

Disposal of wastes

Dr. Md. Rahul Parvez
Lecturer (Community Medicine)
Rajshahi Medical College

Solid waste

- **Solid wastes** include-
 - ✓ **garbage** (food wastes, vegetable peelings and organic matters),
 - ✓ **rubbish** (paper, plastic, wood, metal, throw-away containers, glass),
 - ✓ **demolition products** (bricks, masonry, pipes),
 - ✓ **sewage treatment residue** (sludge and solids from the coarse screening of domestic sewage),
 - ✓ **dead animals**,
 - ✓ **manure and other discarded materials.**

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Sources/types of refuse

- **Street refuse:** collected by street cleansing service or scavenging
- **Market refuse:** collected from market contains a large proportion of putrid vegetable and animal matter
- **Stable litter:** collected from stables contains mainly animal droppings and left-over animal feeds
- **Industrial refuse:** comprises wide variety of wastes ranging from completely inert materials to highly toxic and explosive compounds
- **Domestic refuse:** consists of ash, rubbish and garbage

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Solid waste is a health hazard

- If solid waste is allowed to accumulate, it is a **health hazard** because-
 - It decomposes and **favours fly breeding**
 - It **attracts rodents** and vermin
 - The **pathogens** which may be present in the solid waste may be **conveyed back to man's food** through flies and dust
 - There is a possibility of **water and soil pollution**
 - Heaps of refuse present an **unsightly appearance and nuisance** from bad odours

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Methods of refuse disposal

- The principal methods of refuse disposal are-
 - **Dumping**
 - **Controlled tipping or sanitary land-filling**
 - **Incineration**
 - **Composting**
 - **Manure pits**
 - **Burial**

Dumping

- Refuse is dumped in **low lying areas** as an easy method of disposal
- **Drawback** of open dumping-
 - ✓ The refuse is **exposed to flies and rodents**
 - ✓ **Source of nuisance** from odour and unsightly appearance
 - ✓ The loose refuse is **dispersed by wind**
 - ✓ Drainage from dumps causes **soil and water pollution**
- WHO condemned dumping as “**a most insanitary method** that creates public health hazards, a nuisance and severe pollution to environment”.

Controlled tipping

- **Controlled tipping or sanitary landfill** is the most satisfactory method of refuse disposal where suitable land is available.
- It differs from ordinary dumping is that the materials is placed in a trench or other prepared area, adequately compacted and covered with earth at the end of working day.
- Three methods are used in this operation-
 - **The trench method**
 - **The ramp method**
 - **The area method**

Incineration

- **Incineration or burning** is the method of choice where suitable land is unavailable.
- **Hospital refuse** which is particularly dangerous is best disposed of by incineration.

Composting

- Composting is a method of **combined disposal of refuse and nightsoil** or sludge.
- It is a process of nature whereby **organic matter breaks down under bacterial action** resulting in the formation of relatively stable humus-like material, called the compost which has considerable manurial value for the soil.
- The following methods of composting are now used-
 - a. **Bangalore method (Anerobic or hot fermentation method)**
 - b. **Mechanical composting (Aerobic method)**

Manure pits

- In rural areas, there is no system for collection and disposal of refuse.
- This problem can be solved by digging '**manure pits**' by the individual householders.
- The garbage, cattle dung, straw and leaves are dumped into the manure pits and covered with earth after each day's dumping.
- In **5-6 months**, the refuse is converted into **manure** which can be returned to the field.
- This method of refuse disposal is **effective and relatively simple** in rural communities.

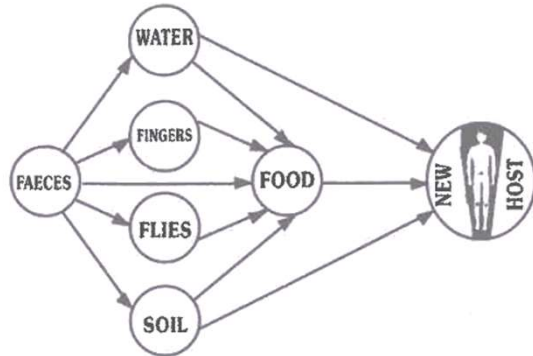
Burial

- This method is **suitable for small camps**.
- A **trench 1.5 m wide and 2 m deep** is excavated and at the end of each day the refuse is covered with 20-30 cm of earth.
- When the level in the trench is **40 cm from the ground level**, the trench is filled with earth and compacted, a new trench is dug out.

Excreta disposal

- The health hazards of improper excreta disposal are-
 - a. **Soil pollution**
 - b. **Water pollution**
 - c. **Contamination of food**
 - d. **Propagation of flies**
- The resulting diseases are typhoid and paratyphoid fever, dysenteries, diarrhoea, cholera, hookworm disease, ascariasis, viral hepatitis etc.

Transmission of faecal-borne diseases

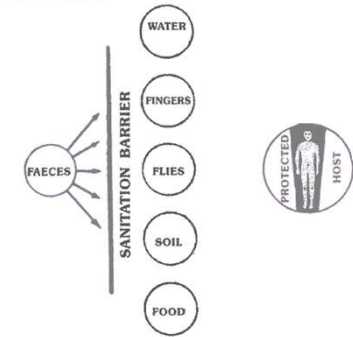


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Sanitation barriers

- Community medicine aims at breaking the disease cycle at vulnerable points:
 - Segregation of feces
 - Protection of water supplies
 - Protection of foods
 - Personal hygiene
 - Control of flies
- Of these, the most effective step is to segregate the faeces.



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Methods of excreta disposal (Unsewered areas)

- Service type latrines (Conservancy system)**
- Non-service type latrine (Sanitary latrine)**
 - ✓ Bore hole latrine
 - ✓ Dug well or pit latrine
 - ✓ Water-seal type latrine
 - ✓ Septic tank
 - ✓ Aqua privy
- Latrine suitable for camps and temporary use**
 - ✓ Shallow trench latrine
 - ✓ Deep trench latrine
 - ✓ Pit latrine
 - ✓ Bore hole latrine

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Methods of excreta disposal (Sewered areas)

Water-carriage system and sewage treatment

- Primary treatment:**
 - ✓ Screening
 - ✓ Removal of grit
 - ✓ Plain sedimentation
- Secondary treatment**
 - ✓ Trickling filters
 - ✓ Activated sludge process
- Other methods**
 - ✓ Sea outfall
 - ✓ River outfall
 - ✓ Sewage farming
 - ✓ Oxidation ponds

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Sanitary latrine

A **sanitary latrine** is one which fulfils the following criteria:

- Excreta should **not contaminate the ground or surface water**
- Excreta should **not pollute the soil**
- Excreta should **not be accessible to flies, rodents, animals** and other vehicles of transmission
- Excreta should **not create a nuisance** due to odour or unsightly appearance

Sewage and sullage

- Sewage** is waste water from a community, **containing solid and liquid excreta**, derived from houses, street and yard washings, factories and industries.
- The term **sullage** is applied to waste water which **does not contain human excreta**, e.g. waste water from kitchens and bathrooms.
- The average amount of sewage which flows through the sewerage system in 24 hours is called the **"dry weather flow"**.

Health aspect of sewage

- Improper disposal of sewage may create following problems:
 - ✓ **Creation of nuisance**, unsightliness and unpleasant odour
 - ✓ **Breeding of flies and mosquitoes**
 - ✓ **Pollution of soil and water** supplies
 - ✓ **Contamination of food** and
 - ✓ Increase in the **incidence of disease**, especially enteric and helminthic diseases

Modern sewage treatment

- Modern sewage treatment plants are based on biological principles of sewage purification, where the purification is brought about by the action of **anaerobic and aerobic bacteria**.
- The treatment of sewage is divided into two stages-
 - **Primary treatment**: the solids are separated from the sewage partly by **screening** and partly by **sedimentation** and subjected to **anaerobic digestion** which is the first stage in purification
 - **Secondary treatment**: the effluent is subjected to **aerobic oxidation**, which is the second stage in purification

Modern sewage treatment: Primary treatment

- **Screening:** Sewage arriving at the disposal work is first passed through a metal screen which intercepts large floating objects such as pieces of wood, rags, masses of garbage and dead animals.
- **Grit chamber:** Sewage is then passed through a long narrow chamber called the grit chamber or detritus chamber. The function of grit chamber is to allow the settlement of heavier solids such as sand and gravel, while the organic matter to pass through.
- **Primary sedimentation:** The organic matters which settles down is called sludge and removed by mechanically operated devices. A small amount of biological action takes place by the microorganisms.

Modern sewage treatment: Secondary treatment

- The effluent from the primary sedimentation tank still contains a proportion of organic matter and is subjected to further treatment, aerobic oxidation, by one of the following methods:
 - Trickling filter method:** The effluent from the primary sedimentation tank is sprinkled uniformly on the surface of trickling filter formed of crushed stones. Very soon a biological layer or zoogeal layer is formed over the surface and the effluent percolates through this layer undergoes oxidized. The oxidized sewage is now led into the secondary sedimentation tanks.

Modern sewage treatment: Secondary treatment

- Activated sludge process:** It is the modern method of purifying sewage, in place of trickling filter. The heart of the activated sludge process is the aeration tank.
- Secondary sedimentation:** The oxidized sewage from the trickling filter or aeration chamber is led into the secondary sedimentation tank. The sludge that collects in the secondary sedimentation tank is called 'aerated sludge' or activated sludge. Part of the activated sludge is pumped back into the 'aeration tank' in the activated sludge process and rest pumped into the sludge digestion tanks for treatment and disposal.

Modern sewage treatment

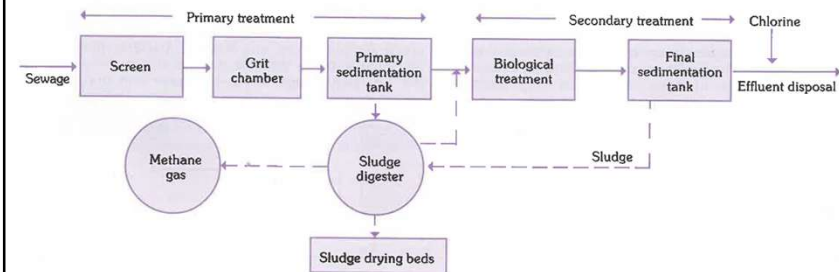


Fig: Flow diagram of a modern sewage treatment plant

Medical waste or biomedical waste

- The term **medical waste or biomedical waste or health-care waste** includes all the waste generated within health-care facilities, research centres and laboratories related to medical procedures.
- In addition, it includes the same types of waste originating from minor and scattered sources, including waste produced in the course of health care undertaken in the home (e.g. home dialysis, self-administration of insulin, recuperative care).

Sources of medical waste

• Major sources:

- Hospitals, other healthcare facilities i.e. health complex, outpatient clinics, obstetric and maternal clinics etc.
- Related laboratories and research centres
- Mortuary and autopsy centres
- Animal research and testing
- Blood banks and blood collection services
- Nursing homes for the elderly

Sources of medical waste

• Minor sources:

- Small health-care facilities i.e. first-aid posts and sick bays, physicians' office, dental clinics, acupuncturists, chiropractors etc.
- Specialized health-care facilities i.e. convalescent nursing homes, psychiatric hospitals, disabled persons' institutions
- Activities involving intravenous or subcutaneous interventions
- Funeral services
- Ambulance services

Categories of medical waste

Waste category	Types of waste	Example	Treatment & disposal
Category-1	General waste	Paper, plastic box, cartoon, polythene, water bottle, injection vial etc.	Dumping, recycling
Category-2	Anatomical waste	Dissected human organ, tissue, aborted waste	Pit disposal, dumping, autoclaving, incineration
Category-3	Pathological waste	Blood, urine, stool, sputum sample taken for test	Same as category-2
Category-4	Chemical waste	Reagents, dialysis agents etc.	Disposal into sewerage line after disinfection

Categories of medical waste

Waste category	Types of waste	Example	Treatment & disposal
Category-5	Pharmaceutical waste	Rejected, expired, infected medicine	Same as category-4
Category-6	Infected waste	Gauze, bandage, swab, mop, infected with blood, pus etc.	Same as category-2
Category-7	Radioactive waste	Waste of radiation activity	According to rules of BAEC
Category-8	Sharp waste	Suture materials, blade, broken slide, amputated, orthopedic materials etc	Same as category-2

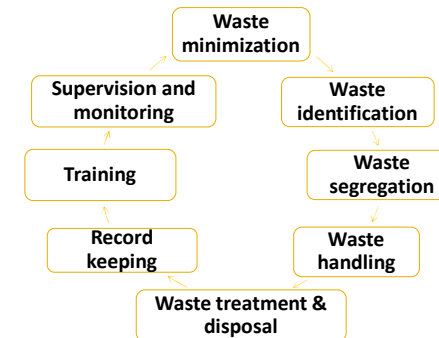
Categories of medical waste

Waste category	Types of waste	Example	Treatment & disposal
Category-9	Recyclable general waste	Paper, plastic box, cartoon, polythene, water bottle, injection vial etc.	Recycling by autoclaving, chemical disinfection
Category-10	Liquid waste	Used water, vomit, sputum, suction liquid, pus, blood, amniotic fluid, liquid drug	Disposal into sewerage line after chemical disinfection
Category-11	Pressurized waste	Pressurized can, container, bottle etc.	Dumping, recycling

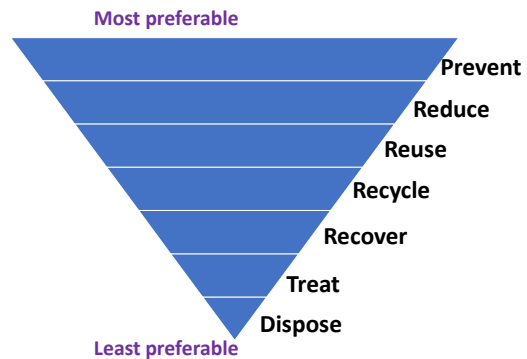
Colour code for medical waste management

Colour code	Type of waste	Waste category	Pot used
Black	General waste	Category-1, 11	Non-porous plastic bin
Yellow	Infectious waste	Category-2,3,4,5,6	Non-porous plastic bin
Red	Sharp waste	Category-8	Non-porous plastic bin
Blue	Liquid waste	Category-4,10	Non-porous plastic bin
Silver	Radioactive waste	Category-7	Non-porous lead box
Green	Recyclable waste	Category-9	Non-porous plastic bin

WHO medical waste management cycle



Waste management hierarchy



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Medical waste management

- In Rajshahi, Prism Bangladesh foundation is assigned for collection and disposal of medical waste.



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Biotechnology

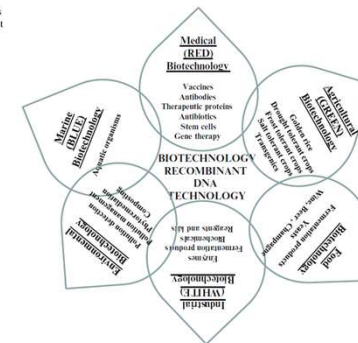
- Biotechnology** is the application of **biological knowledge and techniques** to create products or processes that benefit various sectors, including human health, agriculture, and environmental sustainability.
- Medical biotechnology is a field that utilizes **biological systems and living organisms** to develop innovative solutions for healthcare challenges, including disease diagnosis, prevention, and treatment.
- It encompasses the application of biological science and engineering principles to **create new drugs, therapies, diagnostic tools, and other medical products**.

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Major application of biotechnology

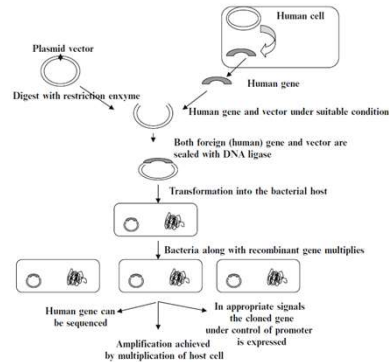
Fig.1.1 Major applications of biotechnology in different areas and some of their important products



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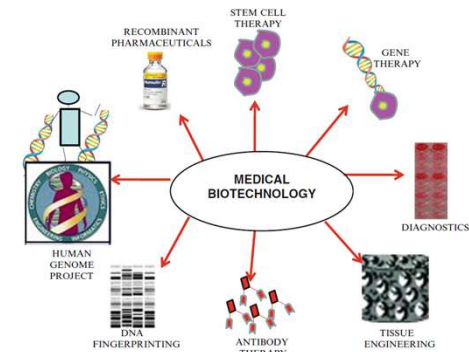
Steps of recombinant DNA technology



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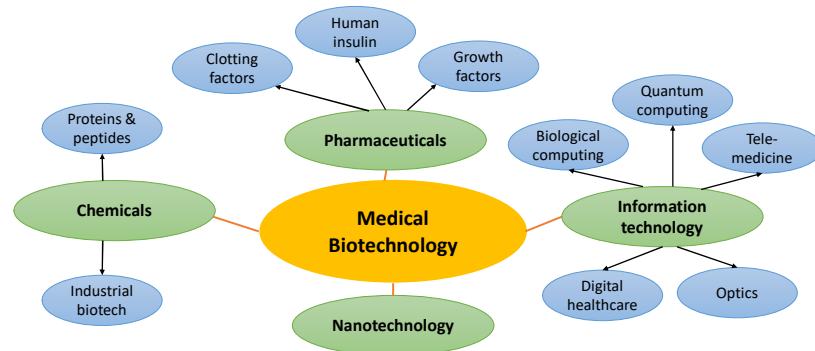
Application of medical biotechnology



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Fields of medical biotechnology



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