Treatment and Disposal Technologies for Medical Wastes in Developing Countries

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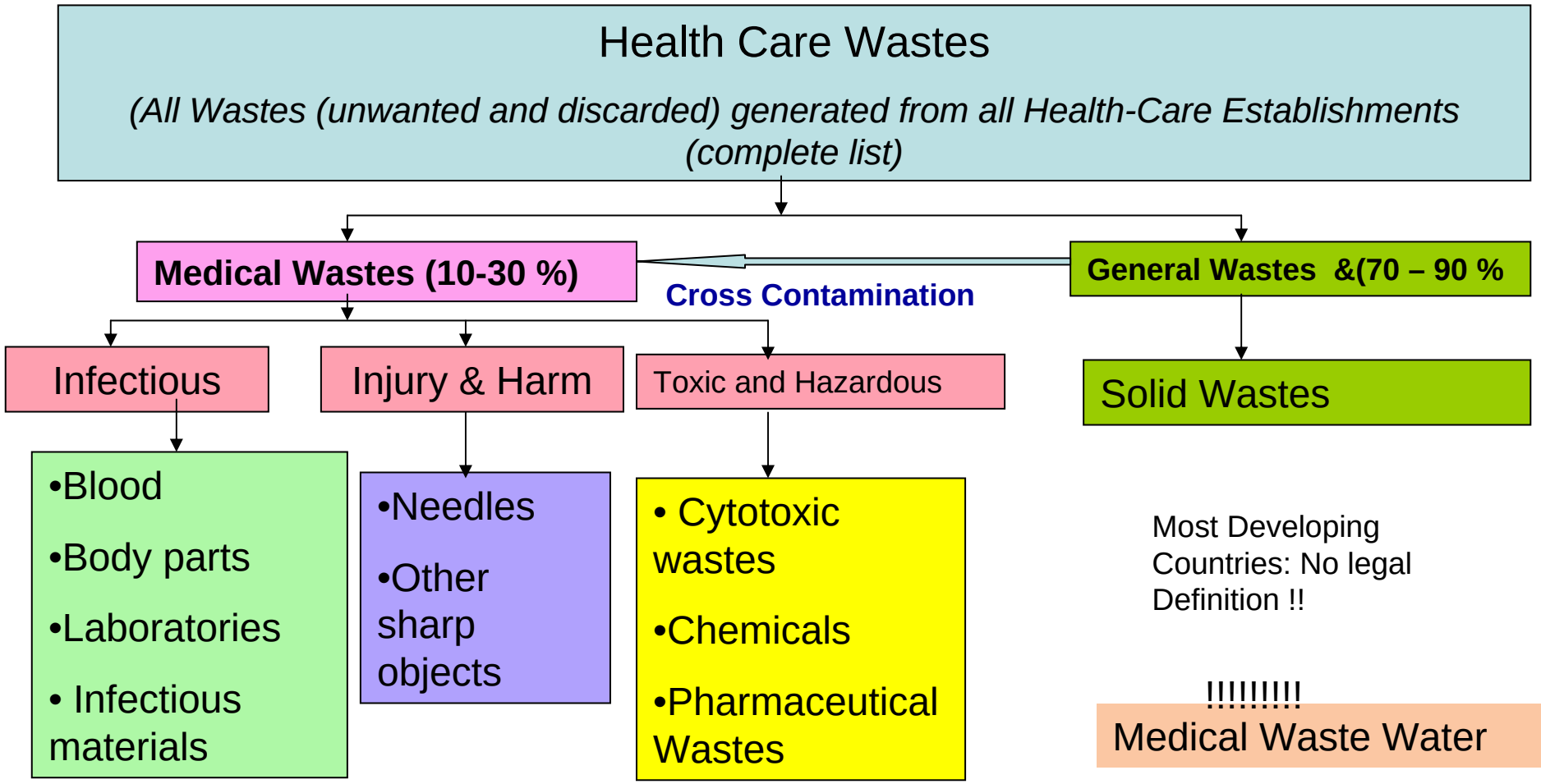
Where do We Start ?

Definition>>>>Legal Implications>>>What are medical wastes and what are not ???



Most Developing Countries: No legal Definition !!

!!!!!!!!

Medical Waste Water

Pathological Wastes: Body Parts

Medical wastes: How Much Produced ?

- 1.0-1.5 kg/bed/day in a large hospital,
- 0.3 kg/bed/day in a small hospital.

World Health Organization

Used Blood Samples

World Health Organization

World Health Organization

Blood

World Health Organization

World Health Organization

Laboratory Cultures

World Health Organization

Sharps

World Health Organization

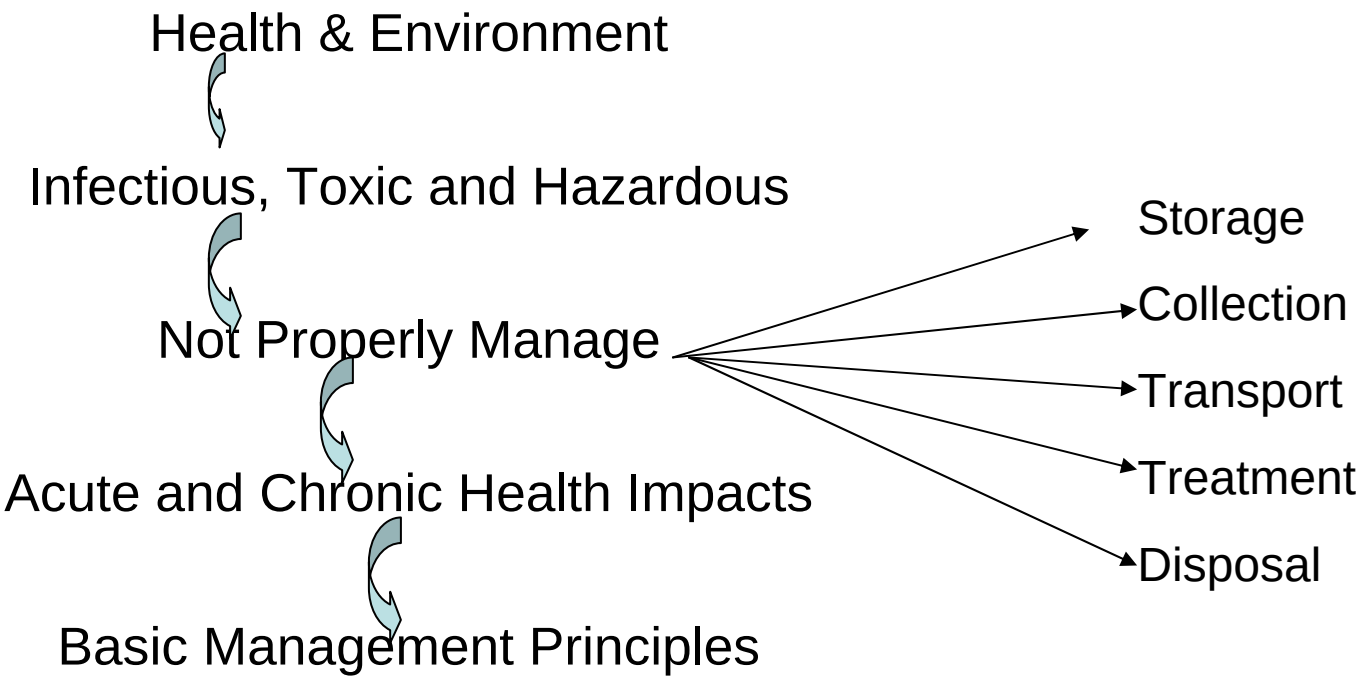
World Health
Organization

World Health Organization

Used Chemicals

Medical Wastes in Developing Countries

Challenge No 1: Failed to Understand the Risk (Health and Environment)



World Health Organization

Challenge No 2:

A Technology May Not Work Every Place

Appropriate Technology

Failed to understand the principles of medical waste management

Risk Management
- Managing the exposure
- Managing the concentration

Risk Characteristics:
- Actual condition
- Transformation
  - chemical changes (incineration)
  - biological changes (biotransformation)

Challenge No 3:

Economic Constraints

Poor

Less Important Sector (least priority until ???)>>>financial resources not properly allocated

Very Minute Budget for:

- Storage bags/containers
- Temporary Storage Room
- Poor Transportation Systems
- Haphazard Treatment + Poor Operation and Maintenance
- Extremely Unsanitary Disposal

Challenge No 4:
Policies, Strategies and Plan of Action

No Policy, Guidelines on Medical Waste Management
+
Cross-cutting responsibilities

Intermediate Systems:

- Regulations
- Guidelines
- Technology can be improved

Advanced Systems

- Regulations
- Technical Guidelines
- Adequate resources

Poor Systems:

- Regulations
- Guidelines
- Not implemented

Very Poor Systems:

- No Regulations
- No Guidelines
- Not implemented

Developing Countries:

In 2002 of 22 developing countries:

18 to 64 % of health care facilities with poor health-care waste management

Pathological Wastes: Body Parts Or ??

Black Bags are Meant for General Wastes

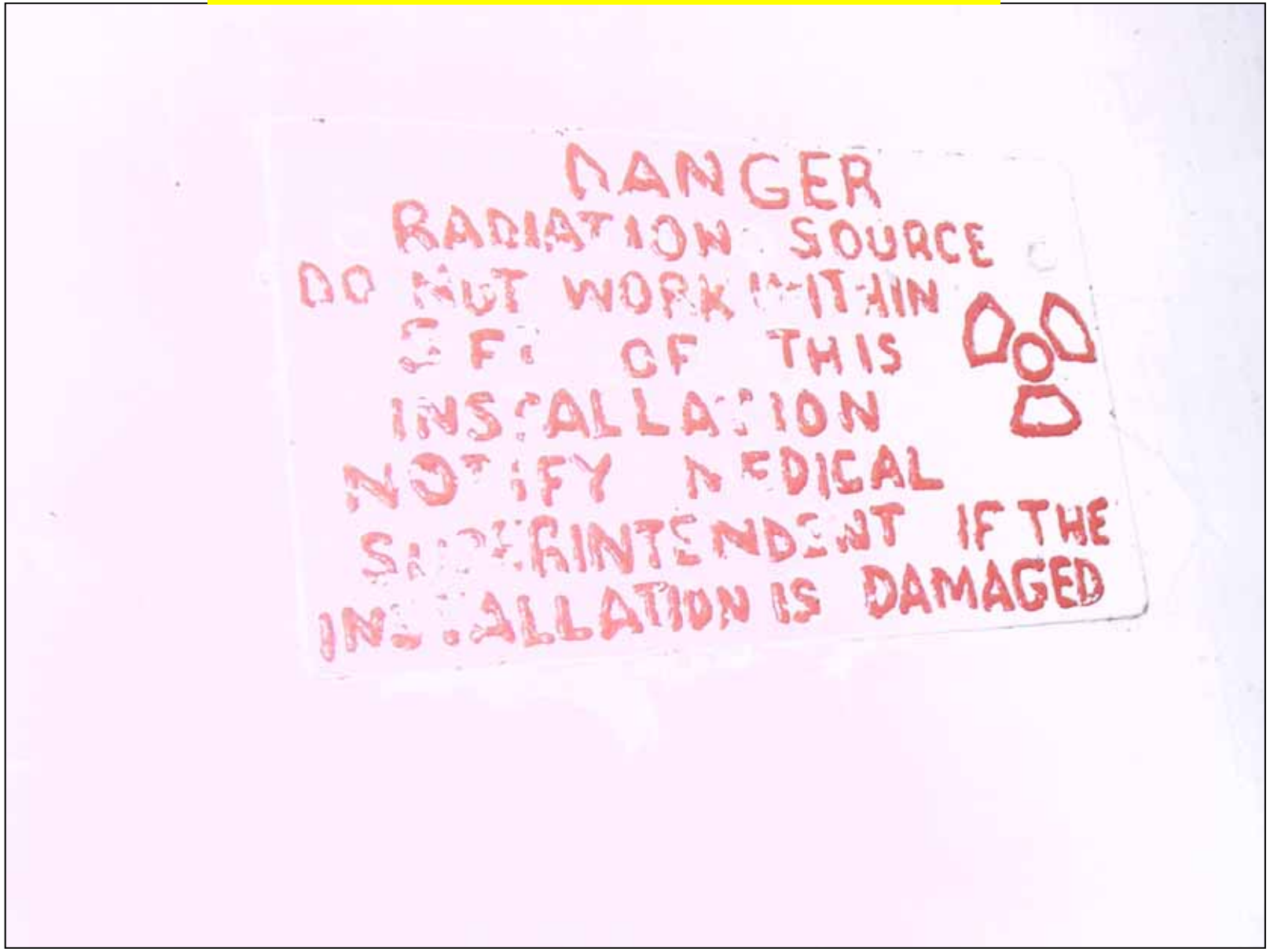
Food Wastes + Sharps !!!!!

80-85% is general, non-hazardous waste, but often not segregated – need to deal with them as hazardous

Over-used Sharp Containers

Is this APPROPRIATE

CAN YOU READ THIS ???



Medical Wastes are Stored in Open Containers

WILL YOU APPROVE THIS ???

OR THIS ??

OR THIS ??

OR THIS ??


THEN
THESE


THEN
THESE


THEN
THESE


THEN
THESE

The Way Forward

POLICY

Administrative Requirements/Guide
(Regulations/Guidelines/Standard Operating Procedures)

↓

Health-care Establishments Covered by Regulation
(Govt + Private)

↓

Responsible Agency ????

↓

Reporting
Consignment Notes
(Tracking System)

↓

Offence and Violation

↓

Emergency Response
Small Health-Care Establishments
(Health Centres/Islands)

Definition

TECHNOLOGY

Technical Requirements
(Regulations/ Guidelines/ Standard Operating Procedures)

Segregation

Bags and Containers
- Infectious materials
- Sharps
- Chemicals
- Pharmaceuticals

Collection
Storage Area
[Preliminary Treatment]

Transportation

Treatment and Disposal

Inertization
Encapsulation
Disinfection
Destruction
(Thermal Treatment)
- Autoclave
- Incineration

Landfill

?????

Guiding Principles

Organizational Guidelines:

a. Dedicated waste management team.
b. Clear and practical organization.
c. Underpinning legislation or guidelines or regulations.
d. Affordable.
e. Full participation

Guiding Principles

Technical Guidelines:

a. Elimination or reduction of risk.
b. Toxicity reduction.
c. Volume reduction.
d. Waste producers responsibilities.
e. Cradle to grave management
f. Training

Type of Wastes	**Colour of Container and Markings**	**Type of Container**
Infectious wastes, pathological wastes	Yellow, marked “INFECTIOUS”	Strong, leak-proof plastic bag, or container capable of being autoclaved
Sharps	Yellow, marked “SHARPS”	Puncture-proof container
Chemical and pharmaceutical wastes	Brown, marked “HAZARDOUS’	Plastic bag or container
Wastes with High Content of Heavy Metals	Brown, marked with the specific heavy metal content and “HAZARDOUS’	Puncture and corrosive proof container, separate containers for different heavy metal contents.
Radioactive and Genotoxic wastes	Red, marked with “RADIOACTIVE SYMBOL”	Lead box, labelled with radioactive symbol
Pressurised containers	Black	Plastic bag; could mix with the general wastes
General Waste	Black	Plastic bag


DISPOSAL SAFE
FOR SHARPS
& CONTAMINATED WASTE
"BIOHAZARD"
DESTROY
IN ACCORDANCE WITH REGULATIONS


LIMBAH INFEKSIUS

Incineration: Most Countries Resort to Burning of Wastes

Advantages:

- Destruction (risk)
- Volume reduction
- Flexible
- (can handle most types of medical wastes)

Disadvantages

- Costly
- Environmentally sensitive:
  - Emissions
  - Ashes
- Maintenance – sophisticated
- Limited effective life-time

- Score: Extremely Risky
- Verdict: Unless specifications/regulations are met (environment + health requirements)
  - ***NOT ENCOURAGED***
- Strict requirements:
  - Temperature
  - Double combustion
  - Emission treatment
  - Auto-shut down
- So What is the Appropriate Technology
  - Simple high temperature systems
  - Sophisticated high tech system
  - Combination

Substance	Daily Average (mg/Nm3)	Hourly Average (mg/Nm3)	4 hours Average (mg/Nm3)
Total dust	5	10	-
Total organic carbon	5	10	-
Chlorine compounds	5	10	-
Fluorine compounds	1	2	-
Sulphur oxides as SO2	25	50	-
Nitrogen oxides as NO2	100	200	-
Carbon monoxide	50	100	-
Mercury	-	-	0.05
Cadmium and thallium	-	-	0.05
Lead, chromium, copper, and Manganese	-	-	0.5
Nickel and arsenic	-	-	0.5
Antimony, cobalt, vanadium and tin	-	-	0.5
Dioxins and furans	-	-	0.1
Oxygen content	At least 6 % at any moment		

DIOXINS, FURANS, CO-PLANNER PCBS

- Polychlorinated dibenzo-para-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polychrolinated biphenyls (PCBs).
  - Persistence, bioaccumulate.
  - Related to combustion at low temperature, plastics (esp. PVC).
    - Lower than 800^{o}C
    - Especially in the range of 250-450^{o}C
    - Temperature not uniform.
- Presence in bottom ash, fly ash, emissions.

Safe Levels of Dioxins

- WHO:
  - Provisional Tolerable Monthly Intake (PTMI)
    - 70 picograms/kg body-weight (10^{-12}g).
  - Emission Limits:
    - Europe 0.1 ngTEQ/m^3 (Toxicity Equivalent)

Criteria for Selection:

- Environment:
  - Emissions.
  - Residues.
- Technical:
  - Efficiency
  - Parts, components and maintenance.
  - Technological: proven (commercialised); experimental (pilot).
- Costs:
  - Capital
  - Operating

Incinerators

Technology Management

- **Waste Reduction** and **Waste Segregation**.
- **Site** of incinerators.
- Detailed Engineering Design :
  - Residence Time, Temperature, treatment of emissions.
- Operation & Maintenance.
- Disposal of Ash.
- Training

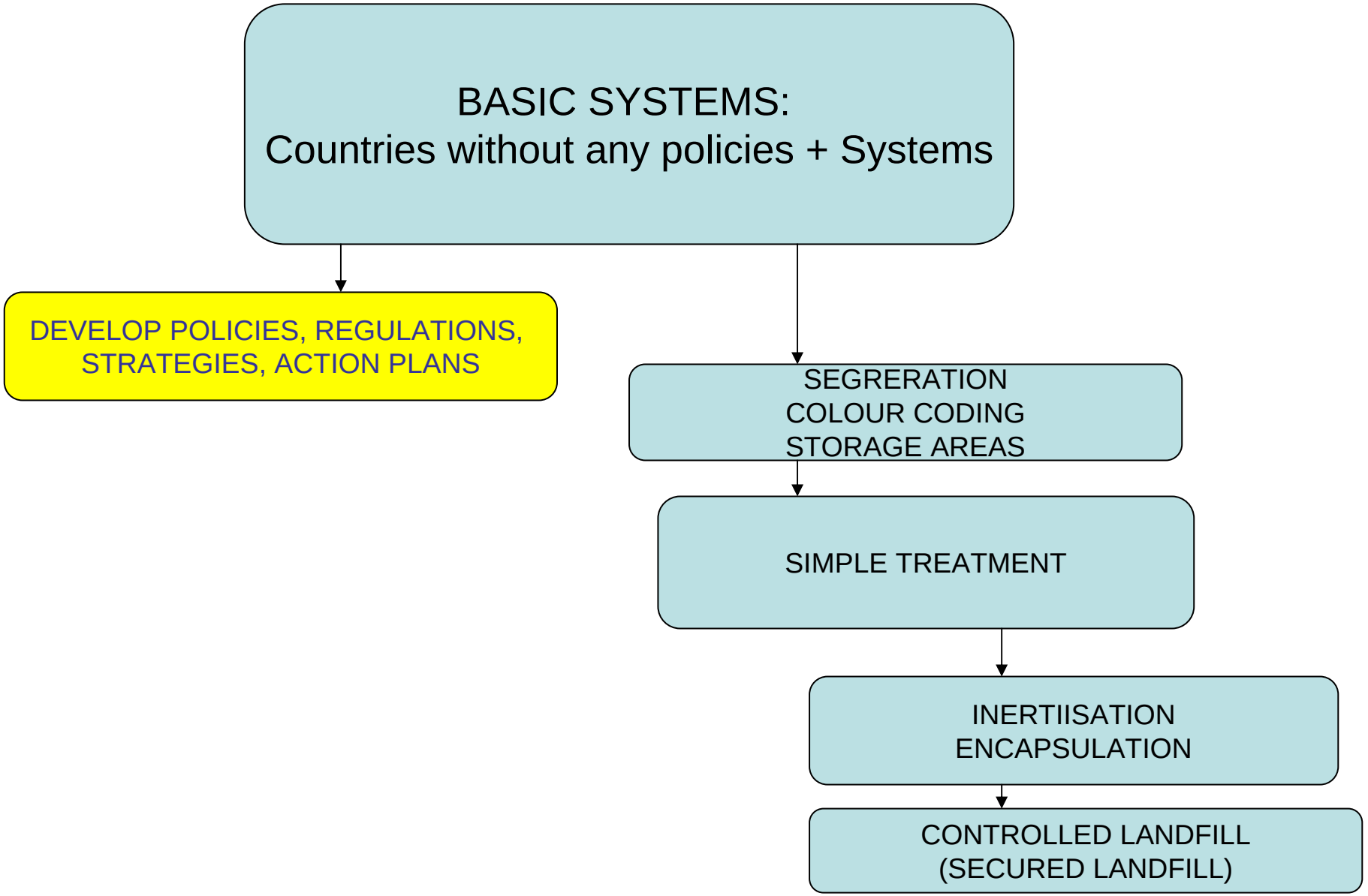
(Problems due inadequate training, waste segregation and poor maintenance)

Before YES

- Good Practices in Incineration Design, Construction and Operation (eg. pre-heating, not overloading, temperature above 800oC), maintenance, lowest emissions.
- Waste segregation and waste minimisation.
- Good practice tools (dimensional construction plans, operational guidelines).
- Operator Training and Management Support.
- Avoid materials containing Chlorine (some blood bags, IV Bags, IV tubes), heavy metals (mercury).


EUROTHERM
ON
ON
OFF - ON
START
STOP
ON
ON
ON - ON
TRIPPED
ON
OFF - ON
TRIPPED

Intervention



Medium
(COUNTRIES HAVE REGULATIONS BUT TECHNICALLY AND FINANCIALLY INCAPABLE

FINANCIAL ASSISTANCE

DEVELOP PILOT HOSPITALS, HEALTH CENTRES

NATION-WIDE SYSTEM

High
(COUNTRIES WITH REGULATION + SYSTEMS)

Research and Development:

Technology

Systems: Public Vs Private

3 Rs

Systems to reduce the amount of waste produced

Systems to reduce toxic contents so that we can promote reuse

Systems that eliminate risks to allow recycling