of reminder and will also make the hospital and its personnel aware of the responsibility with which they have entrusted themselves.

3. **Where selected personnel are targeted:** In this form of awareness building, reminders and letters are sent to the heads of various departments about the scheme. This should be done at regular intervals.

## Chapter 6

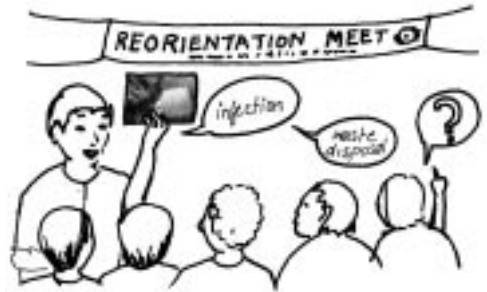
# Sustaining the scheme

Even though there have been policy level suggestions which are being made into rules and laws, it is essential that attention be paid to communities and hospitals at the grassroots. Hospitals should make an effort to implement waste management schemes. Other hospitals which already have such schemes running need to make conscious efforts to continually revitalise the scheme to avoid slackness, and encourage other hospitals to develop similar programs.

The process of waste management never ends and employees will continually develop better methods which will save the hospital money. Research will also provide better technologies on waste management. But in the hospitals, mindsets have to be changed and reminded by the following:

### 6.1 ONGOING EDUCATION AND TRAINING

1. **On site staff training:** The staff must be updated with the latest happenings in the field of medical waste management. Reorientation programmes should be held for all levels of personnel at regular intervals. Memorandums to heads of department within a hospital and staff education through service demonstrations at different units of the hospital is necessary.



2. **Development of training manuals, curriculum and videos:** Groups and official bodies concerned with hospital waste management can prepare videos, manuals, curriculum for training, within the hospitals and for training students related to the medical field. The topic of waste management should be added to the curriculum of the students pursuing medical and paramedical courses.



3. **Design and organisation of seminars, forums and conferences:** A routine update on the topic of hospital waste has to be organised for each level of the staff. This will keep them aware of the happenings in the field like the ways of reducing waste, other types of chemical disinfectants, alternative methods of treatment of waste (other than incineration) also case studies of other institutions managing their waste can be taken up at such meetings.



## SUGGESTED REPORTING FORMATS – I. NURSING STATION

Hospital Name : \_\_\_\_\_

Name of Station -in-Charge : \_\_\_\_\_

Name of Safai Karamcharis : \_\_\_\_\_

Date : \_\_\_\_\_

Time & Shift : \_\_\_\_\_

Area : \_\_\_\_\_

S. No	Work	Completion (Y/N) & Comments
1.	Waste Segregated	
2.	Disposables treated & Mutilated a. Needles b. Sharps c. Plastic and Rubber	
3.	Needle cutter working	
4.	Bleach solution prepared in bin for mutilated Plastic and Rubber waste	
5.	Each bin lined with Plastic bag a. Infectious-Red b. Non-infectious- Black	
6.	Different coloured plastic bags for waste collection from points of generation a. Infectious - Red/Yellow b. Plastic and Rubber - Yellow/Black c. Non-infectious- Black	
7.	Is everything collected by sweeper	
8.	Gloves being worn	
9.	Sharps collected in separate containers	
10.	Only non-infectious waste in patients bin	
11.	Are bins labelled	

FORM 3 photostat and use

Signed  
(Designation)



4. **Spreading the messages through cultural activities:** The health care institutions should make the subject more fascinating by regularly organising street plays, showing films and getting people from other places work with them.
5. **Awarding the best department:** To keep the system at its best it is significant that the entire staff feels important about the subject this can be initiated by awarding the best department for its waste management system.

SUGGESTED REPORTING FORMATS – II. SANITARY SUPERVISOR

Hospital Name : \_\_\_\_\_

Name of Person : \_\_\_\_\_

Name of Safai Karamcharis : \_\_\_\_\_

Date : \_\_\_\_\_

Time & Shift : \_\_\_\_\_

Area : \_\_\_\_\_

S. No	Work	Completion (Y/N) & Comments
1.	Separate bins for different waste types	
2.	Plastic Bags with waste sealed	
3.	Is the area around the bin clean	
4.	Are bins routinely disinfected	
5.	Waste from bin routinely picked up	
6.	Kitchen waste being composted a. kitchen waste being segregated b. Is biodegradable waste being composted c. General waste being thrown in designated bin d. Is the pit smelling e. Slurry of cow dung being added at regular intervals f. Contents of the pit being mixed g. Is the pit being covered	
7.	Do workers wear protective clothing	

Signed  
(Designation)

6. **Reporting format:** Regular checkups of the system have to be carried out by the nodal person and the waste management committee to ensure that waste segregation, collection, transportation and treatment are functioning well. A copy of the reporting format has been attached (see form 3-5, for reporting formats).

6.2 QUALITY ASSURANCE

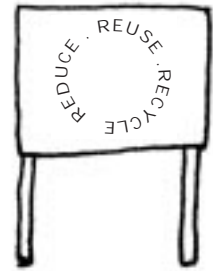
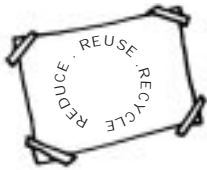
Doctors and the medical centres, as such, are dictated not only by the Hippocratic oath but also by considerations of money and profit. Today they are professionals providing a service. This concept makes the patient a consumer and the medical institution and doctor a service provider.

Bringing in professionalism which is directly equated by the profits of a hospital or the income of a doctor makes the person or institute answerable on many accounts, a major one being the waste generated and managed.

With more hospitals coming up and with each offering specialised services, hospitals find the

SUGGESTED REPORTING FORMATS – III. PROGRAM INCHARGE									
Hospital Name			:	_____					
Name of Person			:	_____					
Date			:	_____					
ICU	O.T	Ward	OPD	Kitchen	Composting	Outside bin	Solved / When	Rec	
Signed (Designation)								FORM 5 photostat and use	

need to be different in their approach in providing medical care. Hospitals should advertise their holistic approach in medical services by publicising their efforts to manage their waste in an environmentally friendly manner. This can be done by publishing features about the hospital and by posting posters in the hospitals itself. The process will percolate to the visitors to hospital . Other hospitals will also try to emulate these attempts. This promise of quality management in all aspects, no matter how small, will help the hospital create a niche for itself.



### 6.3 SHARING OF RESPONSIBILITY

Implementing a new system includes installing new equipment as well as changing a mindset. To bridge the gap between the intruder (the body setting up the system) and the intruded (personnel from the hospital) it is vital that a person within the hospital be cultivated by the administration and the organisation setting up the system. The idea is not only for the person to help change the mindset but also be part of a regular check up of the system. This can be termed as 'responsibility sharing'. A new system will also include a chain-of-command that will ensure that the system is running in an appropriate manner.

Each unit in a health care institution should have selected personnel who are capable of understanding the importance of the new system and can also take small decisions by themselves. These personnel will report to a division head and then finally the division head will bring the report to the waste management committee. Meetings within the division should be held every week or more often if desired. While the waste management committee can meet on a monthly basis.



In each of these units, divisions and also within the committee there should be provisions made to have back-up personnel. Thus if someone is on leave or if a person resigns the vacancy is immediately filled and there is no break-up in the chain-of-command.

This concept of responsibility will ensure that the waste management scheme is running at all levels and problems at the micro level are immediately solved.


### 6.4 OTHER USEFUL PRACTICES FOR A HEALTH CARE FACILITY

Hospitals have to realise their responsibility not only in providing better medical facilities but also to reduce the risks to its personnel and the society at large. General hospital hygiene is a prerequisite for good medical waste management.

1. **General cleanliness:** To minimise the spread of infection it is important that the hospitals and the surroundings remain clean, and no waste lies spilled anywhere in or outside the hospital premises. A clean hospital has a positive effect on



its patients and the personnel too.

2. **Floors** tend to be dirty very soon and have to be mopped every 2-4 hour by mixing an effective disinfectant such as Phenyl or Domex in the water used for mopping.
  3. **Cleaning** the wash basins and the table tops. It is important to take care that the spills do not fall on the floors. If spills happen, the floors have to be cleaned after the wash basins.
  4. **Water:** To prevent spread of infection it is advisable not to use the same water for mopping the entire floor of the hospital. Water has to be changed for every room and the used mop heads should be washed, rinsed and dried thoroughly before being stored for further use.
  5. **Spitting** should be in separate bowls provided to patients for the purpose, thus insuring that all waste is not infected with fluids from the body.
  6. **Spills** need special care as spills of body fluids can spread infection. Separate swab should be used for clearing a spill. The spill should be removed with the swab in a manner that least spreads the liquid. After which the area should be wiped with a disinfectant and detergent. The swab should then be tied in a separate bag and put into the infectious waste containing bin. Protective devices like face masks and gloves should be worn.
- 
7. **Ventilation** of the hospital needs to be ensured. An appropriate ventilation in the hospital is necessary for the proper circulation of the air to support a healthy atmosphere within the hospital.
  8. **Linen** also needs special mention. Care has to be taken to keep the infection away from linens. Bedding, clothing, furnishings make up the largest group of items which are not disposed after a single use. It is a requirement that after use these should be treated by a process that completely disinfects them in a manner that does not unreasonably shorten their life. This is usually achieved by a process of soaking them in a chemical disinfectant, washing in water at a high temperature (70°C for 1/2 hour) followed by drying and ironing.

These small but very useful precautions taken together help us in building a healthier atmosphere within hospitals.

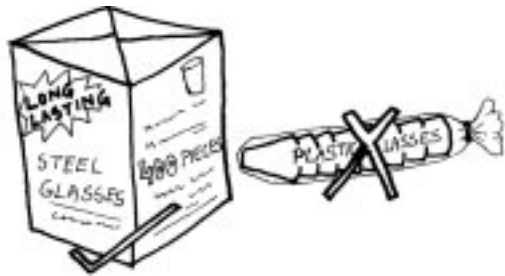
## 6.5 WASTE REDUCTION AND REUSE

There is a growing trend in hospitals to provide or use disposal materials in all aspects of work. Some are quite necessary for proper infection control and worker and patient safety. Hospitals should select a mix of disposal and reusable items depending on their situation. Nursing homes can use mostly reusable items but Casualty Departments may incorporate more disposable items.

In many countries, and in India too, waste disposal had come under the government, and was considered a basic function which the authority had to do. Thus all large waste producing institutions which include hospitals did not have any need to manage their waste. However in the US and other developed countries where waste producers have to manage their waste, more waste means more

expense on waste disposal. They have found that reuse not only reduces disposal costs but also reduces procurement costs for medical items.

Some of the things a hospital can do to reduce the waste it produces is to procure products that have a longer life cycle, and also choose products with less packaging. Proper procurement is not an easy task and it will need a lot of people coming together.



The idea behind proper procurement is:

1. Find alternatives to single use items, where possible.
2. Find materials which are more environmentally benign at all stages and even during disposal.
3. Find medical kits that do not have much packing.

To do this the purchasing department will first have to find out:

1. What are the most frequently used disposables and what is their use?
2. Who are the alternative manufactures?
3. What are the materials used in the kits?
4. Will the doctors accept the alternative kits?



Once these decisions are made a team can be formed with representatives from the purchasing department, finance department and doctors from various departments. This team can be in charge of all future purchases.

Some of the immediate things a hospital can do to reduce its waste are:

1. Use cloth aprons, caps and masks instead of disposable paper ones in the O.T
2. House cleaning chemicals can be bought in concentrates
3. Hospital canteens can serve beverages in proper cups, glasses or kullad, Paper envelopes instead of aluminium foil for serving rotis.

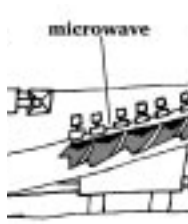



## Chapter 7

# Disposal Technology Efficacy

Incineration has been the most widely used method of treating hospital waste in India and abroad. But the growing awareness among the public about the hazards caused by the harmful emissions coming out of the stacks of the incinerators has forced hospitals to shift to environment friendly

TABLE 7: CPCB GUIDELINES FOR THESE ALTERNATE TECHNOLOGIES

S.No.	Autoclave (gravity flow)	Autoclave (Vacuum)	Microwave
1.	Pathological waste, recognisable animal carcasses, chemotherapeutical waste, antineoplastic waste, bulk liquids, body parts not to be autoclave	Pathological waste, recognisable animal Carcasses, chemotherapeutical waste, antineoplastic waste, bulk liquids, body parts not to be autoclave	Microwave shall not be used for cytotoxic, hazardous or radioactive waste, contaminated animal carcasses, body part and large metals
2.	Medical waste shall be autoclave in the container which is received at the facility, unless reusable container utilised	Medical waste shall be autoclave in the container which is received at the facility, unless reusable container utilised	The microwave system shall comply with the efficacy test/routine tests and a performance guarantee may be provided by the supplier before operation of the unit
3.	A temperature of not less than 121°C and a pressure of 15 pounds per square inch (psi) for an autoclave residence time of not less than 60 minutes	A temperature of not less than 121°C and a pressure of 15 psi for an autoclave residence of not less than 45 min	The microwave should completely and consistently kill the approved biological indicators at the maximum design capacity of each microwave unit. Biological indicators for microwave shall be Bacillus subtilis spores using vials or spore strips, with at least 1* 10 spores per millilitre
4.	A temperature of not less than 135°C and a pressure of 31 psi for an autoclave residence time of not less than 45 min.	A temperature of not less than 135°C and a pressure of 31 psi for an autoclave residence of not less than 30 min	
5.	A Temperature of not less than 149°C and a pressure of 52 psi for an autoclave residence time of not less than 30 min		

NOTE: The CPCB rules also provide operational parameters to continuously check the operation of the autoclave and to ensure that all pathogens are killed.

TABLE 8 : WASTE SUITABILITY AND TYPES OF DISINFECTION

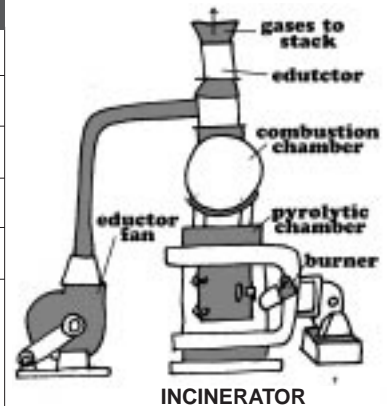
S.No	Type of disinfection	Waste suitability
1.	Chemical Disinfection	All waste; except body fluids and body parts
2.	Microwave	All waste, except metals, body parts etc.
3.	Autoclave	All waste; except body fluids and body parts
4.	Incineration	All waste; except chlorinated plastics

The key parameter critical to each alternate technology are:

Autoclaves : \* Internal Waste Load Temperature, 30 to 60 psi, 121°C  
 \* Time length of steam exposure

Chemical : \* Active ingredient concentration  
 \* Contact time between contaminated surface and treatment chemical

Microwave : \* Frequency and wavelength of radiation  
 \* Duration of exposure  
 \* Composition and moisture content of waste



alternatives like microwaving, chemical treatment and autoclaving in place of incineration. These techniques are equally effective in destroying pathogens and may also reduce the mass of waste considerably. (see table 7 & box)

7.1 EFFICACIES OF ALTERNATIVE MEDICAL WASTE DISPOSAL TECHNOLOGIES:

Treatment may be defined as any method, technique or process designed to change the biological character or

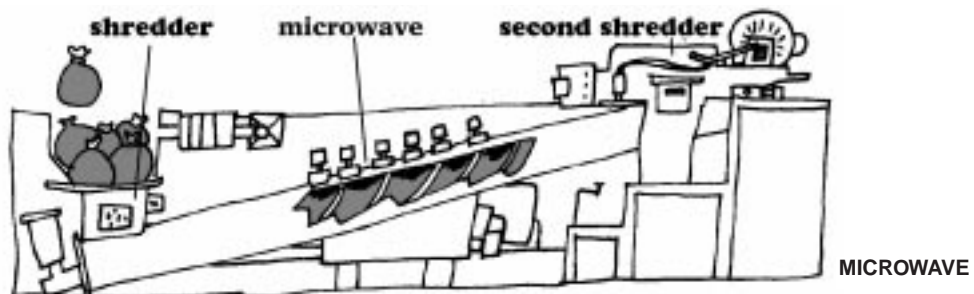
TABLE 9 : EPA EFFICACY TESTS : ALL FIELD TEST RESULTS

Waste Treatment	Microbial Inactivation			
	Level 1 <sup>a</sup>	Level II <sup>b</sup>	Level III <sup>c</sup>	Level IV <sup>d</sup>
Steam Autoclave	Yes	Yes	Yes	No
Microwave	Yes	Yes	Yes	No
Chemical	Yes	Yes	No	No

<sup>a</sup> Inactivation of vegetative bacteria, fungi, some viruses  
<sup>b</sup> Inactivation of vegetative bacteria, fungi, all virus and mycobacteria  
<sup>c</sup> Inactivation of vegetative bacteria, fungi, viruses, mycobacteria, and *B.subtilis* 10<sup>4</sup> : or *B.stearotherophilus* 10<sup>4</sup> (chemical)  
<sup>d</sup> Inactivation of vegetative bacteria, fungi, virus, mycobacteria and *B.stearotherophilus* 10<sup>6</sup> or greater

NOTE:  
 1. Subtilus and *B.stearotherophilus* have death curves similar to human pathogen spores and are standard methods for testing level of disinfection.  
 2. Level IV is equivalent to sterilisation)

In the above table:  
**Autoclave:** Pre-vacuum system 138°C, 30 psi, double door gravity system, 163 °C, 80 psi  
**Microwave** treatment system (six units at 2,450 MHz each)  
**Chemical / mechanical** systems, sodium hypochlorite, 1000, 2000, 3000 ppm FAC



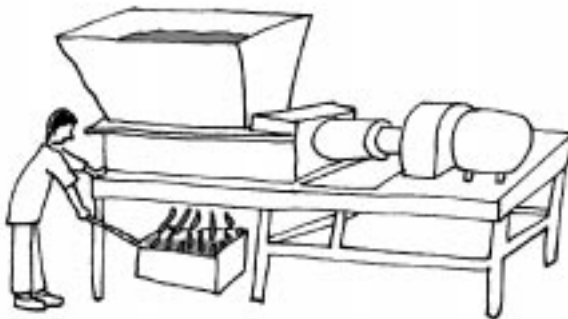
composition of any medical waste so as to reduce and/or eliminate its potential for causing disease.

Levels of microbial inactivation, as used in the table below, are commonly used to indicate efficacy of medical waste treatment processes. Level I to Level II inactivation can be associated with disinfection ranging from low level disinfection to high level disinfection. Level IV is equivalent to sterilisation. Level III inactivation is generally considered as an appropriate level of medical waste treatment.

## 7.2 ESTABLISHMENT OF COMBINED FACILITY

Smaller health care units with low funding, space constrain and high cost of establishment of the facilities are unable to afford an individual facility. Such health care institutions can solve their problem of waste treatment by joining hands with one another and establishing a common waste treatment plant running by common funding from all the health care institutions sending their waste to the plant for treatment.

The MOEF standards allow for sharing of facilities. Many municipalities and pollution authorities around the country are proposing common facilities or sharing existing facilities.



**SHREDDER**

### BOX 3 : DISPOSAL TECHNOLOGIES

After the Supreme Court Order which stated that incineration and its alternatives should be used to manage solid waste there has been a flood of alternate technologies into India. The Central Pollution Control Board is the body which has been given the task of providing specifications for these technologies.

Some of the alternate technologies which are being promoted in India are :

#### 1. AUTOCLAVE:

An autoclave is a instrument which uses steam at high temperature to kill all microbes. There are two type of autoclaves.

- Gravity displacement Autoclaves: In this system the air within the autoclave is pushed out by entering steam.

This process has a problem. There may be air pockets left within the waste which is being autoclaved. This reduces the temperature of the waste and therefore reduces the efficacy of the system.

- Pre -vacuum Autoclaves: Once the waste is put into the autoclave a vacuum is created within the autoclave( all the air from the chamber is removed). Steam which enters the chamber is able to penetrate the

entire waste. And the absence of air pockets ensures that high temperatures are achieved within the waste rendering it harmless.

#### 2. MICROWAVE:

A microwave system uses high frequency waves. These waves cause the molecules within the waste material to vibrate. This generates heat from within the matter itself. The heat generated is high enough to ensure that all microbes are killed.

#### 3. CHEMICAL DISINFECTION:

Chemical disinfection is cost effective and does not require large investments. In this form of disinfection a chemical is used to destroy the pathogens. Some of the Chemical disinfectants that can be used are:

- Sodium Hypochloride
- Bleach

Not all medical waste should be treated in this way. Only plastic, rubber and metals should be disinfected. It is not advisable to disinfect cloth based medical waste because it is difficult to handle wet waste and it also adds to the weight and volume of the waste being disposed. Pathological waste, also, cannot be disinfected in this manner unless it is crushed - this procedure may cause aesthetic problems.



## Chapter 8

# Ragpickers' role

A city's waste management system is greatly subsidised by the ragpickers. These people reduce the quantity of waste by 12-15% by collecting recyclables. Ragpickers are known to collect recyclables from hospitals too.

Until now hospitals have been careless in managing their waste by throwing all waste including sharps, pharmaceutical, chemicals and infectious waste into municipal bins making them freely accessible to ragpickers. Thus, not only are there chances of spreading disease to other communities, the ragpickers are themselves exposed to various diseases due to the callousness of these hospitals.

If the hospitals were to disinfect the plastic waste and destroy the other infectious waste currently being thrown in the municipal bin, the ragpickers would play a more vital role in the overall waste management system. Also the recycled product would be safer to use.



### Municipality Interface

Sanitation and garbage disposal comes under the purview of the municipality. As the burden of waste increases the municipal corporation has to devolve work while still ensuring that waste is managed properly. In the context of waste management the municipality can do just this:

It can provide certain basic specialised facilities to hospitals and aid in disposing the waste in an appropriate manner.

### Some of these ways are-

1. **Waste collection:** Waste could be collected by special trucks procured by the municipality. There would be a charge for collection. The collected waste can be taken to a combined facility operated by it or by another party.
2. **Waste disposal:** The waste can be collected by a second party and be disposed by the municipal corporation. It is necessary that the municipality collect a fee because of the costs involved. The municipal corporations may not want to give away total control to a private body. This is



important because medical waste handling needs stringent and constant control. Besides being part of the waste management process the municipality should also be a monitoring body against erring hospitals and private waste managers.

## Chapter 9

# The Orthonova Case Study

The Orthonova Medical Centre is a private 35 bedded hospital. The hospital administration was keen to start a scheme which not only could contain and disinfect the waste, but also reduce the amount of waste reaching the main bin.

### STAGE I

The implementation started with a survey. During the survey Srishti personnel were accompanied by the Nursing Superintendent, and the Sanitary Inspector. Their attendance in the survey provided useful insights into the current waste management system, points about the personnel, the quantity of waste being generated at different locations. The survey also studied the lay out of the hospital and the purchases of the pharmacy.

GENERATION POINT	NO	TYPE	PERSON SURVEY
DT	48	INFECTIOUS	SANIL
OPD	90	PLASTIC, BIODEGRADABLE	ZENA, PREETI

Srishti had a program schedule when the proposal was sent to the hospital. The schedules were again looked into with the administrative staff so that sufficient time was given for procurement

of various items. Also discussions with the sanitary chief and the Nursing Superintendent were held to discuss the training programme. The administration was also informed of the steps that they would have to carry out and the role of Srishti in the program.

The decisions on the number, volume and types of bins were determined after the survey. Also the survey was able to identify the manner in which the waste should be segregated to ensure that it would be properly managed.

During the period of procurement training sessions were held. Key personnel like the Sanitary Inspector, the Nursing Superintendent were involved in these sessions. Nursing Superintendent conducted trainings with the nurses separately too. This proved to be of great help because ideas could be reinforced by a senior person.

The training of these personnel depended on the type of work they were doing. Points such as the problems with improper waste disposal, need for proper segregation, disinfection and protection were discussed. All these subjects were essential to the type of scheme being implemented.



The first session gave sufficient time for procuring various items like:

1. Bins of different varieties (with a inner chamber and the simple bins) and colour
2. Coloured plastic bags
3. Needle cutters
4. Bleach
5. Fresh dung
6. Place for composting

## STAGE II

After the first session the scheme was implemented in all the wards. The waste was segregated into three categories (based on the suggested CPCB guidelines).

The categories were:

1. General waste-
  - a. Biodegradable kitchen waste
  - b. Non biodegradable kitchen waste
2. Rubber and plastic waste
3. Infectious waste

Treatment was decided on available space and funds. Thus:

1. The segregated general waste would reach the final bin without treatment
2. The infectious rubber and plastic waste would be chemically treated at the point of generation
3. The biodegradable waste would be converted into manure through pit composting
4. The non-biodegradable kitchen waste would be put in the final bin
5. The infectious and pathological waste would be treated in a centralised facility

All waste would be collected separately depending on their type and would be put in separate final bins.

Bins were provided at all points of generation

**Bin 1** was meant for the general waste and lined with a black plastic bag.

**Bin 2** (Cream colour) was meant for the plastics and other recyclable items having bleach in it.

**Bin 3** (Red colour) was meant for the infectious waste and lined with red plastic bags.

Apart from the bins, needle cutters were also provided in each nursing station for the containment and destruction of the sharps.

The plastic and rubber waste had a special bin which had a perforated inner chamber so that the disinfectant could reach the waste. This could also allow waste collection with minimum exposure.

It was suggested that bleaching solution be prepared to disinfect the needles and other sharps. While the syringes would be dis-



posed into the bin for plastic and rubber waste.

It was also suggested that the bins be emptied after every shift or whenever the bins were 3/4 full. A ward boy was specially kept for the collection of sharps.

**After the installation of the scheme the second training session was held:**

During this session it was found that the nurses were not keeping a proper check on the ward boys, as the nurses did not know the exact nature of responsibility that needed to be assigned to the ward boys. Therefore, it was once again explained to them that they had to ensure that the waste was being segregated by the ward boys and no bins were over full. They were also informed that they had to check the bleach solution was properly made.

The ward boys were explained their responsibility for proper segregation. The ward boys also came up with an observation that the bleach was rusting the needle cutter and therefore bleach solution should be kept in a different container. This was a good suggestion and was implemented. Another feed back obtained was that removing the needles was a dangerous task and one of the ward boys suggested the use of a strainer to drain of the contents. This was implemented too.

The method as of today for the disinfection of sharps is: All needles are destroyed in the needle cutter and other sharps have a separate container. This is collected by the ward boy after every shift and taken to a large container containing bleach. The contents are removed after the specified period with a strainer. All disinfected sharps are then kept in a puncture proof container for disposal.

Segregation in the kitchen was started immediately after the first training. Kitchen waste was segregated into biodegradable and non-biodegradable waste. The Safai Karamcharis were trained on how the biodegradable waste could be converted into manure.

To keep up the tempo of the scheme and to inform all personnel about their duties, posters were prepared. Posters for ward boys, nurses, doctors, patients and general information on the scheme were placed at strategic locations like the nursing stations, entrance. It was also suggested that a few pertinent posters be placed in the staircase.

Also as a step towards instilling responsibility among the personnel a committee was formed with the Director as its head and the chiefs of various departments as members. They were given a reporting format so that they could check various procedures of the waste management system.

**Precautions:**

The hospital authorities were advised to take certain precautions while purchasing bleach. Small packets of bleach were advised to be purchased by the authorities as once the bleach is exposed to air it changes its chemical composition and does not remain very effective any longer. Whenever the container containing waste are 3/4<sup>th</sup> full it was advised to have it removed to the appropriate bin outside the hospital.

**With the scheme in place Orthonova now has:**

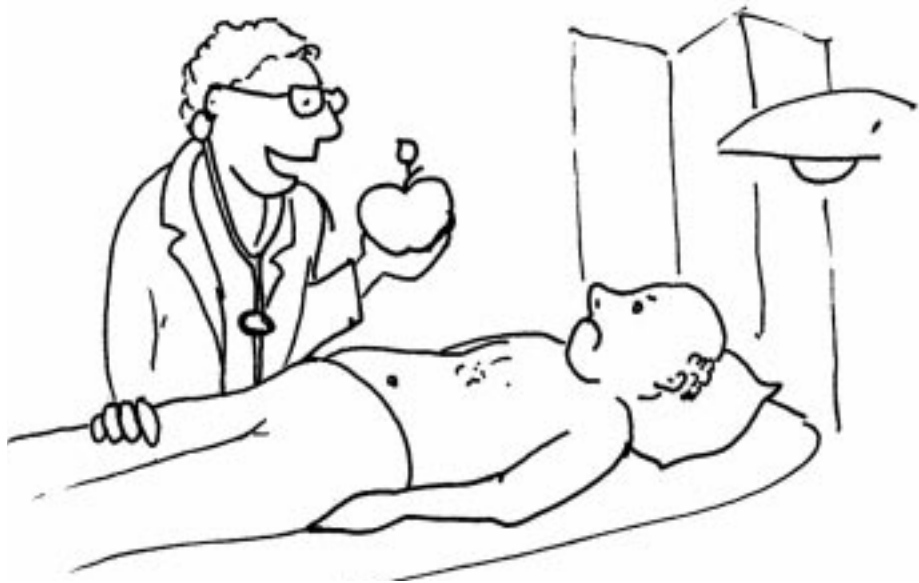
1. A process to segregate the waste at all points till the final disposal point.
2. Proper containment and disinfection.
3. Trained personnel who are responsible.
4. Method of waste reduction.
5. Information distribution system.
6. A format to ensure that the system runs smoothly.



*Cleaning up is Simple! Let's start with some easy steps*

## DOCTORS

- Do not dispose dressings in patients bin/Ask for disposal bags.
- Ensure all the plastics and gloves are cut and put into bleach solution
- Ensure all used injections are cut using needle cutters
- Ensure compliance of this scheme during ward visits.



*Cleaning up is Simple! Let's start with some easy steps...*

## WARD BOYS

- Cut all tubes
- Cut all gloves
- Check if waste in bleach is only plastic or glass. If not, report to the supervisor.
- Help patients understand the scheme.



*Cleaning up is Simple! Let's start with some easy steps...*

## NURSES

- Put cut gloves and plastic in bleach solution.
- Put all other infectious waste, such as pathological waste, bandages, dressings, cotton etc... in red bin.
- Always cut needles with the needle cutter and disinfect with bleach solution.
- All sharps to be put in needle cutter container.
- Help patients understand the scheme

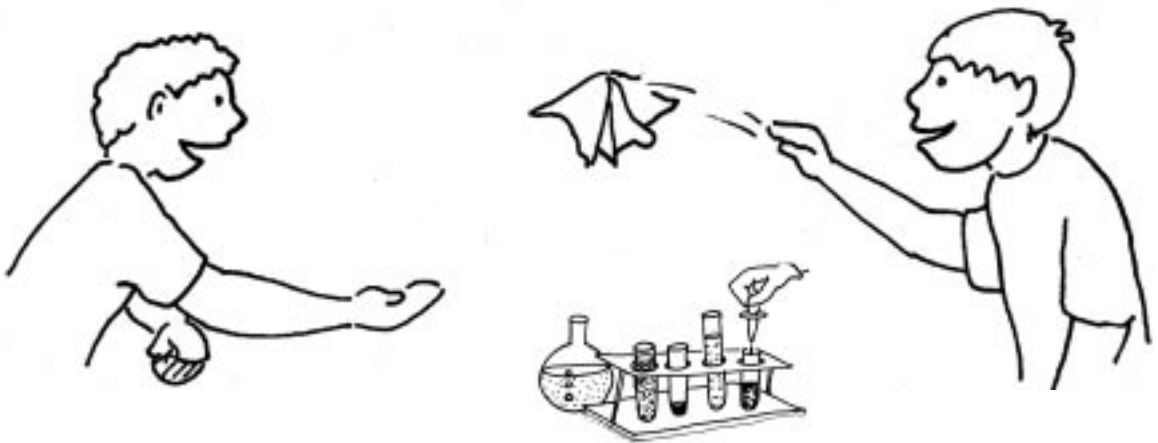


ORTHONOVA -  
SRISHTI HOSPITAL  
WASTE MANAGEMENT  
INITIATIVE

*Cleaning up is Simple! Let's start with some easy steps...*

## LAB TECHNICIANS

- Use gloves during all tests.
- Reusable items to be soaked in bleach and heated at high a temperature.
- Media plates to be put in separate bleach solution.
- Cut gloves, syringes to be put in cream coloured bin with bleach.
- Needles to be cut with needle cutter and disinfected with bleach.
- Sharps to be put in needle cutter container.





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