

Interventions to prevent transmission of the common cold

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Abstract

Theoretically, there are several ways of preventing the common cold: quarantine, immunisation (or vaccination); early treatment of effected individuals; or physical barriers to reduce transmission. All these methods can be dismissed after considering the epidemiology of the common cold, apart from the last. Evidence for effectiveness for physical barriers (which include masks to reduce aerosol transmission; handwashing; and gloves and gowns) come from a variety of empirical studies. The chance of bias for these studies is variable, but we can conclude that all of these barrier methods have important potential for preventing transmission of the common cold, although some methods will not be acceptable to the community currently.

Introduction

The burden of disease of the common cold is enormous, not so much because it is a severe disease (it usually is not, although it may act as a precursor for more serious secondary infections), but because it is so common. No-one escapes infection with colds (see the chapter by Ian M. Mackay et al.). It is an endemic disease hardly amenable to treatment (see the chapter by Ian M. Mackay et al.). This leads us to consider prevention.

The most immediately obvious opportunity is the interruption of the transmission.

The model of the phenomenon – Theoretical considerations

Infectious diseases are critically influenced by how many other people are infected by an infected person. If the number is less than one on average, the disease will die out and disappear. If the number is more than one, it will infect more and more of the population in an explosive manner – an



Figure 1. “Coughs and sneezes spread diseases” [1]. Propaganda cartoon from the Ministry of Health and Ministry of Information, UK, 1942, designed to reduce person-to-person transmission of virus infections, here by the use of handkerchiefs.

epidemic. If the number is exactly one (on average) the infection is endemic, meaning it remains always with us (with fluctuations).

This means that preventive interventions are directed at reducing the number of people susceptible to catching the infection.

There are several directions this could take;

1 Quarantine

The term is derived from a practice in the Middle Ages in Italy during the plague, meaning ‘40 days’, during which ships had to stand off port before disembarking. It assured the port population that no-one was infected or incubating infection.

It now involves isolating people who are infected (or could be infected), to prevent their infecting a susceptible population.

This is not a suitable method for the common cold because

a) the common cold is so common;

- b) the symptoms are non-specific (colds can easily be confused with allergic phenomena, and a myriad of other respiratory infections);
- c) such isolation is not (currently) culturally acceptable (people expect to still be able to work and study – or, indeed they are expected to – or congregate in sporting and entertainment crowds);
- d) virus infections causing colds are often asymptomatic [2];
- e) such a policy would be impractical to implement.

2 Immunisation or vaccination

Many infectious diseases have been managed by immunisation or vaccination. Indeed, smallpox is no longer an epidemic disease because of vaccination programs against it in the past.

The method depends on vaccinating a sufficient proportion of the population to reduce the person-to-person infection rate to <1 .

However designing a vaccination strategy for the common cold presents challenges.

- a) The common cold consists of several different viruses (see the chapter by Olaf Weber) [3]. A successful program would have to pick off each of these in turn – and no population benefit would be discernable until a large proportion had been addressed;
- b) Many of the viruses mutate easily (see the chapter by Olaf Weber). They are so unstable that the antigens quickly change, making them a quickly moving target for any vaccination program;
- c) Common colds are seen by the population as sufficiently trivial, and vaccines, viewed with some suspicion in the past, pose a difficulty in establishing a cost-harm benefit.

3 Early treatment of infected people

This method depends on treating people who are recently infected – or potentially infected by being in contact with an infected person – so that the infection is aborted. It is a method used to protect health workers potentially infected with the HIV virus, or contacts of children with suspected meningococcal disease, for example.

However for the common cold, no effective and available treatment is yet widely available.

4 Physical methods of prevention of transmission

This is left as the main opportunity for prevention of the common cold. It exploits the need for the virus to travel from person to person to spread infection. If we can interfere with that, we can reduce the number of people infected by any infected individual, and hence the total number of people infected. If we reduced the number infected to zero, the common cold would die out.

An intensive investigation of such methods has been undertaken over the years.

There are a number of ways virus can transmit from an infected to an uninfected person. They include two principal modes:

- a) aerosol from coughing and sneezing;
This is the traditional means for the spread of virus particles (and the basis of the caution in the adage *Coughs and sneezes spread diseases* referred to above).
- b) fomites* from virus left on contact surfaces in which virus is deposited by an infected person and then picked up by an uninfected one. This is less obvious, and has been the subject of considerable research.
(* the word 'fomite' derives from the Latin '*fomites*', meaning the tinder or lighting taper for starting fires).

Studies have investigated the relative importance of these two means of common cold transmission.

Sharing an office increased the risk of catching more colds in a Norwegian office study of nearly 900 office workers [4]. However, this did not settle the question of which mode of transmission was the more important [4]. An experiment in which 18 volunteers (playing cards) were prevented from touching common property or not (that is, restricting transmission of cold virus to aerosol or not), suggested that aerosol was the most common method [5].

Evidence for a fomite route comes from artificial studies of rhinovirus inoculation on the fingers of volunteers and then detecting it later [6], or actually transmitting infection to family members [7] or other volunteers [8, 9], although the evidence is conflicting [10]. Certainly inoculation titres picked up by recipients can be high enough to cause fomite spread of colds [11].

In summary, it seems that both methods are important in spreading infection through the community. There seems to be no consensus on the relative importance of either one, but nevertheless it might be reasonable to suppose that both are important, and worth exploiting in any preventive intervention.

Empirical evidence for ways of interrupting the transmission of respiratory virus infections

Theories about the way viruses are spread are important. However, we can decide whether exploiting them is of any use more directly by examining studies that have empirically tested the interruption of these modes of transmission.

The literature is confusing. There are many studies, of different study designs, and reaching different conclusions. For the clinician interested in deriving a useful clinical conclusion from the literature, this can be unsatisfactory. Happily, a method of undertaking such a literature review has been developed which is as explicit, transparent, and objective as possible. It is

called “systematic review”, and includes its quantitative methods, “meta-analysis”.

Some of the best are Cochrane reviews, that is, systematic reviews that are designed in full open view for the world to examine and criticise.

One includes studies of relevance to the question of whether the common cold can be prevented by interfering with physical modes of transmission [12, 13]. The next section summarises that review.

The Cochrane review: Physical methods of interrupting the spread of respiratory viruses

Sources of evidence

The Cochrane review systematically reviewed the empirical evidence for the effectiveness of physical methods aimed at preventing viral animal-to-human or human-to-human transmission of respiratory viruses (isolation, quarantine, social distancing, barriers, personal protection and hygiene) compared with do-nothing or with another intervention. It considered experimental studies (randomised or quasi-randomised trials), observational studies (cohort and case-control designs), and any other comparative design provided some attempt had been made to control for confounding.

The review reports on 49 reports of 51 studies with variable risk of bias, such as could be introduced by incomplete reporting; ignoring the impact of several potential biases such as the impact of viral incidence variability over time. Some studies also used inappropriate comparison interventions, impractical interventions (such as using, as a virucidal agent, iodine which causes unacceptable cosmetic staining), and interventions with low compliance (especially in educational interventions).

The settings of the studies, conducted over four decades, were highly heterogeneous (meaning very variable in terms of their settings and design). Settings ranged from suburban schools to military barracks, intensive care units, and paediatric wards in industrialised countries, slums in developing ones, and to special needs day care centres with a very high teacher to pupil ratio. There were few studies from developing countries, where the vast majority of the burden lies and where cheap interventions are most needed.

What is effective?

Handwashing

The most impressive effects came from cluster-randomised trials of low risk of bias in preventing respiratory virus spread from ‘hygienic measures in younger children’. Roberts et al. [14] reported a significant decrease in

respiratory illness in children up to 24 months (RR 0.90, 95% CI 0.83–0.97), although the decrease was not significant in older children (RR 0.95, 95% CI 0.89–1.01). Luby et al. [15] reported a 50% (95% CI 65–34%) lower incidence of pneumonia in children aged under 5 years of age in a developing country. Additional benefit from reduced transmission from them to other household members is broadly supported from the results of other study designs, although their potential for confounding is greater.

Physical barriers: Hand washing, gloves, masks and gowns

Six case-control studies assessed the impact of public health measures to curb the spread of the SARS epidemic in 2003 in China, Singapore and Vietnam. The data suggest implementing barriers to transmission, isolation and hygienic measures are effective and relatively cheap interventions to contain epidemics of respiratory viruses such as SARS, with estimates of effect ranging from 55% to 91%: hand washing >10 times daily [odds ratio (OR) 0.45; 95% CI 0.36–0.57, number need to treat (NNT) 4], mask wearing (OR 0.32; 95% CI 0.25–0.40, NNT 6), glove wearing (OR 0.43; 95% CI 0.29–0.65, NNT 7), wearing gowns (OR 0.23; 95% CI 0.14–0.37, NNT 5), and handwashing, masks, gloves and gowns combined (OR 0.09; 95% CI 0.02–0.35 NNT 3). All studies selected cases from hospitals, except one [16] in which the cases were people with probable SARS who reported to the Department of Health in the territory of Hong Kong up to 16 May 2003. There was limited evidence of the superior effectiveness of droplet barrier devices such as the N95 masks (respirators with 95% filtration capability against non-oily particulate aerosols [17]) over simple surgical masks. There was an incremental effect of decreased respiratory disease burden by adding virucidals or antiseptics to normal handwashing in somewhat atypical settings, but the extra benefit may have been, partly at least, from confounding additional routines.

Few studies reported resource consumption for the physical intervention they evaluated. The case control by Lau et al. [12, 13] concluded that handwashing needs to be carried out more than ten times daily to be effective. Ryan (in a military training setting) reported a need to wash hands more than four times daily [18]. Hall and colleagues reported that during 1 month of the RSV 'season' on a ward containing 22 cribs, 5350 gowns and 4850 masks were used [19]. It seems reasonable to advise as frequent handwashing and change of barriers as is possible during an epidemic and at least one complete change per patient seen.

Isolation of cases

The evidence for isolating cases is inconclusive. One study found that isolating together children of less than 3 years of age with suspected RSV

reduced transmission by “up to 60%” [20]; however, the statement that nosocomial transmission “was minimised” was not supported by data in a similar study [21].

Isolation of cases during the 2003 epidemic of SARS in China was reported to limit transmission to only those contacts who had actually had home or hospital contact with a symptomatic SARS patient (attack rate 31.1%, 95% CI 20.2–44.4 for carers; 8.9%, 95% CI 2.9–22.1 for visitors; 4.6%, 95% CI 2.3–8.9 for those living with a SARS case) but not to contacts living in the same building, working with cases, or without contact with SARS cases during the incubation period. This suggests that quarantine only needs to be extended for contacts of symptomatic SARS cases [22, 23]. Another brief report carried out in 2003 during the SARS epidemic in a military hospital in Taiwan and 86 control hospitals, compared an integrated infection-control policy to protect healthcare workers against infection; only two from the military hospital were infected with SARS compared to 43 suspected and 50 probable cases in the control hospitals [24].

Quarantine

An ecological study analysed the effects of quarantine and port of entry screening on the SARS epidemic in early 2003 in Beijing, China, from data collected centrally. Hospitals were the initial sources of transmission of the SARS virus. The shape of the epidemic suggests these measures may have reduced SARS transmission, although only 12 cases identified out of over 13 million people screened puts in doubt the direct effectiveness of entry port checks at airports and railway stations, and screening was probably more important [25]. An Israeli study of 186 094 children aged 6–12 years reported that school closure was temporally associated with a 42% decreased morbidity from respiratory tract infections, a consequent 28% decrease in visits to physicians and to emergency departments, and a 35% reduction in purchase of medications [26].

The lack of proper evaluation of global and highly resource-intensive measures such as screening at entry ports and social distancing was disappointing. The handful of studies do not allow us to reach any firm conclusions, although a recent analysis of historical and archival US data from the 1918–1919 influenza pandemic suggests an effect of social distancing measures such as school closures and public gathering bans [27].

Implications for practice

Simple public health measures appear to be highly effective, especially when they are part of a structured programme including instruction and education, and when they are delivered together. There is a clear mandate

to carry out further large pragmatic trials to evaluate the best combinations. In the meantime we recommend implementing the following interventions in a combined fashion to diminish transmission of viral respiratory disease:

- frequent handwashing with or without adjunct antiseptics;
- barrier measures such as gloves, gowns, and masks with filtration apparatus; and
- suspicion diagnosis, with isolation of likely cases.

Most effort should be concentrated on reducing transmission from young children.

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