

Prevention and control of infections in the home

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Increasing concern exists that antimicrobial-resistant microorganisms can be acquired in the community or that they can be introduced into the community from health care facilities. Antimicrobial resistance may also evolve or be acquired in the community and be introduced into a health care facility from the community, where the infection can spread widely.¹⁻⁶ The suggestions presented in this review provide a basic approach that can be applied to prevent the transmission of current antimicrobial-resistant pathogens and those that may arise in the future.

Prevention is the key step in halting the transmission of these microorganisms.⁷⁻¹⁰ Limited recommendations exist for preventing the transmission of these microorganisms in the provision of health care in the community and the home.^{3,11-20} Many of the existing recommendations followed in health care facilities cannot easily be transferred to the community or home because of limitations in the environment or resources or the inability to implement measures. Some suggestions to prevent the transmission of respiratory viruses have included the use of masks, gowns and gloves. Although these suggestions are based on meta-analysis of an extensive number of reports and intervention studies, they are resource intensive and are, thus, impractical and unrealistic in the home.^{4,5,12}

Within the home, the concern about antimicrobial-resistant microorganisms, such as methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus* and *Clostridium difficile*, in addition to *Mycobacterium tuberculosis* and respiratory and gastrointestinal viruses, relates to the implications for the patient and other people living with or visiting people infected or colonized with these pathogens,^{1,11,12,21-28} as well as to home-based health care providers. The true prevalence and risk of transmission of MRSA, vancomycin-resistant *Enterococcus*, extended spectrum β -lactamase-producing gram negative bacteria, *Acinetobacter baumannii* and *C. difficile* in the community among patients, their caregivers and family members is not known. However, the risk of transmission is believed to be low.^{2,29} This is in contrast to the risk of transmission of respiratory and gastrointestinal viruses and *M. tuberculosis*, for which the attack rate for people living in the same dwelling is much higher.^{1,3,13-15}

Prevention and control of infections

The chain of transmission (Appendix 1, available online at www.cmaj.ca/cgi/content/full/180/11/E82/DC1) may be similar

Key points

- Recommendations for the prevention of transmission of microorganisms in the hospital are not readily applicable to the home.
- Hand hygiene, personal protective equipment and environmental cleaning are critical to breaking the chain of transmission in the home.
- Hand washing with soap and water or an alcohol-based hand rub is the most important measure for preventing transmission.
- The use of antibacterial hand soaps or antibacterial disinfecting solutions in the home is not supported by evidence.

in the home to that in health care facilities. It may include transmission from person to person and from inanimate object to person. This chain should be considered when determining principles of infection prevention and control in the community.^{12,16,17} As well as being spread from the patient to family members, health care providers and other patients, these microorganisms may also spread from family members, health care providers and pets to the patient. Each of these may be susceptible hosts.^{12,16,17}

Microorganisms can spread by contact, droplet, airborne and vector transmission. Contact transmission, which includes both direct and indirect transmission,^{8-10,16,17} is the most frequently encountered mechanism of spread of antimicrobial-resistant microorganisms in the home environment.

The foundation of infection prevention and control in the health care environment is the use of routine practices.⁸ Routine practices include the use of hand hygiene at all times and the use of personal protective equipment (e.g., gloves, gowns, masks, eye protection and face protection when indicated) and environmental controls (e.g., equipment and environmental cleaning) as required.⁸ Some of these practices cannot be readily implemented in the home and should be tailored to the available resources, individual situation and potential pathogen.

Hand hygiene is the most important aspect of infection prevention and control activities because it reduces the bur-

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den of microorganisms on the hands and minimizes the chance of transmission to other people.^{8-10,12,23} Hand hygiene can be performed by using soap and water or, alternatively, an alcohol-based hand rub.^{8-10,18, 30-35} In the home, hands may be dried with a dry, clean towel.

The use of antimicrobial hand soaps, compared with the use of regular soaps, provides a greater reduction in the number of bacteria on the hands. Antimicrobial soaps may decrease the transmission of microorganisms from the hands to inanimate objects and food products.^{36,37} However, the use of antibacterial soaps may lead to the selection of antimicrobial-resistant bacteria. There appear to be no additional health benefits to using triclosan-containing consumer soap.^{38,39} This is an area of controversy. Therefore, until more data become available, the only recommendation that can be made is to continue using regular household soap in the home.

Data are also lacking to support the use of special antibacterial cleaning products in the home. Concern has been raised about the potential evolution of bacteria resistant to triclosan.⁴⁰ In vitro experiments have suggested a link between exposure to biocides and resistance to antimicrobials; however, this remains a theoretical concern because there is little evidence showing that use of biocides in the community has led to the emergence and spread of antimicrobial-resistant pathogens.⁴¹

There is evidence to support the use of alcohol-based hand rubs to break the chain of transmission of microorganisms.⁴²

For a visitor entering the home of a person who is colonized or infected with MRSA, vancomycin-resistant *Enterococcus* or *C. difficile*, strict attention should be paid to hand hygiene before and after the visit, with either soap and water or an alcohol-based hand rub. These measures will minimize the risk of acquiring and transmitting these organisms.

Methicillin-resistant *Staphylococcus aureus*

A number of reports summarize Canada's experience with MRSA; however, this experience is limited primarily to health care facilities and clusters in northern communities.⁴³⁻⁴⁵ MRSA has been characterized into health care-associated MRSA strains and community-associated strains.⁴⁶ Community-associated MRSA can affect otherwise healthy people, such as athletes, those who are incarcerated, soldiers, injection drug users, men who have sex with men and those in specific ethnic populations, such as Aboriginal people.⁴⁶⁻⁵² There are many reports of the isolation of MRSA from domestic pets and farm animals, with the possibility for cross-transmission to humans.⁵³⁻⁵⁶ Community-associated MRSA strains produce the Pantone-Valentine leukocidin.^{46,48-57} These microorganisms are frequently associated with skin and soft tissue infection and necrotizing pneumonia.

In contrast, MRSA associated with health care typically affects residents of long-term care facilities, individuals who have extensive exposure to health care facilities, as well as people with underlying medical problems.⁴⁶

Prevention and control

There are a limited number of reports of the spread of MRSA in the home.^{2,22} Proper hand hygiene (Box 1),⁸ as well as cleaning of equipment and the environment, is important in

Box 1: When to perform hand hygiene²⁵⁻²⁷

Before:

- Direct contact with a patient
- Performing invasive procedures
- Handling dressings or touching open wounds
- Preparing and administering medications
- Preparing, handling, serving or eating food
- Feeding a patient

After:

- Contact with blood, body fluids, broken skin or mucous membranes
- Contact with items known or considered to be contaminated
- Removal of gloves
- Use of toilet or wiping nose

Between:

- Performing procedures on the same patient in which soiling of the hands is likely

both the home and institutions where health care is provided. In the home, it is neither realistic nor practical to attempt to isolate a family member who is colonized or infected with MRSA. Because MRSA is transmitted by direct person-to-person contact, particularly on the hands of caregivers, hand hygiene among all family members, visitors and health care providers is key in the prevention of transmission.^{16,17}

Because domestic pets may serve as a reservoir of MRSA, hands should always be washed thoroughly with soap and water after contact with animals or their feces.^{57,58} In cases of outbreaks within a family of an infection caused by community-associated MRSA that cannot be arrested, a colonized pet may need to be temporarily removed from the home.⁵⁷ However, it may be prudent to re-emphasize the importance of personal hygiene before taking such a drastic measure. Skin-to-skin contact should be minimized by avoiding sports and play in which close contact occurs.^{16,17,57} Given that this may be difficult, particularly for children, keeping open and draining wounds covered may be a prudent more approach.⁵⁷ It is also important to have good personal hygiene and to cover cuts and abrasions.

Some recommend that articles, such as clothing, towels, face cloths and linens, that come into close contact with the body should not be shared among family members.^{16,17,57} Clearly, these recommendations may be difficult to implement, particularly in close quarters and where resources are limited. Clothes, household linens, including cleaning cloths, should be washed on a regular basis. The home should be cleaned regularly with standard household cleaners that do not contain antibacterial agents.^{16,17}

There are no specific recommendations for home nursing. However, routine practices, specifically the use of hand hygiene and gloves, should be used if there is the potential for the hands to become soiled.⁸

Environmental contact surfaces should be kept as clean as

possible with the use of a disinfectant cleaner. Objects for personal hygiene should not be shared. Intimate apparel, towels, linens, and sports clothing, should be washed at 40°C using a bleach-containing laundry detergent, or at 60°C if a bleach-containing laundry detergent is not used.¹⁷

People infected or colonized with MRSA should pay strict attention to hand hygiene to minimize transmission. Children may attend school and adults may attend work or educational venues; however, the principles of hand hygiene need to be reinforced and any open or draining wound should be covered.

Vancomycin-resistant *Enterococcus*

Vancomycin-resistant enterococci are infrequently observed in the community. They are transmitted in health care facilities by the hands of health care workers⁵⁹⁻⁶¹ and by contaminated equipment and surfaces.⁶¹⁻⁶⁷ In Canada, the incidence of infection and colonization with vancomycin-resistant *Enterococcus* is very low but has been slowly increasing.⁶⁸

Prevention and control

There are no published reports on how to manage the care of patients infected or colonized with this microorganism in the community. General infection prevention and control principles should be followed, and it is critical that strict attention be paid to hand hygiene (Box 1). In addition, contact by family members with potentially infectious material should be avoided at all times. The person infected or colonized with vancomycin-resistant *Enterococcus* should also pay strict attention to hand hygiene to prevent transmission within the household.

Those providing health care in the home should adhere to the routine practices and pay specific attention to hand hygiene and, when necessary, environmental cleaning.⁸ The home needs to be cleaned regularly, and clothes and linens should be washed as for the prevention of MRSA transmission.^{12,17}

Clostridium difficile

The ease with which *C. difficile* has spread within health care facilities has been attributed to the spores produced by the organism, suboptimal housekeeping practices, the widespread use of antimicrobial agents and inadequate hand hygiene.⁶⁹ Although *C. difficile* transmission has not been reported in the home, the uniforms of health care workers can become contaminated by *C. difficile* spores,⁷⁰ and people with symptomatic and asymptomatic *C. difficile* infections can shed spores.⁷¹ Spores can be transmitted by the hands of health care workers⁷² and by dogs used for hospital visitation.^{73,74}

One of the key elements for the transmission of *C. difficile* is the alteration of the gastrointestinal flora. Although the microorganism may be shed asymptotically in the stool of carriers, susceptible hosts are required for the pathogen to cause disease. Thus, although the risk of transmission of *C. difficile* exists in the home and community, the risk is likely quite low.^{16,17} However, steps should be taken to minimize the risk of transmission in the home and institutions.

Basic principles to prevent the acquisition and transmission of microorganisms in the home

- Wash hands with soap and water or use an alcohol-based hand rub before and after contact with people who may be infected or colonized.
- Wear gloves if there is a chance of soiling of hands and perform hand hygiene after removing the gloves.
- If clothes become soiled, promptly remove and launder them.
- Promptly dispose of all potentially infectious waste in a household waste receptacle.
- Clean surfaces with a standard household cleaning solution that does not contain antibacterial agents.

Prevention and control

Because *C. difficile* spores are not effectively killed by alcohol-based hand rubs, mechanical cleaning with soap and water is required to remove spores. *C. difficile* spores may contaminate the home and serve as a potential source of infection for family members and reinfection of the patient.

The use of routine practices should prevent the transmission of *C. difficile* within the home. Careful attention must be paid to hand-washing practices.⁸ Clothes and linens should be washed as for the prevention of MRSA transmission.

Good personal hygiene is essential. The home, especially the bathroom, should be cleaned regularly with standard household cleaners.^{16,17} Health care workers who provide care in the home should pay strict attention to hand hygiene when caring for patients infected or colonized with *C. difficile*. Gloves should be worn if there is a chance of soiling of the hands.⁸

Conclusions

Hand hygiene, with soap and water or alcohol-based hand rubs, is the most important strategy for preventing transmission of antibacterial-resistant organisms in the home. It is neither realistic nor practical to expect people who are infected or colonized to be kept in isolation or that family members and health care providers wear personal protective equipment for direct or indirect contact.

Available recommendations for the prevention and control of infections¹⁶⁻²⁰ are clear, well-written and based on available reports. Hand hygiene and routine practices can serve as a basis to prevent the transmission of these pathogens between colonized or infected family members and other family members or health care providers. In the absence of specific recommendations, the basics of infection prevention and control (Box 1) can be used as templates to help prevent the transmission of antimicrobial-resistant microorganisms in the home.

Family members and those who provide home health care for people infected or colonized with antimicrobial-resistant microorganisms should understand the chain of transmission of infection and should apply the measures outlined here to prevent transmission of these microorganisms in the home.

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Recommended reading

- Bloomfield S. The changing hygiene climate: a review of infectious disease in the home and community (draft). Cheshire (UK): International Scientific Forum on Home Hygiene; 2008. Available: [www.ifh-homehygiene.org/IntegratedCRD.nsf/111e68ea0824afe1802575070003f039/29858AA006F AAA22802572970064B6E8/\\$File/hygieneclimate_review608_23july_4.doc](http://www.ifh-homehygiene.org/IntegratedCRD.nsf/111e68ea0824afe1802575070003f039/29858AA006F AAA22802572970064B6E8/$File/hygieneclimate_review608_23july_4.doc)
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- International Scientific Forum on Home Hygiene. *Hand hygiene in the home and community: an IFH briefing document for health professionals July 2007*. Cheshire (UK): The Forum; 2007. Available: www.streams.net/resources/uploaded/HH/Hand_Hygiene_in_Home_and_Community.pdf

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- Johnston LB, Bryce E. Hospital infection control strategies for vancomycin-resistant *Enterococcus*, methicillin-resistant *Staphylococcus aureus* and *Clostridium difficile* *CMAJ* 2009;180:627-31.
- Matlow AG. Control of antibiotic-resistant bacteria in the office and clinic *CMAJ* 2009;180:1021-24.