

GUIDE TO INFECTION CONTROL IN THE HEALTHCARE SETTING

Horizontal vs Vertical Infection Control Strategies

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Topic Outline

Key Issue

Known Facts

Controversial Issues

Suggested Practice

- Active surveillance and testing (AST)

- Hand Hygiene

- Universal Decolonization

- Antibiotic Stewardship

- Environmental Cleaning

Suggested Practice in Under-Resourced Settings

Summary

References

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KEY ISSUE

- Healthcare-associated infections such as central line-associated bloodstream infections, catheter-associated urinary tract infections, ventilator-associated pneumonias, and surgical site infections represent a major challenge for healthcare today¹. These infections are often caused by multidrug-resistant organisms (MDROs) such as methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin resistant *Enterococci* (VRE), and carbapenem-resistant Enterobacteriaceae (CRE)¹. Strategies designed to prevent the spread of these infections can be grouped into two categories: vertical and horizontal. Vertical strategies focus on a single organism while horizontal strategies aim to control the spread of multiple organisms simultaneously².

KNOWN FACTS

- Active surveillance and testing (AST) is a vertical infection prevention strategy. Patients colonized with organisms such as MRSA, VRE, and CRE are identified by culturing (or using other diagnostic testing) at various anatomic sites such as the nares, axillae, and rectum. This may be followed by cohorting or isolating patients and the use of additional measures such as decolonization².
- Horizontal strategies include hand hygiene, universal decolonization, selective digestive tract decolonization, antimicrobial stewardship, and environmental cleaning².
- Vertical strategies are costly and their impact is short-lived. Horizontal strategies are utilitarian and cost-effective. Table 14.1 summarizes the key features of vertical and horizontal strategies².

Controversial Issues

- Though still in use, vertical strategies such as AST remain controversial (outside of outbreak settings)^{3,4}. A comparative effectiveness review of universal MRSA screening revealed a low strength of evidence associating universal screening with reductions in healthcare-associated MRSA infection; this same review did not reveal other screening strategies to be effective⁵.
- Universal decolonization is a popular horizontal infection prevention strategy. Chlorhexidine (CHG), the agent of choice, for patient bathing is generally well-tolerated and active against Gram-positive, Gram-negative, and fungal pathogens. Its widespread use raises concerns over the development of resistance, however. Genes implicated in CHG resistance include *qac A/B* among MRSA and *qac E* among *Klebsiella* species. Although resistance is a concern, at this point in time it is believed to be a rare phenomenon⁶. Of note, CHG resistance testing is not routinely performed and breakpoints have not been established by the Clinical and Laboratory Standards Institute (CLSI)⁷.
- Selective digestive tract decolonization (SDD) is a prophylactic strategy designed to reduce the gastrointestinal burden of *Candida* species, *S. aureus*, and Gram-negative organisms. Protocols vary and may combine intravenously administered antibiotics such as third and fourth generation cephalosporins with oral polymyxin E, amphotericin B, and vancomycin. Oral and rectal surveillance cultures are then performed at regular intervals to determine the effectiveness of SDD. While effective at reducing the gastrointestinal carriage of organisms, this strategy remains controversial due to concerns for the selection of multidrug-resistant organisms⁸

SUGGESTED PRACTICE

Horizontal and vertical infection prevention strategies have their pros and cons. While horizontal strategies are generally favored, vertical interventions are useful in certain situations. The choice of infection prevention strategies should be informed by local epidemiology.

Active surveillance and testing (AST)

- In most non-outbreak settings, the costs associated with AST outweigh their benefits. This includes direct costs as well as opportunity costs (in terms of personnel and financial resources).
- In outbreak settings AST can be useful in controlling the spread of organisms such as MRSA and CRE^{9,10}.

Hand Hygiene

- Hand hygiene is the most important of infection prevention strategies. This involves minimizing the spread of microorganisms between patients via the contaminated hands of healthcare workers. Hand hygiene may be implemented in conjunction with other strategies as part of a bundle¹¹.
- The World Health Organization recommends five moments of hand hygiene: before contact with patients, before performing aseptic procedures, after exposure to body fluids, following contact with patients and contact with patient surroundings (Figure 14.1)¹².

Universal Decolonization

- CHG is the most commonly used agent for decolonization. CHG bathing may be limited to high acuity areas such as ICUs or implemented hospital-wide.
- Hospitals should formulate guidelines and bathing protocols and these should be made available to hospital staff. Compliance with CHG bathing should be monitored periodically. CHG resistance should be considered but testing is not routinely recommended⁷.

Antibiotic Stewardship

- According to a CDC estimate, 30-50% of antibiotics prescribed in the United States are unnecessary. Antibiotic stewardship programs (ASPs) can help reduce antibiotic exposure, lower rates of *Clostridium difficile* infections and minimize healthcare costs¹³. Most antimicrobial stewardship activities effect multiple organisms simultaneously and have as a primary goal the prevention of the emergence of antibiotic resistance. Thus, ASPs can largely be viewed in the context of horizontal infection prevention. Additionally, ASPs can contribute to the prevention of surgical site infections via the optimized use of surgical antibiotic prophylaxis.

Environmental Cleaning

- Surfaces of bedrails, nurse call buttons, television remote controls, and medical equipment may harbor organisms such as MRSA, VRE, *C. difficile*, *Acinetobacter* species, *Pseudomonas aeruginosa*, and norovirus, amongst others¹⁰.
- Staff who perform environmental cleaning should be dedicated to specific units to reduce the risk for cross-contamination. Thorough cleaning of commonly contaminated surfaces such as bedrails, bedside charts, medical equipment, and door knobs is recommended¹⁰.

- Units should be frequently monitored to ensure compliance with environmental cleaning practices.

SUGGESTED PRACTICE IN UNDER-RESOURCED SETTINGS

Infection control practices in under-resourced areas are often limited by access to human, technologic, and financial resources. Many under-resourced areas lack infection prevention infrastructure and guidelines on optimized infection prevention practices are often not available to hospital staff members. As a result, infection surveillance is often not performed consistently, perioperative prophylactic antibiotics are often not optimally administered, and hand hygiene is suboptimal, as well¹⁴.

- Infection control programs should be created and guidelines formulated. Guidelines should be made available to hospital staff members to help ensure consistency in practices.
- Educational programs should be designed to familiarize hospital staff with infection prevention guidelines.
- Infection prevention programs should collaborate with microbiology labs to find economical means for performing surveillance and other related tests.
- ASPs should be established to promote the judicious use of antibiotics.
- Adherence to measures such as hand hygiene, perioperative antibiotic administration, and the disinfection of equipment and patient care areas should be promoted. Local epidemiology and antibiograms should inform practices at individual centers.
- Periodic assessments should be informed to ensure compliance with guidelines.

SUMMARY

Strategies designed to prevent the spread of healthcare-associated infections can be grouped into two categories: vertical and horizontal. Vertical strategies focus on a single organism while horizontal strategies aim to control the spread of multiple organisms simultaneously. Horizontal strategies include hand hygiene, universal decolonization, selective digestive tract decolonization, antimicrobial stewardship, and environmental cleaning. Horizontal and vertical infection prevention strategies have their pros and cons. While horizontal strategies are generally favored, vertical interventions are useful in certain situations. The choice of infection prevention strategies should be informed by local epidemiology.

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Table 14.1: Vertical vs Horizontal Infection Control Strategies²

	Vertical	Horizontal
Focus	Single organism	Multiple organisms
Target population	Selective or universal	Universal
Cost	High	Relatively low
Philosophy	Exceptionalism	Utilitarian
Values Favored	Hospital, infection prevention experts	Patient
Temporal Focus	Present	Present, future