

HOSPITAL WASTE TIME TO ACT

Srishti's factsheets on 14 priority areas

JUNE

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SRISHTI

दुसऱ्या संस्करणामध्ये
नासपूर महानगरपालिका अखत्येता
द्वारा संचालित

~~भस्मीकरण भट्टी
(INCINERATOR)~~

दवाखान्यातील घातक कचरा जाळण्याकरिता

revised edition

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Srishti is an environmental group deeply involved in the issue of medical waste management. 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 inclusion of alternative technologies and their standards in the ruling, both of which were agreed to. Subsequently Srishti was involved with Central Pollution Control Board to help evolve medical waste national standards, which have been notified as Rules in July 1998, by the Ministry of Environment & Forest. Srishti has already set up waste management schemes in four hospitals in Delhi, besides keeping a tab on practices being followed around the country. Srishti has been working with the Central Government to develop recommendations for Guidelines for Biomedical Waste (Management & Handling) Rules. Srishti is also a part of Medical Waste Action Network a co-alition of citizens and medical groups around the country and regularly disseminate information on the issue. Srishti is also running a list serve of the people actively working on this front.

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

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June, 2002

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Printed at: Excellent Printing House, New Delhi



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CONTENTS

FACTSHEET	1	Sharps disposal	1
FACTSHEET	2	Economy of hospital waste management	5
FACTSHEET	3	Plastics in healthcare	8
FACTSHEET	4	Incineration	12
FACTSHEET	5	Mercury handling	14
FACTSHEET	6	Glutaraldehyde	16
FACTSHEET	7	Training for medical staff	23
FACTSHEET	8	Universal Precautions	28
FACTSHEET	9	Disinfectants against the microbes	33
FACTSHEET	10	Exploring mercury and its alternatives	36
FACTSHEET	11	Radioactive waste	39
FACTSHEET	12	Treatment technologies	43
FACTSHEET	13	Safety of healthcare workers	47
FACTSHEET	14	Cytotoxic drugs	49
		References	53

FOREWORD

This is the second edition of the compilation of factsheets, which continues to cover the priority areas in the field of medical waste. Its wide distribution hopefully will help in understanding these issues better.

The problem with medical waste lies in the fact that it is not handled and treated according to its type, which leads to hazardous working conditions for hospital personnel and exorbitant investment in technology that creates more problems. Through our factsheets we have been trying to focus on the possible solutions to the commonly asked questions, generally faced problems and usually misunderstood facts.

Our attempt is to assist evolve innovative solution, relevant to the subject which will help deal with the key problems of biomedical waste management. These factsheets have emerged through Srishti's continuing efforts to improve the medical waste management scenario in the country.

Our factsheets and newsletters are published quarterly and is an attempt to spread awareness about medical waste among individuals, organizations and community at large. This edition is a compilation of fourteen factsheets covering different topics related with medical waste and includes six new priority areas to the previous edition of 'Time to Act'. We hope that this edition will also be widely used and helpful in understanding the issues further.

Poking danger

A FACTSHEET ON

SHARPS HANDLING AND DISPOSAL

Sameer Nazareth, Megha Kela Rathi

This factsheet, 'Sharps Handling and Disposal', has been created keeping in mind the use of sharps and the personnel using and disposing them off. It should only facilitate better sharps management. Hospitals should choose and adopt sharps management practices that decrease the possibility of injury and spread of infection.

The factsheet has been divided into sections, which provide information on personnel who are most prone to dangers resulting from improper handling of sharps, areas where sharp injuries can occur and possible methods to reduce/negate sharps injuries. We have also listed manufacturers of alternatives to syringes and technologies to handle used sharps.

INTRODUCTION

Sharps consist of needles, syringes, scalpels, blades, glass etc., which have the capability to injure by piercing the skin. As these sharps are used in patient care, there is every chance that infection can spread through this type of injury. Nurses can get a sharp injury before and after using a sharp on a patient. Further, sharps discarded without any special containment or segregation can injure and transmit disease to those who collect waste (including safai karamcharis, municipal sweepers and ragpickers). There have been reports that waste collected from the hospitals are resold, this creates an additional occupational and community health hazard.

In a research paper on the cost of needle stick injuries, the author states that the incidence of such injuries is between 7.5 to 16 per 100 employees and from 4.27 to 12.4 per 100 registered nurses.¹

It further adds that these figures are grossly underestimated, as many incidents go unreported.

Use of a needle, lancelet or scalpel has the potential of causing a sharps injury.

AREAS WHERE 'NEEDLE-STICK' INJURIES CAN OCCUR

Nursing stations

Nursing stations are areas where, in addition to

Categories of hospital personnel exposed ²	Percent injured
Staff nurses	34.6%
Interns	15.7%
Residents	11.7%
Practical nurses	8.5%
Technical staff	6%

Procedures during which needle stick injuries can occur ³	Number of times (in percent)
Drawing blood	22.6%
Recapping needle	11%
Needle disposal	10.5%
Garbage disposal	12.5%

patient care activities, the waste generated is initially stored (in some hospitals). During our surveys we observed that the nurses generally break the injection vials in such a manner that they spill on the floor or the tabletop, increasing the chances of sharps injury, as these are not removed immediately. These sharps are collected by hand either by the nurses or by the sweeper who comes to collect the waste. Thus, at all stages – prior to use, during use, storage, collection and finally disposal, either the nurse or the sweeper is in close proximity to sharps that can cause them injury and infect them.

Pathology laboratories & blood banks

In these two places a lot of blood-tainted syringes are disposed. The use of syringes for blood sampling exposes the laboratory personnel to needle-stick injuries. The exposure happens because, to avoid ***Haemolysis*** (clotting of blood) the needle is removed from the syringe by hand before blood is poured out. Lancets, used to take out small samples, are also thrown near sinks or into a dustbin immediately after use.

During blood collection, when the needle is removed from the vein of the donor, the tube is cut and the needle is thrown in the bin, increasing the chances of needle-stick injuries.

Operation Theatre

During operations, lots of sharps are used and these are placed separately, as they need to be counted later. Surgeons and nurses are equally susceptible to stick injuries in the OTs. Some surgeons have tried to devise working norms for OTs which can reduce the number of such injuries. They involve specially designed OT tables so that the passing of sharps is minimal and done in a manner that has least chances of causing injury.

During disposal

In many cases, all the waste from the hospital is collected in one large plastic bag and taken to the main bin. In this procedure, a lot of needles stick out from the bag, which could injure the person carrying the bag and also those moving close to, or around the bag.

During sorting by ragpickers

Ragpickers collect non-biodegradable waste from

municipal bins and from places where garbage is piled. During sorting, ragpickers can get pricked by these infected sharps and acquire infections. Ragpickers say that they get as many as 5-6 needle-stick injuries in a day and even though they know that there is a chance of getting an infection, they carry on with their work, as this is their only source of income. They occasionally take an anti-tetanus injection to 'decrease the risk' involved in their work.

OTHER PROBLEMS ASSOCIATED WITH IMPROPER DISPOSAL OF NEEDLES

Besides the danger of needle-stick injuries and the transmission of infection to hospital personnel and the public, improper disposal of sharps spells another risk – the risk of reuse. Sharps, from syringes to lancets, have been said to re-enter the market. What happens is that once these sharps are used and disposed off, people pick them up, wash them, repack them and place them on counters to be sold. They are sold at cheaper prices and therefore have a ready market. This once again raises the spectre of transmission of infection through its reuse.

REMEDIES

The problems associated with sharps can be handled if they are considered to be a specific type of waste that requires treatment of a special kind.

1. USE OF EQUIPMENT

Needle cutter

A needle cutter is a mechanical instrument that consists of a container with a blade. The blade cuts the nozzle of the syringe and also the base of the needle. This ensures that both the needle and the syringe are mutilated and therefore cannot be reused.

When using a needle cutter, it is necessary to keep a liquid disinfectant (see end of chapter for liquid disinfectants) to disinfect the mutilated needle and the syringe should be stored separately. The barrel of the syringe has to be removed from the plunger and placed in a container of liquid disinfectant. This container has a perforated inner chamber so that the contents can be removed without displacing the liquid.

The cut needles can also be put in a small

Table 1.3
Equipment required for a sharps management scheme

If at point of disposal	If, central treatment is done
Needle cutter/destroyer	Puncture proof container
Container with chemical disinfectant	Autoclave/Microwave
–	Shredder

container with liquid disinfectant. The contents of this container can be removed with the help of a strainer. The needles from the needle cutter can be emptied into this container

Needle destroyer

This is an electrical gadget that cauterises the needle. The destroyer has an exposed filament. When the needle is inserted, the circuit inside gets completed and a high temperature electric arc is generated, which burns the needle. The destroyer also has a cutter to cut the nozzle of the syringe so that it can no longer be used.

User points

When using a needle destroyer at a nursing station, it should be remembered that it is an electrical appliance. Most nursing stations have only one plug point on the table. Therefore, this would lead to competition between various appliances that run on electricity, which in turn would defeat the purpose of installing such a gadget. To reduce this problem, a separate socket should be provided for the needle destroyer.

The hospital should be careful to replace all the non- functioning equipment as fast as possible if it

wants to ensure a good sharps management scheme.

On the trolley

When injections have to be given to in-patients and a medicine trolley is being used, the trolley should have a stand similar to the test tube stand. This stand could hold the syringe upside down from the syringes' finger grip.

Shredder

The shredder does not disinfect the waste; it only mutilates the waste beyond recognition. Lancets and blades can be disfigured and placed in a liquid disinfectant. If the hospital has a shredder, then waste can be shredded after disinfection. Shredding ensures that the waste cannot be reused.

2. PROPER SHARPS HANDLING

Using a needle cutter/destroyer

1. Place used needle in the cutter/destroyer.
2. Cut/destroy the needle and the nozzle of syringe in the destroyer/cutter.
3. Separate syringe's barrel and plunger and put in liquid disinfectant.
4. After every shift empty the contents of needle container/destroyer into liquid disinfectant, remove through pouring out contents through a sieve.

If using equipment other than above two

1. Place the used syringe in puncture resistant container (heavy-duty plastic container) immediately after use.
2. Disinfect in microwave/ autoclave.
3. Shred the disinfected waste.

Table 1.4
Technology mix

Needle Destroyer/Cutter	Liquid disinfectant	Shredder	Microwave	Autoclave	
Needle cutter		√	√		
Needle destroyer		√	√		
Liquid disinfectant	√		√	√	√
Shredder	√	√		√	√
Microwave	√		√		
Autoclave	√		√		

Table 1.5
A list of disinfectants⁴

Type of disinfectant	Clean conditions*	Dirty conditions*
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
NaDCC** powder (60% available chlorine)	1.7 g/litre	8.5 g/litre
NADCC tablets (1.5 g available chlorine per tablet)	1 tablet/litre	4 tablets/litre
Chloramine (25% available chlorine)n	20g/litre	20g/litre

After removal of bulk material. * on bulk organic material, eg for flooding on blood or before removal of bulk material.

**Sodium dichloroisocyanurate. As it releases chlorine at a slower rate than hypochlorites, a higher initial concentration is required

Always use gloves when handling and carrying this type of waste

ALTERNATIVES TO CURRENTLY USED SHARPS

A. Vacutainer

This equipment is used for blood collection. It is single use appliance and thus protects the person handling it. The Vacutainer consists of a needle that has a plastic band around it. The needle on one side of the band is inserted into the patient and the other

part into a test-tube that has a vacuum in it. The vacuum draws the blood into the test-tube. The needle that goes into the test tube has a plastic cover that protects the user. More than one sample of blood can be taken from the patient using the same needle.

B. Vygo

Vygo is a medical instrument, which connects a patient's vein to more than one syringe. Needles do not have to be changed when a patient is being given fluids intravenously.

Table 1.6
Addresses of manufacturers/ suppliers of alternative instruments and technologies for sharps management

Technology	Address
Vacutainer	Becton-Dickinson India Pvt Ltd, Signature Towers-II Gurgaon, Haryana.
Needle cutter	Core Health Care, Core Towers, Parimal Crossing, Ellis Bridge, Ahmedabad.
Needle destroyer	<ol style="list-style-type: none"> 1. Mansa-impex, 2 DLF Industrial Area, Najafgarh Road, New Delhi-110015 Phone: 530971, 5440598. 2. Robonik, 31-D, Laxmi Industrial Estate, Link Road, Andheri (W), Mumbai- 400053. 3. Penpol, Peninsula Polymers Limited, Cabin No.5, Basement-137 Sant Nagar, East of Kailash, New Delhi-110065 Phone: 011-6236436, fax- 6225847. 4. Shredder Pulse Pharma, 208 Ashirwad Commercial Complex, D-1 Green Park, New Delhi-110016 Phone: 68635053. 5. Microwave Pulse Pharma, 208 Ashirwad Commercial Complex, D-1 Green Park, New Delhi-110016 Phone: 68635053. 6. Autoclave Omron Medical Pvt Ltd. J-13 RB Enclave, Paschim Vihar, New Delhi. Phone: 5681536

Srishti does not endorse any particular product or company. The information is provided so that hospitals, institutions and people can make informed choices.

Small price-Big returns

A FACTSHEET ON

THE ECONOMICS OF HOSPITAL WASTE MANAGEMENT

Anu Goel

During our work in setting up waste management programmes in hospitals and during seminars and meetings, we realized that budgets and investments are a major concern, when one thinks of setting up such a system. The question generally asked by people is- How much will it cost?

This factsheet aims at answering some of the queries that people have about bins, bags, trolleys and various other equipment, needed for a sound waste management system within the hospital.

The factsheet has been divided into two parts — the first half talks about the various options available in the market and the latter half gives case studies of two hospitals (a 300 and a 30-bedded hospital). Case studies speak about various investments and some strategies that these hospitals adopted to minimise expenditure.

Some bins, trolleys and bags specifically being marketed for the purpose of hospital waste may be too expensive and thus it becomes imperative for the small set-ups to go in for affordable and

Table 2.1

Economics of waste management

	300 bedded hospital		30 bedded hospital	
Material Required	Initial cost*	Recurring Cost/mth*	Initial cost*	Recurring Cost/mth*
Bins, bags, needle destroyers, chemical disinfectant	76,583	10,000	7000	700

* Based on actual cost in Rupees

Table 2.2

Garbage collection trolleys/bins and bags

S.No.	Size	Bin dimension (inches)	Cost (Rs.)	Bag dimension (inches)*	Cost (Rs.) (for all the colours)
1.	Small	8 x10 x 21	900	17 x 25	2.50
2.	Small with plastic bin	9 x11 x 16	900	17 x 22	2.50
3.	Large	12 x 14 x 33	1200	25 x 37	5
4.	Extra large	17 x 14 x 33	2200	36 x 40	9
5.	Tilt Bin	14 x12 x 28	2500	29 x 36	3.5

All the bins listed are covered and pedal bins. *These bags are made up of High Density Polyethylene

Table 2.3

Garbage collection bags

Colour	Dimension (inches)	Cost (/bag, in Rs.)
Yellow	12 x 21	7
Red	23 x 37	8
Black	32 x 40	15

**These bags are made up of High molecular weight high Density Polypropylene*

workable alternatives. The process of segregation should not get held up because of lack of funds.

Table 1 gives an overall expenditure incurred by the hospital to have a hospital waste management system in place, excluding final treatment & disposal costs.

Table 2 and 3 list the material available specifically for hospital waste management within hospitals

CASE STUDIES**A 300-bedded Hospital**

Investments made by the hospital for setting up the system

Initial The investments including items 5A, 5D and 5E (with provision of stocks) amounted to Rs. 90,330,

Table 2.4

Break up of expenses

Equipment	Initial Cost (Rs.)	Recurring cost/ mth(Rs)
Bins	17,243	Nil
Needle destroyers	52,500	Nil
Polythene bags	Nil	3000
Chemical disinfectant	Nil	7000
Scissors & forceps	6840	Nil

though, due to use of available bins, the actual cost came down to Rs. 76,583.

Monthly 10,000 (3000 + 7000, for plastic bags and disinfectant respectively)

5C. Chlorine Solution

- 30 % Liquid concentrate of bleach solution- Rs. 19/ltr
- 1.8% Solution used for disinfection of plastic waste and soiled linen. (Dilutions made in Pharmacy and supplied throughout)
- Daily Consumption of concentrate for waste and linen- 12.5 ltrs (Rs. 240)

5D. Needle Destroyers - Rs. 3500**5E. Scissors and Forceps**

(For mutilation and handling of waste)

Scissors- Rs. 135 Forceps- Rs. 321

Protective Gear

Boots/ Pair- Rs.225 Gloves / Pair- Rs. 64

Provided as part of the uniform and thus not included in waste management expenditure

Transportation & Disposal

Trolleys (Hydraulic Lift) In process

Table 2.5 B

Polythene Bags

Colour & Size	Waste Type	Cost (Rs.)
Yellow (20x22)	Infectious	1.02
Black (28x30)	General	2.16
Translucent (20x22)	Disinfected plastics	0.82
Translucent (28x30)	Disinfected plastics	1.50

TABLE 2.5 A

Bins

Bin type	Waste Type	Cost(Rs.)	Req. No.	No.purchased
Galvanised iron bin	Infectious	545	15	0
Hard plastic bins (60 lt capacity)	General	796	15	8
Hard plastic bin (40 lt capacity)	Disinfected plastic	635	15	15
Twin bin system for chemical disinfection of plastics	Infected plastics	90	15	15

Strategy

1. Already existing bins were used.
2. Hard plastic bins were purchased instead of cheap alternatives or pedal bins, as the hospital, going by their experience, wanted to go in for bins which would last longer.
3. Initially, changing of bags was done on a regular basis. In case of infectious and plastic waste, bags were changed once a day, and for general waste, bags were changed twice daily. The cost of this exercise was coming to almost Rs. 100 daily. The hospital has now decided to experiment with plastic reduction in its waste stream. Thus, only the infectious waste bags are replaced daily, the bags meant for disinfected plastics and general waste are retained till the bag remains intact and clean.
4. The plastic bags purchased by the hospital are cheaper alternatives to the expensive bags available.
5. The hospital purchased extra stock in addition to its present needs, as done for other items, to prevent any slack in the system.
6. To minimize the use of chemical disinfectant in the wards, two bins have been provided, one for disinfection of plastics and one for disinfected plastics. After each shift, or when the bin with disinfectant is full, the contents are transferred to the other bin (min. residence period of any item in disinfectant is 2hrs)

A 25-bedded hospital

Initial Investments	Rs. 7000
Monthly Expenditure	Rs. 700

Chlorine Solution

Powdered bleach - Rs. 30/ 400gm
 10% Solution used for disinfection of plastic waste;
 200 gm powder used in a day.

Needle Cutters - Rs. 600

Protective Gear- Provided as part of the uniform and thus not included in this expenditure.

Strategy adopted

1. To reduce the load of plastics, the hospital is planning to go in for cloth lining. This would cost them 1-2 Rs. / bag.
2. Microbiological studies in the hospital's laboratory have shown that 10% bleach is effective for two days, thus a new solution is prepared every alternate day.

Table 2.6
Break up of expenses

Equipment	Initial Cost (Rs.)	Recurring cost/mth(Rs)
Bins	2200	Nil
Needle cutters	4800	Nil
Polythene bags	-	250
Chemical disinfectant	-	450

Table 2.7
Bins

Bin type	Waste Type	Cost (Rs.)	No. Purchased
Pedal plastic bin	Infectious	90	8
Paper baskets	General	100	existing bins used
Covered twin-bin system for chemical disinfection of plastics	Infected plastics	150	10

Table 2.8
Polythene Bags

S.No	Colour & Size	Waste Type	Cost (Rs.)
1.	Red	Infectious	0.40
2.	Black	General	0.45

Transferring life or death?

A FACTSHEET ON

PLASTICS IN HEALTHCARE

Sameer Nazareth

Plastics constitute a major chunk of medical waste. The use of disposable plastics symbolises the healthcare establishment's attempt to reduce infection and transmission of disease during patient care. Plastics decrease infections within hospitals as they are meant for single use. Thus, inter-patient transfer of pathogens via equipment is reduced.

As a lot of equipment is no longer reused, the hospital's liability to ensure proper patient care is shifted to the patients' ability to procure good (sterile) disposable plastic equipment (Table 3.1).

International scenario

Plastics comprise 15 percent of the total waste generated in the hospital. In the US, a higher percentage of plastics is contained in medical waste than in municipal solid waste (MSW). The medical community in the US was projected to consume 2.4 billion pounds of plastics annually by 1994.

Indian scenario

There has been a major shift towards plastics within hospitals, be it syringes or blood and urine bags. In India, the market for medical disposables has grown from USD 2,350 million (1979) to 4,000 million (1986). The use of plastics in medical equipment is now growing at the rate of 6 percent per annum.

Aggressive industry growth

The trend started in the 1960s, when plastics started replacing steel bedpans due to their low cost. In the 1990s, the estimated use of plastics in medicine was four times that in municipal waste. In 1987, medical plastics accounted for USD 48 billion in sales, in 1992, the plastic industries earned USD 60 billion from the sale of medical plastics.

Why has there been such a growth in the sale of plastics, and especially in the healthcare sector? To understand this, we must first realise why plastic was introduced in the first place. Plastic is a petroleum by-product and therefore relatively cheap. It was used in healthcare because of the assumed low cost involved - it did away with the cost of treating reusable equipment. In addition to this was the fear of spread of infection through reusable medical equipment.

However, a major problem with plastics is its disposal and the pollution involved. Therefore, plastic use is now tempered with its disposal and pollution costs.

Even with the indirect costs increasing in the use of plastics, there has been no let up in its use in the healthcare sector. Besides that cost, plastics are also used for their versatility and transparency.

Type of Plastic	Use in medical equipment
Polyvinyl Chloride(PVC)	Blood bags, urine bags, packaging, oxygen sets
LDPE	Disposable gloves (some manufacturers)
HMHDPE	Pediadrips (some manufacturers)
Moulded rubber	RMS infusion sets (some manufacturers)
Latex	Disposable gloves

INFECTION CONTROL AND PLASTICS

Hospitals use plastics because they fear a spread of infection through the use of reusable medical equipment. Thus, plastic use has grown with increasing concern for infection control. However, there have been cases where even with the use of plastics there has been a spread of infection in wards. Nurses complained of nosocomial infections in wards even though disposable equipment was used — they related it to improper waste disposal of disposable equipment within the wards.

What are the problems related to plastics

Even though plastics reduce the possibility of transmission of infection within the hospital, there are many problems related to its use and disposal.

Collection and reuse of certain plastic equipment after disposal

A major problem found in the developing countries is the collection and reuse of plastic disposables after they have been disposed of. There have been reports in newspapers on the alleged collection and resale of these plastic disposables. The resale of disposable products has many problems related to it; the major problem is the possible spread of infection as well as the possibility of injury to the patient because of substandard instruments. The reuse of medical equipment also means there is a possibility of the sale of spurious fluids.

Besides the possibility of reuse, there is a real problem of injury and spread of infection to rag-pickers who collect waste. Ragpickers tell us that they receive 5-6 needle-stick injuries per day because of the crude manner in which hospitals throw their waste (Table 3.2).

Identification of plastics

This is the main problem faced by the developing countries, where the healthcare system has been deluged by plastic disposable items. These medical items are sold as scrap to be recycled. The hospital not only reduces its disposal costs but also earns from the waste.

In India, people outside the hospitals (the informal waste collectors) recognise different types of plastic merely through touch. This lack of in-house plastic identification skill reduces the hospital's ability to 'earn from waste' and also reduces the options of treatment.

Earn from waste: Plastic medical waste after being properly disinfected and mutilated can be sold as plastic scrap. This waste has a lot of value, because medical disposables are made of virgin high-grade plastic. However, different types of plastic have to be separated before they can be recycled, because of different melting points, different viscosity etc. Therefore, if different type of plastic are mixed they becomes very difficult and expensive to recycle.

The only solution is to determine the type of plastic being used by the manufacturer and then treat different types of plastic separately, or segregate them prior to shredding, or attempt to use similar types of plastics after discussions with medical equipment manufacturers and suppliers.

POLY VINYL CHLORIDE (PVC)

An introduction to PVC

PVC is a thermoplastic, with approximately 40 per cent of its content being additives. Plasticisers are added to make PVC flexible and transparent. The most commonly used plasticisers fall under the

Table 3.2

Item	How is it disposed	Price/Kg (Rs.)	
		Buying price	Selling price
Syringes	Disposed into community bins	15-16	22
IV Bottles	Disposed into bins	16-18	22
IV Tubes	Disposed into community bins	10	13
Blood bags	Disposed into bins	Are not collected as they are soaked in blood	

generic name of Phthalates, among Phthalates di-2-ethyl-hexyl phthalate (DEHP) is the one most commonly used. These chemicals do not form any chemical bonds with the plastic polymers. The chemicals within PVC can be equated to water in a sponge. This is one of the major problems associated with PVC.

Medical equipment made from PVC

Blood bags	Breathing tubes
Feeding tubes	Pressure monitor tubes
Catheters	Drip chamber
IV Containers	Parts of a syringe (only from one Indian company)
IV Components	Labware
Inhalation masks	Dialysis tubes

Problems associated with PVC

■ Use in medical equipment

PVC contains additives like lead, cadmium and phthalates (Di-ethylhexyl phthalate). A study has shown that storage of cyclosporine 3 mg/ml in dextrose (5% in water) in PVC bags causes leaching of significant amounts of DEHP. Lead is neurotoxic and cadmium affects the kidneys, thus, instead of helping to heal, this equipment causes more harm.

DEHP has been classified as a possible/probable human carcinogen by the US EPA and the International Agency for Research on Cancer. DEHP is also weakly estrogenic.

■ During disposal

Disposal of PVC via incineration leads to the formation of dioxin and furans. Dioxin and furans are unwanted by-products of incineration with carcinogenic and endocrine-disrupting properties. They are toxic at levels as low as 0.006 picograms per Kg of body weight.

India does not have safe landfilling sites. Disposing PVC in the dumps that are being currently used can contaminate the surrounding soil and waterbodies through leaching.

LIFE CYCLE OF PVC

PVC poses a problem throughout his lifecycle, starting from its production to its use and finally to its disposal.

- PVC production creates dioxins and uses toxic inputs like Vinyl Chloride Monomer (VCM).

VCM is a mutagen both to animal and human cells and can cause cancer (liver/brain/central nervous system) when inhaled or ingested.

- The stabilisers used in PVC medical equipment are known to leach into the contents, exposing the patient to these toxic chemicals.
- Burning PVC via incineration releases dioxins. Dumping or landfilling PVC can release the stabilisers into the environment by the process of leaching.
- The US Environmental Protection Agency and the plastics industry itself agree that less than 1 per cent of post-consumer PVC products are recycled.
- Will the recycling of PVC reduce the toxic emissions. Dioxin is produced both during the production of PVC and during its disposal by incineration. Recycling PVC decreases dioxin emissions, but leads to the creation of toxic fumes of Vinyl Chloride Monomer and the stabilisers.

Other problems associated with the recycling of PVC

The first problem in India is identification of PVC products. The second problem is the removal of the non-PVC material on it - like the sticker and/or the IV ports, usually made of rubber, and the attached reconstitution devices in which the medications are mixed (in case of IV sets). Thus, there are heavy labour costs involved.

Recycling of PVC medical equipment is not the complete answer to the problems associated with Poly Vinyl Chloride. The problems associated with PVC can only be solved if it is not used or produced.

How should plastics be treated?

Plastics should be treated by non-burn technologies. The World Health Organisation recommends that medical waste be disinfected and not sterilised. Therefore, there is no need to destroy the material, it is sufficient to ensure that the material is disinfected and mutilated. Mutilation ensures that the waste is not reused and also enhances the disinfection process by increasing the surface area of the waste.

Use of alternative technologies like microwaves, autoclaves, hydroclaves, needle cutters/destroyers and chemical disinfection are the most suitable methods for the treatment of plastics.

Legal Position

The Ministry of Environment and Forests has passed a notification called the Biomedical Waste (Management and Handling) Rules 1998. These Rules provide methods of waste treatment for plastic and other medical waste and state that chlorinated plastics cannot be incinerated.

Even though there are reports confirming the unsuitability of certain plastics for the storage of medical fluids, no efforts have been made to regulate the type of plastic used in different medical equipment.

There is a need for the government to introduce a proper plastic use policy that would include -

1. Identification/marketing of different types of plastics.
2. A packaging policy for use of plastics in medical equipment.
3. A policy for the use of plastics for different types of medical equipment.

MANAGING PLASTIC WASTE

Conscious plastic usage

Hospitals need to determine the levels of plastic used and whether there are ways to reduce its usage. This is not only necessary from the point of view of patient care, but also the cost of disposal of plastics.

Areas of waste reduction

Reduction in waste generation can only be made if waste generation points are identified and effective alternates determined.

● **Outside patient care**

Hospitals have canteens to cater to visitors and kitchens to cater to patients. Plastics are generally used in the form of containers either for beverages, food or for carrying packets. This is a major source of plastics and finding alternatives can reduce this plastic waste.

Plastics in present use	Alternatives
Plastic beverage containers	Beverage bottles and glass containers.
Plastic food containers	Earthen containers, metal trays
Plastic bags	Paper bags

Role of the CSSD (Central Sterile Supplies Department)

The CSSD will play a very important role if hospitals plan to reduce the use of plastics. Ensuring that there is a proper sterilisation policy for reusable medical equipment through checks and balances is very important to replace plastics.

Pros and cons of plastics and alternatives

A lot of plastic disposable material is illegally reused, and what is worse is the fact that there is no proper disinfection of such equipment.

Thus, even though plastic disposables are being used in patient care, there is no certainty of the sterility of the equipment.

Use of equipment without looking into other facets of waste disposal will not lead to better patient care. It is therefore important to use a mix of materials with proper systems of disposable and treatment.

PLASTIC MANAGEMENT PRACTICES FOR SMALL HOSPITALS AND NURSING HOMES

Reduction in the use of plastics within smaller hospitals will depend on the ability of the hospital /nursing home to set up a small CSSD. If, however, due to a lack of funds a CSSD cannot be opened, the hospital/nursing home should attempt to shift away from the use of PVC equipment and use alternative technologies such as Vacutainers to reduce the quantum of plastics. Further, the canteens in such hospitals can avoid the use of plastics in the methods suggested above.

Do's and Don'ts

Ensure

1. that the used product is mutilated.
2. that the used product is treated prior to disposal.
3. segregation

Do not

1. reuse plastic equipment.
2. mix plastic equipment with other waste.
3. burn plastic waste.

Be careful with that cure

A FACTSHEET ON

MEDICAL WASTE INCINERATION

Sameer Nazareth, Megh Kela Rathi

- 1. Incineration is a complex technology** that is used to burn waste. The problem of medical waste is one of disinfecting the waste and not of destroying it. With the increased use of disposables in medicine, the amount of plastic going for incineration has increased manifold. The burning of plastics, especially in unregulated incinerators, creates a new set of chemical toxins, some of which, are super toxins even in extremely small quantities. Incineration thus converts a biological problem into a chemical one.
- 2. The problem of medical waste is not of quantity but of nature** Estimates say that the total quantity of medical waste, in a city like Delhi, is less than 60 metric tonnes in a total municipal waste stream of 5000 metric tonnes. This is about 1.5 percent. Only 15-20% of this 60MT is of concern, because of its infectious nature, as the other 85% of it is non-infectious. Segregation is the key to proper medical waste management, not incineration.
- 3. Some of the chemical toxins produced by medical waste incinerators** are (a) heavy metals, such as lead, cadmium etc., which reside in plastics; (b) acid gases, such as sulphur gases, hydrogen chloride and nitrogenous gases; (c) particulate matter and (d) dioxins and furans. These toxins have grave health effects on humans— if not trapped in pollution control devices, they enter the foodchain via the air and if trapped, they become part of the flyash. This flyash becomes very toxic to dispose of as it contains heavy metal impurities. If it is not disposed of in secured landfills, it can contaminate soil and groundwater.
- 4. Of all these toxins, dioxins and furans are the most toxic.** These are a family of polycyclic aromatic hydrocarbons, formed when PVC plastic such as blood bags, urine bags, IV tubes and syringes, or any other chlorine containing material (like bleached paper) is burned in the presence of organic matter. The heavy metals present in the waste stream act as catalyst and hasten up the process of dioxin formation.
- 5. No testing facilities** for the dioxins and furans emitted from the incinerators are available anywhere in India. These tests cost around \$1000 to \$50,000 for complete profiling.
- 6. International regulations:** In the United States, a dioxin risk assessment carried out by the US Environmental Protection Agency (Estimating Exposure to Dioxin-like Compound, Vol. II, Office of Research and Development, EPA/600/688/005Cb) was published on September 13, 1994. **It stated that dioxin was toxic in concentrations as low as 0.006 picogram (one-trillionth part of a gram) per kilogram body weight per day.** This comes to 0.42 pg of dioxin per day for a 150 pound adult. Dioxin enters the body through fatty foods such as meat and dairy products like chicken, egg, meat, milk etc, as they are fat soluble. In Britain, the Department of Environment (DOE) estimates that the average daily consumption is up to 500 times the EPA limits. It also reported that **Medical Waste Incinerators were the highest source of dioxins** in the US, and of a total of 9,300 TEQ (Toxic Equivalency Quotients) produced there,

5,100 were contributed by Medical Waste Incinerators (Source USEPA 1994 report).

7. The USEPA proposed new standards on Medical Waste Incinerators on 27 February 1995 Federal Register (60 FR 10654). Under the new regulations, USEPA predicts 80 percent of the present on-site incinerators will be shut down and an alternative method for disposal would be sought.

8. **Regulations for Incinerators** now exist in India. CPCB has laid down standards for incinerators, microwaves, chemical disinfection and autoclaving

9. **Health Effects** of toxins produced by medical waste incineration: In an attempt to destroy pathogens, chemical hazards are created, which are extremely expensive to monitor and control. The different types of toxic air emissions from incinerators: *i) acid gases; ii) dioxins and furans; and iii) heavy metals.*

- *Acid gases* include nitrogen oxide, which has been shown to cause acid rain formation and affect the respiratory and cardiovascular system. As large amounts of plastic are incinerated hydrochloric acid is produced. This acid attacks the respiratory system, skin, eyes and lungs with side effects such as coughing, nausea and vomiting.
- *Dioxins and furans* are organochlorines, which form as a result of the combination of chlorine molecules in plastics (PVC) with organic material. Organochlorines mimic hormones and do

not break down or biodegrade; thus, they bio-accumulate and are magnified up the food chain. They are proven carcinogens and endocrine disrupters, they also weaken the immune system and damage the male and female reproductive organs.

- *Heavy metals* are released during incineration of medical waste. Mercury, when incinerated, vaporizes and spreads easily in the environment. Lead and cadmium present in the plastics also accumulates in the ash.

Acute and chronic exposure to lead can cause metabolic, neurological and neuro-psychological disorders. It has been associated with decreased intelligence and impaired neurobehavioral development in children.

Cadmium has been identified as a carcinogen and is linked to toxic effects on reproduction, development, liver and nervous system.

Incinerators are difficult to run: In a hospital environment, technologies like incineration fail because untrained janitor staff run them. Our surveys show that most of the incinerators (over 85%) run at temperatures lower than those specified in the rules. Due to poor operation and maintenance, these incinerators do not destroy the waste, need a lot of fuel to run, and are often out of order. **There is a lot of difference between the theory and practice of incinerator operation.** This is true around the world. ***The problem of medical waste needs a systematic approach, with investments in training of staff, segregation, waste minimisation and safe technologies, as also centralised facilities. Merely investing in unsafe incinerators cannot solve it.***

Harbouring an unnecessary evil

A FACTSHEET ON

MERCURY IN HEALTH SET UPS

Sameer Nazareth, Megha Kela Rathi

Mercury has been known for its usefulness through the ages, as it is found in the liquid state at ordinary temperature. It is only now that the hazards associated with this element have been recognised. It affects the central nervous system, kidney and liver and also affects the ability to feel, see, touch and move. According to the USEPA, medical waste incinerators are a large source of mercury in the environment. Studies show that there is up to 50 times more mercury in hospital waste than general municipal waste, and the amount of mercury emitted from MWIs averages more than 60 times that from pathological incinerators.⁵

This factsheet is an attempt to introduce you to the sources of mercury in a medical facility, the related health hazards and their proper management. Suggestions for alternatives to mercury-based technology are also given.

Sources of Mercury in hospitals:

1. Thermometers
2. Blood pressure cuffs
3. Feeding tubes
4. Dilators and batteries
5. Dental amalgam
6. Used in laboratory chemicals like Zenkers solution and histological fixatives.

Present System of Handling

Other than its handling as a compound in the laboratory, mercury is most frequently handled due to the breakage of medical equipment. Most hospitals do not have a set procedure to handle such mercury spills. It is cleaned up without the use of protective gear or a proper disposal system. This not only exposes the worker who is cleaning up the spill, but also the community at large, as it is either

thrown in the community waste bin, flushed down the sewer, or incinerated.

Health hazards of mercury

Due to the current means of disposal (incineration, in sewers and regular dumping in municipal waste bins) mercury pollution endangers the whole environment. When products containing mercury are incinerated, the mercury becomes airborne and eventually settles in waterbodies from, where via bio-magnification in the food chain and bio-accumulation, it reaches humans. If it is flushed, it enters waterbodies directly, and if it is thrown in bins it could enter the body of animals via skin or inhalation, or permeate into the ground causing soil and groundwater poisoning. This metal accumulates in the muscle tissues.

Three major types of mercury are found in the environment – methyl mercury, mercury (zero), mercury (two). Out of these, methyl mercury is the most toxic; it bio accumulates and has the capability to interfere with cell division and cross the placental barrier. It also binds to DNA and interferes with the copying of chromosomes and production of proteins. Pregnant women and children are most vulnerable to the effects of mercury.⁶ The Minamata disaster in Japan is an example of mercury-poisoning via bio-magnification and bioaccumulation. Mercury exposure can lead to pneumonitis, bronchitis, muscle tremors, irritability, personality changes, gingivitis and forms of nerve damage.⁷

Entry into the body

Mercury can be consumed via food, inhaled or be absorbed via the skin.

Procedure of handling of mercury spills in hospitals

Mercury in the hospitals should be handled and

disposed of not as infectious or general waste, but as hazardous waste and with a licensed hazardous waste company dealing with it.

While dealing with a spill, the hospital workers should be ready with the MERCURY CONTAINMENT KIT, which should include -

- a. Nitrile gloves or at least two pairs of latex gloves (Mercury passes through a single pair of latex gloves);
- b. Face mask;
- c. Protection for the eyes;
- d. Scotch tape;
- e. 10c.c syringe;
- f. Covered plastic/glass container with water;
- g. Posters depicting the process of mercury spill containment

PRECAUTION: Mercury based instruments should never be used in a carpeted area.

Once a mercury spill occurs, the steps to be taken are -

- a. Never touch mercury with bare hands as mercury is absorbed quickly through the skin.
- b. Remove all jewellery when dealing with mercury as mercury combines with gold, silver and other metals.
- c. Clear the area around the spill.
- d. Wear all the protective gear.
- e. Contain the spread of mercury and use two hard cardboard sheets to gather all the mercury.
- f. Use a syringe to suck up mercury : minor mercury spills can be managed by gathering the mercury together using stiff paper to scoop it or by using the sticky end of a scotch tape. Mercury is a non-wetting liquid, with an affinity for its own molecules. Once all small droplets of mercury come close, they form a big droplet and one can now use a syringe to suck in this large droplet.
- g. Pour contents of the syringe into the plastic/glass container with 5 to 10 ml of water.
- h. Put scotch tape, if used, in the plastic/glass container.
- i. Put the used syringe in a separate plastic container for further use.

Storage and Disposal of Waste Mercury

Mercury is a highly toxic and dangerous substance. Spills can be cleaned up safely following the proce-

dures listed above. The container should be stored in a central and easily accessible area within each nursing station for future spills. Mercury can be stored indefinitely in this condition, but the hospital should seek out a government approved and licensed hazardous waste disposal firm or a mercury recycler, which can handle mercury. Mercury collected in this manner can be cleaned and reused in new equipment.

It should be ensured that the whole staff is trained to understand the dangers of mercury, the need to isolate the spill to keep it from spreading and the need to handle it with care.

Alternatives to mercury based instruments

Digital instruments are available as substitutes to the mercury containing instruments.

Costs: The cost of the blood pressure instruments ranges from Rs 2000 to 7000 and the cost of thermometers ranges from Rs 200 to 300

Why are the alternative technologies better ?

These less harmful, non-toxic substitutes pose no environmental or health hazards and last for a longer duration. The life span of the mercury instruments, on the other hand, is short because of their fragility. Even though the initial investment cost of the alternative technologies is high, the assets associated with them are lifelong.

Table 4.1

Mercury in the laboratory⁸

Mercury-based chemical	Alternatives
Mercury (II) chloride Histological fixatives	Freeze drying
Mercury (II) oxide	Copper catalyst
Mercury (II) chloride	Magnesium chloride/ sulphuric acid
Mercury (II) sulfate	Silver nitrate/potassium/ chromium (III) sulphate
Mercury iodide	Phenate method
Mercury nitrate	Ammonia/copper sulphate

Know your chemicals

A FACTSHEET ON

GLUTARALDEHYDE/ CIDEX

Anu Goel

This factsheet is an attempt to unveil glutaraldehyde, a widely used disinfectant. We expect the readers to take due precautions while dealing with this chemical and spread the message across, so that ignorance does not cause harm to the people using it. The factsheet is divided into the following sections-

- ☛ WHAT IS GLUTARALDEHYDE?
- ☛ WHERE IS THIS CHEMICAL USED?
- ☛ WHAT ARE THE HEALTH EFFECTS OF GLUTARALDEHYDE?
- ☛ SAFETY ACTION PROGRAM TO REDUCE EXPOSURE LEVELS
- ☛ PRECAUTIONS AND FIRST AID

WHAT IS GLUTARALDEHYDE?

Glutaraldehyde is a colourless, oily liquid, which is also commonly available as a clear, colourless, aqueous solution. It is a powerful, cold disinfectant, used widely in the health services for high-level disinfection of medical instruments and supplies and available with trade names such as: Cidex, Totacide, and Asep.

Glutaraldehyde is toxic and harmful if inhaled or swallowed, irritating to the eyes and respiratory tract, also corrosive to the eyes and skin, and may cause permanent eye injury. Glutaraldehyde is a skin sensitizer and may cause a severe allergic skin reaction, dermatitis and skin irritation, nasal/throat irritation, headaches, cough, and asthma.

KNOW YOUR CHEMICALS: SOME FACTS ABOUT GLUTARALDEHYDE

FACT 1: Glutaraldehyde is a fixative, (particularly

with nitrogen, ammonia, amines, proteins) thus making it a powerful disinfectant. It attacks proteins in the nucleus of microorganisms, DNA and protein sacks of viruses, so microorganisms do not build up resistance to it. It is active optimally at a neutral pH to alkaline pH.

FACT 2: Factors which influence the activity of glutaraldehyde, are:

- Contact times- times are longer for killing spores as compared to those required for vegetative bacteria.
- Concentration- 0.2% for Staph. E Coli & Pseud. 0.5% for fungicidal, 2% for spores
- Temperature- increase in temperature between 25°C – 40°C increases reactivity time and killing efficiency.
- pH is a very important factor affecting the killing ability of glutaraldehyde

FACT 3: Surfactants used with glutaraldehyde enhance glutaraldehyde's killing efficiency, increase its stability and reduce its volatility.

FACT 4: Exposure Limits

NIOSH, Occupational Safety and Health Act, and the American Conference of Governmental Industrial Hygienists has set the exposure limit for glutaraldehyde at 0.20 ppm as a Ceiling Value Limit which must not be exceeded, even for an instant, at any time during the work day. It has been found that short-term exposure to glutaraldehyde in concentrations of 0.3 ppm or higher, results in significant risk of irritation to the eyes, nose, and throat. Even at low concentrations (below 0.2 ppm), studies have found that glutaraldehyde causes symptoms of irritation.

Glutaraldehyde is classified in the hazardous substance list- OSHACT - which sets an occupational exposure limit for 'airborne glutaraldehyde' at 0.2ppm.

Glutaraldehyde, aqueous solution meets the Canadian WHMIS criteria for class(es):

- D1B** Poisonous and infectious material - Immediate and serious effects - Toxic
- D2B** Poisonous and infectious material - Other - Toxic
- E** Corrosive material

FACT 5: EU Comments on various concentration: (see box)

Our country still does not have any standards and regulations for the use of this chemical.

WHERE IS THIS CHEMICAL USED?

Glutaraldehyde is a widely used disinfectant and a sterilizing agent (commonly available in 1 percent and 2 percent solutions) in medical and dental settings. It is used in embalming (25% solution), as an intermediate and fixative for tissue-fixing in electron microscopy (20 percent, 50 percent and 99 percent solutions) and in X-ray films.

Places in medical sets up where glutaraldehyde is used:

- Endoscopy units
- Theatres
- ICUs
- Labour wards
- For infection control
- Dental units

WHAT ARE THE HEALTH EFFECTS OF GLUTARALDEHYDE?

⇒Irritates skin, eyes, throat and lungs, causes sensitization of skin and respiratory tract.

Once sensitized to glutaraldehyde, further exposure to even very small amounts of the substance can lead to: ⇒ Dermatitis ⇒ Rhinitis and Conjunctivitis ⇒ you may never be able to work near glutaraldehyde ever again.

■ What are the main health hazards associated with breathing in glutaraldehyde?

Glutaraldehyde is a moderate to strong irritant. Vapour levels below 0.2 ppm (0.8 mg/m3) have been reported to cause nose and throat irritation, nausea and headaches. Chest discomfort, tightness and difficulty in breathing may also occur. There are a few reports of glutaraldehyde causing a late

Concentration	Effects
greater than or equal to 50%	Toxic; toxic by inhalation and if swallowed. Causes burns. May cause sensitization by inhalation and skin contact.
greater than or equal to 25% and less than 50%	Toxic; harmful if swallowed; toxic by inhalation, causes burns, may cause sensitization by inhalation and skin contact.
greater than or equal to 10% and less than 25%	Corrosive; harmful by inhalation and if swallowed; causes burns, may cause sensitization by inhalation and skin contact.
greater than or equal to 2% and less than 10%	Harmful; harmful by inhalation and if swallowed irritating to respiratory system and skin; risk of serious damage to eyes; may cause sensitization by inhalation and skin contact.
greater than or equal to 1% and less than 2%	Harmful; irritating to eyes, respiratory system and skin; may cause sensitization by inhalation and skin contact.
greater than or equal to 0.5% and less than 1%	Irritant; irritating to eyes, respiratory system and skin; may cause sensitization by skin contact.

allergic reaction, like asthma, when inhaled. However, there is insufficient information to conclude it is a respiratory sensitizer.

■ ***What happens when glutaraldehyde aqueous solution comes in contact with the skin?***

Solutions may cause mild to severe irritation, depending on the concentration of the solution and the duration of contact. There is one report of severe irritation seen in a study with volunteers. Corrosive effects (necrosis) were seen when rabbits were skin tested with solutions containing 25percent or more glutaraldehyde. Glutaraldehyde may cause an allergic skin reaction in sensitised individuals. No skin absorption has been reported in humans. However, in rabbit studies, glutaraldehyde was absorbed in amounts great enough to cause death.

■ ***Can glutaraldehyde aqueous solution hurt the eyes?***

The vapour is irritating to the eyes. Depending on the concentration, solutions may be very irritating and may cause serious, irreversible injury. This evaluation is based on the observation of severe burns in animal studies.

■ ***What happens if glutaraldehyde aqueous solution is accidentally swallowed (enters the digestive system)?***

No human information is available. Ingestion in an occupational setting is unlikely due to the pungent odour and irritating qualities of glutaraldehyde. If ingested, it will cause irritation. This evaluation is based on animal information and information available for other aldehydes. Ingestion of a large amount of glutaraldehyde may cause toxic effects similar to alcohol poisoning with symptoms of central nervous system depression (drowsiness, dizziness), nausea and vomiting.

■ ***What are the long-term health effects of exposure to glutaraldehyde aqueous solution?***

SKIN CONTACT: Repeated or prolonged contact may cause drying and cracking of skin (dermatitis).

ALLERGIC CONTACT DERMATITIS: Contact with solutions or the vapours have resulted in skin sensitization. Symptoms of skin sensitization include rashes and itching, reddening and scaling (eczema)

of the skin (hands, wrists, arms, face). An aqueous solution containing 0.5percent glutaraldehyde was found to produce a sensitization reaction in volunteers in a challenge study. However, concentrations of 0.1 or 0.2percent glutaraldehyde did not produce a reaction.

RESPIRATORY SENSITIZATION: There is limited evidence that glutaraldehyde causes respiratory sensitization. In particular, one study found that two workers with pre-existing respiratory problems (asthma) developed a late respiratory allergic reaction when exposed to glutaraldehyde vapour. Symptoms of respiratory sensitization resemble asthma and include sneezing, wheezing, chest tightness and difficulty in breathing.

■ ***Will glutaraldehyde aqueous solution cause any problems with the reproductive system?***

No human information is available. There was no evidence of reduced fertility in male mice treated with glutaraldehyde.

■ ***Will glutaraldehyde aqueous solution cause effects on the foetus/unborn baby?***

One study found no increase in the number of spontaneous abortions in hospital workers exposed to glutaraldehyde. Teratogenic and fetotoxic effects were seen in an animal study. However, the doses given were great enough to also produce maternal toxicity. According to some other studies, it is a mutagen and teratogen.

■ ***Is there potential for glutaraldehyde to build-up or accumulate in the body?***

Aldehydes are metabolised in the body and there is little potential for accumulation. Glutaraldehyde is largely metabolised to carbon dioxide and excreted in exhaled air.

GLUTARALDEHYDE SAFETY ACTION PLAN

Because of the increased awareness of the potential hazards of exposure to glutaraldehyde, many medical facilities have begun to search for alternative germicides. Automated systems utilising peracetic acid or hydrogen peroxide are examples of new technologies that have been promoted as safer alternatives. New automated equipment technologies require significant initial capital outlays and

can be very expensive to use on a daily basis.

The following seven-step program, if carefully implemented, will eliminate all glutaraldehyde overexposure during routine work procedures, protect workers during emergency spill clean-up procedures, and help the facility comply with safety regulations.

Identify All Usage Locations

All departments that use glutaraldehyde must be identified and included in the safety program. Eliminate as many usage locations as possible and centralize usage to minimize the number of employees involved with the handling of glutaraldehyde.

Monitor Exposure Levels

Measurement of glutaraldehyde exposure levels must be conducted in all usage locations. Currently, three types of monitoring methods are available for glutaraldehyde: passive diffusion monitors (monitoring badges); sample pumps and cassettes, which require sophisticated lab analysis (OSHA Method #64); and hand-held direct reading meters (sold by several companies as a Glutaraldemeter or Glutameter), which provide a discrete sample of an instantaneous measurement.

Training

An in-depth education and training program should be conducted for all employees who work with hazardous chemicals. The training program should include discussion on safe work practices, proper protective clothing, and safe spill clean-up procedures.

Use Personal Protective Equipment

All employees who work with glutaraldehyde must be provided appropriate personal protective equipment. This equipment includes proper eye/face protection, chemical protective gloves, and protective clothing. Only splash goggles with side shield protection and fitting snugly all around the eyes are acceptable when working with glutaraldehyde. These goggles should have combination eyeshield/face masks, which are commonly used for splash protection because the liquid could splash on the forehead and drip into the eyes. In addition to splash goggles, OSHA guidelines require face protection when working with

glutaraldehyde. Employees should wear face shields that wrap around the face and extend down past the chin for adequate face protection.

Protective gloves: Disposable latex surgical or exam gloves do not provide adequate glutaraldehyde protection. These gloves are usually only 5 to 6 millimetres thick and can deteriorate through contact with glutaraldehyde. Most latex gloves are 9 to 10 inches long and extend only to the wrist. Acceptable glutaraldehyde protective gloves should be 11 to 13 inches long so that they extend far enough up the arm to provide protection from drips and splashes. Studies have shown that 'nitrile and butyl rubber gloves are the materials most impervious to glutaraldehyde, showing no breakthrough after eight hours of exposure. Gloves made of polyethylene and certain man-made copolymers give protection for several hours'. Polyvinyl chloride and neoprene gloves are not recommended because they do not give adequate protection from glutaraldehyde and may actually absorb the chemical.

Protective clothing: Isolation gowns, lab coats, or aprons plus sleeve protectors are also necessary when working with glutaraldehyde. All protective clothing must be made of a material that is impervious to glutaraldehyde i.e 'Liquid-resistant' or 'liquid-impervious' clothing. One type of material that provides acceptable protection is polyethylene-coated polypropylene.

IMPLEMENT ADMINISTRATIVE, WORK PRACTICE, AND ENGINEERING CONTROLS

Administrative controls

Limit employee access to glutaraldehyde usage locations and eliminate as many usage locations as possible by centralizing usage in a few locations. Central Supply is a logical choice for such consolidation. CS Department workers regularly work with other chemicals and are familiar with protective clothing requirements. Also, the CS Department has good general room ventilation, which can help control vapour levels.

Suitable eyewash units must be available for immediate emergency use in all glutaraldehyde usage locations.

Work practice controls

Studies have shown that glutaraldehyde vapours increase whenever the solution is agitated. Vapour levels increase when glutaraldehyde is poured into or dumped out of a soaking bin, when instruments are placed into and removed from the solution, and when instruments are rinsed. Employees should be trained to minimize agitation of the solution as much as possible during these work procedures. If exposure monitoring shows that these procedures result in excessive exposure levels, the work process should be enclosed in a glutaraldehyde fume hood system.

Engineering controls

Rooms in which glutaraldehyde is used should have a minimum of 10 air exchange rates per hour. General room ventilation, however, will not effectively control glutaraldehyde exposure levels. As recommended glutaraldehyde exposure limits decrease, installing glutaraldehyde local exhaust fume hoods becomes more important. The manufacturer of the CIDEX brand of glutaraldehyde solutions modified its MSDS to state that a local exhaust fume hood should be used in any room that does not have a minimum of 10 air exchange rates per hour. Placing the glutaraldehyde-soaking bin in a fume hood will eliminate virtually all glutaraldehyde exposure problems. To ensure proper performance, the fume hood should have a minimum face velocity of at least 80 feet per minute.

Neutralize solutions before disposal

Most health care facilities dispose of spent glutaraldehyde solutions by simply pouring them down a drain connected to a sanitary sewer. This practice causes two significant problems. First, the spent solution may adversely affect the operation of the local sewage treatment facility. The local Publicly Owned Treatment Works (POTW) may therefore prohibit disposal into the sewer system. Second, the physical process of pouring several gallons of glutaraldehyde solution into a sink or toilet may cause significant worker exposure to glutaraldehyde vapours.

Spent glutaraldehyde solutions can have residual antimicrobial activity that may affect sewage treatment operations. Increasingly, local sewage treatment facilities have chosen to prohibit the disposal of glutaraldehyde solutions into their

sewer systems.

These problems can be avoided by neutralizing the spent Cidex. A neutralizing agent will, over time, chemically inactivate the glutaraldehyde. The chemical reaction transforms glutaraldehyde into a harmless solution that is safe to pour into the sanitary sewer and does not give off vapours when poured.

Glutaraldehyde-neutralizing agents should be chosen carefully, as the performance of products on the market varies greatly. The time required for complete neutralization can range from 10 minutes to 8 to 12 hours or longer. The glutaraldehyde concentration of the solution in the end should be approximately 10 ppm or less, as above this concentration, the solution may retain antimicrobial activity and adversely affect the operation of the sewage treatment facility.

Develop a Spill Clean-up Plan

The last potentially hazardous situation is the clean-up of a glutaraldehyde spill. A 'response team' should be created to develop and execute procedures for glutaraldehyde spills. All spills, no matter how small, should be cleaned up immediately.

Response team personnel must be thoroughly trained and required to wear the following protective attire: eye/face protection, impervious gloves, full length, glutaraldehyde-impervious clothing, impervious boots or shoe protection and respirators. Exposure levels should be measured with a direct-reading meter and respirator selection must be based on glutaraldehyde exposure levels in the spill area. Remove contaminated clothing immediately. Keep it in closed containers. Discard or launder before reusing. Inform laundry personnel of contaminant's hazards. Wash hands thoroughly after handling this material. Maintain good house-keeping.

GLUTARALDEHYDE EXPOSURE

Exposure to glutaraldehyde vapour in the workplace is a significant hazard to employees, which must be addressed in a manner consistent with the Health & Safety in Employment Act 1992.

The Occupational Safety & Health Service of the Department of Labour (OSH) has published a booklet entitled 'The Safe Occupational Use of Glutaraldehyde in the Health Industries'. The booklet

provides a general overview of the hazards posed by glutaraldehyde in radiographic and high-level disinfection applications, and presents principles for control of the hazards.

Under the Health & Safety in Employment Act 1992, the employer is obliged to ensure that for all processes using glutaraldehyde, adequate measures are taken to limit exposure to airborne glutaraldehyde vapour. Adequacy of these safety measures should be verified for the process and re-verified if the process is changed in a way that may impact glutaraldehyde exposure. Furthermore, the process should be regularly audited to ensure that the safety measures continue to be effective.

■ ***What are the fire and explosion dangers associated with glutaraldehyde aqueous solution?***

Aqueous solution is not flammable. However, after the water evaporates the remaining material will burn. During a fire, toxic decomposition products such as carbon monoxide and carbon dioxide can be generated.

■ ***Is glutaraldehyde aqueous solution stable when exposed to air, moisture, or heat?***

Normally stable, but can oxidize in air. Stability decreases as the pH and temperature increase. Commercial solutions are usually stored at an acidic pH (about 3-4) to slow down polymerization and are later activated by raising the pH to a slightly alkaline state.

■ ***Are there any conditions to avoid when using glutaraldehyde aqueous solution?***

High temperatures (above 100°C), evaporation of water.

■ ***Does glutaraldehyde aqueous solution have an odour threshold (at what level can I smell it)?***

0.04 ppm (recognition); 0.3 ppm (irritation threshold)

■ ***Is the odour of Glutaraldehyde aqueous solution reliable as a warning property?***

NOT RELIABLE – odour threshold and irritation level is about the same magnitude as the TLV.

PRECAUTIONS AND FIRST AID

According to the Occupational Safety & Hazardous

Act, some basic precautions that should be taken are:

- Use it where there is proper ventilation equipment or at least in a well-ventilated area.
- Avoid skin contact, splashes and exposure to fumes or droplets in the air (wear gloves, masks and goggles)
- Keep lids on troughs, buckets and waste bins.

■ ***How can I work with glutaraldehyde aqueous solution safely?***

This material is CORROSIVE and TOXIC. Before handling, it is very important that engineering controls are operating and that protective equipment requirements are being followed. Avoid generating vapours or mists. Wear appropriate personal protective equipment. Inspect containers for damage or leaks before handling. Use the type of containers recommended by the manufacturer. Unprotected persons should avoid all contact with this chemical, including contaminated equipment. Do not use with incompatible materials such as strong acids, strong alkalies and amines. To avoid splashing, cautiously dispense into sturdy containers made of compatible materials. Whenever possible, use self-closing portable containers for dispensing small amounts of this material. Never transfer liquid by pressurizing original container with air or inert gas. Never add water to a corrosive. Always add corrosives to water. When mixing with water, stir small amounts, slowly. Use cold water to prevent excessive heat generation. Never return contaminated material to its original container. Label containers. Avoid damaging containers. Keep containers closed when not in use. Empty containers may contain residues, which are hazardous.

FIRST AID

☞ ***If you inhale glutaraldehyde***

Remove source of contamination or move victim to fresh air. Obtain medical advice immediately

☞ ***If it touches your skin***

Avoid direct contact and always wear protective clothing. Flush the contaminated area with lukewarm, gently running water for at least 20-30 minutes. If irritation persists, repeat flushing. Do not interrupt flushing. Under running water, remove

contaminated clothing, shoes, and leather goods (e.g. watchbands, belts). Transport victim to an emergency care facility immediately

Completely decontaminate clothing, shoes and leather goods before re-use or discard.

☛ ***If someone gets glutaraldehyde aqueous solution in their eyes***

Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for at least 20-30 minutes. Neutral saline solution may be used as soon as it is available. Take care not to rinse contaminated water into the unaffected eye. If irritation persists, repeat flushing. Quickly transport victim to an emergency care facility

☛ ***If someone swallows glutaraldehyde aqueous solution***

Never give anything by mouth if victim is rapidly losing consciousness, is unconscious or convulsing.

Have victim rinse mouth thoroughly with water. ***Do not induce vomiting*** Have victim drink 240 to 300 ml (8 to 10 ozs) of water. If vomiting occurs naturally, rinse mouth and repeat administration of water. Obtain medical attention immediately

☛ ***Is there anything else I need to know about first aid?***

Provide general supportive measures (comfort, warmth, and rest). Consult a doctor and/or the nearest Poison Control Centre for all exposures except minor instances of inhalation or skin contact.

References

Booklet on Glutaraldehyde : HSEs Information Centre, Broad Lane, Sheffield S3 7HQ
Via internet <http://www.ccohs.ca/>,
<http://edoc.co.za/disclaimer.html>

A problem well defined is half solved

A FACTSHEET ON

TRAINING IN HOSPITAL WASTE MANAGEMENT FOR MEDICAL STAFF

Anu Goel and Shipha Tomar

Through our training sessions in various hospitals we realized the need for some reference training material which covers all aspects of training, but at the same time is very concise, brief and easy to use. Thus, this is an attempt to get all the important facts in a capsule.

WHAT IS THE OBJECTIVE OF TRAINING & WHO NEEDS TO BE TRAINED?

A chain is as strong as the weakest link in it, thus, not even one person in the hospital should be missed while training is given. The entire staff is involved in waste management at some point or the other, including administrators, stores personnel and other, seemingly uninvolved, departments. To ensure that the waste is carried responsibly from cradle to grave, and to see that all the material required for waste management is available to the staff, it is important to involve everyone, including:

- **Doctors**
- **Administrators**
- **Nurses**
- **Technicians**
- **Ward Boys and safai karamcharis**

The sessions for all of them should be taken separately, as different ideas need to be stressed upon for each category.

HOW A TRAINING SESSION SHOULD BE CONDUCTED?

Training covers the following aspects:

- *Sensitization*
- *Teaching (Dissemination)*
- *Discussion & Feedback*

The first session is devoted to sensitizing the audience on the need to manage waste in the hospital. In the second session, they are told about various aspects of hospital waste management like segregation, disinfection etc. The last session is taken only after the trainees have implemented the scheme for about one to two weeks in their respective areas. They are asked about the problems, if any, that they face while following the instructions given.

Training sessions should be lively; they may start on a formal note but should be made informal, and one should try to make them interactive at all stages.

Training modules should include equipment and other materials to be used later by the staff for waste management, slides on various aspects of waste management, including efforts by a hospital already following the system, slides on health effects of mismanagement of waste, etc.

Medium- As far as possible all training modules should be in the vernacular medium or the language known to the staff.

Demonstrations- Demonstrations and live acts help not only in making the training sessions lively, but also in making trainees understand things easily.

Ongoing Training- This is one of the most important components of training. Generally, the staff turnover rate in a hospital is quite high. Ongoing training ensures that the new staff knows about the scheme, besides being a continuous reminder for the old staff. These sessions thus help in sustaining the scheme.

WHO SHOULD DO THE TRAINING?

Initially, training can be done by

- Hospital person. Only a staff member who is well-versed in the subject should take the training sessions. This person should be given special time for this purpose, or else the regular duties would never leave him/her with any time to devote to the training and the issue would take a back seat.
- Outside Agency- A qualified outside agency can also be asked to train the staff.

Ongoing training can be carried out under the auspices of the

- Waste Management Committee
- Infection Control Committee, or
- by the Medical/ Nursing/ Sanitary Superintendents for their respective staff.

SESSION 1

It is imperative to tell people why something needs to be done. Once its importance is realized, then people are motivated to do something and make an extra effort to resolve it. Thus, sensitize the trainees by telling them about the **problems associated with mismanaged hospital waste-**

DANGERS TO THE COMMUNITY THROUGH BIO-MEDICAL WASTE

Spread of infection through waste

According to various surveys and reports, of the total waste generated by the hospitals only 10- 15% of the waste is infectious and needs treatment. The rest of it comes under the category of general waste, which does not need any treatment. But, if all the waste is mixed, the total waste generated by a hospital becomes infectious. As the quantity of waste to be treated increases, the hospital fails to treat all its waste and a large chunk of this infectious waste reaches the municipal dumps, increasing the possibility of spreading infection.

Problems due to incinerators

Incinerator is a burn technology and is linked with problems like: i) acid gases, ii) dioxins and furans iii) and heavy metals released in air and ash

- Acid gases include nitrogen oxide, which forms acid rain and also affects the respiratory and cardiovascular system.
- Dioxins and furans are organochlorines, which form as a result of the combination of chlorine molecules in plastics (PVC) with organic material. Organochlorines mimic hormones and thus disrupt the hormonal cascades. They are proven carcinogens and endocrine disrupters, and also weaken the immune system and damage the male and female reproductive organs.
- Heavy Metals are released during incineration of medical waste. Mercury when incinerated vaporizes and spreads easily in the environment. Lead and cadmium, which are very toxic heavy metals, present in certain plastic, also accumulates in the ash, when plastic is incinerated.

Spread of infection through the recycling trade

A lot of hospital disposable items like syringes and IV bottles have been seen to enter the market again and reach the hospitals. This increases the risk of spreading infection in the community, through the ragpicker who collects it, person who repacks it, the nurse who opens it and finally the patient who gets injected. Thus, it is the duty of the nurse or any other person involved in the work to see that disposables are mutilated immediately after use to prevent their reuse.

DANGERS TO THE HEALTHCARE WORKERS

Hours spent at workplace

The healthcare workers spend a major part of their day in hospitals. Any problem here would affect them the most.

Needle stick injuries- Skin is our primary protective barrier and sharps have the ability to penetrate it. Thus a needle stick injury has a very high rate of transmitting infections. According to a study by WHO, worldwide, 8-16 million hepatitis

Table 6.6
Categories of hospital staff exposed to needle stick injuries

Categories of hospital personnel exposed ⁹	Percent injured
Staff nurses	34.6%
Interns	15.7%
Residents	11.7%
Practical nurses	8.5%
Technical staff	6%

B, 2.3-4.7 million hepatitis C and 80,000-160,000 HIV infections are estimated to occur yearly from re-use of syringe needles without sterilization.

Another published paper gives other statistics for such injuries- (Table 6.6 and 6.7)

DANGERS ASSOCIATED WITH MERCURY SPILLS

Mercury is a persistent, bioaccumulative toxin. This heavy metal has the capability to bind to DNA and interfere with cell division. It is a potent neurotoxin, i.e., it attacks the central nervous system, and it can also harm other vital organs like the brain, kidney and lungs. It not only passes the skin, blood-brain but also the placental barrier. Pregnant women and children are most vulnerable to the effects of mercury. Fetuses exposed to mercury show nervous system damages. The Minamata disaster in Japan is an example of mercury poisoning via biomagnification and bioaccumulation. Mercury exposure can lead to pneumonitis, bronchitis, muscle tremors, irritability, personality changes, gingivitis and other forms of nerve damage. Some symptoms of mercury poisoning are - impairment of peripheral vision, disturbances in sensation, lack of coordination of muscles, memory loss and mental disturbances.

BODY FLUID SPILLS

Blood or any other body fluid, including urine or aspirations from any body part, if not cleaned up properly may lead to spread of infection in that area.

The New Legislation for medical waste

The entire hospital team needs to know about the

Table 6.7
Procedures that can cause needle stick injuries

Procedures when injuries can occur ¹⁰	Number of times (in %)
Drawing blood	22.6%
Recapping needle	11%
Needle disposal	10.5%
Garbage disposal	12.5%

provisions under the Bio-Medical Waste (Management & Handling) Rules 1998. The reasons of how and why these came into existence should be explained so that they appreciate the usefulness of this legislation. It must also be impressed upon them that much effort would be needed from their side to make it succeed. The clauses regarding fines and other legal implications should also be dwelt upon, though the monitoring system within the hospital can be discussed at a later stage.

INTERACTION

Get inputs from them about waste management practices in their hospital. Ask them about what happens to different types of waste, what they think constitutes the major chunk in the waste, and how they think they can help in minimizing the waste and the risk.

SESSION II

Once you tell them the problems, leave the trainees for two to three days. The second meeting should focus on introducing and discussing all the aspects of waste management. Tell them in detail how a little effort on their part can help solve these problems

• Segregation

The Bio-medical Waste (Management & Handling) Rules 1998 instruct the generator to segregate waste (depending on its type) in different containers. The rules give the categories of waste, the colour codes to be used for them and treatment options.

Segregation in a general set up would require three containers (See box)

Yellow	Red/ Blue	Black
Only incinerable waste, which should be mainly anatomical waste and body parts. In case other treatment options are not available, then other waste, not pretreated by any disinfectant, such as blood-soaked bandages, swabs etc. can also go here.	All waste that needs disinfection, including all plastic waste used in patient care- blood and urine bags, IV sets, syringes etc. Lab waste and also blood soaked bandages, swabs, anatomical tissues etc.	All general waste, including packaging material, food waste, i.e., anything that is not specific to the hospital, including kitchen, canteen, administration, stores waste etc.

■ **Disinfection**

Medical waste needs to be disinfected before disposal, and this can be done centrally using technologies like autoclaves, microwaves, hydroclaves etc. If disinfection has to be done at all the points of generation, then chemical disinfection is the only available option. According to the rules, 1 percent hypochlorite or any other equivalent reagent can be used for disinfecting, but it has to be ensured that chemical treatment ensures disinfection. For this the Central Sterile Supply Department (CSSD) has to follow the supplier's directions closely.

■ **Sharps management**

Sharps constitute a special category of waste and they include needles, syringes, scalpels, blades, glass etc., which have the capability to injure by piercing the skin. As these sharps are used in patient care, there is every chance that infection can spread through this type of injury. Thus, it is necessary for all healthcare setups to have a sharps management policy.

One can handle this problem in two ways—either avoid contact with the sharp or treat it. The hospital can choose any of these ways—all sharps, including the needles can be stored in big puncture resistant containers with a small hole to discard sharps. Once this box is full, it can go for autoclaving and finally for recycling. The recycler returns the containers, which are again put to use. The second option would be to provide needle destroyers to destroy the needles and cut the syringes and then disinfect both of these in separate containers. All the other sharps can be directly put in the disinfecting solution.

■ **Mercury spill handling**

While dealing with a mercury spill the hospital

workers should be ready with the following items, which can be put together in all the wards in advance and labeled as MERCURY CONTAINMENT KIT. This would ensure the availability of these things the moment the spill occurs.

- Nitrile gloves or at least two pairs of latex gloves (Mercury passes mercury can pass through single pair of latex gloves)
- Face mask
- Protection for the eyes
- Scotch Tape
- 10c.c syringe
- Covered plastic/ glass container with water
- Posters depicting the process of mercury spill containment

PRECAUTION: Mercury-based instruments should never be used in a carpeted area.

Once a mercury spill occurs the steps to be taken are -

- Never touch mercury with bare hands, as mercury is absorbed quickly through the skin
- Remove all jewellery when dealing with mercury, as mercury combines with gold, silver and other metals.
- Clear the area around the spill and contain the spread of mercury.
- Wear all the protective gear.
- Try to gather all the small droplets of mercury with the help of two hard cardboard sheets and then use a syringe to suck this big droplet of mercury. (Mercury is a nonwetting liquid, which has the affinity to hold to itself; thus when you get all the small drops of mercury together, they join and form a big drop).
- Pour contents of the syringe into a plastic/ glass

container with 5 to 10 ml of water.

- g. Put scotch tape, if used, in the plastic/ glass container.

Put the used syringe back in the kit, upside down.

■ ***Body fluid spill***

Cover the spill with absorbent cotton or a cloth. Discard this in the yellow or red container depending on the treatment option available. Disinfect the surface with 10% bleach for 10-15 minutes or use phenolic disinfectants.

■ ***Demonstrate all new material, which will be introduced in the wards.***

SESSION III

• ***Discussing problems, answering queries***

Once people start adopting these practices, they may face some problems and it is important to solve their problems and also discuss these together, as the other staff members who may not

have faced them may also benefit.

List problems from monitoring sheets.

AWARENESS - NEED & MEANS

These are a few ways to help a hospital spread awareness about the scheme-

- Posters and circulars,
- Hospital magazine
- Attitude survey
- Tea sessions
- Infection/ waste control committee meetings
- Hospital functions
- Evaluation of nursing stations

Define the problem well to your staff and see how easily and efficiently they tackle it.

Note: This factsheet aims to highlight some basic points, which should be dealt with while training. If the reader wants to go into the details of any of the topics covered, he/ she can refer to our earlier factsheets.

Prevention is better than cure

A FACTSHEET ON

UNIVERSAL PRECAUTIONS

Megha Kela Rathi

Through our factsheets we have tried to bring up the issues which are very important in our day to day activities in healthcare institutions. In this factsheet we are focusing on Universal Precautions and infection control. We believe these precautions can take us a long way in fighting deadly diseases like Hepatitis and AIDS. We welcome your suggestions on this subject.

What is an infectious disease?

An Infectious disease is caused by either viruses, bacteria, parasites and fungi, which can spread from person to person through blood and other body secretions, respiratory droplets, direct skin to skin contact, or through sexual contact.

What are Universal Precautions?¹¹

Universal precautions are a series of recommendations for healthcare providers to protect themselves, their patients and other healthcare workers from the spread of infectious diseases. One needs to be careful while dealing with blood, other body fluids containing visible blood, semen and vaginal secretions. They also apply to tissues and cerebrospinal, synovial, pleural, peritoneal, pericardial and amniotic fluids. Sometimes nasal secretions, sputum, saliva, sweat, tears, vomit, urine and faeces can be sources of infection and one should take precautions while handling them.

Emergence of Universal Precautions

In 1985, largely because of the HIV epidemic, isolation practices in the United States were altered dramatically by the introduction of a new strategy which became known as Universal Precautions (UP).

Following the initial reports of hospital personnel getting infected with HIV through needlestick injuries and skin contamination with patients' blood, a outcry created an urgent need for new isolation strategies to protect hospital personnel from bloodborne infections. The subsequent modification of isolation precautions produced several major strategic changes in the process of adding protection against patient to personnel transmission.

In acknowledgment of the fact that many patients with bloodborne infections are not recognized as such, the UP approach emphasises on applying Blood and Body Fluid Precautions universally to all persons. Healthcare workers should presume that the blood and body fluids of all persons being treated could be a potential source of infection, regardless of their presumed infection status. Until this time, most patients placed on isolation precautions were those for whom a diagnosis of an infectious disease had been made or was suspected. This provision led to the new name of Universal Precautions.

In addition to emphasizing on prevention of needlestick injuries and the use of traditional barriers such as gloves and gowns, UP expanded Blood and Body Fluid Precautions to include use of masks and eye coverings to prevent mucous membrane exposures during certain procedures and the use of individual ventilation devices when the need for resuscitation was predictable.

FUNDAMENTALS OF UNIVERSAL/ ISOLATION PRECAUTIONS¹²

A variety of infection control measures are used

for decreasing the risk of transmission of microorganisms in hospitals. These measures make up the fundamentals of universal precautions. The OSHA (Occupational Safety & Hazardous Act) Bloodborne Pathogens final rule makes it mandatory to wear gloves, masks, eye protection, face shields and protective apparel in the specified circumstances to reduce the risk of exposure to bloodborne pathogens.

Hand washing and Gloving

Hand washing frequently is called the single most important measure to reduce the risks of transmitting microorganisms from one person to another.

Wash hands between patient contacts, or after contact with blood, body fluids, secretions, excretions, equipment and articles contaminated by them, regardless of whether or not gloves are worn, to avoid transfer of microorganisms to other patients or environments. Use plain (non antimicrobial) soap for routine handwashing.

Use an antimicrobial agent or a waterless antiseptic agent for specific circumstances (eg, control of outbreaks or hyperendemic infections). This is an important component of infection control and isolation precautions.

Gloves: In addition to hand washing, gloves play an important role in reducing the risk of transmission of microorganisms.

Wear gloves (clean, nonsterile gloves are adequate)

- when touching blood, body fluids, secretions, excretions, and contaminated items
- while performing procedures involving sharps or open sores.
- when cleaning up around the care-giving area.

Put on clean gloves just before touching mucous membranes and nonintact skin. Change gloves each time a procedure is performed and also in case the gloves have been damaged. Remove gloves promptly after use, before touching noncontaminated items and environmental surfaces (like doors), and before going to another patient, and wash hands immediately to avoid transfer of microorganisms to other patients or environments. Do not wash gloves, discard them in appropriate containers.

Double gloves are recommended for each procedure; the outer layer is to be removed if leaving the operatory or entering a drawer/cabinet and

upon returning to the procedure, a second pair of gloves is to be donned.

Gloves are worn for three important reasons in hospitals.

- I. to provide a protective barrier and to prevent gross contamination of the hands when touching blood, body fluids, secretions, excretions, mucous membranes, and non intact skin.
- II. to reduce the likelihood that microorganisms present on the hands of personnel will be transmitted to patients during invasive or other patient-care procedures that involve touching a patient's mucous membranes and nonintact skin.
- III. to reduce the likelihood of transmitting microorganisms to a patient through hands contaminated with microorganisms from another patient. In this situation, gloves must be changed between patient contacts and hands should be washed after gloves are removed.

Wearing gloves does not replace the need for hand washing, because gloves may have small, apparent defects or may be torn during use, and hands might get contaminated during removal of gloves.

Types of gloves vary according to the activity being carried out. Latex gloves/ rubber gloves are mainly recommended while performing standard procedures. Waste handlers, should be provided with heavy-duty rubber gloves.

Masks, Respiratory Protection, Eye Protection, Face Shields

Various types of masks, goggles, and face shields are worn alone or in combination to provide a protective barrier. A mask that covers both the nose and the mouth, and goggles or a face shield should be worn by hospital personnel during procedures and patient care activities that are likely to generate splashes or sprays of blood, body fluids, secretions, or excretions or aerosols to provide protection of the mucous membranes of the eyes, nose, and mouth from contact transmission of pathogens. A surgical mask is generally worn by hospital personnel to provide protection against spread of infection through large particle droplets that may be transmitted by close contact and generally travel only short distances (up to three ft) from patients with infectious diseases who are coughing or sneezing.

RECOMMENDED RESPIRATORS:

Particulate respirators including dust mist (DM), dust fume mist (DFM), or high-efficiency particulate air (HEPA) filter respirators certified by the CDC. These should be worn while dealing with minute particulate matter and highly infectious cases.¹²

Gowns and Protective Apparel

Gowns are worn to prevent contamination of clothing and the skin. Some gowns specially treated to make them impermeable to liquids should be worn while dealing with blood or other body fluids. Remove a soiled gown as promptly as possible, and wash hands immediately.

Leg coverings, boots, or shoe covers provide greater protection to the skin when splashes or large quantities of infective material are present or anticipated.

Dental professionals are exposed to a wide variety of microorganisms through blood and saliva of patients. These microorganisms may cause infectious diseases. The use of effective infection control procedures and universal precautions in the dental office and the dental laboratory will prevent cross-contamination that could extend to dentists, dental office staff, dental technicians and patients.¹³

Linen and Laundry

Handle, transport and process used linen soiled with blood, body fluids, secretions, and excretions in a manner that prevents skin and mucous membrane exposures and contamination of clothing.

Linen and clothing, which have been heavily soiled with blood or other body fluids, should be transported in bags that prevent leakage. Bags should be tagged indicating the contents. Ideally, such articles should not be sorted and be handled as little as possible. If sorting or a cold rinse by hand is required, gloves should be worn. They should be unloaded directly into the washing machine/ first soaked in a disinfectant (10 percent hypochlorite solution) for 30 minutes. Then after it can be mixed with regular linen.

ROUTINE AND TERMINAL CLEANING^{11,12}

The cubicles and bedside equipment of patients on Transmission-Based Precautions are to be cleaned using the same procedures used for patients on

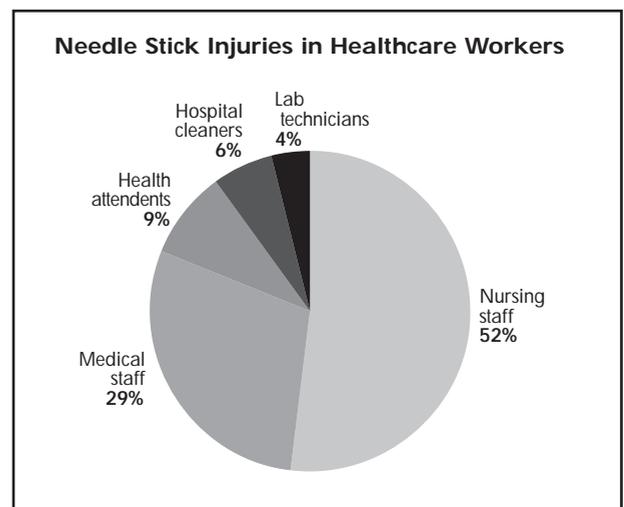
Standard Precautions, unless the infecting microorganisms and the amount of environmental contamination indicate special cleaning. In addition to thorough cleaning, adequate disinfection of bedside equipment and environmental surfaces (eg, bed rails, bedside tables, carts, commodes, doorknobs, faucet handles) is indicated for certain pathogens, especially enterococci, which can survive in the inanimate environment for prolonged periods of time. Patients admitted to rooms that were previously occupied by patients infected or colonized with such pathogens are at increased risk of infection from contaminated environmental surfaces and bedside equipment if they have not been cleaned and disinfected adequately. The methods, thoroughness, frequency of cleaning and the products used, are determined by hospital policy.

Dishes, Glasses, Cups, and Eating Utensils

No special precautions are needed for dishes, glasses, cups, or eating utensils. Either disposable or reusable dishes and utensils can be used for patients on isolation precautions. The combination of hot water and detergents used in hospital dishwashers is sufficient to decontaminate dishes, glasses, cups, and eating utensils.

Sharps Handling and Disposal

Care should be taken to prevent injuries while using, handling and disposing needles, scalpels, and other sharp instruments or devices.



A retrospective review of sharps and needlestick injuries among healthcare workers of a regional hospital at Singapore between 1992 and 1997¹⁴

Never recap used needles, or manipulate them using both hands. Avoid directing the point of a needle towards any part of the body. Maximum needlestick injuries in healthcare workers have been reported while recapping of needles. If recapping is essential, then either a one-handed 'scoop' technique (the needle sheath is placed on a table top and the needle is inserted into it by using only one hand) or a mechanical device designed for holding the needle sheath should be used.

Avoid removing used needles from disposable syringes by hand, and do not bend, break, or otherwise manipulate used needles by hand.

The risk posed following a needle stick exposure is

Hepatitis B	10-30% (one or three out of every 10 who are injured)
Hepatitis C	1-10% (One in every ten who are injured)
HIV	0.3-0.4% (three or four 1000 out of every 100 injured)

In case of a needlestick injury, the finger /precutaneous exposure should be pressed around the site of injury letting blood ooze out from the point of injury, the finger should then be placed under running water. Then the cuts or sores on the hands should also be covered with a waterproof dressing.

Mucocutaneous Exposure:- There have been cases when HIV was acquired through contact with non-intact skin or mucous membranes. If mucocutaneous exposure occurs, wash the affected area thoroughly with soap and water. If the eye is affected, wash it thoroughly with water.

POST EXPOSURE PROPHYLAXIS (PEP)

In case the injury has occurred from the same sharp instrument being used by a Hepatitis B positive patient, the healthcare worker should immediately be given immunoglobulins and the vaccination for HBV. Research evidence seems to suggest that the use of anti-HIV drugs like zidovudine in combination with other anti-HIV drugs if given soon after the injury, can reduce the rate of transmission. All accidents should be recorded and the person in-charge of the hospital should be informed.

Waste Disposal

Waste disposal should be in accordance with the

rules and the guidelines prescribed by the government. Multiple handling of waste should be discouraged. All waste needs to be placed in appropriate containers at the point of generation. Protective clothing must be worn by the waste handlers to reduce the chances of infection.

INFECTION CONTROL¹²

1. Universal Precautions

All the healthcare workers being exposed directly or indirectly to infectious diseases must take Universal Precautions to reduce the chance of spread of infection.

2. Sterilization and cleaning

Ensure that the hospital has adequate procedures for the routine, cleaning, and disinfection of environmental surfaces, beds, bed rails, bedside equipment, and other frequently touched surfaces, and ensure that these procedures are being followed.

Routine microbiology tests for air and water contamination should be carried out in all parts of the hospital.

Sterilize and disinfect instruments that enter tissue, or through which blood flows, before and after use. Sterilize devices or items that touch intact mucus membranes. In all the autoclave cycles, spore strips need to be placed to check the efficacy of the machine.

Recommended chemical disinfectants should be used for the storage of instruments and fumigation of rooms. All the rooms must have proper ventilation.

3. Managing Body Fluid Spillages

Urine, Vomit & Faeces

All spillages of body fluids (urine, vomit or faeces) should be dealt with immediately. Gloves (ideally disposable) should be worn, spillage should be mopped up with absorbent toilet tissue or paper towels: this should be disposed of into the waste bin meant for soiled waste. Pour 10 percent hypochlorite solution and leave it for 15 min. Clean the area with a swab. For spillages outside (e.g. in the playground) sluice the area with water. Do not forget to wash the gloves and then wash your hands after you have taken the gloves off.

Blood

Blood spillages should be dealt with immediately. All blood should be treated as though it were infected. The blood from patients known to be HIV or hepatitis B infected does not need to be treated any differently from other blood spillage.

Wear gloves and mop the area with absorbent cotton and throw it in the yellow bin meant for infectious waste. Cover the area with 10 percent hypochlorite solution and leave it for 15-20 minutes. Clean the area with a mop.

Blood, or other body fluid spillage on carpets and upholstery should be cleaned with warm soapy water or a proprietary liquid carpet shampoo since the use of hypochlorite granules may discolor fabrics.

Mercury

In case of mercury spills, all the jewelry must be removed. The person cleaning the spill should wear two pairs of latex gloves and a face mask. Scoop all the mercury together by using stiff paper, then suck it in a syringe (without a needle) and place it in a bottle with some water. This bottle should be handed to the stores.

4. Patient Placement

A separate room is important to prevent direct/indirect contact transmission when the patient is with highly transmissible microorganisms, or the patient has poor hygienic habits.

If a separate room is not available, the patient must be can share the room with a patients infected by the same microorganism, provided they are not infected with other potentially transmissible microorganisms. If this is not possible, the patient should be placed in the corner of a well-ventilated room.

Transportation of Infected Patients

When patient transport is necessary, it is important that (1) appropriate barriers (eg, masks, impervious dressings) are worn or used by the patient to reduce the opportunity for transmission of pertinent microorganisms to other patients, personnel and visitors, and to reduce contamination of the environment. (2) personnel in the area to which the patient is to be taken are notified of the impending arrival of the patient and of the precautions to be used to reduce the risk of transmission of infection.

5. Immunization programmes

Since hospital personnel are at risk of exposure to preventable diseases, maintenance of immunity is an essential. Optimal use of immunizing agents will not only safeguard the health of personnel but also protect patients from becoming infected by personnel. The most efficient use of vaccines with high risk groups is to immunize personnel before they enter high-risk situations.

Mastering the Masters

A FACTSHEET ON

DISINFECTANTS AGAINST THE MICROBES

Aparna Dutta, Anu G Agrawal

Microorganisms occur everywhere on the surface of the earth. They are able to grow and survive under wide range of environmental conditions. Man has always been searching for toxic chemicals, which kill or inhibit the growth of microorganism mainly to prevent their infective or destructive actions. The search for such chemicals goes on continually in an effort to find those having highest toxicity for microorganisms with lowest possible effect on man, animals and plants.

These chemicals act at different levels and their mode of action can be-

- **Disinfection**- Microorganisms can be killed, removed or inhibited by various chemical agents called disinfectants. It kills vegetative cell but not heat resistant spores. It is normally applied to inanimate objects such as floors, utensils, equipment, laundry etc.
- **Sterilization** -Process of destroying all forms of life by physical and chemical agent. It implies the complete absence or destruction of microorganisms including spores. An object or substance is sterile or nonsterile but never semi or almost sterile.

When a disinfectant is used the following factors have to be considered

- It should have wide range of microbial activity.
- Surface disinfection should be rapid.
- It should not be neutralized by soaps, hard water, organic matter and plastics.
- Control of substances hazardous to health regulations needs to be considered.
- It should not be irritating to the skin.

Factors influencing antimicrobial activity

Anything, which can interfere with molecular complexity of a cell, can kill it. Factors related to a killing agent are

- Concentration
- Time
- Temperature

Factors related to the microorganisms to be killed-

- Number of organisms
- Kind of organism
- Physiological state

Nature of environment

There must be interaction between the organism the agent, and the environment may prevent or enhance the interaction with a particular disinfectant. One of the commonly used disinfectant is **Sodium hypochlorite (NaOCl)**. It is a pale greenish liquid also known as soda bleach or liquid bleach. Its properties are a result of the equilibrium reaction between elemental chlorine and caustic soda. The presence of caustic soda is necessary to keep the pH at high values, thus avoiding the release of free chlorine (very toxic gas).

Reasons for using sodium hypochlorite solution:

- Cheap
- Broad spectrum
- Comparatively less harmful
- Easy to handle
- Water soluble

Chemical Reactions:



Properties/Specifications

pH	12
Solubility	Soluble in cold water, decomposes in hot water

Chlorine is slowly liberated. It is very effective in its germicidal action. The action is due to the formation of hypochlorous acid when free chlorine reacts with water.



The hypochlorous acid formed is further decomposed: $2\text{HClO} \rightarrow 2\text{HCl} + \text{O}_2$

The oxygen released in this reaction (nascent

oxygen) brings about microbial destruction by oxidation. Combination of chlorine with proteins of the cell membrane and enzymes is also responsible for the death of organisms. Hence making it a very powerful oxidizing, bleaching and disinfecting agent.

In hospitals, infected syringes or other substances are dipped in hypochlorite solution to disinfect them before final disposal. Buckets containing this, should not be covered, because oxygen is required for the disinfection action.

Common uses of Sodium Hypochlorite: The common uses of Sodium Hypochlorite are given in Table 10.1.

Validation Test: Sodium hypochlorite solution may be tested at intervals with a starch iodine paper to confirm that is still reactive by the demonstration of a dark blue colour.

Hazard Identification: Depending on the concentration involved, hypochlorite solutions can be classified as either irritant or corrosive and appropriate precautions should be taken while handling it. Particular attention must be paid to avoid mixing with other products, such as toilet bowl cleaners, rust removers, ammonia or acids. *Hypochlorite should not be applied to metals which it corrodes or to cloth, which it may damage.*

Although skin and mucous membrane irritation can occur when the exposure concentration is greater than 5%, these effects are reversible. It is documented that sodium hypochlorite is not a mutagen, carcinogen, teratogen or skin sensitizer.

Under normal household use, sodium hypochlorite is broken down in the environment into table salt, oxygen and water. Other substances

may be formed, to a small extent. These by-products are most often referred to as AOX (adsorbable organic halides). the amount of AOX is very small both in absolute terms and relative to other human activities and natural sources,

Emergency Overview: Harmful if swallowed or inhaled. Causes irritation to eyes and respiratory tract. Causes substantial but temporary eye injury.

Potential Health Effects

- **Inhalation:** May cause irritation to the respiratory tract, (nose and throat); symptoms may include coughing and sore throat.
- **Ingestion:** May cause nausea, vomiting.
- **Skin Contact:** May irritate skin.
- **Eye Contact:** Contact may cause severe irritation and damage, especially at higher concentration.
- **Chronic Exposure:** A constant irritant to the eyes and throat. Low potential for sensitization after exaggerated exposure to damaged skin.
- **Aggravation of Pre-existing Conditions:** Persons with impaired respiratory function, or heart disorders (or disease) may be more susceptible to the effects of the substance.

First Aid Measures

- **Inhalation:** Move to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
- **Ingestion:** If swallowed, do not induce vomiting. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
- **Skin Contact:** Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical

Table 10.1

Common Actions	Used in places	Property responsible
Bleaching	Laundry and home	Oxidation
Disinfection	Hospitals	Coagulation
Odor Control	Toilets	Precipitation
Chlorination of drinking and process water	Water tanks	Septication
Elimination of slime and algae	Swimming pool and boiler water	pH Adjustment

Table 10.2

Do's and Don't for Sodium Hypochlorite Solution

DO's	DON'Ts
Measure the disinfectant correctly	Use disinfectant for sterilization
Put right amount of water	Store instruments in disinfectant
Use clean dry pot or bucket	Cover the lid of the bucket
Wash away dirt if possible	Use two disinfectants together
Throw away the solution after use	Add your detergent to a disinfectant
Remember if disinfectant is used carelessly it may grow microbes and spread infections	Expect any disinfectant to make your dirt safe
	Use yesterdays disinfectant solution

Source: Hospital Hygiene by Isobel M Maurer, 1985 (3rd edition)

- attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.
- Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.
- Note to Physician:** Consider oral administration of sodium thiosulfate solutions if sodium hypochlorite is ingested. Do not administer neutralizing substances since the resultant exothermic reaction could further damage tissue. (see Tables 10.2,3)

Table 10.3

Recommended usage and dilution of various disinfectants

DISINFECTANT	STRENGTH	RECOMMENDED USAGE
Sodium Dichloroisocyanurate rate(hypochlorite)	Granules 10000ppm 1000ppm 140ppm	Blood spillage only Spillage of body substances Baths, bed pans of infected persons Babies feeding bottle
Phenolic	2%	Spillage of body substances on carpet, soft furnishing etc.
Chlorhexidine	0.5% in 70% alcohol 4% in 70% alcohol 0,5% in 70% alcohol 0.5% in 70% alcohol	Preoperative and pre procedural skin preparation Hand washing prior to clinical or surgical procedures Disinfection of clean hands dressing, nursing procedures etc Cleaning of infected wounds and genitalia prior to urinary catheterisation
Chlorhexidine And cetrimide	0.015% to 0.15%	Cleaning of dirty (traumatic wounds), theatre and accident and emergency, preoperative skin preparations for sensitive areas e.g face, scrotum, obstetric examination.
Providone-iodine	Dry powder spray Surgical scrub 10% solution	Care of skeletal pinsites, infected pressure sores, ulcers etc Handwashing Preoperative and pre procedural skin preparations
Alcohols	70%	Skin preparations prior to injection, cleaning of Thermometers
Gluteraldehyde	2%	Sterilisation of non autoclavable instrument e.g endoscopes

Source: Glaxo, Qualigens Fine Chemicals training manual

Breaking the ice

A FACTSHEET ON

EXPLORING MERCURY AND ITS ALTERNATIVES

Anu G Agarwal

When we think of a hospital or any person down with a disease, for that matter, one thing we spontaneously ask for is – the patient's temperature and blood pressure. The recording of the two always brings the picture of a long sleek thermometer & sphygmomanometer which we all know has mercury. Mercury is a very toxic metal and is on priority action lists of the state and federal government of US as well as international organizations. This seemingly routine, easy and harmless job of maintaining temperatures can be quite fatal, not just for hospital employees but for the whole mankind because finally this mercury poisons the biota through air, water or soil, wherever it is disposed.

Though mercury alternatives are now available. There is a lot of bias and confusion about them. Through this factsheet we want to break the ice between the user and these alternatives.

The expression 'mad as a hatter' comes from mental disorders that occurred in hat workers caused by the mercury once used to process felt for hats.

HANDLE MERCURY WITH CARE

- ◆ NEVER TOUCH MERCURY WITH BARE HANDS
- ◆ WEAR ALL PROTECTIVE GEARS
- ◆ GATHER MERCURY USING STIFF PAPER AND SUCK IT IN THE SYRINGE WITHOUT THE NEEDLE
- ◆ POUR CONTENTS OF THE SYRINGE IN A BOTTLE CONTAINING WATER
- ◆ PUT SCOTCH TAPE AROUND THE BOTTLE
- ◆ KEEP THE SYRINGE FOR FURTHER USE

Mercury use in the healthcare sector:

- Thermometers
- Blood pressure cuffs
- Feeding tubes
- Dilators and batteries
- Dental amalgam
- Fluorescent tubes
- Laboratory chemicals like Zenkers solution and histological fixatives.

HEALTH HAZARDS OF MERCURY

Mercury has the ability to pass all the three delicately designed barriers in nature- the skin, blood brain and the placental barrier. Mercury can be consumed via food, inhaled or be absorbed through the skin. Mercury exposure can lead to pneumonitis, bronchitis, muscle tremors, irritability, personality changes, gingivitis and other forms of nerve damage. The effect of mercury on the central nervous system includes tremors, impaired vision and hearing, paralysis, insomnia, emotional instability, developmental deficits during fetal development, attention deficit, and developmental delays during childhood. It is particularly dangerous to fetuses, women of childbearing age, pregnant women and young children. One gram of mercury is enough to contaminate a lake of 20 acres and one thermometer contains 0.5-1.5 gms of mercury.

There are two main effects that mercury has on the environment. When industry discharges mercury into rivers and other water bodies, the bacteria in water convert it into methylmercury. Small fish eat the bacteria and as the food chain works, the highest in the pyramid (fish lovers) get the maximum dose of this poison. The second effect involves the acidity of a river or lake. A more acidic environment encourages organic mercury (a form of mercury) to increase. Organic mercury is easily

absorbed by fish, thus making the situation worse.

Mercury is considered a global pollutant because it travels long distances, carried by wind and rain. Mercury does not break down; it accumulates in the muscles of animals concentrating as it moves up the food chain. Studies show that there is up to 50 times more mercury in hospital wastes than general municipal waste.

ALTERNATIVES TO MERCURY BASED INSTRUMENTS

Digital instruments are available as substitutes to the mercury containing instruments.

Costs:

- The cost of the blood pressure instruments ranges from Rs 4000 to 5000/-
- The cost of thermometers ranges from Rs 250 to 350/-

Initial cost of digital instruments is around 8-10 times higher than the mercury instruments. Digital thermometers are available with flexible tips rendering them unbreakable even if they fall down and if the bulb breaks it can be replaced making them cost effective in the long run.

	Mercury	Alternate
Cost	Low	High
Life span	Short	Long
Accuracy	Accurate	Accurate
Overall cost effectiveness	Not effective	Cost effective

WHY ARE THE ALTERNATIVE TECHNOLOGIES BETTER?

These non-toxic substitutes pose no environmental or health hazards and last for a longer duration. The life span of the mercury instruments, on the other hand, is short because of their fragility. Even though the initial investment in the alternative technologies is higher, the assets associated with them are lifelong.

Alternative technologies are accurate and they are relatively easy to use.

A study¹⁵ in an elderly population evaluated the differences in the self-recording of blood pressure with automatic & semi-automatic equipment, using a mercury sphygmomanometer by a physician as a 'gold standard' control." The findings indicated that there was no difference between the mercury and automatic methods of BP measurement. Interestingly, they found significant differences when the semi-automatic system was used.

This was thought to be related to the errors made by the patient while measuring (e.g.: several patients couldn't inflate the cuff).

The use of the mercury sphygmomanometer is limited by factors such as observer bias, which confound the ability to discern the true blood pressure value. Automated blood pressure machines demonstrated less within subject variability during repeated measures than with mercury sphygmomanometers. Hourly blood pressure profiles recorded throughout 24 hours by automated and manual methods from hypertensive patients were nearly identical. These data suggest that blood pressures measured by auscultatory automated methods are similar to and representative of those obtained manually.¹⁶

A study was done to determine the accuracy of a particular brand of automatic meter. Again, it was measured against the mercury sphygmomanometer and was found to perform in a highly satisfactory manner, particularly in the mild-moderate hypertensive range. The researchers determined that this device could be recommended for clinical use.¹⁷

DISASTERS AROUND THE WORLD

One major environmental disaster that involves mercury happened back in 1956. Chisso Corp. made its home in **Minamata**, Japan. Chisso dumped its pollution into the Minamata Bay beginning in 1907. By 1956, people in Minamata started having extreme muscle spasms, delirium and difficulty in walking and speaking. Cats would run amok and jump into the sea. Birds dropped from the sky. Fingers were pointing to Chisso. After much cover up, it was concluded that organic mercury from Chisso was the cause of all the illness.

Thor Chemical disaster in South Africa - three workers died, more than forty injured as a result of a mercury "recycling" plant employing mainly

informal labor?

Grassy narrows in Ontario had a very similar mercury-poisoning crisis as Minamata. It was downstream of a pulp and paper mill, which was the source of the mercury.

All the Great Lakes have fish consumption advisories on them. 40 of the 50 US states have advisories for mercury on all or part of their waters. This means people eating fish have to stop or minimize their intake of certain species of fish because of mercury contamination. There are no disasters on the scale of Minamata in the US, though there are cases of homes, schools, etc being closed because of elemental mercury exposure to children. **Expenses for clean up are very high and they are now motivating schools to eliminate their use of mercury, to prevent potential clean-up costs.**

MERCURY ELIMINATION ORDINANCES¹⁸

- **March 6, 2000 Duluth, Minnesota:** Ordinance banning retail sale of mercury fever thermometers
- **May 9, 2000 San Francisco, CA:** Ordinance banning manufacture, import and retail sales of mercury fever thermometers
- **June 2000 New Hampshire:** State law that prohibits the sale of certain mercury-added products; establishes notification and disclosure requirements for permissible mercury-containing products; establishes limitations on the use of elemental mercury; etc.
- **July 10, 2000 Ann Arbor, MI:** Ordinance banning manufacture, import and retail sales of mercury fever thermometers
- **July 12, 2000 Dane County, WI:** Ordinance banning retail sale of mercury fever or basal thermometers
- **September 5, 2000 DeForest, WI:** Ordinance banning manufacture, import and retail sales of mercury fever thermometers
- **October 10, 2000 Stoughton, WI:** Ordinance banning manufacture, import and retail sales of mercury fever thermometers

According to an EPA report, the largest source of mercury in municipal solid waste is from mercury thermometers. The **American Hospital Association** has signed an agreement with the EPA that member hospitals will be mercury-free by 2005 and Dane County hospitals are discontinuing their

practice of distribution of mercury thermometers with newborn children.

The prestigious National Academy of Scientists has estimated that 60,000 American children may develop neurological problems or learning disabilities each year because their mothers ate mercury contaminated fish during pregnancy.

San Francisco has an ordinance banning manufacture, import or retail sale of fever thermometer. Following the example **Boston, Duluth (Minnesota), New Hampshire, Ann Arbor (MI), Dane County, WI DeForest, WI Stoughton, WI** have put a ban on the sale of fever thermometers in their respective cities.

Over 340 lakes in **Wisconsin**, including **Monona** and **Waubesa in Dane County**, have fish consumption advisories due to high levels of mercury in the fish. Due to bioaccumulation of mercury in fish, the **Michigan Department of Community Health** has issued fish consumption advisories for every inland lake in Michigan. The advisories recommend that the general population of adults should eat no more than one meal per week of many types of sport fish from these lakes and women of childbearing age and children under age fifteen (15) should not eat more than one meal per month of these fish.

Thoughts for the day

- For bedside use, there is no obvious accuracy benefit to using the mercury sphygmomanometer routinely.
- In light of the health risk (and associated patient/staff safety as well as spill clean-up & waste management costs) associated with use of mercury in the clinical areas, it appears that it is most appropriate to use non-mercury system on a broad scale.
- It is highly recommended (no matter whether mercury, aneroid, or electronic BP devices are used) that:
 - Appropriate size and cuff placement is ensured
 - Integrity of all system components is ensured (via routine preventative maintenance)
 - Accurate calibration of the device is ensured (via routine preventative maintenance)
 - Appropriate technique for inflation, deflation, and auscultation is ensured
 - The users are aware of, and efforts are made to counteract, common error points prone to cause inaccurate blood pressure determinations.

Beware of these Radiations

A FACTSHEET ON

RADIOACTIVE WASTE

Megha Kela Rathi

Radiations are used for wide variety applications in research, industry, medicine, manufacturing, agriculture, consumer goods and services. The common concern is that in all these uses, care must be taken to ensure that everyone is protected from the potential hazards of radiation.

Accidents due to improper disposal of nuclear therapeutic material from unsafe operation of x-ray apparatus, improper handling of radio-isotopic solutions like spills and left over doses, or inadequate control of radiotherapy have been reported world over with a large number of persons suffering from the results of exposure. In Brazil while moving, a radiotherapy institute a left over sealed radiotherapy source resulted in an exposure to 249 people of whom several either died or suffered severe health problems (International Atomic Energy Agency, 1988). In a similar incidence four people died from acute radiation syndrome and 28 suffered serious radiation burns (Brazil, 1988)¹⁹

As reported by WHO (1999)¹⁹ the type of disease caused by radioactive waste is determined by the type and extent of exposure. It can range from headache, dizziness, and vomiting to much more serious problems because radioactive waste, like certain pharmaceutical waste, is genotoxic, it may also affect genetic material. Handling of highly active sources, e.g. certain sealed sources from diagnostic instruments, may cause much more severe injuries (such as destruction of tissue, necessitating amputation of body parts) and should therefore be undertaken with utmost care.

KINDS OF RADIATION

Radioactivity arises naturally as well as artificially when certain elements that compose matter emit particles and radiations spontaneously. This

phenomenon is known as Radioactivity. Radioactive elements decay at different rates. Rates are measured as half life – the time taken for a given radioactive isotope to lose half of its radioactivity.

There are three kinds of rays associated with radiation: **alpha, beta and gamma**. A fourth kind, neutron radiation, generally only occurs inside a nuclear reactor.²⁰

- **Alpha** particles are heavy, positively charged, and include protons and neutrons. They have a low penetration power, and are hazardous to humans mostly when inhaled or ingested. They cannot penetrate the skin and can be blocked out by a sheet of paper, but is dangerous in the lung.
- **Beta** particles are negatively or positively charged electrons with significant ability to penetrate human skin; they affect health through ionization of intracellular proteins and proteinaceous components. They can penetrate into the body but can be blocked out by a sheet of aluminium foil.
- **Gamma** particles are electromagnetic radiations similar to X-rays but of shorter wavelength. Their penetrating power is high and lead (or thick concrete) shielding is required to reduce their intensity. The radiation penetrates right through the body and requires several centimetres of lead or concrete, or a metre or so of water, to block it.

RADIOACTIVE WASTE GENERATION

Radioactive wastes comprise of a variety of materials generated from the process of production, utilization and storage of radioactive substances that emits nuclear radiation. The disposal of these substances requires different types of management to protect people and the environment. Radioactive

wastes are normally classified as low-level, medium-level or high-level wastes, according to the amount and types of radioactivity in them.

Factors influencing managing of wastes include the level of radioactivity and the time for which they are likely to remain hazardous. This depends on the kinds of radioactive isotopes in them, and particularly the half life characteristic of each of those isotopes.²¹

Low-level radioactive waste: Low-level radioactive waste includes all unwanted material created in the process of handling and using radioactive substances such as tools, instruments, pipes, syringes, paper, water, soil, and protective clothing such as gloves contaminated with radioactive materials.

Intermediate-level waste contains higher amounts of radioactivity and may require special shielding. It typically comprises resins, chemical sludges and reactor components, as well as contaminated materials from reactor decommissioning. Generally short-lived waste (mainly from reactors) are buried, but long-lived waste (from reprocessing nuclear fuel) are disposed of deep underground.

High-level waste may be the spent fuel itself, or the principal waste from reprocessing this. It contains the highly radioactive fission products and some heavy elements with long-lived radioactivity requiring special shielding during handling and transport and eventually encapsulated before disposal in secured deep underground areas.

Radioactive waste management involves minimizing radioactive residues, handling waste packing safely, storage and safe disposal in addition to keeping sites of origin of radioactivity clean.

PRINCIPLES OF RADIOACTIVE WASTES MANAGEMENT²¹

- *Concentrate-and-contain-* The waste is concentrated and then isolated.
- *Dilute-and-disperse-* The waste is diluted to acceptable levels and then discharged to the environment.
- *Delay-and-decay-* this is unique to radioactive waste management; it means that the waste is stored and its radioactivity is allowed to decrease naturally through decay of the radioisotopes in it.

Radioactive waste from the hospitals:

Radioactive material generated from medical facilities includes solid, liquid and gaseous materials contaminated with radionuclides. It is produced as a result of procedures such as in-vitro analysis of body tissues and fluid, in vivo organ imaging and tumor localization and various investigative and therapeutic practices, which include the radiotherapy and nuclear medicine.

Radionuclides used in health care are usually conditioned in unsealed (or open) sources or sealed sources. Unsealed sources are usually liquids that are applied directly and not encapsulated during use; sealed sources are radioactive substances contained in parts of equipment or apparatus or encapsulated in unbreakable or impervious objects such as seeds or needles.

Medical facilities produce low-level radioactive waste [<1 MBq (Mega Becquerel)], with mostly short half-lives. That is, they decay quite quickly. These wastes are stored in a container at the hospital until they decay. (The actual storage time depends on the half-life of the radioactive materials present.) After the wastes are analyzed for radioactivity to confirm that they have decayed, they can be disposed of as ordinary trash. This method of handling low-level waste is called storage for decay. It reduces the volume of waste to be sent to a low-level waste disposal facility. The liquid (unsealed) radioactive waste generated from the health care institutions is discarded in this manner (into the drains) after the potency of the radiation is reduced to the acceptable limits.

SOURCES OF RADIOACTIVE WASTE IN HOSPITALS^{19,21}

The waste produced by health-care and research activities involving radionuclides and related activities such as equipment maintenance, storage, etc., can be classified as:

- sealed sources;
- spent radionuclide generators;
- low-level solid waste, e.g. absorbent paper, swabs, glassware, syringes, vials;
- residues from shipments of radioactive material and unwanted solutions of radionuclides intended for diagnostic or therapeutic use;
- liquid immiscible with water, such as liquid scintillation-counting residues used in radio

- immunoassay, and contaminated pump oil
- waste from spills and from decontamination of radioactive spills;
- excreta from patients treated or tested with unsealed radionuclides;
- low-level liquid waste, e.g. from washing apparatus; gases and exhausts from stores and fume cupboards.

EXCESSIVE EXPOSURE

In case of excessive exposure to radionuclides they should be contained and later disposed according to the type of waste (sealed or unsealed) as per the required standards. Investigations carried out by the Radiation Safety Officer (RSO) on the circumstances causing excessive exposures and steps initiated to prevent recurrence of such mishaps must be recorded. The personal monitoring badges used by the employees should be sent for analysis and in case of over exposure the personnel must be immediately shifted from the department. Details of excessive exposures received, if any, should be recorded for further analysis by Atomic Energy Regulatory Board (AERB).

EXISTING RULES²²

GSR 125 Atomic Energy (Safe Disposal of radioactive wastes) Rules 1987 govern the disposal or transfer of radioactive wastes generated at any nuclear installation. Atomic Energy Regulatory Board (AERB) is conferred with the authority for enforcement of these rules. Chairman, AERB is the competent authority to issue/suspend/amend the authorisation for safe disposal of radioactive wastes from an installation or their transfer to any waste management agency.

As per the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987 agency for waste disposal is the organization, which will receive sealed sources and or radioactive waste.

Agency for Waste disposal is the organisation, which will receive sealed sources and/or radioactive waste from the applicant for ultimate disposal. Examples of such agencies are (i) Board of Radiation and Isotope Technology (BRIT) for disposal of decayed sealed sources used in industrial

radiography or radiotherapy and (ii) Waste Management Division, Bhabha Atomic Research Centre, Mumbai for disposal of packages containing unsealed radioactive wastes.

The rules describe the mode of waste collection, transfer, storage, treatment, disposal and monitoring system of radioactive waste.

Facilities and procedures described in the rules

(a) Collection: It is mandatory to mention the facilities available e.g. polythene lined waste bins for collection of solid wastes, and corrosion resistant cardboards or delay tanks for collection of liquid wastes.

Gases: The rules mention that most cases it is possible to release contaminated air directly through the fume hood exhaust system without exceeding the DAC limits for the public at the discharge point. In rare cases, where it is not so, absorbent filters in exhaust air or scrubbing of exhaust fumes may be provided.

(b) Transfer: it is important to state the type of container employed during transfer of waste/sources e.g. cardboards, sturdy polythene bags, radio-graphy camera.

(c) Interim Storage: State where the waste is to be stored e.g. (i) in an exclusive area or room, delay tank, deep freezer etc. or (ii) storage pit.

(d) Disposal: Identify the disposal methods for solid, liquid and gaseous wastes briefly such as for:

- Solids:** Burial pits, municipal dumping site or waste management agency e.g. BRIT etc.
- Liquids:** Sanitary sewerage system, soak-pit, waste management agency etc.
- Gaseous wastes:** Incineration facility, fume hood etc.

(e) Monitoring & Surveillance: Specify the make and type of available radiation survey meter(s), equipment(s) for contamination monitoring, and counter(s) for estimation of total activity contents of the wastes and the activity concentration. Indicate also the type of personnel monitoring badges being used by radiation workers (TLD/Film badge).

Notes:

- i. The activity should be corrected for decay during interim storage/delay of the waste, or applying these limits.
- ii. The total activity, discharged locally by the institution in the environment, shall not exceed 37 GBq in any one year.
- iii. The activity in the effluents should be in soluble and dispersible form.
- iv. Disposal of radioactive wastes, in earthen pit(s) or a soak pit, should not lead to migration of activity into nearby water bodies. Therefore, land topography and underground geological/hydrological characteristics should be considered when establishing these facilities.
- v. The size of each earthen pit may be 120 cm x 120 cm. Depth of each pit should be decided keeping in view the anticipated volume of waste to be buried; a top layer of 120 cm thick compact earth should be ensured when the pit head is finally closed.
- vi. The number of pits needed will be governed by the waste volume/activity to be disposed. However, not more than 12 pits should be excavated in a year; minimizing the number by conditioning of waste: reduction of volume or delay and decay etc. Successive burial pits should be separated by a distance of at least 180 cm.
- vii. The burial ground should be located in an isolated area belonging to the institution and duly fenced off to prevent unauthorised access to the pits.
- viii. The contents of a pit may be removed for disposal as normal waste, after its activity has decayed (or dispersed e.g. in case of H-3 and C-14) to below detection limits, and the same pit reused.
- ix. Environmental monitoring, for presence of any contamination in nearby soil, water etc. should be conducted up to a radial distance of 200 m around the disposal site(s), if more than 20 GBq [540 mCi(milli Curie)]of activity is discharged in the environment in the past one year by the institution.
- x. The disposal limits for radionuclides, not listed in the above table, shall be as specified by the competent authority on a case by case basis.

Room for Thought

A FACTSHEET ON

MEDICAL WASTE TREATMENT TECHNOLOGIES

Anu G Agrawal

The main objective of this fact sheet is to begin analyzing the status of medical waste treatment technology in India. There still seem to be apprehensions about which technology would work better and whether centralized facilities will provide complete solutions. This fact sheet also contains a compilation of two surveys done on the status of alternatives in India and the cost of on site incinerators based on new information.

The last few years have seen a number of studies showing the negative impacts of incinerators on the environment and living organisms. The effects range from endocrine disruption to cancers, from immune suppression to birth defects and a huge array of other abnormalities and health effects. Is it important to alter the native form of waste to destroy the pathogens or are alternative technologies, which do not destroy the material on which the pathogen resides, good enough? Alternates to incinerators do exist and more are under development.

Centralized facilities are yet another concept. Due to space, monetary and manpower constraints it becomes difficult for individual setups to have their own treatment plants and thus centralized facilities help a great deal. Besides, they are easier to maintain, though safe transport remains a key issue.

INCINERATION: ALTER THE NATIVE FORM OF WASTE

Incinerators are being shut down internationally. In the Indian context the problems with incinerators are even worse, since there is no adequate capacity to cope with pollutants released from incineration let alone to minimize them. According to the Bio-Medical Waste Rules, incinerator ash needs to be disposed in a secured landfill. But the

irony is that while there are just four centralized secured landfills, around hundreds of incinerators exist. **A city such as Delhi for instance, which has around 60 incinerators does not possess even one secured landfill.**

Where do we then expect this ash to go? How can one allow incinerators in a city with no disposal option and is it not a blatant violation of the law of the land?

The other major problem with incinerators is the production of toxic gases like dioxins and furans. The laboratory and regulatory infrastructures required to monitor dioxin levels in incinerator releases — stack gases, fly ash, bottom ash or slag, and other residues (e.g., effluent and sludge from wet scrubbers, quenching water, etc.) — and to ensure compliance with requisite legal standards are both costly and complex. For example, **fewer than 50 laboratories in the world have been certified by WHO for the analysis of dioxins in human tissue, and the cost of such an analysis ranges from US\$1,000 to US\$3,000 per sample.**²³ The costs for analyzing other media, such as gases and ashes, are comparable. The cost of establishing a laboratory for dioxin analysis is estimated at US\$1.5-2 million.²⁴ **Even in the wealthiest countries, such costs are barriers to adequate monitoring of incinerator releases,** as illustrated by the admitted paucity and uncertainty of relevant data presented in the European Union's dioxin inventories.^{25,26} (A compilation by Pat Costner, Greenpeace)

Air pollution Control equipment, which are cited in meetings and forums, as methods of pollution abatement, look remote on the ground. All the hospitals surveyed did not have any scrubbers. But the interesting part was, that **none of the hospitals even knew about scrubbers.**

In a recent survey carried out by Srishti in six

Table 13.1

Incinerators: Feeding the Monster – Some facts on the operating cost of incinerators

Hospital	No. of beds	Capital cost	Annual Expenses on running incinerator *	Charges if subscribe to centralized facility#
A	600	NA	Rs. 15,01,644	Rs. 6,57,000
B	230	Rs. 21,00,000	Rs. 7,16,000	Rs. 2,53,000
C	150	Rs. 6,00,000	Rs. 8,52,000	Rs. 1,65,000
D	300	NA	Rs. 6,92,000	Rs. 3,28,500
E	1500	NA	Rs. 15,00,000	Rs. 16,42,500
F	500	Rs. 25,00,000	Rs. 17,66,000	Rs. 5,47,500

* THIS COST INCLUDES- ELECTRICITY, DIESEL, ANNUAL MAINTENANCE COST AND EMPLOYEE COST. This cost would help hospital to deal with only 10-15% of its waste, same amount of waste (infectious plastic) still needs treatment

THIS COST HAS BEEN CALCULATED ASSUMING THAT PER DAY PER BED TREATMENT CHARGES ARE Rs. 3

Note – An adequate Heat resistant paint on the incinerators can cost 4-5 lacs, though a government construction company did it for 37,000 for one of the hospitals.

Hospitals are spending a huge sum of money on up gradation. Hospital A , for example, has spend Rs 7 lacs and hospital E is planning to spend 20 lacs .

Hospital D's incinerator chimney alone cost them 3 lacs.

Hospital C has spent about Rs1 lac for having various parameters for running incinerator, tested

***All the data has been obtained from hospitals and the names of the hospitals have not been revealed on request of anonymity for the.

Delhi hospitals, it was evident that **the hospitals are spending enormous amount of money to run these machines and in most cases they have not started spending on pollution control equipment or ash and stack analysis.** Once these costs are added up running an incinerator would become highly unaffordable. The question is – Does a country need to invest in a technology like this?

Can our people or country afford this expensive technology, expensive not just in terms of money but also in its environmental impacts? (see Table 13.1)

In 1997 USEPA, released its rules on incineration

emissions, which required installation of pollution control equipment, regular stack tests and monitoring of various parameters, trained staff, workers safety. The increased cost and regulatory requirements and public pressure forced people to drift from incineration and move towards alternative technologies. In India also a few installations have taken place. This is a small attempt to compile the list of installations in India, however it may be incomplete due to paucity of information.

Status of Alternatives in India- List of installations*(see Tables 13.2,3,4,5)

Table 13.2

List of Installations – Microwaves

Name of the Hospital	Manufacturer	On/off-site	Capacity
Command Hospital, B'lore	Meteka	On	6 ltrs / cycle
LHMC, Delhi	Meteka	On	6 ltrs / cycle
Government Medical College, Trivandrum	Meteka	On	NA
NHL Municipal Medical College, Ahmedabad	Meteka	On	NA
Civil Hospital, Kharar	Meteka	On	NA
Dr. RML Hospital	Meteka	On	60 ltrs /cycle
Bangalore Centralized facility	Sintion	Off	60-80kg/hr
Hyderabad Centralised facility	Medi aid	Off	NA

Table 13.3

List of Installations – Autoclaves

Name of the Hospital	Manufacturer	On/off-site	Capacity
Lok Nayak Jai Prakash Hospital	Tuttaneur, Omron Pvt.Ltd. India.	On	1700 ltrs / cycle
Lal Bahadur Shastri Hospital	Tuttaneur, Omron Pvt.Ltd.	On	850 ltrs / cycle
Sushruta Trauma Centre	Tuttaneur, Omron Pvt.Ltd.	On	850 ltrs / cycle
Guru Tegh Bahadur Hospital	Tuttaneur, Omron Pvt.Ltd.	On	1700 ltrs / cycle
Rao Tula Ram Hospital	Tuttaneur, Omron Pvt.Ltd.	On	850 ltrs / cycle
Deen Dayal Upadhaya Hospital	Tuttaneur, Omron Pvt.Ltd.	On	1700 ltrs / cycle
GB Pant Hospital	Tuttaneur, Omron Pvt.Ltd.	On	1700 ltrs / cycle
Babu Jagjiwan Ram Hospital	Tuttaneur, Omron Pvt.Ltd.	On	850 ltrs / cycle
Sanjay Gandhi Memorial Hospital	Tuttaneur, Omron Pvt.Ltd.	On	1000 ltrs / cycle
Apollo Hospital	Tuttaneur, Omron Pvt.Ltd.	On	850 ltrs / cycle
Escorts (2)	Tuttaneur, Omron Pvt.Ltd.	On	250, 1000 ltrs / cycle
AIIMS	Tuttaneur, Omron Pvt.Ltd.	On	NA
Lala Ram Swaroop	TB Hospital Maridi Ecotherms Pvt. Ltd.	On	250 ltrs/ cycle
Jaipur Centralized facility	NA	Off	NA
Hyderabad Centralised facility	NA	Off	NA
Madras Medical Mission	Self Engineered	On	100 ltrs / cycle
Apollo Hospital	Self Engineered	On	150 ltrs / cycle
Sundaram Medical Foundation	Self Engineered	On	25 ltrs / cycle
Bhilai Steel Plant	Self Engineered	On	NA

Table 13.4

List of Installations – Hydroclave

Name of the Hospital	Manufacturer	On/off-site	Capacity
Tata memorial hospital	Hydroclave Systems Corp.	On	95 Kg / hr
Command Hospital, Bangalore	Jain Hydroclave	On	—

Table 13.5

List of Installations – Vapoclave

Name of the Hospital	Manufacturer	On/off-site	Capacity
SAIL, Rourkela	Hydroclave	On	110 Kg / hr

*This is not an attempt to promote any particular technology. This is a compilation of total number of installations about which we have information
All the information is as given by the manufactures and hospitals.

Standardization of these technologies is an important issue now. There are a lot of companies who are selling their equipment in the market and the hospitals do not have any clues about their efficiency. It thus becomes important that the implementing bodies take up this matter.

Centralised Facility

The draft rules in 1995 did not have any provision of centralized facilities but at the behest of NGOs this clause was added and the final rules give an option to the health care facilities to subscribe to these.

Table 13.6

Centralised facility

	Technology available	Capacity	Clientage	Amount of waste	Cost of treatment
Delhi	Incinerator, autoclave	175kg/hr, 1700ltrs/ cycle	1500 units	~1300 kgs/day	Rs. 3/ bed/day
Delhi	Incinerator, chemical disinfection		100 units	NA	NA
Hyderabad ^(a)	Incinerator+ microwave. Autoclave-standby	60ltrs/cycle	413 units, 13,500 beds	~1300 kgs/day	Rs.2/bed/ day
	Incinerator, autoclave	NA			NA

Some cities like Hyderabad, Bangalore, Delhi, Chandigarh, Gulbarga, Jaipur, have centralized facilities. Mumbai and Chennai are

planning to set up. The concept of such facilities is in very nascent stages and needs support from all stakeholders.

(a) Jyotsna Chauhan Associates, Hyderabad

Occupational safety: Where Ignorance is not bliss

A FACTSHEET ON

THE SAFETY OF HEALTHCARE WORKERS IN INDIA

Anu G Agrawal

Thirty die in a mineblast, 4 factory workers die in a gas leak and so on....., all these figures are indicative of the gross under reporting of the actual figures; and are so obviously wrong. Occupational safety has been totally ignored and disregarded in the country.

About 75 percent of the global workforce lives and works in the Third World countries. The International Labour Organization (ILO) estimates that more than 125 million workers are victims of occupational accidents and diseases in a single year. Of these approximately 220,000 workers die and about 10 million are seriously disabled.²⁷ Surprisingly in India there is a record of just 192 cases of occupational accidents. Under the Workmen's Compensation Act 1923 all serious accidents need to be reported to the commissioner within 7 days of the accident. Failure to maintain a notice book, submit a statement of fatal accidents or accident reports is considered an offence. **Considering these figures, almost all the industries would be booked under this clause if the law were enforced strictly.**

All these provisions of compensation, accidents reporting apply to people covered under the Factory Act. Incidentally, people expected to treat patients including treatment for occupational diseases have not been considered for standards for safety.

Hospitals that are considered a very safe place are not really safe, owing to the hazardous and toxic material used there. Some of the things commonly found in hospitals, including chemicals like formaldehyde, glutaraldehyde etc., radioactivity, cytotoxic drugs, mercury used in various equipment, latex gloves, infectious waste contaminated with patients body fluids etc. can cause serious health effects to the healthcare workers constantly in contact with these.

In USA, Universal Precautions and Occupa-

tional Safety and Health Act (OSHA), Needlestick Bill, Blood Borne Pathogen Standard etc. have been used as a tool to give protection to the healthcare workers. In India however, there is no such concern. Whether it is making standards for ambient glutaraldehyde in air, which is extensively used in operation theatres, safety training for use of cytotoxic drugs and sharps, awareness on issues of allergies due to fumes, vapors, latex etc., authorities seem unconcerned.

Considering seroconversion rates of 30%, 0.3% and 3% for HBV, HIV and HCV respectively, the situation calls for a serious move to have some standards for the healthcare worker to minimize exposure and ensure follow up of all needlestick injuries or any other form of exposure to body fluids.

Glutaraldehyde irritates skin, eyes, throat and lungs, causes sensitization of skin and respiratory tract. It can cause allergic reaction, like asthma, skin sensitization and contact Dermatitis. National Institute of Occupational Safety and Health, US (NIOSH) has set the ceiling value limit for Glutaraldehyde at 0.2ppm as the ceiling value and this limit should not be exceeded. In India there are no such standards for glutaraldehyde usage. There is hardly any awareness about the health effects and usage instructions and this attributes to the use of this potent carcinogen in a very casual way in most of the places. All Glutaraldehyde usage points in Delhi hospitals surveyed had very high ambient levels (not measured), evident by the occurrence of effects of exposure to the surveyors.

INDIA

National Policy

Safety and health occupies a very significant position in India's constitution, the national policy aims to protect the health and strength of all

workers. It prevents employment in occupations unsuitable for the age and strength of the workers. It is the policy of the state to make provisions for securing just and humane conditions of work. **The constitution provides a broad framework under which policies and programmes for occupational health and safety could be established.**

National Legislation

India has had legislation on occupational health and safety for over 50 years. The principal health and safety law, The Factories Act, 1948 is based on the British Factories Act and is amended from time to time. The amendment made after the Bhopal gas tragedy demanded a **shift from dealing with disaster (or disease) to prevent its occurrence.** The Factories (Amendment) Act came into force on 1 December 1987. But this Act does not cover hospitals.

There was a move to form the Occupational^(a) Safety and Health Act- India, in 1989 to address the occupational safety concerns of healthcare workers. The labour ministry thought of extending the shield of occupational safety to white-collar jobs and worked towards OSHA- India, keeping the COSSH regulations as base. Since 1989 COSSH has been amended a few times, whereas OSHA- India didn't even see the light of the day.

In July 2001, Union Health Ministry organised a meeting with state secretaries on medical waste management to discuss the status of medical waste management in the country. Realizing the dangers to the Class IV workers in the hospital due to handling medical waste, the labour ministry was urged to make some safety laws for these workers, but again leaving the doctors and nurses out of the purview of the rules.

It is evident that occupational safety shield is been provided to people who are too ignorant to use it; there is a conscious attempt to keep away people who are aware of their rights.

Bio- Medical Waste (Management & Handling) Rules 1998 have a provision of "Accident Reporting" concerned with waste management and handling. But the clause is very ambiguous- nowhere does it mention about what is considered as an accident. A needle stick injury, a mercury spill, glutaraldehyde exposure and!!!!, **till now these are not even considered significant enough to be reported to the Institution head leave aside reporting to a central authority.**

Other laws have also been framed for workers' welfare with due exclusion of healthcare personnel-

OSH Legislation

- The Factories Act 1948, amended 1954, 1970, 1976, 1987
- The Mines Act, 1952
- The Dock workers (safety, health and welfare) Act, 1986
- The Plantation Labour Act, 1951
- The Explosives Act, 1884
- The Petroleum Act, 1934
- The Insecticide Act, 1968
- The Indian Boilers Act, 1923
- The Indian Electricity Act, 1910
- The Dangerous Machines (Regulations) Act, 1983
- The Indian Atomic Energy Act, 1962
- The Radiological Protection Rules, 1971
- The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989

Workmen's Compensation

There are two main laws for compensating occupational diseases and accidents in India:

- Workman's Compensation Act
- Employees State Insurance (ESI)

Occupational safety and Health Institutions

There are two main institutions devoted to occupational health and safety

- Central Labour Institute, Mumbai [Bombay] and Regional Labour Institutes in Calcutta, Kanpur and Chennai under Ministry of Labour;
- National Institute of Occupational Health, Ahmedabad and regional institutes in Calcutta and Bangalore under the Indian Council of Medical Research (ICMR) ministry of health.

The National Institute of Occupational Health (NIOH) is quite active as a research institute but has no system for consultation with employers or trade unions.

The infrastructure exists, the only need is to get all the healthcare personnel associations together (including doctors, nurses and class IV workers) to work with the Health and the Labour Ministry to get a few safety standards in place so that there is enough training of staff and the healthcare facilities of the dangers surrounding them and adequate precautions can be taken to avoid dangers and appropriate measures can be taken in case of accidents, **BECAUSE IGNORANCE IS NOT BLISS.**

(a) Personal Communication with Dr. TK Joshi, Department of Occupational & Environment Health, Lok Nayak Hospital

Safety First: Explore the cytotoxic drugs

A FACTSHEET ON

CYTOTOXIC DRUGS

Megha Kela Rathi

Cytotoxic drugs also known as anti-neoplastic drugs or cancer chemo-therapy drugs refer to a category of drugs which have the ability to kill or arrest the growth of living cells. They play an important part in the treatment of cancer but are also known to have toxic effects on healthy cells, which may pose a health risk to those employees who are involved in their preparation, storage, administration, and disposal.

ROUTE AND POTENTIAL EFFECTS OF EXPOSURE TO CYTOTOXIC DRUGS^{30,31}

Exposure to cytotoxic drugs is mainly through inhalation of droplets or dust. These agents can also be absorbed through the skin or by swallowing food, beverages, or smoking cigarettes which are contaminated with cytotoxic drugs.

Risks of exposure are during the preparation and administration of the drugs, handling of body fluids from patients being treated with cytotoxic drugs (risk from exposure to urine, vomit, and excreta from patients) spillages or accidents while handling and disposal of cytotoxic wastes, related trace contaminated material and transportation of cytotoxic drugs.

Short term exposure to cytotoxic drugs can occur in the form of skin injury which has a direct irritant effect on the mucous membranes, eyes and skin. Spills on skin surfaces with cuts or abrasions and injury due to a contaminated needle or broken glass can lead to severe soft tissue injury and should be treated immediately and observed for potential problems. Symptoms such as dizziness, light-headedness, and nausea have also been

reported, possibly as a result of working in poorly ventilated areas. Major cause for concern among health care workers is the long term exposure which has carcinogenic, mutagenic and/or teratogenic potential.

It is recommended that employees who are pregnant, breast feeding, or planning pregnancy and who are involved in the preparation and/or administration of cytotoxic drugs, should be made aware of the potential risks to the embryo or foetus from absorbed drug, and where possible, be offered alternative duties.

There is currently no form of biological monitoring or health assessment technique, which is sensitive or specific enough to adequately predict the effects of chronic long-term exposure to cytotoxic drugs. Therefore, the primary focus of safety during use of cytotoxic drugs must be on the control of the working environment and safe work practices.

HANDLING CYTOTOXIC DRUGS³⁰

Drug Preparation Procedures and Techniques

- Hands must be washed before gloving and after the gloves are removed.
- Procedures performed in a biological safety cabinet should be done on the solid work surface.
- The solid work surface may be covered with plastic-backed, low particulate generating absorbent liner.
- Preparation of non-cytotoxic sterile parenteral products should not take place in the biological safety cabinet at the same time that cytotoxic

drugs are being prepared.

- Only materials necessary for preparation of the cytotoxic drugs are to be in the biological safety cabinet.
- Syringes must be large enough so that they are not more than 3/4 full when containing the total dose.
- A sterile pledget must be wrapped around the neck of the ampoule before opening to avoid spray.
- A closed collection vessel (vial) should be available in the biological safety cabinet or the original vial can be used to hold discarded excess drug solutions.
- External surface of syringes and IV bottles should be wiped clean of any obvious drug contamination.
- After completing all drug preparation operations, the interior of the biological safety cabinet should be wiped with 70% isopropyl alcohol.

Noninjectable Dosage Form

- Disposable latex gloves should be worn when prepacking or counting tablets and capsules.
- Designated counting trays and spatulas may be used. The counting tray and spatula will be cleaned with 70% Ethyl Alcohol and rinsed with water-saturated gauze after each use.
- Tablets and capsules will not be placed in automatic counting machines.
- Nonsterile compounding will be performed in the biological safety cabinet for ointments and in the fume hood for other products.
- Gloves and gown will be worn when compounding in the biological safety cabinet. Gloves, gown, mask, and goggles will be worn when compounding in the fume hood.

Cytotoxic Drug Administration

- Disposable latex gloves must be worn when administering cytotoxic drugs.
- Long-sleeved clothing, such as a buttoned or closed-front lab coat or gown, should be worn to cover the arms of individuals administering cytotoxic drugs.
- Note: All shelves and/or bins where cytotoxic drugs are stored should be leakproof and labeled with the ***cytotoxic drug warning label*** (Caution: Cytotoxic Drug-Dispose of Properly).

PACKAGING AND TRANSPORT OF CYTOTOXIC DRUGS WITHIN THE FACILITY^{29,30}

Procedures for the packaging and safe transport of cytotoxic drug preparations within the facility should be developed and maintained.

- Sealed, rigid impervious containers with appropriate leak-proof packaging and labeling should be used to transport liquid cytotoxic drug preparations to wards, clinics, between health units and services and to hospices, nursing homes and domestic premises in the community.
- This packaging must also offer protection from light if required. There should be sufficient adsorbent packaging to absorb the contents, and the outer packaging should ensure that breakage will not result in spillage.

Personal Protective Clothing and Equipment

- Protective clothing should be provided for all personnel involved in the preparation reconstitution, handling and disposal of cytotoxic drugs. It should be considered mandatory during circumstances where technique may not be sufficient to prevent exposure, e.g. when dealing with a spillage.
- The protective clothing for personnel preparing sterile solutions of cytotoxic drugs should include the following — a protective gown, shoe or boot covers, headwear, mask, and gloves. Goggles, respiratory protective equipment or a visor may be worn.

Cleanup of Spills

- Wear double gloves, protective disposable gown, mask, and goggles to clean up the spilled cytotoxic drug.
- **Small Spills** (5ml or 5g) outside a hood should be wiped with absorbent gauze and then cleaned (three times) with detergent and clean water. Any glass fragments should be placed in a cardboard or plastic container and then into a cytotoxic drug (CD) disposal bag, along with used absorbent pads. Glassware or other contaminated reusable items should be placed in a plastic bag and washed with detergent.
- **Larger Spills** should be covered with absorbent

sheets or spill-control pads. Damp cloths or towels should be used if powder is involved. Care must be taken not to generate aerosols and access to spill areas should be restricted.

Respirators should be used when there is any danger of airborne powder or aerosol being created.

Chemical inactivators should **NOT** be applied to the absorbed drug because this may produce hazardous by-products. (However, sodium thiosulfate can be safely used to inactivate nitrogen mustard.)

All contaminated surfaces should be thoroughly cleaned with detergent and then wiped with clean water. Contaminated materials should be disposed of in the CD disposal bag.

- **Spills in Hoods** may require decontamination of all interior hood surfaces after the above spill procedures have been followed. If the HEPA filter of a hood is contaminated, the unit must be labeled “DO NOT USE — CONTAMINATED,” and the filter must be changed and disposed of properly as soon as possible.
- **Spill Kits**, clearly labeled, should be kept in or near preparation or administrative areas. Kits should include: a respirator, chemical splash goggles, two pairs of gloves, two sheets (12x12) of absorbent material, a small scoop to collect glass fragments and a container of 70% alcohol for cleaning spill area. Finally, the kit should contain two large CD waste-disposal bags.

CYTOTOXIC WASTE DISPOSAL^{28,29}

Cytotoxic drugs are categorized as regulated wastes and therefore, should be disposed of according to Federal, state and local requirements. In India the Bio-Medical Waste (Management and Handling) Rules, 1998 describes them in its Schedule I as Category 5 waste which should be either incinerated or destructed before disposal into secure landfills.

Containment of Cytotoxic drugs

- Containers containing cytotoxic drugs should be labeled and dated before these items leave the preparation area, an additional label reading, “**Caution-chemotherapy, Dispose of**

Properly” is recommended.

- All bulk contaminated items should be returned to the Pharmacy for disposal.
- As an extra safety precaution, all cytotoxic drugs should be transported in the sealed “zipper” closure bag provided by the Pharmacy.
- Special waste containers should be maintained in units for the disposal of waste from patients receiving cytotoxic drugs.
- Empty containers of used cytotoxic drugs or administration apparatus, and specimen containers should be stored in puncture resistant containers and transported in a manner to reduce the possibility of accidental breakage, spilling, and needle sticks.
- The disposal of cytotoxic drugs and trace contaminated materials (e.g., gloves, gowns, needles, syringes, vials) presents a possible source of exposure to health care workers. Personal protective equipment must be worn when handling cytotoxic drug waste containers.

Patient Excreta

Excreta from patients receiving cytotoxic drug therapy may contain high concentrations of the drug. All personnel should be aware of this source of potential exposure and should take appropriate precautions to avoid accidental contact.

- The handling and disposal of excreta of patients receiving cytotoxic drugs will be the same as for handling infectious waste.
- Disposable latex gloves must be worn; gowns will be worn if circumstances warrant.
- The time period for precautionary excreta handling procedures for patients receiving cytotoxic drugs will begin with the first dose of chemotherapy and continue until 48 hours after the last dose of chemotherapy.

Items to be Placed in Special Cytotoxic Drug Waste Receptacle

- Partial vials or other containers (bags, syringes, bottles) containing unadministered cytotoxic drugs will be disposed of in a cytotoxic drug waste receptacle. Contaminated or expired noninjectable cytotoxic drug dosage forms (e.g., tablets, capsules) will also be disposed of in a cytotoxic drug waste receptacle.
- A record of the cytotoxic drug waste and the amount of wastage should be maintained.

- Cytotoxic drug waste disposal containers will be kept in the area until ready for pick-up; then checked for the appropriate patient care unit or clinic location labels, and the completed list of drug waste; and finally secured for pick-up. The cytotoxic drug waste disposal containers will then be picked up by housekeeping personnel and taken to the holding area on notification.
- should shower and change their clothes and shoes.
- In the case of an eye splash, the eye should be irrigated immediately with cold running water for fifteen minutes. It may be necessary to force water into the eye to ensure that it is thoroughly irrigated. Medical advice should be sought.
- All persons should be evacuated immediately if there is a significant spill of a carcinogenic or highly toxic chemical. The Institutional emergency preparedness procedures (or equivalent) should be put into practice immediately.
- In the case of spillage, properly equipped and trained persons only should be assigned to clean up. Suitable protective clothing should be worn and, if necessary, self-contained breathing equipment used.

Emergency Procedures

- Accidental skin contact with carcinogenic or highly toxic chemicals should be treated immediately by rinsing the affected parts in cold (not warm or hot) running water for at least five minutes, followed by thorough washing with warm soapy water. If necessary, the person

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POSTERS

Think before you throw



- Yellow Bin:** Infectious waste
- Black bin:** General waste
- White/Blue bin:** Cut plastics, Syringes and Rubber gloves after disinfection, Needles to be destroyed and syringes cut

HEALTH IS WEALTH

- ☞ MANAGE SHARPS
- ☞ ALWAYS WEAR GLOVES
- ☞ NEVER RECAP THE SYRINGE
- ☞ AFTER USE DESTROY NEEDLES AND CUT SYRINGES BY NEEDLE DESTROYER
- ☞ SEPARATE SYRINGE BARREL AND PLUNGER
- ☞ PUT THEM IN BLEACH SOLUTION
- ☞ DESTROYED NEEDLES TO BE PUT IN NEEDLE BOX

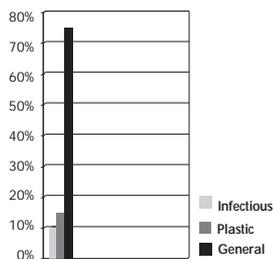
OUR HOSPITAL IS COMMITTED TO

- COMPLY WITH BIO- MEDICAL WASTE RULES
- SEGREGATE WASTE
- REDUCE USE OF HAZARDOUS CHEMICALS
- REDUCE OCCUPATIONAL HAZARDS
- USE OF GREENER TECHNOLOGIES

Handle Mercury With Care

- ◆ Never touch mercury with bare hands
- ◆ Wear all protective gears
- ◆ Gather mercury using stiff paper and suck it in the syringe without the needle
- ◆ Pour contents of the syringe in a bottle containing water
- ◆ Put scotch tape around the bottle
- ◆ Keep the syringe for further use

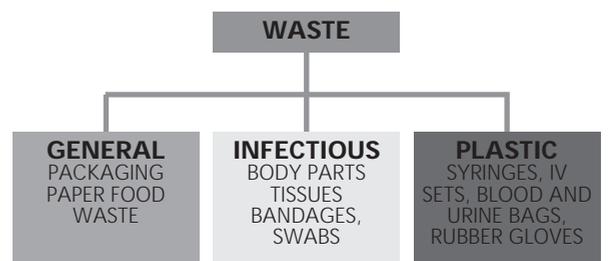
MIX WASTE: END UP IN JAIL



Segregate waste, it helps–

- In infection control
- Saves money
- Avoids illegal misuse
- Decreases occupational hazards
- Fulfills requirement of law

SEGREGATE WASTE



While Handling Waste Remember to –

- **Wear all protective gear**
- **Change bags when 3/4th full**
- **Tie them**
- **Always use a big bin to collect bags**
- **If bags leak contact stores**

BE A LAW ABIDING CITIZEN: SEGREGATE WASTE

- Yellow bin:** Body parts and tissues, cotton and bandage
- Blue bin:** Disinfected & mutilated plastic and rubber
- Black bin:** Food, office and packaging waste
- White bin:** (Sharps) - needles, blades, scalpels