Dynamics of Disease Transmission

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Transmission - prerequisites

- Agent
- Source for agent
- Portal of exit from host
- Suitable mode of transmission
- Portal of entry suitable to agent
- Susceptible host
Chain of Transmission Mode

- Eyes
- Nose
- Mouth
- Skin
- Urinary tract
- Genital tract

Agent → Reservoir → Transmission (Exit Portal) → Host

Entry Portal
Modes of Spread

- **Direct**
  - Contact
    - Ensures certainty
    - Larger dose,
    - Less chances of organism dying outside human host

- **Airborne**
  - Droplet (3-5 microns), Distance 1-2 feet
  - Droplet Nuclei (< 3 microns) Distance 3-5 feet
  - Infected dust

- **Transplacental**
**Indirect**

- **vehicles**
  - ✓ Water
  - ✓ Food
  - ✓ Milk
  - ✓ Blood and plasma
  - ✓ Organs

- ✓ Number of case dependent on dose of infection in vehicle
- ✓ Cases confined to exposed population
- ✓ Large Geographic spread
- ✓ Cases start disappearing with vehicle control
- ✓ Common source is traceable
Vectors
   - Mechanical
   - Biological
     ✓ Cyclo-propogative (change in form & number)
       e.g. Plague bacilli in Rats
     ✓ Cyclo-developmental (Change in form)
       e.g. Malarial parasite in mosquito
     ✓ Propogative (Change in number)
       e.g. Microfilaria in mosquito
Herd Immunity

• Resistance of a group to an attack by a disease to which a large proportion of the members of the group are immune

• If a large % of population is immune ⇒ entire population is protected, not just those who are immune
Herd Immunity

• Why?
  – If a large % of population is immune then likelihood is small that an infected person will encounter a susceptible person and transmit the infection
    • More of the encounters will be with other immune people
  
• Important for immunization programs
  – Do not need 100% coverage immunization rates
**Herd Immunity**

**Necessary conditions:**
- Disease agent must be restricted to a single host species within which transmission occurs
- Transmission must be relatively direct from one member of the host species to another
- Infections must induce solid immunity
Herd Immunity

• Works when:
  – Probability of an infected person encountering every other individual in the population (random mixing) is the same

• Does NOT work when:
  – An infected person interacts only with people who are susceptible (no random mixing); likely to transmit the disease to those people
How to Prevent & Control Diseases?

- **Individual patient level**
  - Counseling
  - Screening
  - Treatment

- **Community level**
  - Surveillance
  - Targeted measures
    - Agent
    - Environment
    - Host
    - Route of transmission
Basic Control Strategies

• Substitution
• Treatment
• Isolation
• Shielding
• Substitution

Usually applicable where Physical / Chemical / Nutritional agents are involved
• Treatment

Treatment with chemicals / Sterilization

Antibiotic use
• Isolation

Disinfection/Sterilization
Universal Precautions
Vector control
• Shielding

Agent

Boosting immune system - Vaccination
Repellents
Housing
Behavioral modifications

Chemoprophylaxis
Prevention & control…
Blocking Transmission

- Food Hygiene
- Water Treatment
- Vector Control
- Personal Hygiene
- Sterilization & Disinfection
- Environmental Engineering
Prevention & Control: Targeted Strategies

Targeted at Reservoir (Human Host)

- Early Diagnosis
- Notification
- Isolation
- Surveillance
- Quarantine
- Disinfection
Targeted at Route of transmission

- Direct spread
  - Contact tracing (TB, HIV)
  - Air quality monitoring
  - Reducing air microbial density
  - Avoid overcrowding, improving ventilation
  - Personal behavior-safe sex, lifestyle advice
  - Isolation/quarantine

- Indirect spread
  - Environmental control (proper food handling; water processing)
  - Safeguarding blood supply
  - Vector control (pest control)

Direct spread through Air borne transmission (Droplet) is difficult to control in general population
Targeted at Susceptible Host

- Immunization
- Chemo-prophylaxis
- Physical barriers-
  - Mosquito nets
  - Clothing
  - Housing
- Improving Quality of life
  - Behavioral
  - Diet/exercise
  - Smoking/Alcohol
  - Hygiene practices
Targeted at Agent

In the environment
- Radiation
- Sterilization
- Antiseptics
- Incineration

In Human beings
- Prompt Diagnosis and Treatment of patients with drugs e.g. Antibiotics
Targeted at Environment

- Early Diagnosis
  - Lifestyle & behavior (e.g. breastfeeding)

- Health services
  - Policy (notification, contact tracing)
  - Adequate provision for prompt Diagnosis & Treatment
– Legislation
  • Food hygiene (PFA Act)
  • Air-
    – The Air (Prevention & Control of Pollution) Act, 1981
  • Water supply
    – The Water (Prevention & Control of Pollution) Act, 1974
  • Sanitation
    – The Environment protection Act, 1986
    – The National Environmental Tribunal Act, 1995