American Journal of Infection Control 41 (2013) 1087-92

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Special article

Community-based infections and the potential role of common touch surfaces as vectors for the transmission of infectious agents in home and community settings

Elizabeth Scott PhD *

Simmons College Center for Hygiene and Health in Home and Community, Simmons College, Boston, MA

Key Words:
Home hygiene
Infection control
Surface hygiene
Targeted hygiene practices

Community-based pathogens that can survive on common touch surfaces include those that can cause gastrointestinal, respiratory, and skin infections. Our hands play an obvious role in the transmission of many of these pathogens, but common touch surfaces are also part of the transmission equation. Traditionally, common touch surfaces have not been the main focus of cleaning and sanitation in household and community settings. Infectious disease continues to be of concern globally due in part to emergence of new pathogens, antibiotic-resistant organisms, and a growing immunocompromised community. As a result, it is important to prevent and minimize the infection risk in homes and in the community. Understanding the role of common touch surfaces should inform surface hygiene practices and these surfaces should be the subject of future intervention studies.

It can be argued that there has been a general decline in support for the promotion of cleaning and hygiene practices in modern homes, partly as a result of the demise of teaching home economics and changes in family structure.[1] However, infectious disease has not declined and the global burden of infectious disease now accounts for more than 13 million deaths annually.[2] Between 1980 and 1992, deaths attributable to infectious disease increased by 22% in the United States, representing the third leading cause of death among the US population.[3] Two factors are reported as largely responsible for this trend: the constant emergence of new pathogens, including antibiotic resistant strains, and the growing immunocompromised community.[4] It is not clear if changing attitudes toward hygiene practice have also contributed although it has been shown that poor hygiene can be a factor in community-based infections such as gastrointestinal, skin, and respiratory infections.[4] At the same time, there has been a lack of evidence-based information regarding the appropriate focus for disinfection/sanitation practices in the home. Currently, there is renewed interest in the role played by common touch and other contaminated surfaces in the transmission of nosocomial infections.[5] The aim of this article is to review the burden of community-based infections and the evidence that common touch surfaces may also play a role in the transmission of these infections in the home and community.

THE HOME SETTING

The population of immunocompromised individuals living at home and at greater risk for infection in the European Union and the United States is growing and is currently estimated at about 20% of the population.[6] This increase is largely being driven by the growing aging population and also by medical interventions that are allowing more people to live longer with chronic illness and to remain in their homes.[7] This trend is also reflected in data from the United Kingdom where national statistics from England indicate that the proportion of all households receiving intensive home care (defined as >10 contact hours and ≥6 weekly visits) increased from 30%-32% between 2007 and 2008.[8] Likewise, data for Scotland indicates that the proportion of people aged 65 years and older receiving intensive home care (≥10 hours/week) as a percentage of all older people receiving long-term care, has increased from 25.6% in 2003 to 32.3% in 2011.[9] In addition, in the United States, the public may be missing an opportunity to protect themselves by immunization. The Centers for Disease Control and Prevention has reported that many children, adolescents, and adults in the United States are underimmunized against diseases such as influenza.[10]

* Address correspondence to Elizabeth Scott, PhD, Simmons College Center for Hygiene and Health in Home and Community, Simmons College, 300 The Fenway, Boston, MA 02115.
E-mail address: Scotte2@simmons.edu.
Conflict of interest: None to report.

0196-6553/$36.00 - Copyright © 2013 by the Association for Professionals in Infection Control and Epidemiology, Inc. Published by Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.ajic.2013.05.014

Community-based infections

Pathogens that were once considered to be specifically hospital-related problems, including antibiotic-resistant pathogens, are now also causing problems in the home and in the community. Poor hygiene is considered to be a factor in the transmission of community-based infections, including gastrointestinal infections, respiratory infections such as colds and influenza, and skin infections caused by *Staphylococcus aureus* and methicillin-resistant *S aureus* (MRSA) in the home.[4] Transmission of these pathogens can occur via both direct contact and indirect contact involving common touch surfaces in the home. Direct contact can largely be mitigated by effective hand washing/hand hygiene practices. Interruption of the chain of transmission involving indirect contact via surfaces is the focus of a combination of both hand hygiene and surface sanitation.

Rates of foodborne illness remain at high levels in the United States[11,12] and Europe.[13] The most recent data from the Centers for Disease Control and Prevention indicate that 1 in 6 Americans are sickened by food each year.[14] Raw meats, poultry, fruit, and vegetables can be contaminated with pathogens and good food hygiene and sanitation practices in the home are therefore essential. In 2004, a World Health Organization report concluded that approximately 40% of reported foodborne outbreaks in the World Health Organization European Region were caused by food consumed in private homes.[15] The report cited several factors as critical for a large proportion of foodborne diseases, including use of contaminated raw ingredients, cross-contamination between raw and cooked foods, and poor personal hygiene by food handlers. European Union data reported for 2007 state that private households were the most common setting of exposure to verified reported foodborne outbreaks, followed by restaurants and cafés.[16] Data for the United States and other countries indicates that norovirus causes the most foodborne illnesses and is a leading cause of foodborne deaths because it affects so many people.[17]

In the United States, the mean number of respiratory illnesses experienced per year in adults is reported as approximately 1.5-3.0 and in children younger than age 5 years it is approximately 3.5-5.5.[18] Colds represent a significant economic burden because of loss of productivity and medical costs. Secondary infections produce complications, such as otitis media, sinusitis, or pneumonia. For children attending day care in North America there is a high risk of respiratory syncytial virus (RSV) infection within the first 2 years of life and accounts for 0.5%-1.0% of hospitalized infants in the United States.[19]

In home and community settings, the influenza virus causes complications that lead to increased physician visits, hospitalization, and death, the risks being highest among persons aged 65 years and older, children aged <2 years, and persons who have medical conditions. The cost of influenza must also be considered in terms of days absent from work and school and pressure on health care services.[20] In the United States, influenza epidemics regularly result in an annual average of 36,000 deaths and 114,000 hospitalizations; among those with influenza who belong to an at-risk group, a significant proportion develop pneumonia, and up to 1 in 10 can die of related complications.[21] Although data indicating the role of hands and other surfaces in the transmission of colds have been available for some time, it is only in the past few years that there has been any real awareness that hands and surfaces may also be a transmission route for flu viruses.[19]

Skin and wound infections are common in the community but apart from *S aureus*, most are unreported. In the United States, community-acquired MRSA (CA-MRSA) is now a major concern in the community and is responsible for significant morbidity and mortality.[22] These staphylococcal pathogens are well documented in their ability to survive on environmental surfaces and to be transferred by both direct skin-to-skin contact and also by indirect contact. A population-based study of the incidence of MRSA infections in San Francisco during 2004-2005 demonstrated that nearly 1 in 300 residents suffered from such an infection in the course of a year and that greater than 85% of these infections occurred outside of the health care setting.[23]

Pathogen transfer and common touch surfaces

The basic components of pathogen transfer in home and community settings are a source of pathogens (eg, humans, pets, and foods), a temporary environmental reservoir of the pathogens (eg, common touch surfaces and cleaning utensils) and a target population, particularly those at higher risk for infection.[24] Pathogens can be transmitted directly between human beings via contact with hands and skin or by breathing in respiratory droplets. Indirect contact and transmission occurs when pathogens are shed onto environmental surfaces from human beings, pets, and food and are then transmitted back to another human being via hand contact or via cross-contamination to another foodstuff or yet another surface.

Both laboratory and field studies demonstrate the transfer of viral and bacterial pathogens via hands and common touch surfaces. The rate of transfer is highly variable, depends upon the species of bacterial or viral pathogen involved, and tends to be highest from nonporous surfaces.

Studies to quantify transfer between hands, foods, and kitchen surfaces[25,26] showed transfer rates ranging from as high as 100% to as low as 1%. Transfer to hands was highest from nonporous surfaces and lower from surfaces such as carrots, sponges, and dishcloths. Rusin et al[25] sampled volunteers hands after touching surfaces contaminated with *Micrococcus luteus*, *Serratia rubidea*, and phage PRD-1. Activities included wringing out a dishcloth/sponge, turning off a faucet, cutting up a carrot, making hamburger patties, holding a telephone receiver, and removing laundry from the washing machine. Transfer efficiencies for the phone receiver and faucet were 38%-65% and 27%-40%, respectively. It was also shown that, when volunteers' fingertips were inoculated with a pooled suspension of *M luteus*, *Ser rubidea*, and phage PRD-1 and held to the lip area, transfer rates ranged from 41%-34%.[25] Paulson[27] showed that, when gloved hands were contacted for 5-10 seconds with surfaces such as cutting boards and doorknobs contaminated with the norovirus surrogate feline calicivirus at log 5.9 particles, the log number of particles recovered from hands was 4.7-5.4. A further study with feline calicivirus showed survival for up to 3 days on telephone buttons and receivers, for 1-2 days on a computer mouse, and for 8-12 hours on keyboard keys and brass disks representing faucets and door handles. The time for 90% virus reduction was 4 hours on computer keys, mouse, and brass disks, 4–8 hours on telephone receivers, and 12-24 hours on telephone buttons.[28] Each of these results highlights the potential for transmission from common touch surfaces.

Pathogen survival studies have shown that community-based pathogens can survive for varying lengths of time on environmental surfaces, depending on the species and surface conditions, including the presence of moisture. The duration of persistence (data provided as a range of duration) for a number of bacteria and viruses responsible for community-based infections is documented as follows. For species of gram-negative enterobacteria such as *Campylobacter*, *Escherichia coli*, *Salmonella*, and *Shigella*, the range of duration was found to extend from hours (in the case of some *E coli*) to 16 months (again in the case of some *E coli*) and the range for norovirus was 8 hours-7 days and for rotavirus from 6-60 days.[29,30]