AJIC commentary

Can we reduce the spread of influenza in schools with face masks?

Sara Y. Del Valle, PhD,[a] Raymond Tellier, MD, MSc, FRCPC,[b] Gary S. Settles, PhD,[c] and Julian W. Tang, PhD, MRCP, FRCPath[d]

Los Alamos, New Mexico; Calgary, Alberta, Canada; University Park, Pennsylvania; and Singapore

There is sufficient evidence indicating that masks, if worn properly and consistently, are an effective nonpharmaceutical intervention in the control of disease spread. The use of masks during a pandemic can minimize the spread of influenza and its economic impact, yet mask-wearing compliance in adults is often poor. Educating the public on the effectiveness of masks can increase compliance whilst reducing morbidity and mortality. With targeted campaigns and the help of the fashion industry, masks may become a popular accessory amongst school children. As children are effective source-transmitters of infection, encouraging a trend toward such increased mask-wearing could result in a significant, self-perpetuating reduction mechanism for limiting influenza transmission in schools during a pandemic.

Key Words: Nonpharmaceutical; intervention; pandemic; transmission; prevention; droplet; social distancing; children.

Despite the current availability of strain-specific vaccines and anti-influenza drugs, nonpharmaceutical interventions can still be used to reduce the spread of infectious diseases, such as influenza. The most common nonpharmaceutical interventions include school closures, travel restrictions, social distancing, enforced or volunteer home isolation and quarantine, improved hand hygiene, and the appropriate use of face masks. However, some of these interventions entail unavoidable economic costs to both employees and employers, as well as possible additional detriments to society as a whole. The recent H1N1 2009 pandemic has already demonstrated the massive financial losses that can result from the implementation of drastic social distancing measures, such as the early widespread closures of public amenities in Mexico City.

For example, it has been shown that school-age children are most likely to be infected and act as sources of infection for others due to their greater societal interaction and increased susceptibility.[1] Therefore, preventing or at least reducing infections in children is a logical first line of defense. For this reason, school closures have been widely investigated and recommended as part of pandemic influenza preparedness, and some studies support this conclusion.[2] Yet school closures would result in lost work days if at least one parent must be absent from work to care for children who would otherwise be at school. In addition, the delay in academic progress might be detrimental due to mass school absenteeism. In particular, the pandemic influenza guidance by the US Department of Health and Human Services recommends school closures for less than 4 weeks for Category 2 and 3 pandemics (ie, similar to the milder 1957 and 1968 pandemics) and 1-3 months for Category 4 and 5 pandemics (ie, similar to the more severe 1918 pandemic). Given the foregoing, it is clear that closing schools for up to 3 months is unlikely to be a practical mitigation strategy for many families and society. Thus, modelers and policy makers need to weigh all factors before recommending such drastic measures, particularly if the agent under consideration typically has low mortality and causes only mild disease.

Face masks are an effective, practical, nonpharmaceutical intervention that would reduce the spread of

From the Los Alamos National Laboratory, Energy and Infrastructure Analysis, Decisions Applications Division, Los Alamos, New Mexico[a]; Provincial Laboratory for Public Health of Alberta and the Department of Microbiology and Infectious Diseases, University of Calgary, Calgary, Alberta, Canada[b]; Gas Dynamics Laboratory, Department of Mechanical and Nuclear Engineering, The Pennsylvania State University, University Park, Pennsylvania[c]; and Department of Laboratory Medicine, National University of Singapore, Singapore.[d]

Address correspondence to Dr Julian W. Tang, Department of Laboratory Medicine, National University Hospital, 5 Lower Kent Ridge Road, Singapore 119074. E-mail: jwtang49@hotmail.com or julian_wt_tang@nuhs.edu.sg.

0196-6553/$36.00

doi:10.1016/j.ajic.2010.03.012

Fig 1. School children wearing masks during the 2009 H1N1 influenza pandemic in Mexico City, Mexico. Children wearing masks in classrooms when they are infectious may limit transmission to their classmates. If wearing such masks becomes fashionable, this may become a very effective intervention in schools (Photo credit: Henry Romero, Reuters, with permission).

influenza among school children, while keeping schools open (Figure 1). Influenza spreads through person-to-person contact, via transmission by large droplets or aerosols (droplet nuclei) produced by breathing, talking, coughing, or sneezing, as well as by direct or indirect (ie, via fomites) contact. Generally, most people touch very few others in their daily lives, although there are some cultural differences regarding this, and children are usually more tactile than adults.

Face masks act as a physical barrier to reduce the amount of potentially infectious inhaled and exhaled particles, although they do not reliably protect the wearer against aerosols. A recent study also demonstrated that face masks can redirect and decelerate exhaled airflows (when worn by an infected individual) to prevent them from entering the breathing zones of others,[3] thereby protecting others from the wearer. Therefore, if a whole classroom (or at least the symptomatic children to start with) were to don face masks, influenza transmission is expected to be greatly diminished.

Another recent study on face masks and hand hygiene showed a 10%-50% reduction in transmission for influenza-like illnesses.[4] Furthermore, face masks can act as an effective physical reminder and barrier to transmission by preventing the wearer from touching any potentially infectious secretions from their mucous membranes (ie, from the nose and mouth), which is another mechanism for direct and indirect contact transmission for influenza.

A recent systematic review has suggested that wearing masks can be highly effective in limiting the transmission of respiratory infections, such as influenza.[5] Admittedly, the effectiveness of this intervention strategy is highly dependent on compliance (ie, the proper wearing of masks in appropriate situations), but this also applies to the taking of postexposure prophylaxis medication, as well as vaccine uptake. Compliance depends on comfort, convenience, mask-fit, and hygiene. Importantly, masks themselves must not become a source of infection (or reinfection), and so should be replaced or sanitized daily when possible to maximize their effectiveness.

One possible solution could be for masks to be touted as fashion accessories. This might be particularly effective in influencing trend-conscious children. With support from the fashion industry and child-targeted public health campaigns, it might be possible to encourage such a trend and make the mask an acceptable fashion item, as well as an important means of infectious disease control.

In summary, poor understanding of influenza transmission risks and a lack of good public health education can lead to the ''worried well syndrome,'' but an effective, well-publicized science-based policy can minimize the probability of this reaction. Educating the public on the severity of influenza and the effectiveness of masks can reduce its economic impact and spread.

This article arose from discussions that took place at the "Mitigating the spread of influenza (H1N1), Part II" mathematical modelling workshop that took place at the British Columbia, Centre for Disease Control, Vancouver, September 14-16, 2009.

References

1. Ackerman E, Elveback LR, Fox JP. Simulation of infectious disease epidemics. Springfield, IL: CC Thomas; 1984. 202 pp 127-8.
2. Heymann A, Chodick G, Reichman B, Kokia E, Laufer J. Influence of school closure on the incidence of viral respiratory diseases among children and on health care utilization. Pediatr Infect Dis J 2004;23: 675-7.
3. Tang JW, Liebner TJ, Craven BA, Settles GS. A Schlieren optical study of the human cough with and without wearing masks for aerosol infection control. J R Soc Interface 2009;6:S727-36.
4. Aiello AE, Murray GF, Perez V, Coulborn RM, Davis BM, Uddin M, et al. Mask use, hand hygiene, and seasonal influenza-like illness among young adults: a randomized intervention trial. J Infect Dis 2010;201:491-8.
5. Jefferson T, Del Mar C, Dooley L, Ferroni E, Al-Ansary LA, Bawazeer GA, et al. Physical interventions to interrupt or reduce the spread of respiratory viruses: systematic review. BMJ 2009;339:b3675. doi: 10.1136/bmj.63675