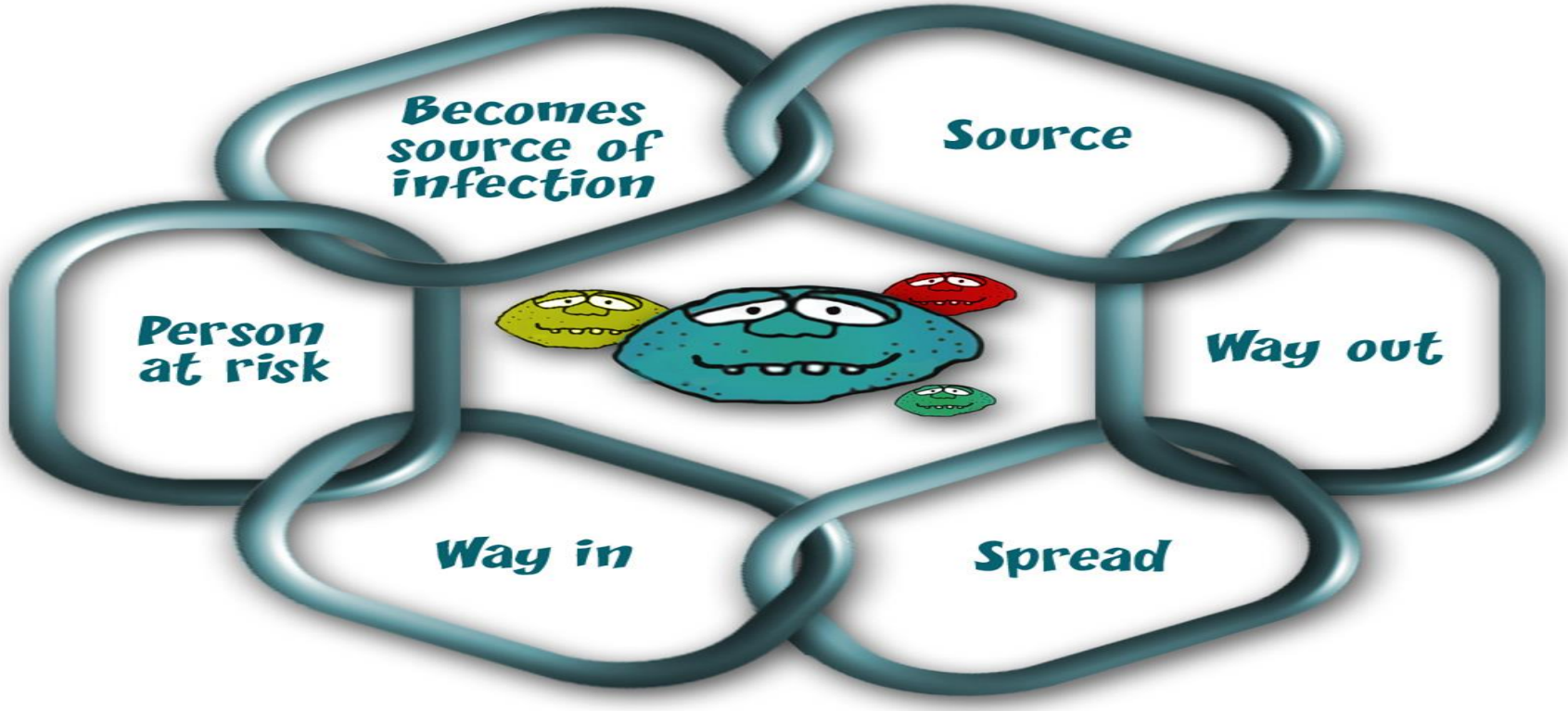
INFECTION CONTROL

UNIT II

Chain of Infection

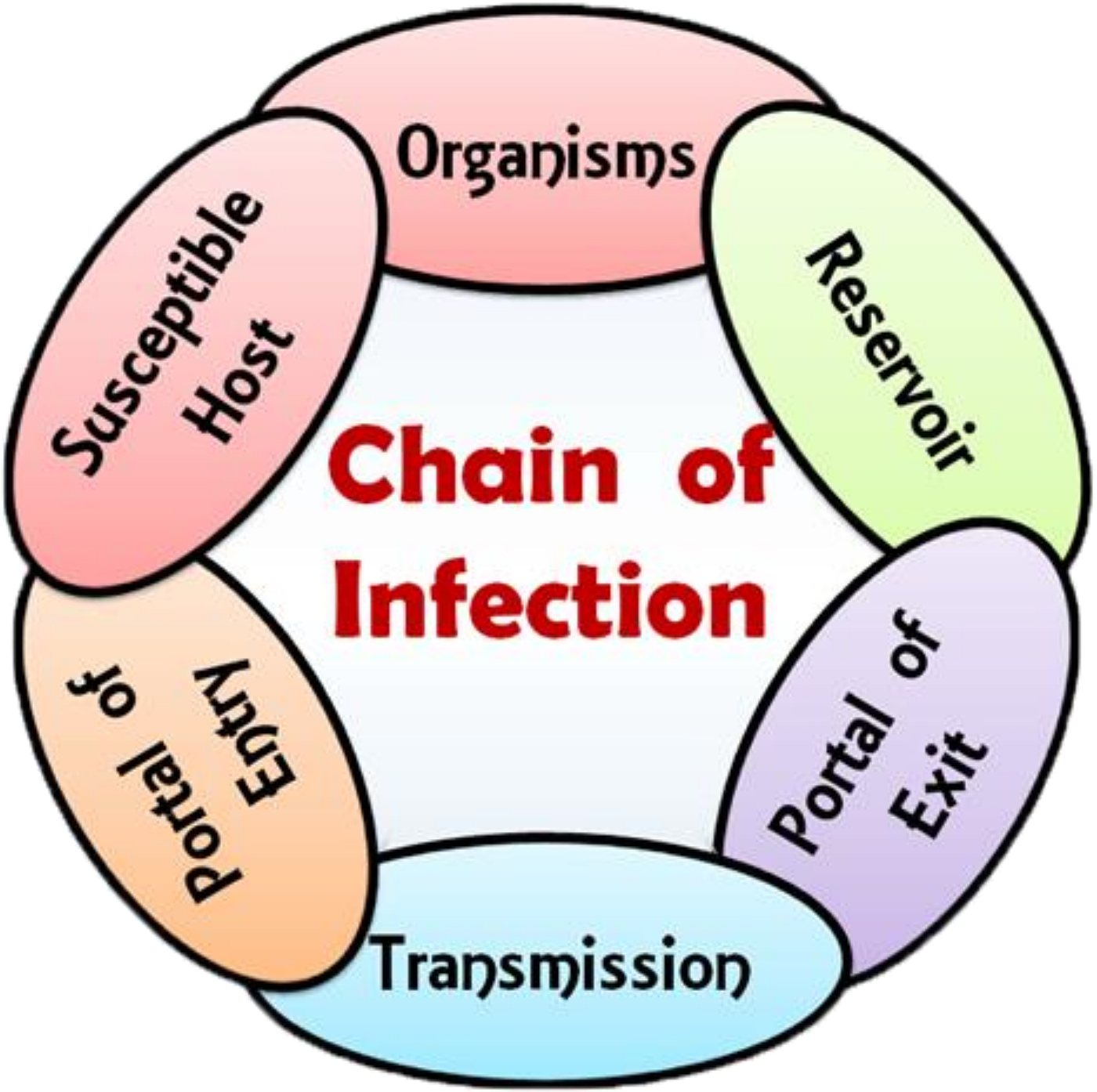
NUR 312 TEAM

Infection chain



Chain of infection

- 1. Causative agent
- 2. Infectious reservoir
- 3. Portal of exit from the reservoir
- 4. Mode of transmission
- 5. Portal of entry into the host
- 6. Susceptible host


Organisms
Reservoir
Portal of Exit
Transmission
Portal of Entry
Susceptible Host
Chain of Infection

1- Causative agent

- The causative agent for infection is any microorganism capable of producing disease.
- Microorganisms responsible for infectious diseases include bacteria, viruses,
- rickettsiae, fungi, and protozoa. Sometimes, microorganisms are part of patient's own body flora and can cause infection in the immunocompromised host.

2- Reservoir of infection

- The second link in the chain of infection is the reservoir, i.e. the environment or object in or on which a microorganism can survive and, in some cases, multiply.
- objects, human beings, and animals can all serve as reservoirs, providing the essential requirements for a microorganism to survive at specific stages in its life cycle. *Pseudomonas* . survive and multiply in nebulizers and the hepatitis B virus (HBV) survives but does not multiply on the surface of haemodialysis machines.

- **Infectious reservoirs** in health care settings, may include everything from patients, visitors, and staff members to furniture, medical equipment, medications, food, water, and blood.
- A **human reservoir** may be either **a case** or a carrier. A case is a patient with an *acute clinical infection* while a carrier is a person who is colonized with a specific pathogenic microorganism but shows no signs or symptoms of infection. A carrier may have a *subclinical or asymptomatic* infection, e.g. Hepatitis B virus.

Carriers fall into four categories:

- An *incubatory carrier :*
- is one who has acquired the infection and has been incubating the illness but does not yet show symptoms.
- Incubation periods vary from one infectious disease to other .

- *A convalescent carrier:*

is in the recovery stage of an illness but continues to shed the pathogenic microorganism for an indefinite period, e.g. a patient who has had a Salmonella infection commonly sheds the organism in his faeces even after symptoms disappear.

- An *intermittent carrier:*

occasionally sheds the pathogenic microorganism from time to time, e.g. some people are intermittent carriers of *Staphylococcus aureus*.

A *chronic carrier:*

always has the infectious organism in his system, e.g. chronic carriers of hepatitis B virus.

- Carriers (especially when asymptomatic) may present a risk of transmission to susceptible patients in health care facilities because their illnesses go unrecognized and they and those around them are unlikely to take appropriate precautions against infection.

3- Portal of exit

- The portal of exit is the path by which an infectious agent leaves its reservoir. Usually, this portal is the site where the microorganism grows. Common portals of exit associated with human reservoirs include the respiratory, genitourinary, and gastrointestinal tracts, the skin and mucous membranes and the placenta (transmission from mother to fetus).

4- Mode of transmission

- The microorganism can be acquired by **inhalation** (through respiratory tract), **ingestion** (through gastrointestinal tract), **inoculation** (through accidental sharp injury or bites), **contact** (during sexual intercourse) and **transplacental transmission** (microbes may cross placenta from the mother to fetus).

- It is important to remember that ***some microorganisms use more than one transmission route*** to get from the reservoir to a new host.

- Of the six links in the chain of infection, the mode of transmission is the easiest link to break and is key to control of cross-infection in hospitals.

Contact transmission:

- Contact is the most common mode of transmission of infection in the health care settings. Contact transmission may be subdivided into direct contact, indirect contact, and contact with droplets that enter the environment.

- ***Direct contact:***

Direct contact refers to person-to-person spread of microorganisms through actual physical contact. Microorganisms with a direct mode of transmission can be transferred during such patient care activities as bathing, dressing changes, and insertion of invasive devices if the hands or gloves of health care worker (HCW) are contaminated. Diseases that spread by direct contact include scabies and herpes simplex (if direct contact with infected oral lesions or secretions occurs).

- ***Hand washing is the most effective way to prevent transmission by the contact route***.

- ***Indirect contact:***

Indirect contact occurs when a susceptible person comes in contact with a contaminated object. In health care settings, virtually any item could be contaminated with certain microorganisms, e.g. endoscopes, respiratory equipment, etc. Thorough cleaning, disinfection, and sterilization are essential in the health care setting to prevent nosocomial infection acquired from contaminated items and equipment.

Droplet transmission:

- Droplet transmission results from contact with contaminated respiratory secretions.
- A person with a droplet-spread infection coughs, sneezes, or talks, releasing infected secretions that spread through the air to the oral or nasal mucous membranes of a person nearby.

- Microbes in droplet nuclei (mucus droplets) can travel up to about 3 ft (1 m).
- Droplet transmission differs from airborne transmission in that the droplets don't remain suspended in the air but settle on surfaces. Examples of diseases spread by droplets include influenza, whooping cough, etc.

Airborne transmission:

- Airborne transmission occurs when fine microbial particles or dust particles containing pathogens remain suspended in the air for a prolonged period, and then are spread widely by air currents and inhaled.
- The tiny particles remain suspended in the air for several hours and may cause infection when a susceptible person inhales them. Examples of diseases spread by the airborne include pulmonary tuberculosis, Varicella, and measles

- **Modes of Infectious Disease Transmission:**

There are two sources of infection occurring in a hospital or health care setting:

Endogenous source:

The causative agent of the infection **is present in the patient** at the time of admission to the hospital as part of his/her normal flora but there are no signs of infection.

The infection develops during the stay in the hospital as a result of the patient's altered resistance or through introduction of microbes into normally sterile areas such as insertion of an intravenous catheter into a vein or from a surgical procedure.

Exogenous source:

Infection occurs from introduction of microbes into or on the patient from an **outside source.**

For example, the patient may acquire infectious agents from the hands of staff or from contaminated equipment and subsequently may develop an infection.

5- Portal of entry

- The portal of entry is the path by which an infectious agent invades a susceptible host. Usually, this path is the same as the portal of exit.
- For example, the portal of entry for tuberculosis and diphtheria is through the respiratory tract, hepatitis B and c is through the blood stream.

- Human Immunodeficiency Virus enter through the bloodstream or body fluids and Salmonella enters through the gastrointestinal tract.
- In addition, each invasive device, e.g. intravenous line, creates an additional portal of entry into a patient's body thus increasing the chance of developing an infection.

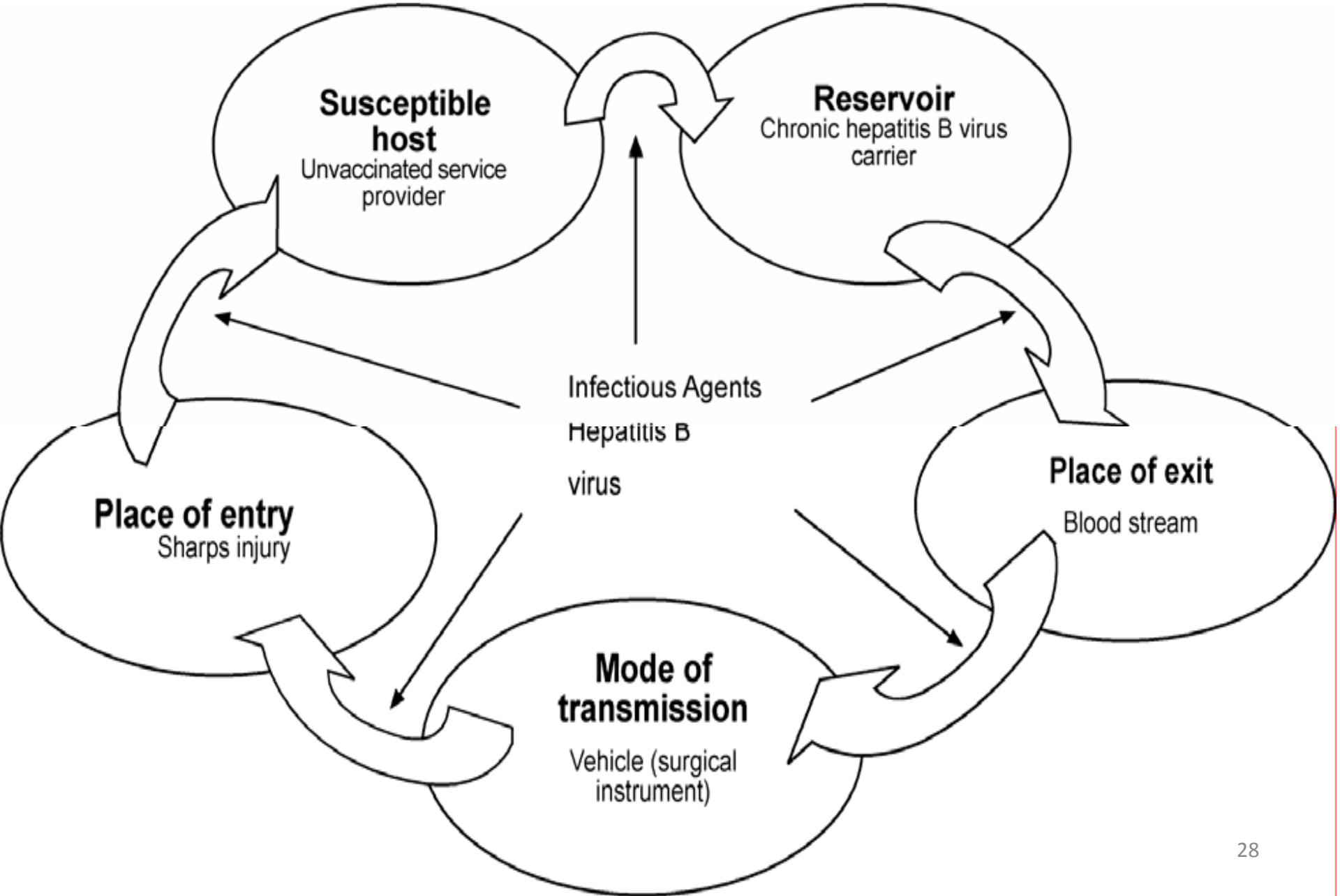
6- Susceptible host

- The final link in the chain of infection is the susceptible host.
- The human body has many defense mechanisms for resisting the entry and multiplication of pathogens.
- When these mechanisms function normally, infection does not occur.

- However, in immunocompromised patients, where the body defenses are weakened, infectious agents are more likely to invade the body and cause an infectious disease.
- In addition, the very young and the very old are at higher risk for infection because in the very young the immune system does not fully develop until about age 6 months, while old age is associated with declining immune system function as well as with chronic diseases that weaken host defenses.

- Antibody production then wanes. Impaired host defenses make patients more susceptible to infection.
- Conditions that may weaken a person's defenses include malnutrition, extremes of age, inherited and acquired immune deficiencies, chronic disease, immunosuppressive therapy, surgery and inadequate immunization.

An example of how hepatitis B may be transmitted in the health care setting


Susceptible host
Unvaccinated service provider
Reservoir
Chronic hepatitis B virus carrier
Infectious Agents
Hepatitis B
virus
Place of entry
Sharps injury
Place of exit
Blood stream
Mode of transmission
Vehicle (surgical instrument)

We eliminate the causative organism by several methods, including:

- Sterilizing surgical instruments and anything that touches sterile spaces of the body
- Using good food safety methods
- Providing safe drinking water
- Vaccinating people so they do not become reservoirs of illness
- Treating people who are ill

Actions we take to eliminate reservoirs include

- Treating people who are ill
- Vaccinating people
- Handling and disposing of body fluids responsibly
- Storing equipment dry
- Handling food safely
- Monitoring soil and contaminated water in sensitive areas of the hospital and washing hands carefully after contact with either

Actions we take to reduce risk from portals of exit include

- Covering coughs and sneezes with a tissue
- Handling body fluids with gloves, then doing hand hygiene
- Keeping draining wounds covered with a dressing
- Not working when you have exudative (wet) lesions or weeping dermatitis

Actions we take to eliminate the mode of transmission include

- Hand hygiene
- Wearing gloves to minimize contamination of hands and discarding them after each patient
- Maintaining Contact, Droplet and Airborne Precautions as indicated.
- Cleaning, disinfection, or sterilization of equipment used by more than one patient
- Cleaning of the environment, especially high-touch surfaces

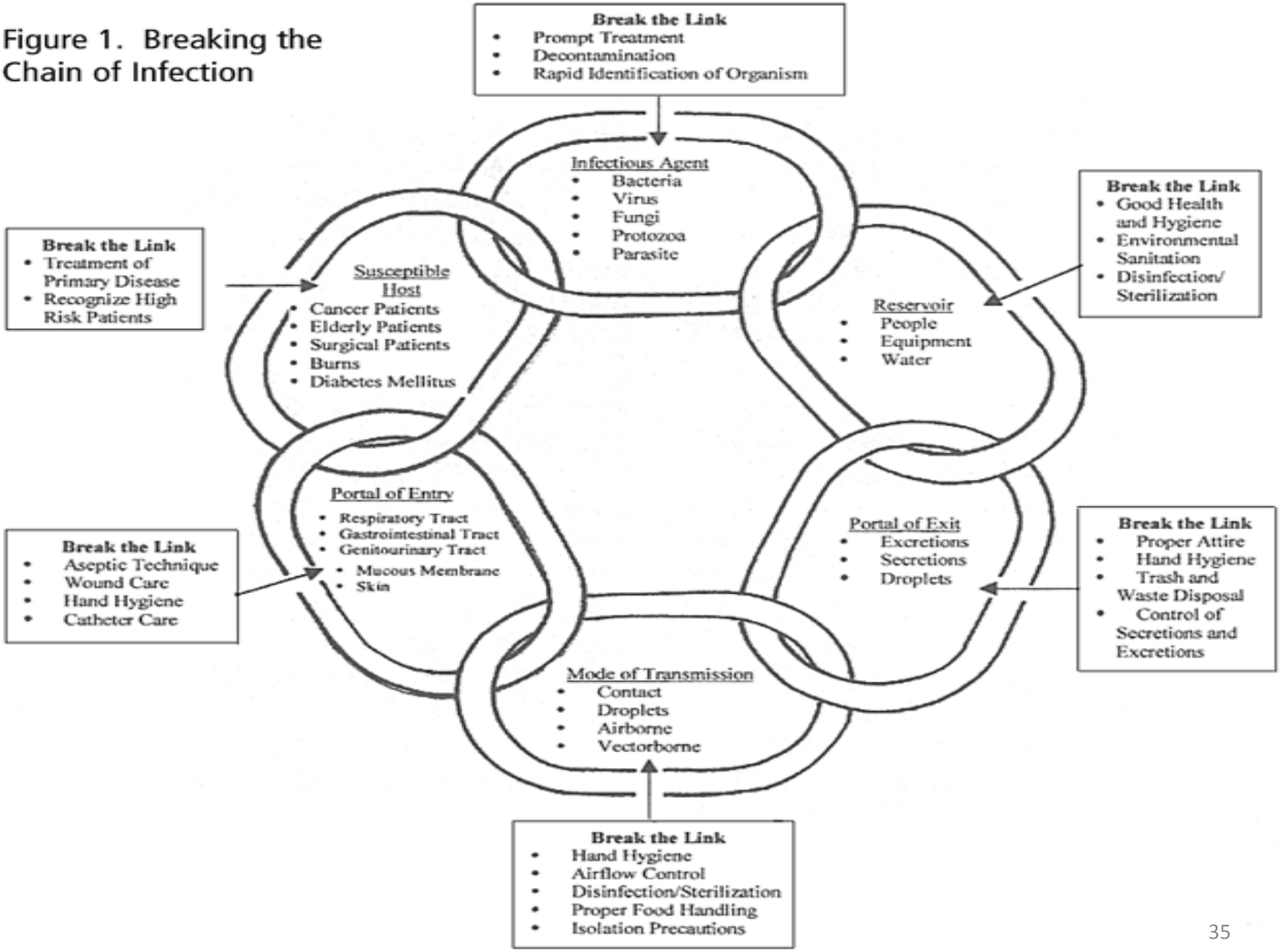
Actions we take to protect portals of entry (our own and our patients) include:

- Dressings on surgical wounds
- IV site dressings and care
- Elimination of tubes as soon as possible
- Masks, goggles and face shields
- Keeping unwashed hands and objects away from the mouth
- Actions and devices to prevent needlesticks
- Food and water safety

Actions we take to minimize risk to susceptible hosts include:

- Vaccinating people against illnesses to which they may be exposed
- Preventing new exposure to infection in people who are already ill, are receiving immunocompromising treatment, or are infected with HIV
- Maintaining good nutrition
- Maintaining good skin condition
- Covering skin breaks
- Encouraging rest and balance in our lives

Figure 1. Breaking the Chain of Infection



Three main factors determine whether the pathogen successfully causes infection

1. Susceptibility of the host
2. Amount of the pathogen.
3. The presence of all elements of the infection chain