Environmental Sources of Transmission: Beyond high-touch surfaces (Floors, portable equipment, sinks)

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Objectives

- To appreciate the potential for floors, portable equipment, and clothing to contribute to transmission
- To be aware of recent developments in transmission of pathogens from healthcare facility water systems
Basic infection control practices

- Chlorhexidine bathing
- Hand hygiene, gloves, gowns
- Infected Patient
- Susceptible Patient
- Decolonization
- Environmental Cleaning

Hand hygiene, gloves, gowns

Environment
Question 1. Would you eat a mint from the floor of a cleaned C. diff room in your facility?

- A. Yes, I am confident that our cleaning and disinfection procedures eliminate *C. difficile* spores from floors
- B. Yes, if 3-second rule compliant
- C. Absolutely not
Are floors an under-appreciated source of transmission?

Deshpande A. Are hospital floors an underappreciated reservoir for transmission of health care-associated pathogens? Am J Infect Control 2017;45:336-8; Fekety R. Am J Med 1981;70:906-8 (floors frequently contaminated with *C. difficile* spores); Mutters R. J Hosp Infect 2009;71:43-8 (floors more heavily contaminated with *C. difficile* spores than hands of CDI patients or other environmental surfaces); Ali S. J Clin Microbiol 2015;53:2570-4 (floors in room and bathroom more heavily contaminated with *C. difficile* spores than other environmental sites); Lemmen SW. J Hosp Infect 2004;56:191-7 (floors frequently contaminated with multi-resistant gram-positive and gram-negative pathogens)
From floor to socks and shoes

MRSA sock print

MRSA shoe print

Use of benign surrogate markers to study pathogen transmission

Viral DNA  
(Cauliflower Mosaic Virus)

Live virus  
(Bacteriophage MS2)

Koganti S, et al. Evaluation of hospital floors as a potential source of pathogen dissemination using a nonpathogenic virus as a surrogate marker. ICHE 2016;37:1374-7 (bacteriophage MS2 disseminated from the floor to the hands of patients and to high-touch surfaces including the nursing station and shared portable equipment)
High-touch surfaces are often in contact with the floor

Deshpande A, et al. Are hospital floors an underappreciated reservoir for transmission of health care-associated pathogens? Am J Infect Control 2017;45:336-8 (41% of rooms surveyed had 1 or more high-touch objects in contact with the floor; contact with objects on the floor resulted in hand contamination)
Current floor cleaning methods may be ineffective

Floor cleaning: a neutral detergent was used and the solution and mop head was changed after every 3rd room

Cleaning and disinfection of floors can be more effective

Floor cleaning: a cleaner/disinfectant was used with multiple disposable mop heads used per room

Question 2. What goes from room to room contacting patients directly or indirectly, but is rarely cleaned?

- A. Hands
- B. Physicians’ white coats
- C. Stethoscopes
- D. Portable equipment

Interactions between hospitalized patients and portable equipment

MICU: ECG machines

Bleach on TV screen
Portable equipment as a vector for ward to ward transmission

Alhmidi H. SHEA 2018
Spores on wheels: Movement of wheelchairs within a hospital and LTCF

Jencson AL. SHEA 2018
Question 3. You have an outbreak of multidrug-resistant *Pseudomonas* in your ICU. Which would you consider as a potential source?

- A. Dirty laundry
- B. Contaminated stool softener
- C. Physician’s ties
- D. Contaminated sinks
Question 3. You have an outbreak of multidrug-resistant Pseudomonas in your ICU. Which would you consider as a potential source?

- A. Dirty laundry (Zygomycosis)
- B. Contaminated stool softener (B. cepacia)
- C. Physicians’ ties
- D. Contaminated sinks

Organisms linked to sinks

- *Pseudomonas aeruginosa*
- *Klebsiella pneumoniae* and *K. oxytoca*
- *Enterobacter cloacae*
- *Elizabethkingia meninogoseptica*
- *Acinetobacter baumanii*
- *Stenotrophomonas maltophilia*

Kotay S, et al. Spread from the sink to the patient: in situ study using GFP expressing *E. coli* to model bacterial dispersion from sink trap reservoirs. Appl Env Microbiol Feb. 2017
Cold

Hot
Improving room design to reduce risk for transmission from sinks

Before renovation

After renovation

Sink drain disinfection

Sink disinfection methods

- Disinfectants poured down sink – bleach, hydrogen peroxide, acetic acid
- Vibration and heat
- Ozonated water
- Valve in sink to enhance disinfectant contact time

Swab from just below strainer

Cover up: A sink drain cap prevents dispersal from sinks

Livingston S, et al. Society for Healthcare Epidemiology of America Annual Meeting, 2018
Contaminated ice machines as a source of pathogen transmission

Summary