

# Infection v. Colonization

Multi Drug-Resistant Organisms Management in Long Term Care  
Facilities Workshop

Louisiana Office of Public Health  
Healthcare-Associated Infections Program

## Colonization

- The presence of microorganisms in or on a host with growth and multiplication but without tissue invasion or damage
- Understanding this concept is essential in the planning and implantation of epidemiological studies in a healthcare infection prevention and control program
- Confusing colonization with infection can lead to spurious associations that may lead to expensive, ineffective, and time-consuming interventions
- Colonization may become infection when changes in the host occur

## Objectives

By the end of the presentation, attendees will be able to:

- Define colonization
- Differentiate colonization from infections
- Apply appropriate laboratory test by common LTC infectious agents
- Understand the necessity of communicating infectious status upon patient transfer

## Colonization: Definition

- **Colonization:** presence of a microorganism on/in a host, with growth and multiplication of the organism, but without interaction between host and organism (no clinical expression, no immune response).
- **Carrier:** individual which is colonized + more
- **Subclinical or unapparent infection:** presence of microorganism and interaction between host and microorganism (sub clinical response, immune response). Often the term colonization is applied for relationship host-agent in which the immune response is difficult to elicit.
- **Contamination:** Presence of a microorganism on a body surface or an inanimate object.

## Carrier

A carrier is an individual that harbors a specific microorganism in the absence of discernible clinical disease and serve as a potential source of infection. A carrier may be an individual who is:

- colonized
- infected and asymptomatic
- in incubation period before disease
- convalescent from acute disease

The carrier status may be short or lengthy.

**Think about carrier as**

- Source
- Explanation for person who apparently is not infected

## Spectrum: No Exposure - Exposure - Colonization - Infection - Disease

Host + Infectious agent

→ No foothold: Exposed

→ Foothold, no reaction

Colonization

Carrier

→ Foothold: epithelial attachment

→ Multiplication: Infection

→ Direct cytotoxicity

→ Toxins

→ Tissue disruption

→ Tissue injury

→ Dissemination

→ Asymptomatic

→ Symptomatic

**What is "Exposed" ?**

• Means of transmission:

Being in the same room as an infectious tuberculous patient or with a person with HIV

• Specific information:

Eating a meal or eating the contaminated food item?

Exposure definition relies on information that may not be all known.

## Infection

- The replication of organisms in host tissue which may cause disease
- **Infection**: defines the entrance and development of an infectious agent in a human or animal body, whether or not it develops into a disease
- Caused by an **infectious agent**: all micro- or macro-organisms capable of producing an infection or an infectious disease
- **Infectious disease**: an illness caused by a specific infectious agent or its toxic product that results from transmission of that agent or its product from an infected person, animal, or reservoir to a susceptible host

## Flora at Colonization Sites

### OROPHARYNX

*Streptococcus viridans* group

*Streptococcus pyogenes*

*Streptococcus pneumoniae*

Staphylococci

*Moraxella catarrhalis*

*Neisseria* spp

*Corynebacterium* spp

*Haemophilus* spp

Anaerobes: *Bacteroides*

*Candida albicans*

### NASOPHARYNX

Staphylococci

Streptococci

*Moraxella catarrhalis*

*Neisseria* spp

*Haemophilus* spp

### CONJUNCTIVA

Staphylococci

*Corynebacteria*

*Haemophilus*

### SKIN

Staphylococci

*Corynebacteria*

*Propionibacteria*

*Candida*

*Malassezia furfur*

### UPPER INTESTINE

Streptococci

*Lactobacillus* spp

*Candida* spp

### GENITOURINARY TRACT

Staphylococci, Streptococci

*Enterococci*

*Lactobacillus* spp, *Corynebacterium*

*Neisseria* spp, Anaerobes

*Candida albicans*

### LOWER INTESTINE

Aerobic G- bacilli: *E. coli*, Klebs

*Enterobacter*, *Proteus*, *Serratia*

*Providencia*, *Bacteroides*, Anaerobic

*Enterococci*, *Streptococci*, *Candida*

### Skin Hand Flora


**RESIDENT FLORA**

- Survives on the skin more than 24 hours
- Not easily removed, hours of scrubbing
- Complete sterilization impossible
- Low virulence
- Staphylococci, diptheroi
- mostly Gram + ,
- very few Gram -

**Humans sheds # 300,000,000 squames/day (4 to 25 mm) able to carry bacteria**

**TRANSIENT FLORA**

- Survive on skin less than 24 hours
- Easily removed with soap and water
- Acquired during contacts with contaminated areas mouth, nose, perineal area, genitals, anal area, catheter, bedpan, urinal, patient care casual contact
- May have high virulence
- Enterobacteria*, Gram - bacilli, *Pseudomonas*...



### Colonization Protects the Host

Normal flora protects against infectious diseases originating at mucous membranes.


There are several mechanisms for protection:

- Non specific stimulation of immune responsiveness
- Specific cross reactive immunization
- Competitive bacterial interference

**Germ free animals reared in good health succumb rapidly from overwhelming infection when transferred with normal healthy animals**

Number of bacteria to colonize gut	
⇒ Normal animal,	10,000,000
⇒ Germ free animal,	100

### Shifts in Colonization Flora



- General shift towards Gram-negative flora in hospitals, LTCF and other health care facilities
- Modification of the skin environment due to skin changes still poorly understood
- Invasive procedures provides portal of entry to different flora
- Antibiotic therapy:
  - In a study of patients on ampicillin long term Rx, 90% colonized by ampicillin-resistant *Enterobacteriae*, controls only 10%

### Clinical Infection

**Clinical infection:** Clinical infection may result in signs and symptoms. Some of these may be less obvious or very minor. At the end of the spectrum is the individual with no sign, no symptoms who has a asymptomatic infection or subclinical infection.

**Asymptomatic infection** does not mean that "all is quiet". It may cover some very active processes as in the asymptomatic phase of HIV infection, tuberculosis infection, hepatitis B carrier state.

## True Infection NOT Colonization

# 1

- Infections are accompanied by signs and symptoms:
  - → fever, malaise
  - → in localized infections: swelling due to inflammation, heat, pain, erythema (tumor, dolor, rubor, calor)
- Use definitions which establish minimum characteristics for infection
- **Remember:** Immunocompromised patients do not show signs of infection as normal patients. Neutropenic patients ( $\leq 500$  neutrophils/mm<sup>3</sup>) show no pyuria, no purulent sputum, little infiltrate and no large consolidation on chest X-ray

## Sufficient Time to Develop Infection

# 3

- diseases with specific incubation period: stay in hospital  $\geq$  incubation period
- numerous infections do not have well set incubation periods (for example, staphylococci, *E.coli* infections)
  - these infections rarely develop in less than **2 days**
- NHSN criterion: Infection present after the 3rd hospital day (day of hospital admission is day 1).

## NO Infection at Time of Admission

# 2

- **establish prior negativity**
- check history, symptoms and signs
- documented at time of admission, lab tests & chest X-rays done
  - normal physical examination
  - absence of signs and symptoms
  - normal chest X-ray
  - negative culture or lack of culture

Excluded:

- Transplacental infections
- Reactivation of old infections (ex Shingles)
- Infections considered extensions of infections present at admission

Example: If urine cultures are collected at day 7 of hospitalization and none was collected before, it implies that no signs of infection were present in urine before

## Methicillin-Resistant *Staphylococcus aureus* (MRSA)

### Colonization

- Approximately 30% of the population is colonized with MRSA
- Organism lives on the skin for long periods of time generally in warm, damp, dark areas of the body
  - Nose
  - Throat
  - Armpits
  - "South of the border"

### Infection

- Occurs when a bacterial strain undergoes uncontrolled growth
- Can be localized to a specific area such as a wound or spread through the bloodstream (bacteremia)

## *Clostridium difficile* (CDIFF)

### Colonization

- Asymptomatic
- CDIFF is detected in the absence of symptoms of infection
- The number of colonized patients is higher than symptomatic CDI cases among hospital patients
- Absence of diarrhea without colonoscopic histopathologic findings of pseudomembranous colitis and
  - Detection of CDIFF or
  - Presence of CDIFF toxins

### Infection

- Presence of diarrheal symptoms (3+ unformed stools in 24h)
  - Stool tests positive for CDIFF toxins or
  - Detection of toxigenic CDIFF or
  - Colonoscopic findings demonstrating ulcerative colitis

**No tests of cure!!!!**

## Vancomycin-resistant Enterococci (VRE)

### Colonization

- Acquired by susceptible hosts in an environment with a high rate of patient colonization with VRE, e.g. intensive care units, oncology units
- Can lead to infection depending on the health of the patient

### Infection

- Weakened hosts have an increased likelihood of developing infection following colonization
- PCR is used to detect infections and outbreaks

## Carbapenem-resistant Enterobacteriaceae (CRE)

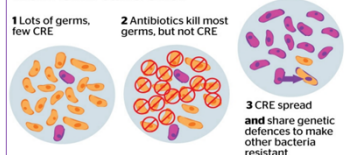
### Colonization

- Organism can be found on the body but is not causing any symptoms or disease
- Strains can go on to cause infections in sterile sites of the body
- Generally colonized in the GI tract

### Infection

- Cause infections when they enter the body through medical devices like central lines, urinary catheters, or wounds
- Treatment options include tigecycline, colistin, and polymyxin B

### How CRE take over



## Urinary Tract Infections

- The prevalence of asymptomatic bacteriuria (ASB), bacterial colonization of the urinary tract without local signs or symptoms of infection, ranges from 23-50% in non-catheterized NH/SNF residents to 100% among those with long-term urinary catheters.
- Differentiating ASB from symptomatic UTI can lead to inappropriate antibiotic use and its related complications.
- High prevalence of ASB and the challenges with diagnosing symptomatic UTI in NH/SNF residents have led to antibiotic overuse in this population.
- Overuse increases the likelihood of adverse events and complications of previous antibiotic treatment (e.g., CDI) along with emergence, transmission, and acquisition of MDROs.
- Appropriate diagnosis and management of symptomatic UTI is a critically important issue in the NH/SNF setting.

## Urinary Tract Infections

- Recommendations
  - Do not text asymptomatic patients
  - Urine is not sterile
  - Bacteria are present at low levels in the urine of healthy people not suffering from a urinary tract infection

### Seek and ye shall find...

Inappropriate surveillance of urinary tract infections	Appropriate surveillance of urinary tract infections
Screening all patients' urine, regardless of presence of symptoms, upon admit to the facility. If organisms are identified, you will be compelled to treat people who are not experiencing disease.	Test the urine of symptomatic persons (fever, dysuria, frequency, etc.) that you suspect have urinary tract infections.

## Testing Methods Summary

Organism	Testing Indication	Appropriate Specimen
MRSA	Wound infection with puss or drainage	Culture or molecular test of drainage
<i>Clostridium difficile</i>	Diarrheal episodes of 3 or more stools in a consecutive 24h period	Loose/watery stools that form to the shape of the container
CRE	Depends on site of infection, but generally aches, pain, fever	Varies depending on site of infection
VRE	Back pain, trouble urinating, fever, chills, body aches; red/warm wound with swelling and drainage	Culture of peri-rectal/anal swabs or stool specimens
MDRSP	Fever, chills, sweats, aches and pains, headache, malaise	Urine or sputum Gram stains or antigen tests – likely to be coordinated by an acute care hospital

## Multidrug-resistant *Streptococcus pneumoniae* (MDRSP)

### Colonization

- Asymptomatic nasopharyngeal colonization
- Resistant to penicillin and other broad-spectrum agents such as macrolides and fluoroquinolones
- Prevention is primarily through Pneumococcal vaccines against the bacteria *Streptococcus pneumoniae*

### Infection

- Causes invasive diseases such as sepsis, meningitis, and pneumonia

## Transferring patients to other facilities

- Implement systems to designate patients known to be colonized or infected with a targeted MDRO
- Notify receiving healthcare facilities and personnel prior to transfer of such patients within or between facilities

**Inter-facility Infection Control Transfer Form**

This form must be filled out by the facility to receiving facility with admission information prior to or with transfer. Please attach copies of latest culture reports with susceptibilities (if available).

Sending Healthcare Facility: Patient Resident Last Name: \_\_\_\_\_ First Name: \_\_\_\_\_ Date of Birth: \_\_\_\_\_ Medical Record Number: \_\_\_\_\_

Name/Address of Sending Facility: \_\_\_\_\_ Sending Unit: \_\_\_\_\_ Sending Facility phone: \_\_\_\_\_

Sending Facility Contact: NAME: \_\_\_\_\_ PHONE: \_\_\_\_\_ E-mail: \_\_\_\_\_

Centr. Manager: Address: \_\_\_\_\_ Infection Prevention: \_\_\_\_\_

Is the patient currently in isolation?  NO  YES  
Type of Isolation (check all that apply)  Contact  Droplet  Airborne  Other: \_\_\_\_\_

Does patient currently have an infection, colonization OR a history of positive culture of a multidrug-resistant organism (MDRO) or other organism of epidemiological significance?

Methicillin-resistant <i>Staphylococcus aureus</i> (MRSA)	Colonization or history	Active infection
<i>Vancomycin-resistant Enterococcus</i> (VRE)	Check # YES	Check # YES
<i>Clostridium difficile</i>		
<i>Acinetobacter</i> , multidrug resistant*		
<i>E. coli</i> , <i>Klebsiella</i> , <i>Pseudomonas</i> , or Extended Spectrum $\beta$ -Lactamase (ESBL)*		
Carbapenem resistant <i>Enterobacteriaceae</i> (CRE)*		
Other:		

Does the patient/resident currently have any of the following?

<input type="checkbox"/> Cough or severe sneezing	<input type="checkbox"/> Central line/PICC (approx. date inserted: ___/___/___)
<input type="checkbox"/> Diarrhea	<input type="checkbox"/> Hemodialysis catheter
<input type="checkbox"/> Wound	<input type="checkbox"/> Urinary catheter (approx. date inserted: ___/___/___)
<input type="checkbox"/> Abscess/drainage of urine or stool	<input type="checkbox"/> Suprapubic catheter
<input type="checkbox"/> Open wounds or wounds requiring dressing changes	<input type="checkbox"/> Percutaneous gastrostomy tube
<input type="checkbox"/> Drainage (nasal)	<input type="checkbox"/> Tracheostomy

Is the patient/resident currently on antibiotic?  NO  YES:  
Antibiotic and dose: \_\_\_\_\_ Treatment for: \_\_\_\_\_ Start date: \_\_\_\_\_ Anticipated stop date: \_\_\_\_\_

## General recommendations for all healthcare settings

- Make MDRO prevention and control an organizational patient safety priority
- Implement systems to communicate information about reportable MDROs to state public health authorities
- Support participation of the facility in coalitions to combat emerging or growing MDRO problems
- Provide education and training on risks and prevention of MDRO transmission during orientation and periodic educational updates for healthcare personnel
- Monitor antimicrobial susceptibility reports

## Summary

- Infection means that germs are in or on the body and make you sick, which results in signs and symptoms such as fever, pus from a wound, a high white blood cell count, diarrhea, or pneumonia.
- Colonization means germs are on the body but do not make you sick. People who are colonized will have no signs or symptoms.
- Judicious surveillance and screening practices are essential to antibiotic stewardship
- Although MDROs cause concern, they may be managed appropriately across a spectrum of provider types

## Patient Placement in LTCFs

- When single-patient rooms are available, assign priority for these rooms to patients with known or suspected MDRO colonization or infection
- Give highest priority to these patients who have conditions that may facilitate transmission, e.g. uncontained secretions or excretions
- When single-patient rooms are not available, cohort patients with the same MDRO in the same room or patient-care area
- When cohorting patients with the same MDRO is not possible, place MDRO patients in rooms with patients who are at low risk for acquisition of MDROs and associated outcomes from infection and are likely to have short lengths of stay

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