Prevention of Nosocomial Infection in the Immunocompromised Patients

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Immunocompromised Patients

- Cancer
- AIDS
- Neoplastic disease: leukopenia
- Organ transplant recipients
- Use of corticosteroids
- Impaired cellular immune response
Risk Factors for Infection

- Age
- Malnutrition
- Invasive procedure
- Antibiotic therapy
- Immunocompromise
- Immunosuppression
- Presence of colonizing organisms
- Skin and mucous membrane integrity
Chain of Infection

- Infectious agent
- Host
- Portal of entry
- Reservoir
- Portal of exit
- Mode of transmission
Causative Agents

- Bacteria
- Viruses
- Fungi
- Protozoa
- Helminths
- Prions
Reservoir

- **Definition:**
  place in which an infectious agent can survive but may or may not multiply

- **Common reservoirs**
  - humans
  - animals
  - equipment/fomites
Human Reservoirs

- Persons with acute or subclinical illness

- **Carriers**
  - during incubation
  - convalescent carriers
  - chronic carriers
  - intermittent carriers
Portal of exit

- The path by which an infectious agent leaves the reservoir
  - respiratory tract
  - GU tract
  - GI tract
  - skin/mucous membrane
  - blood
  - transplacental
Mode of Transmission of NI

The mechanism for transfer of an infectious agent from a reservoir to a susceptible host

- **Contact transmission**
  - Direct contact
  - Indirect contact
  - Droplet spread
- **Common vehicle**
- **Airborne transmission**
- **Vector borne transmission**
Contact transmission

- **Direct contact**: person-to-person spread, actual physical contact

- **Indirect contact**: contact with contaminated intermediate object
Droplet transmission

- Large droplets are generated by an infected or colonized person during coughing, sneezing, talking, suctioning, etc.
- Droplets propelled a short distance < 3 feet...the “spit space”
- Droplets deposited on a susceptible host’s eyes, nasal mucosa or mouth
Airborne transmission

Droplet nuclei, dust particles or skin squames containing microorganisms are transmitted to a susceptible host by air currents.
**Common Vehicle transmission**

Microorganisms are transmitted to susceptible hosts from common items, e.g.

- food
- water
- medications
- devices/equipment
Vector-borne transmission

- Transfer of microorganisms by insects, flies, rats, or other vermin
- uncommon mode of transmission in hospitals
Portal of entry

The path by which an infectious agent enters the susceptible host

- Respiratory tract
- GU tract
- GI tract
- Skin/mucous membrane
- Parenteral
- Transplacental
Susceptible Host

A person lacking effective resistance to a particular pathogenic organism
Mechanism of Transmission

Agent → Environment → Host

Mode of Transmission
Agent

- Endogenous
- Exogenous
  - Food
  - Airborne
  - Environment
  - Water
  - Personnel

- Commensal
- Opportunistic
## Causes of Infection in Patients with Cancer

<table>
<thead>
<tr>
<th>Factor</th>
<th>Type of Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Malignancy</strong></td>
<td></td>
</tr>
<tr>
<td>Acute leukemia</td>
<td>Bacterial, fungal, viral</td>
</tr>
<tr>
<td>Multiple myeloma</td>
<td><em>S. pneumoniae</em></td>
</tr>
<tr>
<td></td>
<td><em>H. influenzae</em></td>
</tr>
<tr>
<td>Hodgkin’s disease</td>
<td>Viral, fungal</td>
</tr>
</tbody>
</table>
# Causes of Infection in Patients with Cancer

<table>
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<tr>
<th>Factor</th>
<th>Type of Infection</th>
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<tbody>
<tr>
<td><strong>Treatment</strong></td>
<td></td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>Bacterial, fungal, viral gram –ve colonization</td>
</tr>
<tr>
<td>Radiation</td>
<td>Altered skin integrity</td>
</tr>
<tr>
<td>Corticosteroids</td>
<td>Immunosuppression</td>
</tr>
<tr>
<td>Bone marrow transplantation</td>
<td>Bacterial, fungal, viral Pneumocystis carinii</td>
</tr>
</tbody>
</table>
**Most Frequent Bacterial Causes of Infections in Patients with Cancer**

<table>
<thead>
<tr>
<th>Gram positive</th>
<th>Gram negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corynebacterium spp.</td>
<td>Enterobacter spp.</td>
</tr>
<tr>
<td><em>Enterococcus fecalis</em></td>
<td><em>Escherichia coli</em></td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td><em>Haemophilus influenzae</em></td>
</tr>
<tr>
<td><em>Staph. Coagulase-negative</em></td>
<td><em>Klebsiella spp.</em></td>
</tr>
<tr>
<td><em>Streptococcus pneumoniae</em></td>
<td><em>Proteus spp.</em></td>
</tr>
<tr>
<td><em>Streptococcus pyogenes</em></td>
<td><em>Pseudomonas aeruginosa</em></td>
</tr>
<tr>
<td><em>Streptococcus viridans</em></td>
<td><em>Salmonella spp.</em></td>
</tr>
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</table>
Nosocomial Infection Sites

- Primary bloodstream infection
- Respiratory tract infection
- Urinary tract infection
- Surgical site infection
- Gastrointestinal tract infection
- Pyrexia cause of unknown origin
Infection Control Program

- NI Surveillance
- Isolation Precautions
- Disinfection & Sterilization
- Employee Health
- Patient Care Practice
- Microbiological Services
- Education and Training
- Environmental Control
- Community Coordination
- Research
Prevention of Nosocomial Infections in the Immunocompromised patients

- Assess risk of infection of patients
- Surveillance
- Hand hygiene
- Environmental control
- Education of patients and relatives
- Patient hygiene
- Employee health
Surveillance of Nosocomial Infections
The **systematic, active, ongoing** observation of the occurrence and distribution of NI within patients and of the events or conditions that increase the risk of NI occurrence.
Purposes of Surveillance

- Provide data that will guide efforts to reduce nosocomial infection rate
- Assess quality of care
Usefulness of Surveillance system

1. Detect NI in a timely way
2. Provide estimates of the magnitude of morbidity and mortality
3. Identify factors associated with the event
4. Detect trends including outbreaks
4. Assessment effect of prevention program
5. Lead to improved behavioral practices
6. Stimulate research intended to prevent NI
Surveillance

Action

Quality of care ↑

Infection rate ↓

Work load ↓
Essential Components of a Surveillance Program

- Define the population and type(s) of infections to be studied
- Collect data using systematic methods
- Consolidate data to aid in evaluation
- Analyze and interpret data
- Report results to those who can bring about change
Hand Hygiene
Ignac Semmelweis
1818-1865

- 1840’s: General Hospital of Vienna
- Divided into two clinics, alternating admissions every 24 hours:
  - First Clinic: Doctors and medical students
  - Second Clinic: Midwives

Maternal mortality, 1842
The Intervention:
Hand scrub with chlorinated lime solution

Hand hygiene basin at the Lying-In Women’s Hospital in Vienna, 1847.
Hand Hygiene: Not a New Concept

Maternal Mortality due to Postpartum Infection
General Hospital, Vienna, Austria, 1841-1850

Hand antisepsis reduces the frequency of patient infections
Microorganism on Hands

- Transient flora
- Resident flora
Definitions

- **Hand hygiene**
  Performing handwashing, antiseptic handwash, alcohol-based handrub, surgical hand hygiene/antisepsis

- **Handwashing**
  Washing hands with plain soap and water

Guideline for Hand Hygiene in Health-care Settings.
*MMWR 2002; vol. 51, no. RR-16.*
Hand decontamination levels

- Normal handwashing
- Hygienic antisepsis
- Surgical antisepsis
Normal handwashing

Objective:

Remove dirt and transient flora contaminating skin of medical-staff hands as a result of contact with infected or colonized patients and/or contaminated environmental objects
Hygienic antisepsis of hands
(Hygienic handwashing)

Objective:
Remove or kill transient micro flora on hands.

Indications:
- Before performing individual procedures
- Before working with especially susceptible patients or neonates
- Before and after procedures involving wounds or catheters
- Before and after donning gloves
- After contact with excreta or objects containing blood or probably contaminated with microbes
Surgical Hand Hygiene
(Surgical antisepsis)

Objective:
Remove or kill transient flora and reduce population of resistant flora.

Indications:
Before all surgical operations.
Surgical Hand Hygiene

- Use either an antimicrobial soap or alcohol-based handrub
- Antimicrobial soap: scrub hands and forearms for length of time recommended by manufacturer
- Alcohol-based handrub: follow manufacturer’s recommendations. Before applying, pre-wash hands and forearms with non-antimicrobial soap

Guideline for Hand Hygiene in Health-care Settings. 

*MMWR 2002; vol. 51, no. RR-16.*
Isolation Precautions

- Standard precautions
- Transmission-based precautions
  - Contact precautions
  - Droplet precautions
  - Airborne precautions
Hospital Personnel

- Hand hygiene with antiseptic soap or alcohol-based hand rub
- Daily screening or self-screening for symptoms of communicable disease
- Vaccination of HCWs for influenza
Environment

- Environmental surface
- Linen
- Plants and flowers
- Food and drinking water
- Water systems
- Dialysis
- Toys
- Air
- Construction
Environmental Control

- Cleaning should be performed by trained personnel
- Daily cleaning of frequently touched horizontal surfaces (avoid dry dusting and mopping)
- Reduce personal belongings or provide other storage areas
Linen

- Using standard linen handling and management
- Unnecessary to provide sterile linen for immunocompromised patients
Plants and Flowers

- Flowers and plants are known to harbor microorganisms.
- Vast water from fresh flowers has yielded gram negative bacilli, e.g. P. aeruginosa.
- Dried and fresh flowers and potted plants can harbor fungi e.g. aspergillus.
- Exclude plants and flowers, both fresh and dried from immunocompromised patient units.
Food and Drinking Water

- Immunosuppressive therapy
- Chemotherapy
- Radiation
- Antimicrobial Therapy
- H2 blockers
- Impaired intestinal motility
- Hematopoietic Stem Cell transplantation
- Solid organ transplant

Increased Risk of Food-borne Illness
Food and Drinking Water

- Low microbial diets
  - Restricting raw fruits and vegetables
  - Concern about contamination with gram negative bacilli

- Safe food preparation at home
  - Handwashing before handling food
  - Using clean utensils
  - Cooking to temperature recommended
Food and Drinking Water

Enteral feedings

- Has potential to become contaminated by bacteria
- Capable of causing severe infection, gastrointestinal colonization, nosocomial pneumonia
- Organisms cultured from enteral feeding included *S. epidermidis*, *S. aureus* and gram negative bacilli such as *Serratia, klebsiella*, and *Pseudomonas spp.*
Contamination of Enteral feeding

- Manipulation of the enteral feeding product and system during preparation and administration.
- Mixing enteral feeding on site results in more highly contaminated solutions compared with premixed feeds.
- Colony counts in enteral feedings increase with the hang time of product and the administration set.
- High risk patients should receive ready-to-feed enteral feeding via closed systems and administration sets should be changed every 24 hrs.
Water Systems

- Water quality can pose different risks for acquisition of infectious disease
- Interventions for testing and treatment of hospital water depend upon the water supply, susceptibility of patients, and historical outbreak information
Toys

- Risk of person-to-person transmission
- It is essential that all toys are cleaned and disinfected regularly and when visibly soiled or mouthed
- Only toys that are easily cleaned and disinfected are appropriate
- Appropriate toy cleaning involves scrubbing with soap and water to remove secretions and surface dirt, followed by disinfection with non-toxic disinfectant and need to be thoroughly rinsed with water
Air

- Private rooms with air filtration and positive pressure
- Well sealed windows
- At least 12 air changes per hour
- A HEPA (high efficiency particulate air) filtration system removes up to 99.97% of particles measuring > 0.3 micron from the air
Construction

- Substantial planning is required to protect patients from the fungal infections, primarily aspergillosis
- Containment measures necessary to protect at-risk populations include adequate barriers and negative pressure inside the construction site
Patients

- Many infections are caused by patient’s endogenous flora
- Maintaining good personal hygiene
- Good oral and dental hygiene
- Changing cleaned clothes regularly
- Daily showers using mild soap
- Inspection of skin integrity, especially perineum, peri-anal area and intravascular access sites
- Hand hygiene (both patients and family members)
Visitors

- Well-developed and strongly enforced policies to screen all visitors for symptoms of communicable illness, including:
  - Diarrhea
  - Vomiting
  - Fever
  - Conjunctivitis
  - Undiagnosed rash
  - Upper respiratory tract symptoms

- Decisions make on a case-by-case basis
  - (taking the patient’s medical status and emotional needs into account, as well as the family member’s ability to implement isolation techniques well enough to protect the patient)
Animals

- Rehabilitation medicine has advocated animal-assisted therapy to enhance physical, cognitive, and emotional participation in treatments.
- Pet therapy programs should be carefully considered.
Solid Organ Transplant (SOT)

- SOT patients are at risk for both HAI and opportunistic infections
- Type of organ transplant, immunosuppression level and time lapsed post-transplant are factors that influence infection risk
- Thorough pre-operative history and assessment may predict opportunistic infection risk
- Standard precautions, including hand hygiene, and isolation precautions are key to preventing HAI
Post-Transplant Risk Factors for Infection

- Bacterial or fungal colonization of the respiratory tract
- Frequent or prolonged exposure in the healthcare system
- Severity of illness prior to surgery
- Longstanding malnutrition
- Patient age
- Disruption of physical barriers (e.g. surgery, intravascular catheters)
Infections in SOT Patients

- **Bacterial**
  - MRSA, VRE, Clostridium difficile, Legionella, M.tuberculosis, atypical mycobacterium, pseudomonas

- **Fungi**
  - Candida, Aspergillus, Cryptococcus, Pneumocystis carinii

- **Endemic mycoses**
  - Histoplasmosis, Blastomycosis, coccidioidomycosis

- **Viruses**
  - Cytomegalovirus, Herpes simplex virus, Varicella zoster virus, Epstein-Barr virus, Hep B, Hep C, Adenovirus, respiratory syncitial virus, Influenza
Infection Control

- Monitoring infection rates
- Post-transplant immunizations
- Environmental control measures
- Patient education
Monitoring Infections

- Bloodstream infection
- Surgical site infection
- Pneumonia
- Urinary tract infection
Post-transplant immunizations

- Live-virus vaccines are not recommended
- Killed immunizations are recommended for both adult and pediatric transplant recipients: Hepatitis A and B if negative serostatus, Influenza
- SOT recipients should receive influenza vaccine annually
Patient education

Infection control education to prevent opportunistic infection should be addressed with SOT recipients prior to discharge.

- Avoid contact with persons with URI
- Food preparation safely
- Avoid raw seafood
- Avoid construction sites
- Decreasing molds in household
- Monitoring of infection
- Good handwashing techniques
Thank You