



# Health Care Waste Management

State Institute of Health & Family Welfare,  
Jaipur



- Problem
- Legislation
- Issues
- Process
- Technology
- Planning



# Source & Waste Type



| Source | Recyclable<br>BLACK   | Reusable<br>BLACK/<br>RED   | Infectious |   | Non-infectious   | Gen. waste   |
|--------|---|---|------------|---|--|--|
|        |   |   | Sharps     | Non-sharps  |  |  |
| OPD    | Paper/<br>Packaging/  |   |            |   |  | Cigarette<br>/ Bidi /<br>Gutaka/<br>Paper                                    |
| IPD    | Paper,<br>packing,<br>Empty<br>vials,<br>Metal cans<br>&<br>container,<br>Fluid<br>bottles,<br>Disposable<br>syringes | Glass-<br>bottles,<br>syringes,<br>Empty<br>vials,<br>soiled<br>linen &<br>mattresse<br>s | Needles    | D.<br>syringes,<br>Soiled<br>linen,<br>Gloves,<br>Catheters,<br>Cannulas,<br>IV-SV sets | Uro bags<br>without<br>blood,<br>Blood<br>bags,<br>Tape,<br>Hot water<br>bottles &<br>ice caps,<br>Drugs | Left over<br>Food,<br>Peeling<br>Paper<br>Glasses<br>Flowers<br>Milk<br>bags |

Continue...

# What is Medical Waste

- **Any waste generated during**
  - diagnosis, treatment , immunization of human beings or animals, or
  - research activities pertaining, thereto, or
  - in production & testing of biologicals, including categories mentioned in schedule-I of the rules

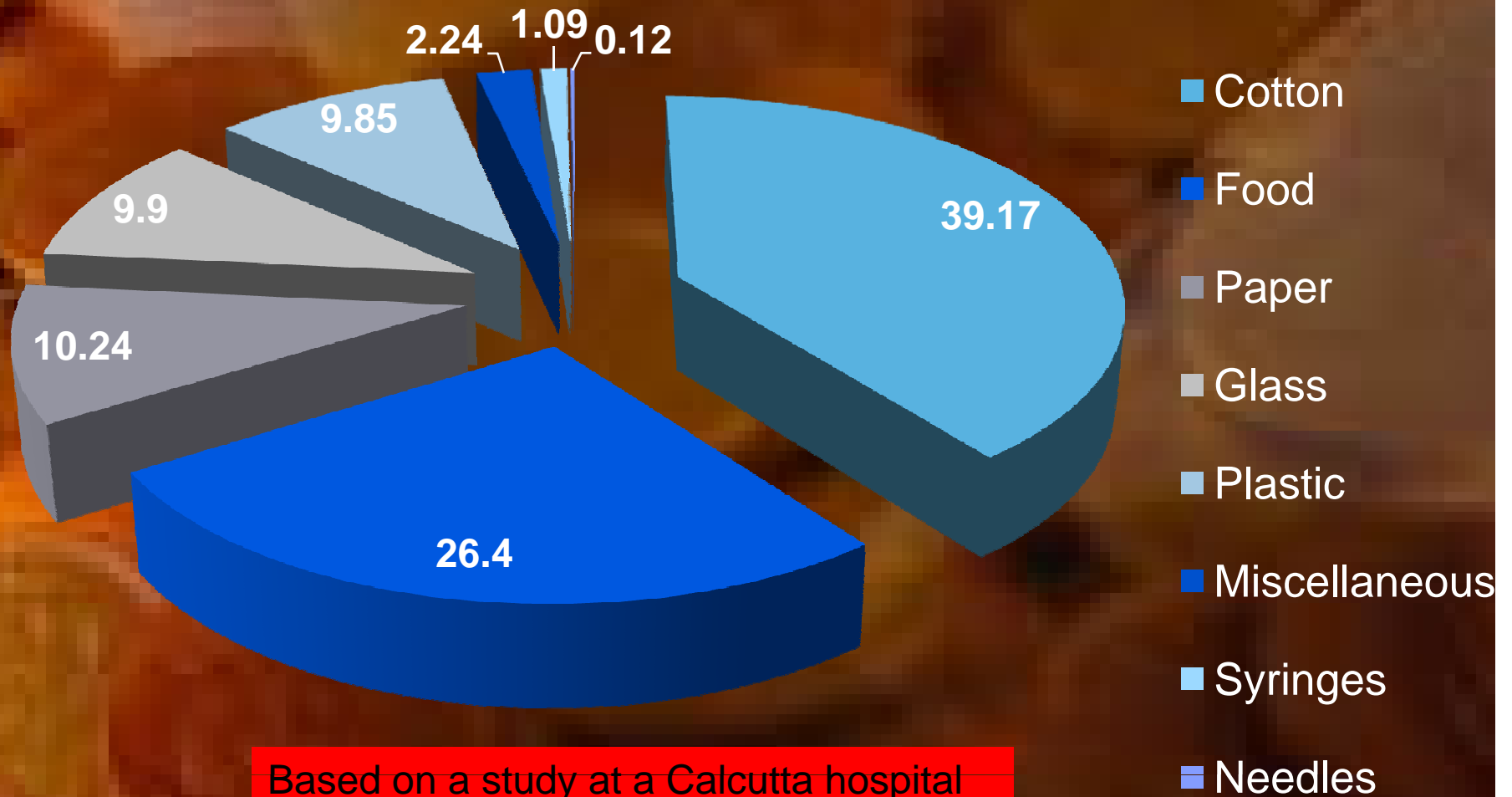
**(Bio-Medical waste (handling & mgt.) rules, 1998), under Environment Protection Act of 1986).**

# Types of Health Care Waste



- Human anatomical waste: human tissues, organs, body parts
- Microbiology & Biotechnology Waste
- Waste sharps: needles, syringes, scalpels, glass
- Discarded Medicines and Cytotoxic drug
- Soiled Waste: contaminated with blood, and body fluids as cotton dressings, soiled plaster casts, beddings
- Solid Waste: tubing, catheters, intravenous sets
- Liquid Waste: generated from labs, washing, cleaning
- Incineration Ash: from any bio-medical waste
- Chemical Waste

# Type of Waste Generated



# Potential Risk

- Infection, Infestations, intoxication
- Needle stick injuries
- Contamination
- Pollution, emissions



# Persons at Risk

- Health care workers
- Patients and their visitors/attendants at the
- support services staff
- Workers in waste disposal facilities



# Problem

- No authentic data, only sporadic studies to extrapolate
  - 1-1.5 Kg/Bed/Day (Mumbai, Kolkatta)
- Public opinion-averse to dumping
- Inadvertent increase in proportion of risk- Mixing of waste
- Risk perception- Yes, Action ?
- No std. definition-
- Medical /Hazardous/ Bio-medical waste
- Professional apathy
- Cluttered concerns
- No one uniform technology applicable
- Standards for technology ?
- Cost of treatment/Technology

# Efforts

- 1995, India's Ministry of Environment and Forests drafted rules for managing BMWs that proposed
  - each health care facility with more than 30 beds or serving more than 1,000 patients per month install an incinerator on its premises; and
  - smaller health care facilities set up a common incinerator facility.
  
- Biomedical Waste (Handling and Management) Rules of 1998. Later amended in 2003.

# The Legislation–

- Notification, under section 6, 8, & 25 of Environment Protection Act, 1986; issued On 16/10/1997
- 60 days to respond
- Effective from July 20, 1998



# The Legislation– BMW (Handling &Mgt.)rules,1998

(w .e .f–July 20, 1998, 2<sup>nd</sup> amendment 2003)

- 13 Rules
- 6 Schedules-
- 3 Forms



# Biomedical Waste Rules, 1998

- Similar to those in international practice
- Based on principle of segregation of communal waste from BMWs, followed by containment, treatment, and disposal of different categories of BMW.
- Classify BMWs into 10 categories and require specific containment, treatment, and disposal methods for each waste category.
- Treatment options include autoclaving, microwaving, incineration, and chemical treatment;
  - Hydroclaving approved by CPCB as an alternative treatment technology.
- BMW disposal options include deep burial and secure and municipal landfilling for solid wastes, and discharge into drains (after chemical treatment) for liquid wastes.

## Main Features

- State Pollution Control Boards (SPCBs) in states and Pollution Control Committees in territories responsible for permitting and enforcing the requirements of the Biomedical Waste Rules.
- Each occupier (operator) handling BMWs and providing services to 1,000 or more patients per month required to obtain a permit from the prescribed authority.

# Main Features

- Biomedical waste: Any waste that is generated during the diagnosis, treatment, or immunization of human beings or animals, or in research activities pertaining to or in the production or testing of biologicals.
- The rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle BMWs in any form.

- It is the duty of the occupier (operator) of a health care facility—that is, hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank—to ensure that BMWs are handled without any adverse effect to human health and the environment, and according to the prescribed treatment and disposal requirements in the Biomedical Waste Rules.





## Main Features

- Each occupier (operator) required to maintain records on the generation, collection, reception, storage, transportation, treatment, and disposal of BMWs. All records subject to inspection and verification by the prescribed authority at any time.
- Each occupier (operator) required to report any accident related to the management of BMWs.
- Each occupier required to submit an annual report to the prescribed authority to provide information about categories and amounts of wastes generated and treated, and modes of treatment.

## Main Features

- Local public entities required to provide common disposal/incineration sites, and occupiers (operators) of such sites required to comply with Biomedical Waste Rules.
- BMWs not to be mixed with other waste. According to the Rules, BMWs to be segregated into labeled bags/containers.

# Main Features

- Transportation of BMWs to be conducted in authorized vehicles. No untreated waste to be stored more than 48 hours, unless special permission is obtained from regulatory authorities.
- Technology and discharge standards for incineration, autoclaving, microwaving, liquid waste discharges, and deep burial prescribed in the Biomedical Waste Rules.

# Rules

Related to:

- Duty of occupier
- Segregation, packaging, transportation, storage of waste
- Treatment and disposal of waste
- Prescribed authority and authorization
- Advisory committee
- Annual report and maintenance of records
- Accident reporting
- Appeal

# Schedules

- Categories of bio-medical waste
- Color coding and type of container for disposal of bio-medical wastes
- Label for bio-medical waste containers/bags
- Label for transport of bio-medical waste containers/bags
- Standards for treatment and disposal of bio-medical wastes
- Schedule for waste treatment facilities like incinerator/ autoclave/ microwave system

# Forms

- **Form I - Application For Authorisation**
  - By waste generator and operator of CTF
  - To prescribed authority
  - Along with prescribed fee
- **Form II – Annual Report**
  - By Waste generator/operator
  - To prescribed authority
  - include information about the categories and quantities of bio-medical wastes handled during preceding year.
  - sent by 31 January every year
- **Form III - Accident Reporting**
  - By authorized person of facility where accident occurred
  - To prescribed authority

# Definitions

- **"Authorization"** means permission granted by the prescribed authority for the generation, collection, exception, storage, transportation, treatment, disposal and/or any other form of handling of bio-medical waste in accordance with these rules and any guidelines issued by the Central Government.



- **"Authorized person"** means an occupier or operator authorized by the prescribed authority to generate, collect, receive, store, transport, treat, dispose and/or handle bio-medical waste in accordance with these rules and any guidelines issued by the Central Government;





- **Bio-medical waste:** any waste, which is generated during the diagnosis, treatment or immunisation of human beings or animals or in research activities pertaining thereto or in the production or testing of biologicals, and including categories mentioned in Schedule ;

- **Biologicals:** any preparation made from organisms or micro-organisms or product of metabolism and biochemical reactions intended for use in the diagnosis, immunisation or the treatment of human beings or animals or in research activities pertaining thereto;



- "Bio-medical waste treatment, facility" means any facility wherein treatment, disposal of bio-medical waste or processes incidental to such treatment or disposal is carried out {and includes common treatment facilities}

- **"Operator of a bio-medical waste facility"** means a person who owns or controls or operates a facility for the collection, reception, storage, transport, treatment, disposal or any other form of handling of bio-medical waste;



# Duty of Occupier (Rule- 4)

- It shall be the duty of every occupier of an institution generating bio-medical waste which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank by whatever name called to take all steps to ensure that such waste is handled without any adverse effect to human health and the environment.



# Treatment and Disposal (Rule-5)

- Bio-medical waste shall be treated and disposed of in accordance with Schedule I, and in compliance with the standards prescribed in Schedule-V.



- Every occupier, where required, shall set up in accordance with the time-schedule in Schedule VI, requisite bio-medical waste treatment facilities like incinerator, autoclave, microwave system for the treatment of waste, or, ensure requisite treatment of waste at a common waste treatment facility or any other waste treatment facility.

# Categories of Waste–Schedule–I



| S No | Waste type  | Treatment   | Container color        | Container type                                |
|------|---|---|------------------------|---|
| 01   | Human anatomical waste  | Deep burial<br>Incineration /                               | <b>Yellow</b>          | HDPE Bags                                     |
| 03   | Microbiology & Bio-Technology waste   | Autoclave<br>Microwave<br>Incineration                      | <b>Yellow/<br/>Red</b> | Plastic bags/<br>Disinfected<br>containers    |
| 04   | Waste sharp   | Disinfection/<br>Autoclaving/<br>Micro waving/<br>Shredding | <b>Blue</b>            | Plastic bags/<br>Puncture proof<br>containers |
| 05   | Discarded medicines & cytotoxic drugs   | Incineration/<br>Secured<br>landfill                        | <b>Black</b>           | Plastic bags                                  |
| 06   | Solid waste-soiled/contaminated-Contaminated items with blood/ body fluids (cotton, dressings, soiled casts | I, M, A   | <b>RED</b>             | Plastic bags/<br>Disinfected<br>containers    |



# Categories .....



|    |                        |  |           |              |
|----|------------------------|--|-----------|--------------|
| 07 | Solid waste-disposable | D, A, M, Shredding                           | Red/ Blue | Plastic bags |
| 08 | Liquid waste           | Disinfection & Discharge in drains           | -         | -            |
| 09 | Incinerator ash        | Landfill                                     | Black     | Plastic bags |
| 10 | Chemical waste         | Discharge in drains/<br>Land fill for solids | Black     | Plastic bags |

category 2 deals in animal waste

# Color coding & Type of Container- Schedule -II



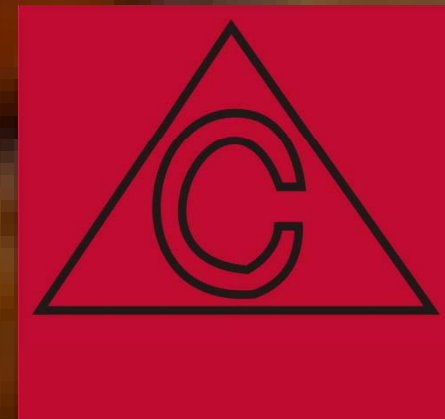
| Color                               | Container                                | Category   | Treatment                                 |
|-------------------------------------|--|------------|---|
| <b>Yellow</b>                       | Plastic bag                              | 1, 2, 3, 6 | Incineration /<br>Deep burial             |
| <b>Red</b>                          | Disinfected<br>Container/<br>Plastic bag | 3, 6, 7    | Autoclaving/<br>Micro waving              |
| <b>Blue / White<br/>translucent</b> | Plastic bag/<br>Puncture proof           | 4, 7       | Autoclaving/<br>Micro waving/<br>Chemical |
| <b>Black</b>                        | Plastic bag                              | 5, 9, 10   | Secured<br>Landfill                       |

# Labels for Bio-medical Waste Containers Schedule-III



■ Bio-hazard Symbol

■ Cytotoxic hazard Symbol





# Label for Transport of Bio-medical Waste Containers Schedule-IV

- Waste category... 5  
27/09/02
- Generated on....  
26/09/02
- Sender... Receiver...
- In case of emergency-contact.....

Label to be non-washable & prominent

# Standards for Treatment & Disposal Schedule- V

## ■ Incinerators

### A. Operating Standards-

- Combustion efficiency- min. 99%
- Temp. of pri. Chamber-800+/- 50 C
- Sec. chamber gas residence time-1 sec.  
at 1050+/-50 C with 3% Oxygen in stack gas

### B. Emission Standards-

Particulate matter--- 150 mg/Nm<sup>3</sup> at 12% CO<sub>2</sub>

Nitrogen oxides --- 450

HCl --- 50

Minimum Stack height --- 30 meters above  
ground

Volatile compounds in ash --- < 0.01%

# Standards for Liquid Wastes–

|                   |   |
|-------------------|---|
| ■ Ph              | 6.5-9.0   |
| ■ Suspended solid | 100 mg/l  |
| ■ Oil & grease    | 10mg/l  |
| ■ BOD             | 30mg/l  |
| ■ COD             | 250 mg/l  |
| ■ Bio-assay test  | 90% survival<br>of fish after<br>96 hrs in<br>100% effluent |

# Standards for Autoclaving

- **For gravity flow autoclave-**
  - 121 C, pressure 15 pounds/ psi- 60 mts.
  - 135 C , 31 pounds/psi -45 mts.
  - 149 C, 52 pounds/psi- 30 mts.
- **For vacuum autoclave-**
  - 121,15,45 mts.
  - 135,31,30 mts

## For Deep Burial

- Trench-2 meters deep, half filled, covered with lime, fill rest with soil
- No access of animals a layer of 10 cm. of soil each time
- No water source close to trench
- Location to be specified by authority



# Schedule for Waste Treatment Facilities Schedule-VI



|  |            |
|--|------------|
| A. Hospitals & NH in towns<br>with pop. 30 & > | 31/12/1999 |
| B. With Pop. < 30 lacs-                        |            |
| 500 beds                                       | 31/12/1999 |
| 200-500 beds                                   | 31/12/2000 |
| 50-200 beds                                    | 31/12/2001 |
| < 50 beds                                      | 31/12/2002 |
| C. All other not included in A & B             | 31/12/2002 |

# Waste Generator

- In compliance with Bio-medical waste (Management & Handling) Rules 1998, the health care facilities are required to obtain authorization / renewal of authorization certificate from state pollution control board.
- Obtaining authorization from RPCB is necessary for all health care facilities with registered patient (OPD & IPD) in excess of 1000 per calendar month.
- Responsible to segregate waste and put in the related colour bags/bins.
- Waste bags to be stored at specified place.



# Health Care Facility Waste Management Plan

- **Generation / Minimization:** Significant reduction of waste generated in healthcare facilities by adopting the principles of 3 R's, i.e., Reduction, Recycle and Reuse.
- **Waste Segregation:** at the point of generation e.g. all patient activity areas, diagnostic service areas, operation theatres, labor rooms, treatment rooms, etc. Responsibility of segregation lies with the generators of bio-medical waste, i.e., doctors, nurses, technicians, etc.



- **Collection:** Only non-chlorinated plastic collection bags. Waste collected daily and transported to the designated storage site / deep burial pits. Bags removed after 2/3 rd filled with bio medical waste.
- **Transportation:** Designated routes and time of transfer of wastes to avoid the passage of waste through crowded and patient care areas. Wheeled containers, trolleys/carts to transport the plastic bags to the site of storage / deep burial.



- **Storage:** A storage location for hospital waste collection is designated inside the establishment.
- **End Treatment and Disposal:** The CTFs are responsible for waste collection and transportation from the hospitals site, followed by treatment and destruction as necessary and finally disposal at the site of CTF. There is a provision of payment for CTF hiring charges to CTF operators through RHSDP at the rate of Rs. 1000/- per bed per year for project-supported facilities only. The payment for CTF hiring charges is being made through RMRS; which is reimbursed on actual basis.
- **Burial Pits / Storage:** in absence of CTF, infectious waste along with the anatomical waste and other hazardous waste is disposed off into deep burial pits.



# Common Bio-medical Waste Treatment Facility

- A set up where biomedical waste, generated from a number of healthcare units, is imparted necessary treatment to reduce adverse effects that this waste may pose.

- Owner of CTF seeks authorization from the prescribed authority (PCB) under the BMW Rules, before installing the equipment and treatment techniques.
- Form I along with fee.

# Need

- Installation of individual treatment facilities by small healthcare units requires comparatively high capital investment.
- Separate manpower and infrastructure development required for proper operation and maintenance of treatment systems.
- Risk of proliferation of treatment equipment in a city.
- Monitoring pressure on regulatory agencies.
- By running the treatment equipment at CBWTF to its full capacity, the cost of treatment of per kilogram gets significantly reduced.



# Coverage

- One CBWTF allowed to cater up to 10,000 beds at the approved rate by the Prescribed Authority.
- Not allowed to cater healthcare units situated beyond a radius of 150 km.
- Where 10,000 beds not available within a radius of 150 km, another CBWTF may be allowed to cater the healthcare units situated outside the said 150 km.

# Location

- Place reasonably far away from residential and sensitive area.
- Near to its area of operation as possible in order to minimize the travel distance in waste collection, thus enhancing its operational flexibility.
- Decided in consultation with the state pollution control board (spcb)/pollution control Committee (PCC).



# Essential Treatment Equipments

- Incineration
- Autoclaving/ Microwaving/ Hydroclaving
- Shredder
- Sharp pit/ Encapsulation
- Vehicle/Container Washing Facility
- Effluent Treatment Plant



# Infrastructure Set-up

- Treatment Equipment Room
- Main Waste Storage Room
- Treated Waste Storage room
- Administrative Room
- Generator Set
- Site Security
- Parking
- Sign Board
- Green Belt
- Washing Room



# Records

- Records of Waste Movements
- Logbook for the Equipment
- Site Records

# Guidelines to CBWTF

- Not accept the non-segregated waste. Report such incident to be reported to the Prescribed Authority.
- Coloured bags handed over by the healthcare units to be collected in similar coloured containers with cover.

# Guidelines to CBWTF

- Each bag shall be labeled as per the Schedule III & IV of the Bio-medical Waste (Management & Handling) Rules. Helps in tracking the health care units not segregating the wastes as per rules.
- The coloured containers should be strong enough to withstand any possible damage that may occur during loading, transportation or unloading of such containers. Containers to be labeled as per the Schedule III of the Rules.

# Guidelines to CBWTF

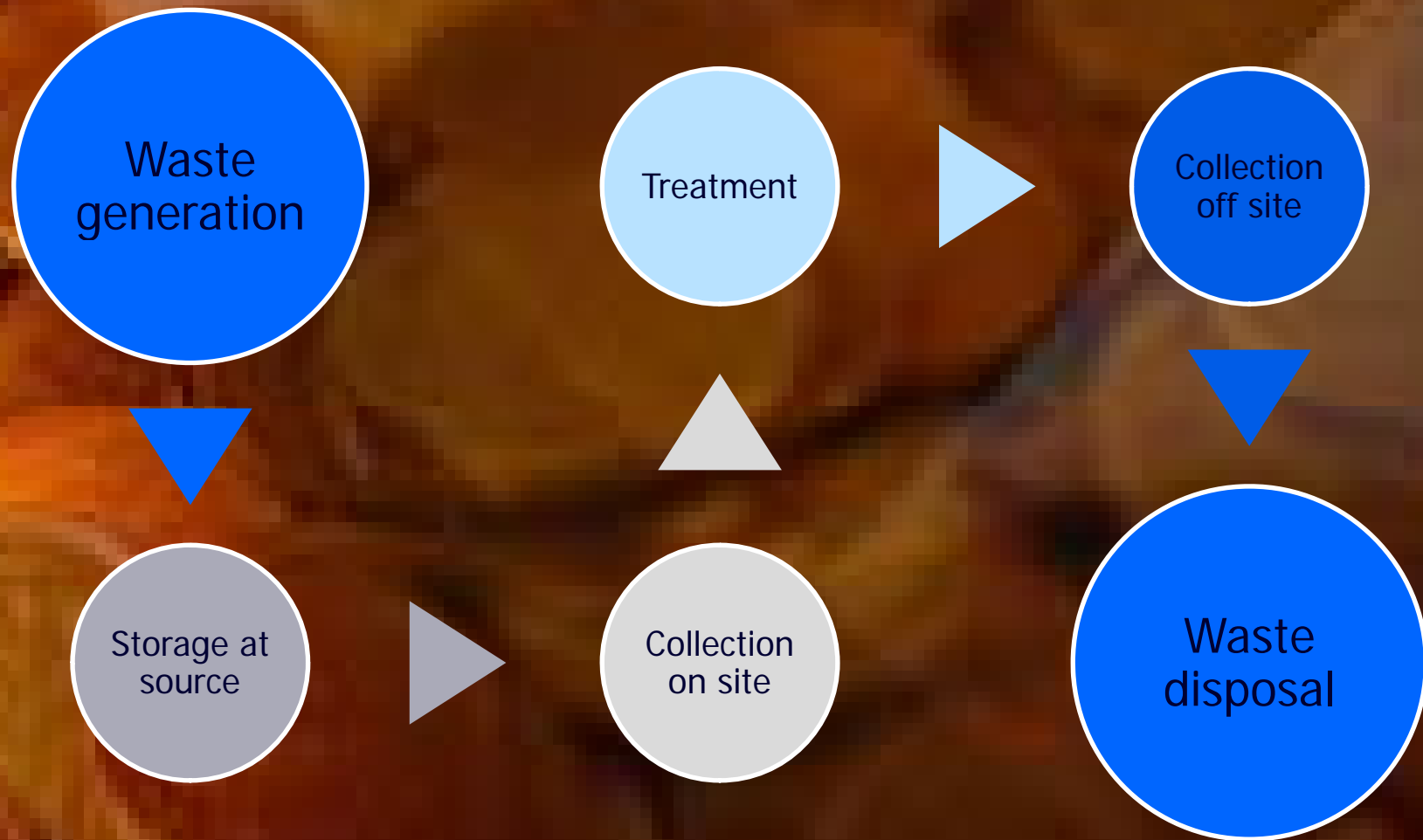
- Sharps shall be collected in puncture resistant container.
- The person responsible for collection of bio-medical wastes shall also carry a register with him to maintain the records such as name of the healthcare unit, the type and quantity of waste received, signature of the authorized person from the healthcare unit side, day and time of collection etc.
- Transported to the CBWTF in a fully covered vehicle with separate cabin for driver and staff.
- cost to be charged from the healthcare units shall be worked out in consultation with the State Pollution Control Board/Pollution Control Committee and the local Medical Association.



# Pollution Control Board

- Monitoring HCWM activities in health sector
- Issuing authorization/ renewal to the health facilities
- Getting annual reports from health facilities
- Legal action
- Issuing license to the CTF operator

# Process of Waste Handling



# Issues

- Appropriate environmental conditions for treatment & disposal
- Climate (rainfall, temp.)
- Social acceptance of treatment & disposal sites
- Perception of types & degree of human risks
- Access & quality of support system
- Cost
- Political will



# Pre-conditions for Waste Management

- Adequate time available to manage waste correctly
- Sufficient training
- Type of medical services provided or excluded
- Larger set-ups need special inputs

# Elements of Proper Management

- Waste stream analysis
- Waste management and contingency plans
- Waste segregation
- Waste minimization- 3 Rs
- Proper collection, transport and storage
- Worker training, awareness programs
- Alternative treatment technologies
- Occupational safety & Health

# Major Components–

- Waste Reduction
- Segregation at point of generation
- Storage
- Collection/Transport
- Treatment
- Disposal

# Waste Management-Approach

**R 3**

**Reduce**

**Reuse**

**Recycle**

**D 3**

**Disinfect**

**Distort**

**Dispose**



# What is Required is...to

- Have top management commitment to waste.
- Involve personnel for proper segregation.
- Conduct ongoing Training.
- Ensure safe transport and storage within hospital.
- Equip for segregation, occupational safety, sharps management, disinfections where needed.
- Ensure ongoing monitoring and improvement.



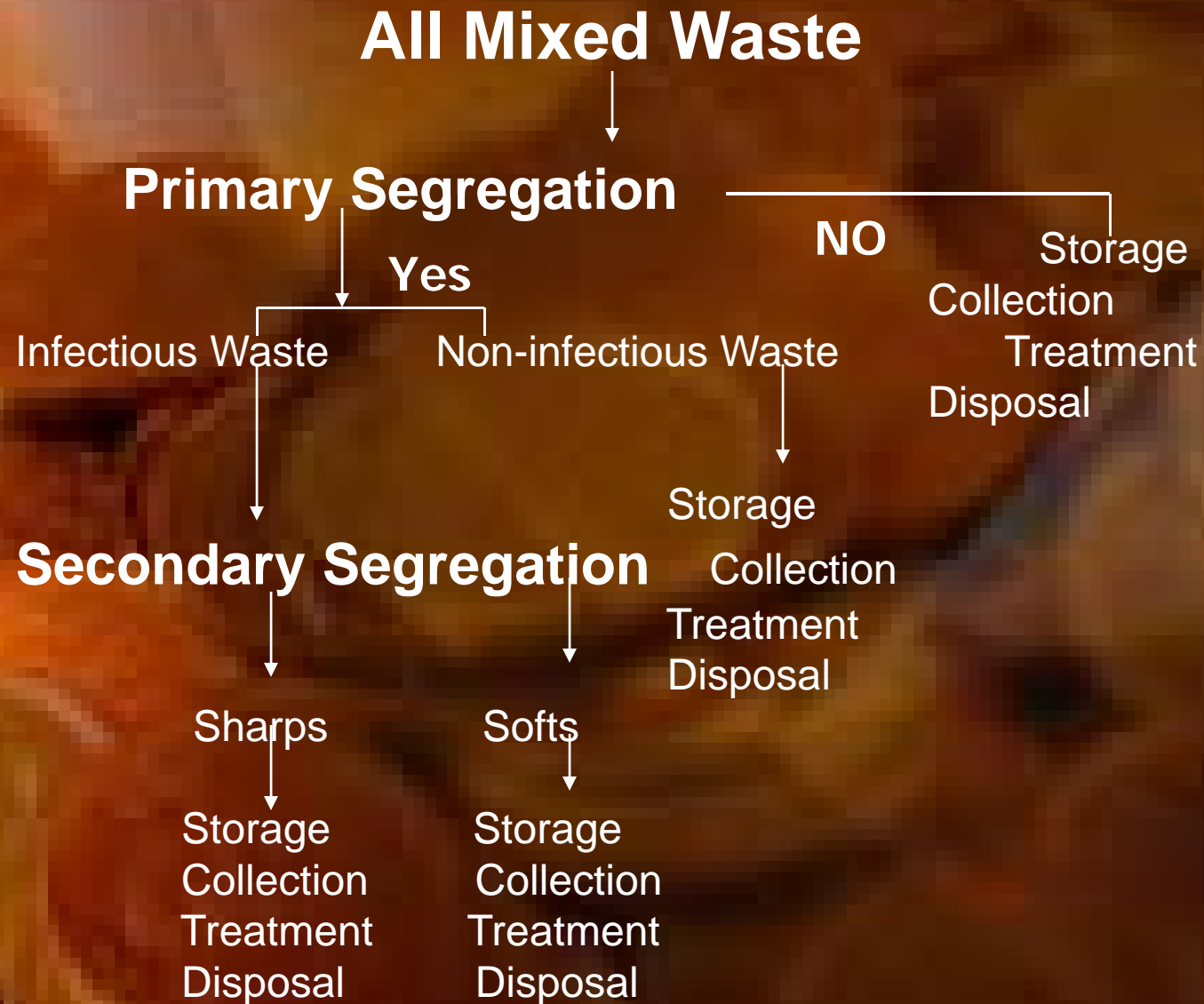
# Collection Alternatives

- Municipal waste collection system
- Collection system from Private /Public sector health care facility
- Storage/Transport from smaller units to point of disposal

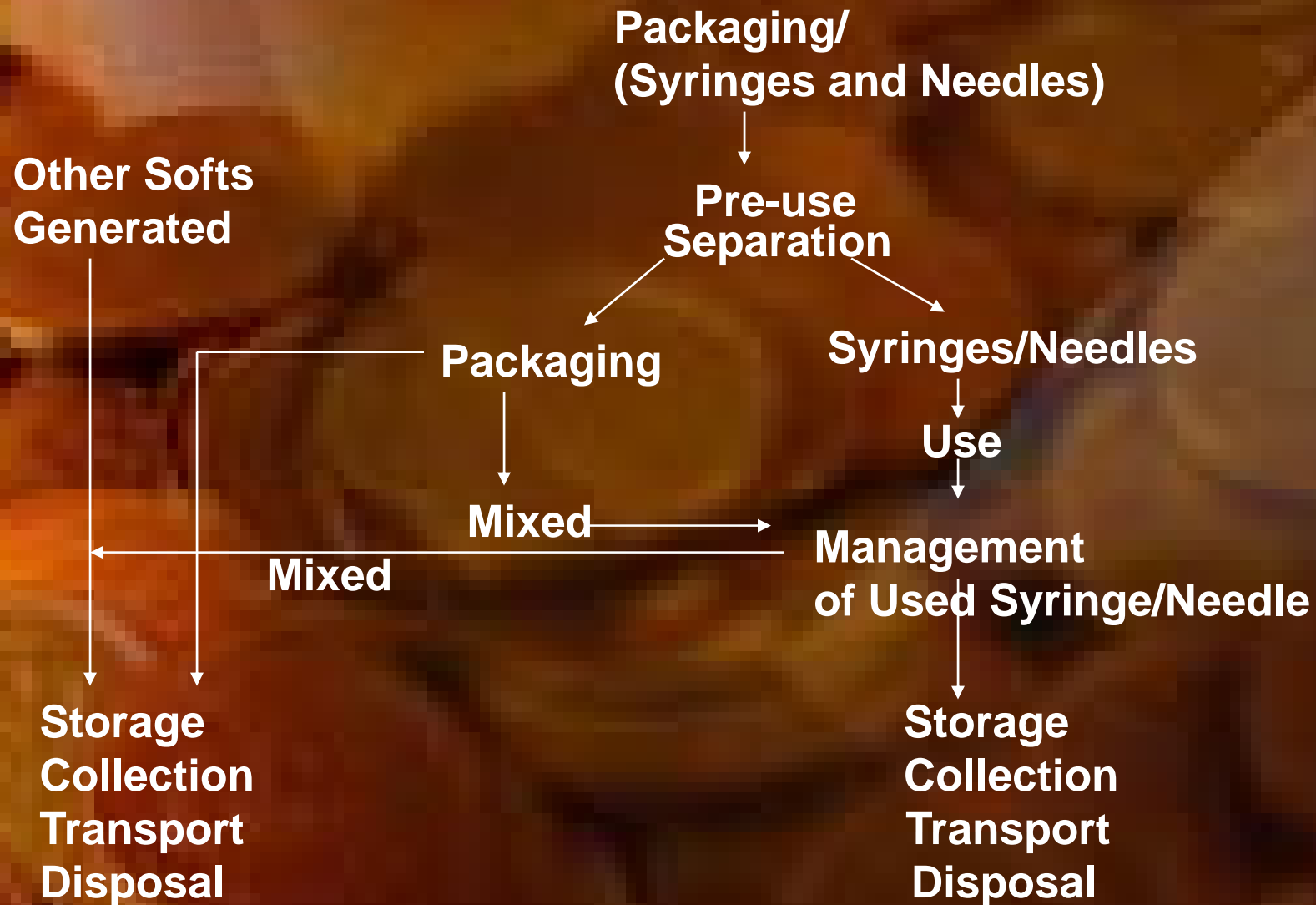
# Storage Considerations

- Non-Infectious
- Infectious-
  - Sharps
  - Softs
  - Availability of storage containers
  - Use of makeshift containers
  - Rate of generation
  - Frequency of collection

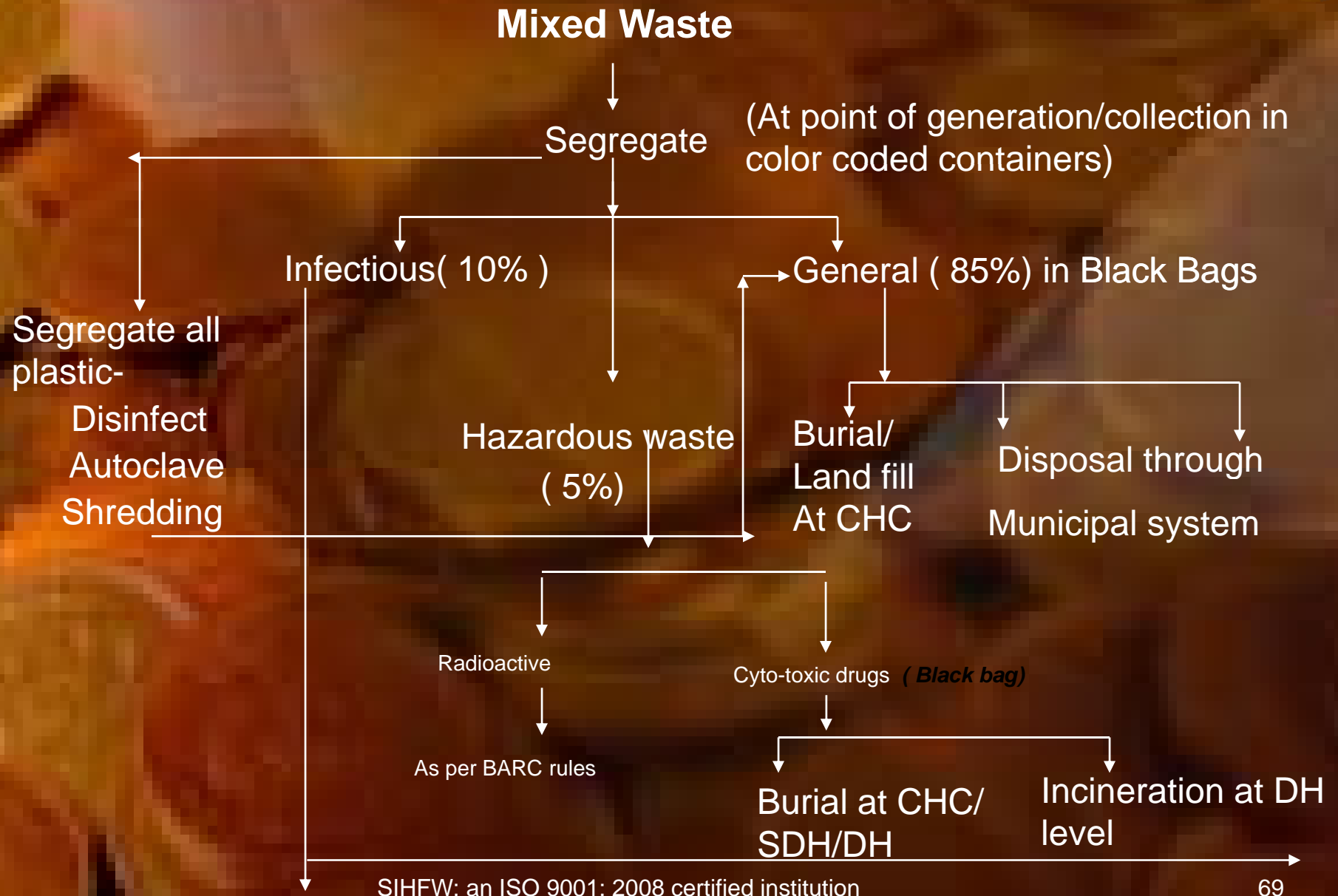
# General Activities–flow



# Waste Management Alternatives



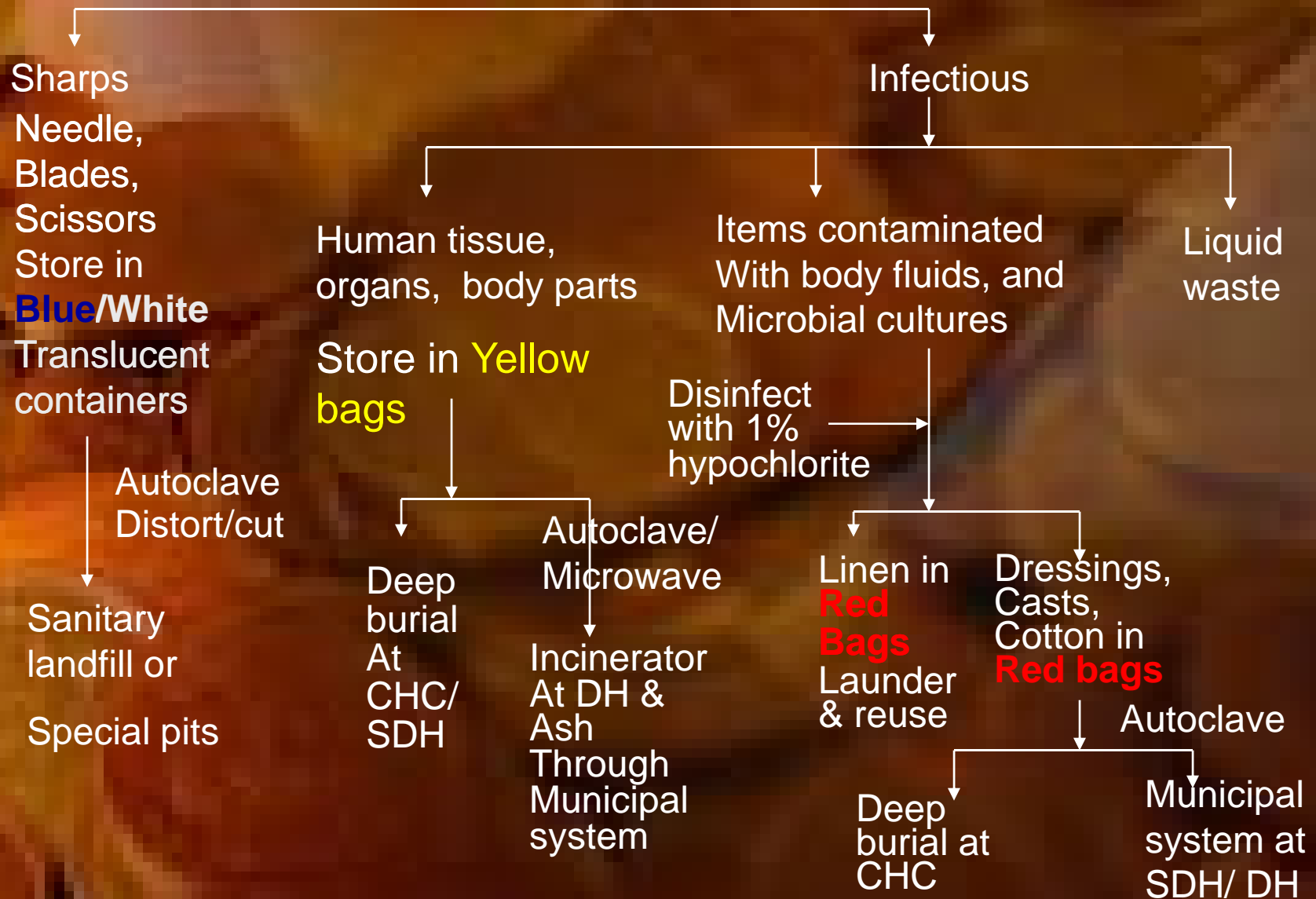
# Waste Segregation Plan.....



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# Infectious waste



# Available Technologies

- **Substitute Destructive Technology**  
(waste & infectious nature both destroyed)
  - Incinerator
- **Substitute Non-Destructive Technology**  
(only infection is destroyed without change in composition)
  - Autoclaving
  - Chemical disinfection
  - Microwave heating
  - Hydroclaving
  - Plasma Torch technology
  - Advanced wet oxidation
  - Detoxification technology

# Factors in Selection of Technology



## Minimum

1. Environmental factors
2. Liquid discharges
3. Occupational hazard & volume reduction
4. Exposed handling
5. Power consumption
6. Operational & maintenance cost
7. Air emissions-heavy metals, acid gas, odor
8. Recognizability of final product

## Maximum

1. Disinfection efficiency
2. Quantum of weight
3. Automation & control
4. Potential for recovery of energy or recyclable product in unrecognizable form



# Realistic Alternatives

- Low-Heat Thermal Technologies
  - Autoclaves or Retorts
  - Advanced Autoclaves
  - Microwave Units
  - Dry Heat Systems
- Chemical
  - Non-Chlorine Technologies

# Types of Treatment Systems

## Sterilization

Thermal

Electro-magnetic  
Radiation

Chemical

## Biological

## Incineration

Uncontrolled-

-Open pit

-Burn container

Controlled-

-Small incinerator

-Large incinerator



# Alternative Medical Waste Treatment Technologies

- Autoclaves
- Microwaves
- Plasma Arcs
- Pyrolysis
- Chemical Disinfection

# Factors to Consider in Selecting Alternative Technologies

- Environmental Emissions and Residues
  - air emissions
  - wastewater discharges
  - solid residue
  - ambient (workspace) air
  - others
- Reduction of Waste Volume
- Occupational Safety & Health



# Factors to Consider in Selecting Alternative Technologies

- Capacity
- Types of Waste Treated
- Space Requirements/ Site Requirements
- Process Monitoring and Documentation
- Equipment Safety and Worker Safety During Repairs
- Ease of Use/ Training Requirements
- Reliability/ Track Record
- Cost

# Standards for Incinerations

## Operating Standards

1. Combustion efficiency (CE) shall be at least 99.00%.

2. The Combustion efficiency is computed as follows:

$$C.E. = \frac{\%CO}{\%CO_2 + \%CO} \times 100$$

3. The Temperature of the primary chamber shall be **800 + 50 deg. C°**.

4. The secondary chamber gas residence time shall be at least 1 (one) second at **1050+50 C°**, with minimum 3% oxygen in the stack gas.

## B. Emission Standards

| Parameters  | Concentration mg/Nm <sup>3</sup> at (12% CO <sub>2</sub> correction ) |
|---|---|
| Nitrogen oxides                                     | 450   |
| HCl   | 50  |
| <b>Minimum stack height -30 meters</b>              |   |
| <b>Volatile organic compounds in ash &lt;0.01%.</b> |   |

## And We Need to...

- Concentrate on critical in-house issues of waste management and minimization.
- Avoid developing non-related technical expertise.
- Pay on waste generation basis rather than on fixed capacity basis.
- Ease regulatory requirements.

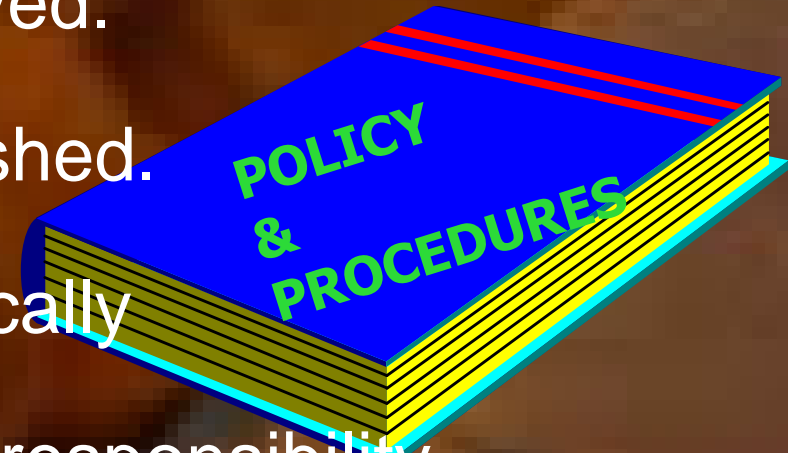
# Role of Private sector

- Improve efficiency & lower cost
- Provide new ideas, technology & skills
- Mobilize needed investment funds



# Issues That Still Haunt...

- Questions of liability unresolved.
- Quality of service not established.
- Viability of operator economically
- Health faculties tend to pass responsibility-  
lead to in-hospital apathy.



# Conclusions

- Centralized facilities can help provide essential service in waste management in urban settings.
- Installation of appropriate technology mixes and their capacities.
- Ensure Quality standards of operation both through standardization of protocols as well as choice of operators.



# Finally

High Tech Centralized Facilities to succeed have to be viewed as a critical component, of the overall waste management hierarchy which extends from waste minimization, on-site segregation at point of generation to final treatment and disposal offsite



# Thank You

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on

[sihfwraj@yahoo.co.in](mailto:sihfwraj@yahoo.co.in)