

# Warned, but Not Well Armed: Preventing Viral Upper Respiratory Infections in Households

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**ABSTRACT** The purpose of this state-of-the-science review was to identify strategies and household-level interventions for public health nurses to help prevent the acquisition and spread of viral upper respiratory infections (URI) in the community. Even though viral URI are a major global economic and social problem, surprisingly little research has been conducted to attempt to prevent them or reduce their transmission, probably because URI (with the exception of epidemic influenza) are generally considered to be mild and self-limited. Based on the research to date, public health nurses can use several promising strategies for prevention: (a) provide more tailored educational messages regarding preventive strategies such as vaccination, hand hygiene, spatial separation of infected household members, avoidance of antibiotics to treat viral URI, and environmental cleaning (e.g., for toys or other shared items), which are delivered personally rather than passively (e.g., pamphlets placed in a waiting room); (b) use each patient encounter in any setting to encourage influenza vaccination for relevant risk groups; (c) encourage use of alcohol hand sanitizers by household members during the cold and flu season; and (d) provide opportunities for skill development for adult and child household members (e.g., cover your cough, when to seek care or an antibiotic).

Key words: infection control, influenza, respiratory infections, viral infections.

Viral upper respiratory infections (URI) such as colds and influenza, although not generally considered to be major causes of morbidity and mortality, take a major global economic and social toll in terms of missed work and school, use of health care services, and costs of over-the-counter and prescribed treatments. The common cold is the most frequent and universal infection; most people have as many as 200 colds in a lifetime. Colds cause more illness in children than all other diseases combined and are responsible for up to 50% of school absenteeism. Colds, for example,

account for approximately 25 million primary care visits, 1.6 million visits to the emergency department, and 42 million missed work or school days annually in the U.S. (Gonzales et al., 2006; Heikkinen & Jarvinen, 2003). The economic burden of non-influenza URI alone is about \$40 billion annually (Fendrick, Monto, Nightengale, & Sarnes, 2003). Even in non-epidemic years, >500,000 persons in the United States are hospitalized annually with influenza-associated disease and 20,000–40,000 die (Thompson et al., 2003). The 2003–2004 end-of-season hospitalization rate for influenza was 8.9 per 10,000 children aged 0–4 years (Centers for Disease Control and Prevention [CDC], 2005a).

The latest potential pandemic strain, avian influenza A (H5N1), continued to be reported in Asia and Europe throughout the 2005–2006 season, and was associated with human infections and deaths. In February 2004, the CDC issued recommendations for enhanced surveillance for human infection with avian influenza among travelers returning to the United

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States from H5N1-affected countries. Warnings and suggested global and national control strategies have also been issued by the World Bank, World Health Organization, the U.S. Homeland Security Office, and Department of Health and Human Services.

Public media and educational campaigns regarding URI, however, provide little practical information regarding effective household-level interventions to reduce individual risk of infection and transmission, leaving the public “warned” but not well armed to respond to the usual “cold and flu” season and certainly inadequately prepared for an influenza pandemic. This means that there is a vital and as yet unfilled role for public health nursing to enable the public to use strategies to minimize the burden of viral URI. Hence, the aim of this paper is to review strategies and household-level interventions that have been tested to prevent the acquisition and spread of URI and to recommend potential approaches to be used by public health nurses to help prevent viral URI in the community.

## What Are the Etiologic Agents of Common URI?

The common cold is most frequently (30%–80%) caused by one of >100 serotypes of rhinovirus; by age 2 years, >90% of children have antibodies against rhinovirus (Savolainen, Blomqvist, & Hovi, 2003). Despite their ubiquitous nature, rhinoviruses are not well described. More than 200 viruses cause the common cold, including, in addition to the rhinovirus, coronaviruses, parainfluenza virus, respiratory syncytial virus, enteroviruses, and adenoviruses. In about 25% of colds, the causative agent is unknown. Further, not everyone exposed to rhinovirus becomes symptomatic; 25% of infected persons do not develop symptoms (van Bentem et al., 2003).

Not surprisingly, the specific pathogenic mechanisms of various agents causing URI vary and involve a complex interaction between the host and agent (Heikkinen & Jarvinen, 2003). In general, virus is deposited into the front of the nasal passages by contaminated fingers or by droplets from coughs and sneezes (Hendley & Gwaltney, 1988). The virus is then transported by mucociliary action to the back of the nose and onto the adenoid area where it attaches to a receptor that is located on the surface of nasal epithelial cells. The receptor fits into a docking port on the surface of the virus (Winther et al., 1997). After

attachment, virus particles are produced and the infected cell ruptures, releasing newly made cold virus to infect other cells in the nose and start the process over again. The incubation period is 8–12 hr, and the time to peak symptoms is 36–72 hr. Small doses of virus (1–30 particles) are sufficient to produce infection (Douglas, 1970). Cold symptoms result from host inflammatory mediators that cause vasodilation and increased vascular permeability, manifested as rhinorrhea, congestion, sneezing, and coughing.

Influenza A and B viruses from the orthomyxovirus family are of importance in human disease. They are designated by their two major antigenic determinants: hemagglutinin (H or HA with 16 subtypes, H1–H16) and neuraminidase (N or NA with 9 subtypes, N1–N9) transmembrane glycoproteins. Since 1977, influenza A (H1N1), influenza A (H3N2), and influenza B viruses have been in global circulation. In 2001, influenza A (H1N2) viruses that probably emerged after genetic reassortment between human A (H3N2) and A (H1N1) viruses began circulating widely (CDC, 2005b). More recently, there is growing concern about the potential for a pandemic with avian influenza A (H5N1) because of animal-to-human and subsequent human-to-human transmission (Beigel et al., 2005).

As with other common URI, the pathogenesis of influenza is associated with a variety of host factors (e.g., immunocompetence, presence of target receptors, availability of essential enzymes in host cells) and viral factors (binding ability, avoidance of host immunosurveillance by recombination or evolution). One of the predominant features of influenza viruses is their ability to mutate rapidly (“antigenic drift”) or undergo genomic reassortment (“antigenic shift”), resulting in the need for frequent modifications of vaccines to keep pace with the rapidly changing antigenic characteristics of the virus. These two features of the influenza virus—the fast and unpredictable antigenic changes of immune targets and the ability to reassort and circulate among non-human reservoirs (birds and pigs, for example)—are responsible for much of the global spread and persistence of the infection (Lavenu et al., 2006).

After entering the host through the respiratory tract, the virus penetrates the mucin layer and targets primarily columnar epithelial cells. Generally, there is a single receptor-binding site, although certain avian influenza viruses like H5N1 are able to bind to different target cells, making possible the direct transfer of

avian flu between birds and humans. The virus-receptor complex is then endocytosed and replication occurs rapidly, with viral shedding occurring within 6 hr of infection. Infectious particles are released from the plasma membrane of epithelial cells by budding, which facilitates the rapid spread to other cells within the lung. Unlike viruses causing the common cold, however, influenza virus replicates in cells of the lower as well as the upper respiratory tract (Kamps, Hoffmann, & Preiser, 2006).

## What Is the Scope of the Problem?

URI are the most common infectious diseases globally, with rates highest among children. The common cold is generally self-limited and is characterized by symptoms that last about a week such as sneezing, runny nose, nasal obstruction, sore or scratchy throat, cough, hoarseness, and mild general symptoms like headache, feverishness, chilliness, and not feeling well in general. On average, adults have 2–4 colds and children have 6–10 colds each year (National Institute of Allergy and Infectious Diseases, 2004). While rhinovirus infections are generally self-limited and mild, they can also cause lower respiratory tract infections and exacerbations of asthma and chronic pulmonary disease (Hayden, 2004).

Uncomplicated seasonal influenza has an incubation period of 1–4 days, with symptoms lasting about a week. Whereas symptoms of the common cold are primarily limited to the respiratory tract, influenza is characterized by systemic symptoms such as fever, headache, myalgia, and severe malaise as well as rhinitis, nonproductive cough, and sore throat. Children with influenza may also experience otitis media, nausea, and vomiting (Harper, Fukuda, Uyeki, Cox, & Bridges, 2005).

Despite the generally benign nature of URI, there are considerable economic and social costs associated with lost time at school and work, reduced productivity, and increased and/or inappropriate use of health care resources and antibiotics. Colds account for approximately 25 million primary care visits, 1.6 million visits to the emergency department, and 42 million missed work or school days annually in the United States (Gonzales et al., 2006; Heikkinen & Jarvinen, 2003). In fact, one U.S. study of >1,000 children attending day care reported that at any given time, 23% had a URI (Carabin, Gyorkos, Soto, Penrod et al., 1999). URI reduce alertness and slow reaction

times at work, even during the incubation period and after clinical symptoms have resolved. In a survey of >3,000 healthy university students, 91% reported having at least one URI and 36.7% reported at least one influenza-like illness in the previous year. These illnesses resulted in 6,023 days in bed, 7,438 missed school or work days, and >45,000 days of illness. In addition, 22.2% made a health care visit, 15.8% took an antibiotic, and 74.1% reported doing poorly on a test or assignment as a result of their illness (Nichol, D’Heilly, & Ehlinger, 2005). In a prospective cohort study of 208 families with at least one child <5 years old, 0.45 viral URI/person-month were reported, with a secondary transmission rate within the household of 0.63 illnesses/person-month (Lee, Friedman, Ross-Degnan, Hibberd, & Goldmann, 2003). Among 383 children aged 2 months–12 years followed by 7 pediatricians in Toronto, 72% had symptoms of a URI during a 6-month time period and medical attention was sought by 56% (Saunders, Tennis, Jacobson, Gans, & Dick, 2003).

Influenza-like illnesses are estimated to account for 10%–12% of all sickness-related work absence (O’Reilly & Stevens, 2002). In one study of working-age adults, the average work time missed due to influenza-like illness was 1.3 days and work loss valued at \$137/person/year (Akazawa, Sindelar, & Paltiel, 2003). In a U.K. survey of 411 workers, the average missed work per episode of flu-like illness was 2.8 days (Keech, Scott, & Ryan, 1998). French researchers in a prospective study reported that 38.3% of household contacts of an influenza-positive index case became secondary cases, 57% of whom sought medical care at least once. The mean duration of illness was 8 days in index cases and 7 days in secondary cases seeking medical care (Carrat et al., 2002). Epidemics of influenza typically occur during the winter months and are associated with >500,000 hospitalizations and about 36,000 deaths/year (Thompson et al., 2004). Among healthy children aged 6–23 months in the Boston area, the rate of outpatient visits during influenza periods was 8 times higher than in non-influenza periods, and the rate of hospitalization for acute respiratory disease was 2.7 times (O’Brien et al., 2004).

A major wasted resource associated with viral URI is the inappropriate use of antibiotics. In 1998, 7.4 million prescriptions were written for viral URI, the cost of which was approximately \$227 million (Gonzales, Malone, Maselli, & Sande, 2001). While

this problem has improved over the past decade, reported rates of antibiotic prescribing for viral URI still range from 30% to 78% (Mangione-Smith, Wong, Elliott, McDonald, & Roski, 2005; Rutschmann & Domino, 2004). Unfortunately, the rates of inappropriate prescribing of antibiotics are similar for nurse practitioners and physicians (Ladd, 2005). Further, the prescription rate is an underestimate of this problem because high rates of unprescribed antibiotic use for viral URI and the availability of antibiotics without prescription have been reported in the community (Larson & Grullon-Figueroa, 2004; Larson, Dilone, Garcia, & Smolowitz, 2006).

## What Are Strategies to Prevent Transmission of URI?

To review the research on interventions to reduce the spread of URI, the literature was searched through PubMed<sup>®</sup>, The Cumulative Index of Nursing and Allied Health Literature, and Cochrane Database of Systematic Reviews using the terms “upper respiratory infection,” “viral URI,” “influenza” linked by Boolean AND with “prevention,” “nursing,” “transmission,” and “community.” Only research papers or reviews (not editorials or commentaries) were examined. Very little research conducted by nurses or in the nursing literature was found, but the results are clearly relevant to the practice of public health nursing.

Colds and influenza are spread from person to person primarily through direct contact, airborne particles, and aerosols. Investigators in the 1960s–1970s demonstrated that rhinovirus is frequently transmitted by self-inoculation and by direct contact with hands contaminated during sneezing or nose blowing (Gwaltney & Hendley, 1978; Hendley & Gwaltney, 1988). Many studies have confirmed an increased risk of URI among children attending day care centers, but only a few studies have focused on transmission in the home environment (Carrat et al., 2002; Chang et al., 2004; Lee et al., 2003). Four general strategies to prevent transmission of URI in households are discussed here: vaccination, education, hygiene, and herbs and over-the-counter therapies.

### Vaccination

Unfortunately, because there are >100 different serotypes of rhinovirus, vaccines are not a feasible option against the common cold. For influenza, on the other

hand, vaccination is the primary mode of prevention. Both an inactivated injection and a live, attenuated nasal spray (approved for non-pregnant persons aged 5–49 years) are available and provide protection within 2 weeks after vaccination against the strains predicted to be circulating in any given year. Priority groups for vaccination include: people aged 65 years and older; residents of long-term care facilities; people aged 2–64 years with chronic health conditions; children aged 6–23 months; pregnant women; health care personnel who provide direct patient care; household contacts; and out-of-home caregivers of children less than 6 months of age (CDC, 2006).

Vaccine efficacy depends upon the degree of similarity between the viruses composing the vaccine and those in circulation as well as the age and immunocompetence of the recipient, but efficacy is generally between 70 and 90% (Harper et al., 2005; Thomas, Jefferson, Demicheli, & Rivetti, 2006). Vaccination significantly reduces influenza-related costs in healthy children as well as their unvaccinated family members. For example, the unvaccinated household members of children who were vaccinated against influenza had 42% fewer febrile illnesses ( $p = .04$ ), 70% fewer missed school days ( $p = .02$ ), and significantly fewer physician visits ( $p = .007$ ) compared with unvaccinated household members of control children (Hurwitz et al., 2000). Despite its effectiveness, there continues to be inadequate vaccine coverage for all recommended groups, Table 1. Even in the absence of full adherence to vaccination, however, herd immunity confers protection. For example, vaccination of ~25% of 1.5–18-year-old children conferred protection to 8%–18% of adults  $\geq 35$  years in several communities (Piedra et al., 2005).

TABLE 1. *Influenza Vaccination Rates, National Health Interview Survey, 2003 (Harper et al., 2005)*

Risk Group	Influenza Vaccination Rate (%)
Aged > 65 years	65.5
Persons with high-risk conditions (e.g., diabetes, emphysema, heart diseases, cancer)	15.8–46.3
Pregnant women	12.8
Health care professionals	40.1
Household contacts of persons at high risk	14.9–38.4



### **Education**

Public misconceptions regarding the effectiveness of antibiotics against viral URI have been well documented (Larson et al., 2006; Lee et al., 2003), but public educational campaigns regarding colds and flu have a rather low message penetration (Vingilis et al., 1998) unless they are targeted and relevant to specific groups (Taylor, Kwan-Gett, & McMahon, 2005; White, Kolble, Carlson, & Lipson, 2005). Parental knowledge has been shown to be a more important predictor of seeking care and antibiotics for URI than child care center policies (Friedman, Lee, Kleinman, & Finkelstein, 2003). However, although parental knowledge regarding URI and antibiotic use seems to be one important predictor of behavior, interventions that have only included parental education have had limited impact on practices regarding viral URI (Taylor et al., 2005).

In one recent educational intervention, teleconferencing between center staff (sometimes also including parents) with a clinician was provided to child care centers regarding acute health problems that might require exclusion from child care. It was estimated that 93.8% of 940 teleconferences prevented an office or emergency room visit (McConnochie et al., 2005). While this intervention prevented loss of work time to parents and reduced unnecessary health care visits, it was costly and not practical in a home setting. In several studies in child care centers, instructional programs directed at the children and their providers have resulted in significant reductions in URI (Carabin, Gyorkos, Soto, Joseph et al., 1999; Niffenegger, 1997).

Educational interventions have been quite effective in improving influenza vaccination rates. Despite the fact that young adults report that 70% of their influenza vaccinations are administered in health care settings (Singleton, Poel, Lu, Nichol, & Iwane, 2005), >75% of encounters by children with chronic medical conditions with the health care setting result in missed opportunities for influenza vaccination (Daley et al., 2005). Since the threat of avian influenza, parental attitudes toward immunizing their children have been shown to improve considerably. For parents of high-risk children as well as Medicare recipients, the most significant predictors of higher immunization rates were awareness of vaccination and provider recommendation to become vaccinated (Daley et al., 2006; Winston, Wortley, & Lees, 2006). Even among high-risk and inner-city children, paren-

tal reminders and other patient-oriented interventions significantly improve vaccination rates (Jacobson & Szilagyi, 2005; Nowalk et al., 2005; Zimmerman et al., 2006).

Hence, the public health nurse is in an ideal position to provide specific education in a variety of care settings that would lead to improvements in appropriate use of antibiotics (i.e., not to be used for viral URI) and increased rates of influenza vaccination. The public health nurse needs to be sure that there are no lost opportunities to increase vaccination rates in the community. During every encounter with groups or individuals for whom vaccination is recommended—in schools, day care centers, WIC programs, home health, clinics, etc.—the public health nurse should confirm the vaccination status of those encountered and offer vaccine or inform patients where it can be obtained.

### **Hygiene interventions**

As person-to-person spread of viral URI occurs most often by droplet and direct touching, hygienic measures to prevent these modes of transmission have focused on reducing droplet spread and improving hand hygiene. Infrequent hand hygiene by children attending day care and their providers, sharing towels, and infrequent washing of sleeping mats have been associated with higher frequencies of URI (St. Sauver, Khurana, Kao, & Foxman, 1998). The majority of intervention studies in industrialized countries have been conducted in child care and school facilities (McCutcheon & Fitzgerald, 2001). Rabie and Curtis (2006) conducted a meta-analysis to determine the effect of hand hygiene on risk of URI in the community. From a pool of 410 studies, 7 clinical trials published in English met their inclusion criteria. These studies reported risk reductions of 5%–44% and the authors concluded that hand hygiene could potentially reduce the risk of URI by 16% (95% CI: 11–21%). All of these studies were in schools, day care centers, or a military camp.

Only two studies have been conducted in homes. In one randomized, double-blind clinical trial that compared antibacterial and plain cleaning and hygiene products in 238 homes, no differences in rates of URI symptoms were found (Larson, Lin, Gomez-Pichardo, & Della-Latta, 2004). In a second randomized trial, Sandora et al. (2005) reported a significant reduction in gastrointestinal, but not in respiratory infections, among families that used an alcohol hand

TABLE 2. *Community-Based Hygiene Interventions in Developed Countries to Reduce Rates of Viral URIs*

Citation/Year	Setting	Measures <sup>a</sup>	Measure of Effect
Butz, Larson, Fosarelli, and Yolken (1990)	24 day care homes	Alcohol hand hygiene product, vinyl gloves, and changing pads	NS <sup>b</sup> reduction in respiratory symptoms
Krilov et al. (1996)	1 school for Down Syndrome children	Environmental cleaning and disinfection, emphasizing toys	Decreased respiratory illnesses (0.67 vs. 0.42 illnesses/child/month, $p < .07$ )
Master, Hess Longe, and Dickson (1997)	1 elementary school	Scheduled handwashing throughout the day	NS difference in absence due to respiratory illness
Niffenegger (1997)	2 child care centers (intervention and control)	Handwashing for teachers and children	Risk ratio 1.47 (1.01–2.13) for control center
Falsey et al. (1999)	1 senior day care center	Alcohol hand hygiene product	NS difference in URI rates
Dyer, Shinder, and Shinder (2000)	1 elementary school	Benzalkonium rinse-free hand hygiene product	Reduced URIs by 30.9% ( $p = .02$ ) and 76% ( $p = .001$ ) in two cross-overs
Hammond, Ali, Fendler, Dolan, and Donovan (2000)	16 elementary schools	Alcohol hand hygiene product	Absenteeism from infection reduced 19.8% ( $p < .05$ )
Roberts et al. (2000)	23 large child care centers	Handwashing, aseptic nose wiping	Reduction in URIs in children $\leq 24$ months (11.4 vs. 13/child-year, $p = .01$ )
Ryan, Christian, and Wohlrahe (2001)	> 90,000 naval recruits	Handwashing	45% reduction in outpatient visits for URIs
White, Shinder, Shinder, and Dyer (2001)	3 elementary schools	Benzalkonium rinse-free hand hygiene product	Absenteeism from infection reduced 33% (95% CI:17–45%)
Guinan, McGuckin, and Ali (2002)	5 elementary schools	Alcohol hand hygiene product	50.6% reduction in absences from infection ( $p < .001$ )
White et al. (2003)	4 college residence halls	Alcohol hand hygiene product	14.8–39.9% reduction in URI symptoms (all $p < .02$ )
Larson et al. (2004)	238 households	Antibacterial cleaning and soap products	NS difference in URI symptoms between plain and antibacterial products
Morton and Schultz (2004)	1 elementary school	Alcohol hand hygiene product	43% reduction in absences from infection ( $p = .005$ )
Ponka, Poussa, and Laosmaa (2004)	60 child care centers	Handwashing, environmental cleaning, washing toys and linens	~26% reduction in URIs ( $p = .05$ ) in children < 3 years
Sandora et al. (2005)	292 households with child in day care	Alcohol hand hygiene product	NS difference in URIs
White et al. (2005)	4 college residence halls	Alcohol hand hygiene product	40% reduction in absences from illness ( $p < .001$ )

Notes. URI = upper respiratory infections.

<sup>a</sup>In addition to the interventions listed, every study included an educational component.

<sup>b</sup>NS = not statistically significant.

hygiene product, but families with higher product usage also had marginally lower rates of household transmission of URI symptoms. Hence, the most promising interventions appear to be use of an alcohol-based hand sanitizer and specific cleaning and environmental interventions such as washing toys and reducing aerosol spread (e.g., aseptic nose wiping and cough etiquette protocols). These studies are summarized in Table 2.

### ***Herbs and over-the-counter therapies***

Hand treatments with organic acids are being tested against rhinoviruses, which are acid-labile, but these have not been tested against the influenza virus and are still in the laboratory trial phase (Turner & Hendley, 2005). The primary herbal and over-the-counter therapies that have been tested for prevention of URI include *Echinacea purpurea*, vitamins E and C, ginseng, and zinc, which are briefly reviewed here.

Preparations of the *Echinacea* plant are a common herbal remedy for URI. In a Cochrane systematic review, Linde, Barrett, Wolkart, Bauer, & Melchart (2006) identified 16 trials of *Echinacea* that included a control group, three of which tested the preparation for prevention of colds. None of these trials showed any benefit over placebo. Vitamin E supplementation has been shown in healthy elderly to improve immune function and potentially reduce URI (Meydani et al., 2004), but it was also associated with increased risk of colds in men who were exercising heavily (Hemila, Virtamo, Albanes, & Kaprio, 2003). Similarly for Vitamin C, a Cochrane review of 30 trials demonstrated no consistent preventive effect on the incidence of URI (Douglas, Hemila, D'Souza, Chalker, & Treacy, 2004). A combination of Vitamins E, C, and  $\beta$ -carotene had no effect on the incidence of colds in a cohort of 21,796 male smokers (Hemila, Kaprio, Albanes, Heinonen, & Virtamo, 2002).

Ginseng is a herb derived from a slow-growing root that has been used for centuries in traditional Chinese medicine. Over 300 papers have been published on its potential therapeutic benefits (Block & Mead, 2003). Although ginseng has demonstrated immunomodulatory effects, Vogler, Pittler, & Ernst (1999) concluded in a systematic review of 16 trials that more rigorous studies of its efficacy and safety are needed. Several recent randomized, blinded clinical trials (RCT), however, have reported reductions in the incidence and duration of URI, including influenza-like illnesses, with the use of ginseng (McElhaney, Goel, Toane, Hooten, & Shan, 2006; Predy et al., 2005). Even more intriguing was a placebo-controlled, double-blinded RCT, which demonstrated in 227 volunteers that ginseng administered for a period of 12 weeks during which they received influenza vaccine had significantly fewer colds and significantly higher antibody titers and natural killer cell activity levels, i.e., the ginseng appeared to potentiate the effects of the vaccine (Scaglione, Cattaneo, Alessandria, & Cogo, 1996). Ginseng appears to be safe and non-toxic; in several clinical trials including >500 adults, reported side effects were comparable to the placebo arm (McElhaney et al., 2004; Predy et al., 2005). The drug has not been tested for safety during pregnancy or breastfeeding.

Zinc salt lozenges have been marketed for several decades to reduce the symptoms and duration of the common cold. Clinical trials of zinc for treating URI have varied considerably and the results are inconsis-

tent (Eby, 1997; Hulisz, 2004). Two meta-analyses of eight clinical trials determined that evidence of effectiveness of zinc lozenges in reducing duration of colds was lacking (Jackson, Lesho, & Peterson, 2000; Jackson, Peterson, & Lesho, 1997). Further, significantly more adverse events have been reported among school-age children taking zinc in a placebo-controlled RCT (Macknin, Piedmonte, Calendine, Janosky, & Wald, 1998).

### **What Is the Role of the Public Health Nurse in the Prevention of Viral URI in the Community?**

Even though viral URI are a major global economic and social problem, surprisingly little research has been conducted to attempt to prevent them or reduce their transmission, probably because URI (with the exception of epidemic influenza) are generally considered to be mild and self-limited. Further, studies that have been conducted are generally of poor quality, almost all have been funded by manufacturers of products, and the results are inconsistent for most interventions that have been tested. Most herbal remedies commonly used by the public (*echinacea*, vitamins C and E, zinc products) have been shown to have little, if any, preventive effect for URI. There have been, however, several recent clinical trials of ginseng in which there was a protective effect demonstrated when compared with placebo. This potential therapy warrants further study.

Finally, there has been little effort to tailor or target informational or educational messages in ways that would maximize their relevance to particular populations. The majority of educational efforts have been either generic, through the mass media, or through care providers such as physician's offices. Such messages are likely to miss large segments of the general public, perhaps even those at the highest risk (e.g., those who live in crowded conditions, may not read the newspapers or use the Internet as frequently, and those households with a number of children in which the adults must work outside the home).

Based on the research to date, public health nurses can use several promising strategies for prevention:

- provide more tailored educational messages regarding preventive strategies such as vaccination, hand hygiene, spatial separation of infected household members, avoidance of antibiotics to treat

viral URI, and environmental cleaning (e.g., for toys or other shared items) that are delivered personally rather than passively (e.g., pamphlets placed in a waiting room);

- use each patient encounter in any setting to encourage influenza vaccination for relevant risk groups; and
- encourage use of alcohol hand sanitizers by household members during cold and flu season;
- provide opportunities for skill development for adult and child household members (e.g., cover your cough, hand hygiene, when to seek care or an antibiotic).

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## References

- Akazawa, M., Sindelar, J. L., & Paltiel, A. D. (2003). Economic costs of influenza-related work absenteeism. *Value Health, 6*(2), 107–115.
- Beigel, J. H., Farrar, J., Han, A. M., Hayden, F. G., Hyer, R., de Jong, M. D., et al. (2005). Avian influenza A (H5N1) infection in humans. *New England Journal of Medicine, 353*(13), 1374–1385.
- Block, K. I., & Mead, M. N. (2003). Immune system effects of echinacea, ginseng, and astragalus: A review. *Integrative Cancer Therapies, 2*(3), 247–267.
- Butz, A. M., Larson, E., Fosarelli, P., & Yolken, R. (1990). Occurrence of infectious symptoms in children in day care homes. *American Journal of Infection Control, 18*(6), 347–353.
- Carabin, H., Gyorkos, T. W., Soto, J. C., Joseph, L., Payment, P., & Collet, J. P. (1999). Effectiveness of a training program in reducing infections in toddlers attending day care centers. *Epidemiology, 10*(3), 219–227.
- Carabin, H., Gyorkos, T. W., Soto, J. C., Penrod, J., Joseph, L., & Collet, J. P. (1999). Estimation of direct and indirect costs because of common infections in toddlers attending day care centers. *Pediatrics, 103*(3), 556–564.
- Carrat, F., Sahler, C., Rogez, S., Leruez-Ville, M., Freymuth, F., Le Gales, C., et al. (2002). Influenza burden of illness: Estimates from a national prospective survey of household contacts in France. *Archives of Internal Medicine, 162*(16), 1842–1848.
- Centers for Disease Control and Prevention [CDC]. (2005a). *2004–05 U.S. Influenza Season Summary*. Retrieved October 10, 2006, from <http://www.cdc.gov/flu/weekly/weeklyarchives2004-2005/04-05summary.htm>
- Centers for Disease Control and Prevention [CDC]. (2005b). *Background on influenza*. Retrieved October 10, 2006, from <http://www.cdc.gov/flu/professionals/background.htm>
- Centers for Disease Control and Prevention [CDC]. (2006). *Key facts about influenza (flu) vaccine*. Retrieved October 10, 2006, from <http://www.cdc.gov/flu/protect/keyfacts.htm>
- Chang, L. Y., Tsao, K. C., Hsia, S. H., Shih, S. R., Huang, C. G., Chan, W. K., et al. (2004). Transmission and clinical features of enterovirus 71 infections in household contacts in Taiwan. *Journal of the American Medical Association, 291*(2), 222–227.
- Daley, M. F., Beaty, B. L., Barrow, J., Pearson, K., Crane, L. A., Berman, S., et al. (2005). Missed opportunities for influenza vaccination in children with chronic medical conditions. *Archives of Pediatric and Adolescent Medicine, 159*(10), 986–991.
- Daley, M. F., Crane, L. A., Chandramouli, V., Beaty, B. L., Barrow, J., Allred, N., et al. (2006). Influenza among healthy young children: Changes in parental attitudes and predictors of immunization during the 2003 to 2004 influenza season. *Pediatrics, 117*(2), e268–e277.
- Douglas, R. G. Jr. (1970). Pathogenesis of rhinovirus common colds in human volunteers. *Annals of Otolaryngology, Rhinology, and Laryngology, 79*(3), 563–571.
- Douglas, R. M., Hemila, H., D'Souza, R., Chalker, E. B., & Treacy, B. (2004). Vitamin C for preventing and treating the common cold. *Cochrane Database Systematic Review, (4)*, CD000980.
- Dyer, D. L., Shinder, A., & Shinder, F. (2000). Alcohol-free instant hand sanitizer reduces elementary school illness absenteeism. *Family Medicine, 32*(9), 633–638.
- Eby, G. A. (1997). Zinc ion availability—the determinant of efficacy in zinc lozenge treatment of common colds. *Journal of Antimicrobial Agents and Chemotherapy, 40*(4), 483–493.
- Falsey, A. R., Criddle, M. M., Kolassa, J. E., McCann, R. M., Brower, C. A., & Hall, W. J. (1999). Evaluation of a handwashing intervention to reduce respiratory illness rates in senior



- day-care centers. *Infection Control and Hospital Epidemiology*, 20(3), 200–202.
- Fendrick, A. M., Monto, A. S., Nightengale, B., & Sarnes, M. (2003). The economic burden of non-influenza-related viral respiratory tract infection in the United States. *Archives of Internal Medicine*, 163(4), 487–494.
- Friedman, J. F., Lee, G. M., Kleinman, K. P., & Finkelstein, J. A. (2003). Acute care and antibiotic seeking for upper respiratory tract infections for children in day care: Parental knowledge and day care center policies. *Archives of Pediatric and Adolescent Medicine*, 157(4), 369–374.
- Gonzales, R., Camargo, C. A. Jr., MacKenzie, T., Kersey, A. S., Maselli, J., Levin, S. K., et al. (2006). Antibiotic treatment of acute respiratory infections in acute care settings. *Academic Emergency Medicine*, 13(3), 288–294.
- Gonzales, R., Malone, D. C., Maselli, J. H., & Sande, M. A. (2001). Excessive antibiotic use for acute respiratory infections in the United States. *Clinical Infectious Diseases*, 33(6), 757–762.
- Guinan, M., McGuckin, M., & Ali, Y. (2002). The effect of a comprehensive handwashing program on absenteeism in elementary schools. *American Journal of Infection Control*, 30(4), 217–220.
- Gwaltney, J. M. Jr., & Hendley, J. O. (1978). Rhinovirus transmission: One if by air, two if by hand. *American Journal of Epidemiology*, 107(5), 357–361.
- Hammond, B., Ali, Y., Fendler, E., Dolan, M., & Donovan, S. (2000). Effect of hand sanitizer use on elementary school absenteeism. *American Journal of Infection Control*, 28(5), 340–346.
- Harper, S. A., Fukuda, K., Uyeki, T. M., Cox, N. J., & Bridges, C. B. (2005). Prevention and control of influenza. Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recommendations Report*, 54(RR-8), 1–40.
- Hayden, F. G. (2004). Rhinovirus and the lower respiratory tract. *Reviews of Medical Virology*, 14(1), 17–31.
- Heikkinen, T., & Jarvinen, A. (2003). The common cold. *Lancet*, 361(9351), 51–59.
- Hemila, H., Kaprio, J., Albanes, D., Heinonen, O. P., & Virtamo, J. (2002). Vitamin C, vitamin E, and beta-carotene in relation to common cold incidence in male smokers. *Epidemiology*, 13(1), 32–37.
- Hemila, H., Virtamo, J., Albanes, D., & Kaprio, J. (2003). Physical activity and the common cold in men administered vitamin E and beta-carotene. *Medicine and Science in Sports and Exercise*, 35(11), 1815–1820.
- Hendley, J. O., & Gwaltney, J. M. Jr. (1988). Mechanisms of transmission of rhinovirus infections. *Epidemiology Reviews*, 10, 243–258.
- Hulisz, D. (2004). Efficacy of zinc against common cold viruses: An overview. *Journal of the American Pharmaceutical Association (Washington, DC)*, 44(5), 594–603.
- Hurwitz, E. S., Haber, M., Chang, A., Shope, T., Teo, S., Ginsberg, M., et al. (2000). Effectiveness of influenza vaccination of day care children in reducing influenza-related morbidity among household contacts. *Journal of the American Medical Association*, 284(13), 1677–1682.
- Jackson, J. L., Lesho, E., & Peterson, C. (2000). Zinc and the common cold: A meta-analysis revisited. *Journal of Nutrition*, 130(5S Suppl), 1512S–1515S.
- Jackson, J. L., Peterson, C., & Lesho, E. (1997). A meta-analysis of zinc salts lozenges and the common cold. *Archives of Internal Medicine*, 157(20), 2373–2376.
- Jacobson, V. J., & Szilagyi, P. (2005). Patient reminder and patient recall systems to improve immunization rates. *Cochrane Database Systematic Review*, (3), CD003941.
- Kamps, B., Hoffmann, C., & Preiser, W. (2006). *Influenza Report 2006*. Cologne: Flying Publisher.
- Keech, M., Scott, A. J., & Ryan, P. J. (1998). The impact of influenza and influenza-like illness on productivity and healthcare resource utilization in a working population. *Occupational Medicine (London)*, 48(2), 85–90.
- Krilov, L. R., Barone, S. R., Mandel, F. S., Cusack, T. M., Gaber, D. J., & Rubino, J. R. (1996). Impact of an infection control program in a specialized preschool. *American Journal of Infection Control*, 24(3), 167–173.
- Ladd, E. (2005). The use of antibiotics for viral upper respiratory tract infections: An analysis of nurse practitioner and physician prescribing practices in ambulatory care, 1997–2001. *Journal of the American Academy of Nurse Practitioners*, 17(10), 416–424.
- Larson, E., & Grullon-Figueroa, L. (2004). Availability of antibiotics without prescription in New York City. *Journal of Urban Health*, 81(3), 498–504.
- Larson, E. L., Dilone, J., Garcia, M., & Smolowitz, J. (2006). Factors which influence Latino com-

- munity members to self-prescribe antibiotics. *Nursing Research*, 55(2), 94–102.
- Larson, E. L., Lin, S. X., Gomez-Pichardo, C., & Della-Latta, P. (2004). Effect of antibacterial home cleaning and handwashing products on infectious disease symptoms: A randomized, double-blind trial. *Annals of Internal Medicine*, 140(5), 321–329.
- Lavenu, A., Leruez-Ville, M., Chaix, M. L., Boelle, P. Y., Rogez, S., Freymuth, F., et al. (2006). Detailed analysis of the genetic evolution of influenza virus during the course of an epidemic. *Epidemiology and Infection*, 134(3), 514–520.
- Lee, G. M., Friedman, J. F., Ross-Degnan, D., Hibberd, P. L., & Goldmann, D. A. (2003). Misconceptions about colds and predictors of health service utilization. *Pediatrics*, 111(2), 231–236.
- Linde, K., Barrett, B., Wolkart, K., Bauer, R., & Melchart, D. (2006). Echinacea for preventing and treating the common cold. *Cochrane Database Systematic Review*, (1), CD000530.
- Macknin, M. L., Piedmonte, M., Calendine, C., Janosky, J., & Wald, E. (1998). Zinc gluconate lozenges for treating the common cold in children: A randomized controlled trial. *Journal of the American Medical Association*, 279(24), 1962–1967.
- Mangione-Smith, R., Wong, L., Elliott, M. N., McDonald, L., & Roski, J. (2005). Measuring the quality of antibiotic prescribing for upper respiratory infections and bronchitis in 5 US health plans. *Archives of Pediatric and Adolescent Medicine*, 159(8), 751–757.
- Master, D., Hess Longe, S. H., & Dickson, H. (1997). Scheduled hand washing in an elementary school population. *Family Medicine*, 29(5), 336–339.
- McConnochie, K. M., Wood, N. E., Kitzman, H. J., Herendeen, N. E., Roy, J., & Roghmann, K. J. (2005). Telemedicine reduces absence resulting from illness in urban child care: Evaluation of an innovation. *Pediatrics*, 115(5), 1273–1282.
- McCutcheon, H., & Fitzgerald, M. (2001). The public health problem of acute respiratory illness in childcare. *Journal of Clinical Nursing*, 10(3), 305–310.
- McElhaney, J. E., Goel, V., Toane, B., Hooten, J., & Shan, J. J. (2006). Efficacy of COLD-fx in the prevention of respiratory symptoms in community-dwelling adults: A randomized, double-blinded, placebo controlled trial. *Journal of Alternative and Complementary Medicine*, 12(2), 153–157.
- McElhaney, J. E., Gravenstein, S., Cole, S. K., Davidson, E., O'Neill, D., Petitjean, S., et al. (2004). A placebo-controlled trial of a proprietary extract of North American ginseng (CVT-E002) to prevent acute respiratory illness in institutionalized older adults. *Journal of the American Geriatric Society*, 52(1), 13–19.
- Meydani, S. N., Leka, L. S., Fine, B. C., Dallal, G. E., Keusch, G. T., Singh, M. F., et al. (2004). Vitamin E and respiratory tract infections in elderly nursing home residents: A randomized controlled trial. *Journal of the American Medical Association*, 292(7), 828–836.
- Morton, J. L., & Schultz, A. A. (2004). Healthy Hands: Use of alcohol gel as an adjunct to handwashing in elementary school children. *Journal of School Nursing*, 20(3), 161–167.
- National Institute of Allergy and Infectious Diseases. (2004) *The common cold*. Retrieved October 10, 2006 from <http://www.niaid.nih.gov/factsheets/cold.htm>
- Nichol, K. L., D'Heilly, S., & Ehlinger, E. (2005). Colds and influenza-like illnesses in university students: Impact on health, academic and work performance, and health care use. *Clinical Infectious Diseases*, 40(9), 1263–1270.
- Niffenegger, J. P. (1997). Proper handwashing promotes wellness in child care. *Journal of Pediatric Health Care*, 11(1), 26–31.
- Nowalk, M. P., Lin, C. J., Zimmerman, R. K., Troy, J. A., Hoberman, A., Kearney, D. H., et al. (2005). Tailored interventions to introduce influenza vaccination among 6- to 23-month-old children at inner-city health centers. *American Journal of Managed Care*, 11(11), 717–724.
- O'Brien, M. A., Uyeki, T. M., Shay, D. K., Thompson, W. W., Kleinman, K., McAdam, A., et al. (2004). Incidence of outpatient visits and hospitalizations related to influenza in infants and young children. *Pediatrics*, 113(3 Part 1), 585–593.
- O'Reilly, F. W., & Stevens, A. B. (2002). Sickness absence due to influenza. *Occupational Medicine (London)*, 52(5), 265–269.
- Piedra, P. A., Gaglani, M. J., Kozinetz, C. A., Herschler, G., Riggs, M., Griffith, M., et al. (2005). Herd immunity in adults against influenza-related illnesses with use of the trivalent-live attenuated influenza vaccine (CAIV-T) in children. *Vaccine*, 23(13), 1540–1548.
- Ponka, A., Poussa, T., & Laosmaa, M. (2004). The effect of enhanced hygiene practices on absences due to infectious diseases among children in day care centers in Helsinki. *Infection*, 32(1), 2–7.

- Preddy, G. N., Goel, V., Lovlin, R., Donner, A., Stitt, L., & Basu, T. K. (2005). Efficacy of an extract of North American ginseng containing poly-furanosyl-pyranosyl-saccharides for preventing upper respiratory tract infections: A randomized controlled trial. *Canadian Medical Association Journal*, *173*(9), 1043–1048.
- Rabie, T., & Curtis, V. (2006). Handwashing and risk of respiratory infections: A quantitative systematic review. *Tropical Medicine and International Health*, *11*(3), 258–267.
- Roberts, L., Smith, W., Jorm, L., Patel, M., Douglas, R. M., & McGilchrist, C. (2000). Effect of infection control measures on the frequency of upper respiratory infection in child care: A randomized, controlled trial. *Pediatrics*, *105*(4 Part 1), 738–742.
- Rutschmann, O. T., & Domino, M. E. (2004). Antibiotics for upper respiratory tract infections in ambulatory practice in the United States, 1997–1999: Does physician specialty matter? *Journal of the American Board of Family Practice*, *17*(3), 196–200.
- Ryan, M. A., Christian, R. S., & Wohlrabe, J. (2001). Handwashing and respiratory illness among young adults in military training. *American Journal of Preventive Medicine*, *21*(2), 79–83.
- Sandora, T. J., Taveras, E. M., Shih, M. C., Resnick, E. A., Lee, G. M., Ross-Degnan, D., et al. (2005). A randomized, controlled trial of a multifaceted intervention including alcohol-based hand sanitizer and hand-hygiene education to reduce illness transmission in the home. *Pediatrics*, *116*(3), 587–594.
- Saunders, N. R., Tennis, O., Jacobson, S., Gans, M., & Dick, P. T. (2003). Parents' responses to symptoms of respiratory tract infection in their children. *Canadian Medical Association Journal*, *168*(1), 25–30.
- Savolainen, C., Blomqvist, S., & Hovi, T. (2003). Human rhinoviruses. *Paediatric Respiratory Reviews*, *4*(2), 91–98.
- Scaglione, F., Cattaneo, G., Alessandria, M., & Cogo, R. (1996). Efficacy and safety of the standardised Ginseng extract G115 for potentiating vaccination against the influenza syndrome and protection against the common cold [corrected]. *Drugs Under Experimental and Clinical Research*, *22*(2), 65–72.
- Singleton, J. A., Poel, A. J., Lu, P. J., Nichol, K. L., & Iwane, M. K. (2005). Where adults reported receiving influenza vaccination in the United States. *American Journal of Infection Control*, *33*(10), 563–570.
- St. Sauver, J., Khurana, M., Kao, A., & Foxman, B. (1998). Hygienic practices and acute respiratory illness in family and group day care homes. *Public Health Reports*, *113*(6), 544–551.
- Taylor, J. A., Kwan-Gett, T. S., & McMahon, E. M. Jr. (2005). Effectiveness of a parental educational intervention in reducing antibiotic use in children: A randomized controlled trial. *Pediatric Infectious Diseases Journal*, *24*(6), 489–493.
- Thomas, R., Jefferson, T., Demicheli, V., & Rivetti, D. (2006). Influenza vaccination for health-care workers who work with elderly people in institutions: A systematic review. *Lancet Infectious Diseases*, *6*(5), 273–279.
- Thompson, W. W., Shay, D. K., Weintraub, E., Brammer, L., Bridges, C. B., Cox, N. J., et al. (2004). Influenza-associated hospitalizations in the United States. *Journal of the American Medical Association*, *292*(11), 1333–1340.
- Thompson, W. W., Shay, D. K., Weintraub, E., Brammer, L., Cox, N., Anderson, L. J., et al. (2003). Mortality associated with influenza and respiratory syncytial virus in the United States. *Journal of the American Medical Association*, *289*(2), 179–186.
- Turner, R. B., & Hendley, J. O. (2005). Virucidal hand treatments for prevention of rhinovirus infection. *Journal of Antimicrobial Agents and Chemotherapy*, *56*(5), 805–807.
- van Bente, I., Koopman, L., Niesters, B., Hop, W., van Middelkoop, B., de Waal, L., et al. (2003). Predominance of rhinovirus in the nose of symptomatic and asymptomatic infants. *Pediatric Allergy and Immunology*, *14*(5), 363–370.
- Vingilis, E., Brown, U., Koeppen, R., Hennen, B., Bass, M., Peyton, K., et al. (1998). Evaluation of a cold/flu self-care public education campaign. *Health Education Research*, *13*(1), 33–46.
- Vogler, B. K., Pittler, M. H., & Ernst, E. (1999). The efficacy of ginseng. A systematic review of randomised clinical trials. *European Journal of Clinical Pharmacology*, *55*(8), 567–575.
- White, C., Kolble, R., Carlson, R., & Lipson, N. (2005). The impact of a health campaign on hand hygiene and upper respiratory illness among college students living in residence halls. *Journal of American College Health*, *53*(4), 175–181.
- White, C., Kolble, R., Carlson, R., Lipson, N., Dolan, M., Ali, Y., et al. (2003). The effect of hand hygiene on illness rate among students in university residence halls. *American Journal of Infection Control*, *31*(6), 364–370.

- White, C. G., Shinder, F. S., Shinder, A. L., & Dyer, D. L. (2001). Reduction of illness absenteeism in elementary schools using an alcohol-free instant hand sanitizer. *Journal of School Nursing, 17*(5), 258–265.
- Winston, C. A., Wortley, P. M., & Lees, K. A. (2006). Factors associated with vaccination of medicare beneficiaries in five U.S. communities: Results from the racial and ethnic adult disparities in immunization initiative survey, 2003. *Journal of the American Geriatric Society, 54*(2), 303–310.
- Winther, B., Greve, J. M., Gwaltney, J. M. Jr., Innes, D. J., Eastham, J. R., McClelland, A., et al. (1997). Surface expression of intercellular adhesion molecule 1 on epithelial cells in the human adenoid. *Journal of Infectious Diseases, 176*(2), 523–525.
- Zimmerman, R. K., Nowalk, M. P., Lin, C. J., Ko, F. S., Block, B., & Anderson, G. (2006). Interventions over 2 years to increase influenza vaccination of children aged 6–23 months in inner-city family health centers. *Vaccine, 24*(10), 1523–1529.