

## *Nosocomial Infections*

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*“We are discharging Mr. SR to your facility for recuperation and transition after his third admission to our hospital. He was in our hospital for 8 days with a leg wound that is now stable but is still draining a little and will require daily dressing changes. The infection is under control, and he will require a full course of antibiotics. Oh, by the way, he has ‘MRSA’ in the wound!”*

**T**he Latin word “nosocomium” means “hospital.” Nosocomial infections are acquired by patients during an admission to a hospital or other health care facility. These microorganisms are usually resistant to several commonly used antibiotics. These organisms were once limited to large hospitals but have now become ubiquitous in health care facilities throughout the USA. To make matters much worse, some of these organisms are now seen in the general community with alarming frequency.

### **Nosocomial Infections and Homeless Persons**

The rising number of homeless and marginally housed individuals in our urban and rural communities has been mirrored by increasing numbers of homeless individuals admitted to hospitals. These individuals are often discharged to skilled nursing care facilities, group homes, homeless shelters, and the streets. It is very likely that your facility has an individual recently discharged from a hospital or other health care setting, often with continuing and complicated health care needs.

In most homeless service facilities, individuals have contact with others, often in crowded living conditions. Such overcrowding, combined with less than optimal hygiene practices, fosters the spread of resistant nosocomial organisms to other individuals.

In these situations, clinicians should be familiar with the possible organisms the patients may have acquired while in the hospital or other health care settings (e.g. a nursing home) and how they can affect you, your staff, and other residents of your facility.

### **Mode of Transmission**

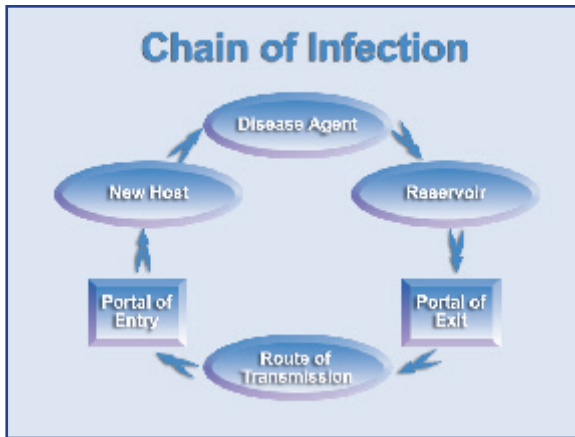
A review of the concept of the “Chain of Infection” helps to explain how patients acquire nosocomial organisms.

A causative or infectious agent is a “bug” that causes disease. This can be a bacteria, virus, parasite, or fungus. The agent usually requires a reservoir in which it survives and multiplies. For most nosocomial infections, the reservoirs for infectious agents are other patients in the hospital or nursing

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*Methicillin Resistant Staphylococcus Aureus. This sputum smear shows Gram positive organisms in clusters, and the culture and sensitivity later showed Staphylococcus aureus resistant to methicillin. Photo courtesy of the CDC*

Figure 1:



home. The “reservoir” patients may have signs and symptoms of the infection or may be silently colonized with the organism and exhibit no symptoms. Infectious agents can survive for long periods of time in certain environmental reservoirs (e.g. water supply, hands, surfaces of objects).

The infectious agent can be found in body secretions such as wound drainage, in excretions such as stool or urine, or in other body fluids such as blood. The agent escapes the reservoir through a portal of exit. Such portals can be any of the openings of the human body, especially the nose, mouth, and rectum. After exiting the reservoir, the organism must find another person or host in which to live. This passage is called the mode of transmission. For most nosocomial infections discussed in this chapter, the common mode of transmission is direct spread from person to person by infectious agents carried on the hands. Some organisms may be indirectly spread through contact with contaminated objects, such as medical equipment or personal care items. These organisms enter the new host via a portal similar to the portal of exit (e.g. mouth, nose).

The fate of the infectious agent is determined by the competency of the host’s immune system. The nosocomial organism infects the new host and either causes disease or results in colonization. Signs and symptoms accompany disease, while colonization does not make people feel ill. In either case, the newly infected or colonized host harbors the agent and serves as a reservoir. The chain of infection can thus continue.

The chain of infection can easily propagate in shelters and respite care programs. Guests, residents, visitors, and staff members can unknowingly harbor nosocomial organisms. Close direct contact and exposure to body fluids or contaminated equip-

ment can result in the transfer of the organism from one person to another if proper infection control precautions are not followed.

### Diagnosis

Patients with symptomatic infections are diagnosed in the usual manner, with cultures and specific tests to isolate and identify the causative agents. In contrast, colonization with nosocomial organisms is detected by performing surveillance cultures, since these individuals are unaware that they have been infected. Specific microbiological tests are able to detect the presence of these organisms in body fluids and excretions. Most hospitals now perform routine surveillance testing of asymptomatic inpatients to specifically look for these organisms. Infected patients are identified and appropriate infection control measures instituted.

We recommend that clinicians seek specific information about possible nosocomial organisms whenever someone is discharged to a respite care program or shelter setting after a long and complicated hospitalization. These individuals have a very high likelihood of acquiring nosocomial infections.

### Common Nosocomial Organisms

#### *Methicillin Resistant Staphylococcus Aureus (MRSA)*

MRSA is a cousin of the regular “staph” that causes many skin and soft tissue infections. This organism has acquired resistance to commonly used antibiotics such as dicloxacillin (Dynapen™) and cephalexin (Keflex™). In many parts of the country, the number of patients in the hospital either colonized or infected with MRSA has grown dramatically in the last two decades.

MRSA is commonly found on the skin, in wounds, and in the nose. The organism is spread by direct contact with body secretions and is rarely transmitted via contaminated surfaces. MRSA is most frequently carried from one patient to the next on the unwashed hands of health care workers.

Infection with MRSA is commonly treated with intravenous antibiotics such as vancomycin (Vancocin™). Newer (and very expensive) antibiotics, such as linezolid (Zyvox™), can be used to treat this organism when vancomycin fails. Active infection is usually treated initially with intravenous antibiotics, followed by a course of oral antibiotics. These oral antibiotics include minocycline (Minocin™), trimethoprim-sulfamethoxazole (Bactrim™, Septra™), clindamycin (Cleocin™), and rifampin (Rifadin™, Rimactane™).

Several outbreaks of MRSA skin and soft tissue infections have occurred among people who have neither been hospitalized nor had any formal contact with any health care facilities. This “community-associated MRSA” is on the rise in several places around the country and represents a shift in how we approach this organism. It is important to keep this in mind when dealing with infections that are not healing or worsening while the patient is being treated with commonly used antibiotics.

#### *Vancomycin Resistant Enterococcus (VRE)*

VRE is a Gram positive bacterium that can cause serious infections in hospitalized patients. In the past, virtually all Enterococcus organisms were sensitive to vancomycin. However, resistance to this antibiotic has been increasing, and VRE has become a major nosocomial organism.

VRE is less common than MRSA and usually colonizes the intestines (gut) without causing any disease. Commonly found in stool, VRE is spread in a similar way to MRSA through direct contact via the unwashed hands of health care workers. VRE can also be spread by contact with contaminated surfaces or medical equipment. Rarely, VRE can be found in other bodily fluids such as urine and wounds.

VRE can cause life-threatening infections in patients who are already ill from other diseases. These infections are notoriously difficult to treat. Certain new and very expensive antibiotics, such as quinupristin/dalfopristin (Synercid™) and linezolid (Zyvox™) have been used with some success.

#### *Clostridium Difficile (C. diff)*

- *Clostridium difficile (C. diff)* is a bacterium that causes diarrhea. These bacteria are most commonly associated with diarrhea that occurs during or after the use of antibiotics.
- In many instances, the gut is colonized with *C. diff* and causes no symptoms. The presence of the bacteria is found only when the stool is specifically cultured for it. In some instances, the bacteria secrete a toxin that causes severe diarrhea.
- *C. diff* is also spread by direct contact via the hands of health care workers that have been in contact with contaminated feces or surfaces.
- Diarrhea from *C. diff* can be treated with a commonly used antibiotic, metronidazole (Flagyl™). Occasionally, this treatment



Handwashing as Prevention. Alcohol-based gel solutions are more effective and easier-to-use than soap and water. Staff members at McInnis House use Calstat™ upon entering and leaving each patient room. Photo by James O'Connell MD

fails, and the oral preparation of vancomycin (Vancocin™) may have to be used. The treatment of *C. diff* diarrhea is the only current indication for the use of oral vancomycin.

#### **Prevention and Control**

National guidelines have been issued by the Centers for Disease Control and Prevention (CDC) and other agencies concerning the control of infections caused by these nosocomial organisms.

The most effective preventive technique is the practice of excellent hand hygiene. This refers to the age-old method of washing hands with soap and water and the newer method of disinfecting the hands with an alcohol-based gel solution, such as Calstat™, GelSan™, and Purell™. The gel solutions have become very popular in hospitals and nursing homes, as recent studies have demonstrated their effectiveness in the prevention of transmission of organisms. The hands can be cleansed and air-dried in a very short period of time. The gel solutions appear to be more effective than washing hands with soap and water, and we are more likely to use the gel rather than the traditional soap and water. At Massachusetts General Hospital and at the Barbara McInnis House in Boston, dispensers of Calstat™ are placed at the entry to each patient care room, and clinicians are expected to perform hand hygiene when entering and leaving each room.

“Contact Precautions” are the most common practice utilized for the control of nosocomial organisms in hospitals and other health care facilities. Patients are usually placed in a private room with a “Contact Precautions” sign on the door. All visitors and health care workers entering the room are required to wear gowns and gloves while interacting with each patient and the immediate environment. Hand hygiene is performed after removing gowns and gloves and upon leaving the



room. Wounds are kept covered, and exposure to body fluids is minimized. Daily cleaning of each room helps to minimize contamination. Certain items, such as rectal thermometers, blood pressure cuffs, and stethoscopes are used exclusively for one patient and are kept in the room.

Considerable controversy surrounds the effectiveness of current prevention and control methods used in hospitals and health care facilities. First, surveillance cultures on all (or a random selection) of inpatients is recommended by some authorities to screen for the presence of nosocomial organisms. This is very expensive and time-consuming, and not all hospitals have the capacity and resources to follow this recommendation. Second, contact precautions have been met with some mixed reactions. While many experts embrace contact precautions as the most appropriate way to control these resistant organisms, others have remained skeptical and have been less stringent in following all the recommendations. It is appropriate to check with your hospital and local health care providers regarding the precautions and protocols utilized for the prevention and control of nosocomial organisms.

### **Special Considerations for Homeless Populations**

Many different facilities care for homeless individuals and families, including shelters, transitional programs, and respite care programs, as well as hospitals and nursing homes. Only basic infection prevention and control activities can be performed in the large adult shelters that are common in many urban cities. Following a discharge from an acute care hospital, respite care programs and nursing homes may frequently care for homeless persons recovering from acute medical and surgical problems. Thus the incidence of nosocomial infections is undoubtedly higher in these facilities than in homeless shelters, and the need for infection control interventions is critically important.

The first principle of infection control is to practice good techniques for ALL patients, regardless of background, risk behaviors, or diagnosis. Surveillance cultures look specifically for nosocomial organisms such as MRSA or VRE and are very helpful in identifying specific patients who are colonized. Clinicians must nevertheless assume that all patients in any health care facility are potential carriers of these resistant organisms.

The level and intensity of infection control depends upon the staffing and resources available at each facility. If available, a private room is ideal for any patient with MRSA, VRE or *Clostridium*

*difficile*, especially when the care of the patient will involve exposure to bodily fluids. However, private rooms are often not available and impractical, and these patients may still be managed in multi-bed rooms as long as careful precautions are in place.

Only rudimentary or basic infection control techniques are possible in most shelter and other homeless settings. All staff members should be educated in the proper techniques for hand hygiene as well as the handling of bodily fluids.

The first and foremost step is to educate guests, residents, staff members, and visitors regarding infectious agents and cleanliness techniques. Everyone should become familiar with the “chain of infection” and the vocabulary surrounding nosocomial organisms. Open wounds should always be kept covered, and appropriate measures should be taken to dispose of soiled dressings. Patients with incontinence of stool and urine must be carefully managed, including the use of diapers whenever possible as well as not sharing personal care items. Housekeeping staff should use standard cleaning agents (with bleach) and should also have access to hospital-grade disinfectants. Soiled laundry should also be carefully handled (preferably with gloves) and can effectively be cleaned with standard laundry protocols. If procedures are performed in your facility, take appropriate precautions in anticipation of possible exposure to blood and other bodily fluids.

Last, and perhaps most importantly, hand hygiene remains the most important intervention and the cornerstone of infection control.

Remember...it's in your hands!!

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*We would like to thank our colleagues at Wasatch Homeless Health Care, Inc. and University of Utah Hospitals and Clinics who reviewed the chapter and made helpful suggestions. ■■*

### Nosocomial Infections Medication List

Generic	Brand	Cost
dicloxacillin	Dynapen	\$
cephalexin	Keflex	\$
linezolid	Zyvox	\$\$\$\$\$
minocycline	Minocin	\$
trimethoprim-sulfamethoxazole	Bactrim, Septra	\$
clindamycin	Cleocin	\$\$
rifampin	Rifadin, Rimactane	\$\$\$
vancomycin	Vancocin	\$\$\$\$
quinupristin + dalfopristin	Synercid	\$\$\$\$\$
metronidazole	Flagyl	\$

### References

Infection Control and Body Substance Precautions Manual. University of Utah Hospitals & Clinics:  
<http://uuhs.c.utah.edu/hospepi/icmanual.cfm>

Guidelines and Recommendations. Centers for Disease Control and Prevention.  
<http://www.cdc.gov/ncidod/hip/Guide/guide.htm>