BUILD SIMUL (2012) 5: 29 – 37
DOI 10.1007/s12273-011-0034-7

# Evaluation of intervention strategies in schools including ventilation for influenza transmission control

**Xiaolei Gao[1], Yuguo Li[1] (✉), Pengcheng Xu[2], Benjamin J. Cowling[3]**

*1. Department of Mechanical Engineering, The University of Hong Kong, Pokfulam Road, Hong Kong SAR, China*
*2. Institute of Applied Mathematics, Academy of Mathematics and Systems Sciences, Chinese Academy of Sciences, Beijing, China*
*3. School of Public Health, The University of Hong Kong, Pokfulam Road, Hong Kong SAR, China*

## Abstract

Many common respiratory infectious diseases transmit readily among school-age children. In major epidemics, school closures and class suspensions may be implemented to attempt to control transmission in the community. However, such intervention measures have been subject to an extensive debate as well as questions of its effectiveness and adverse social impacts. In the meanwhile, engineering intervention methods are also available, but their impacts at the community level were not well studied. A better understanding of how different school interventions contribute to the airborne disease prevention can provide public health officials important information to design infection control strategies, in particular how engineering control methods such as ventilation are compared to other intervention methods. In this study a hypothetical indoor social contact network was constructed based on census and statistical data of Hong Kong. Detailed school contact structures were modeled and predicted. Influenza outbreaks were simulated within indoor contact networks, allowing for airborne transmission. Local infection risks were calculated from the modified Wells-Riley equation, and the transmission dynamics of the disease were simulated using the SEPIR model. Both school-based general public health interventions (such as school closures, household isolation) and engineering control methods (including increasing ventilation rate in schools and homes) were evaluated in this study. The results showed that among different school-based interventions, increasing ventilation rate together with household isolation could be as effective as school closure.

## Keywords

airborne infection,
social network,
engineering control,
school interventions,
Wells-Riley

## Article History

Received: 23 March 2011
Accepted: 25 April 2011



Research Article

Indoor/Outdoor Airflow and Air Quality

## 1 Introduction

The epidemiological studies of the pandemic H1N1 outbreak 2009 have demonstrated a high attack rate to school-age population in many major outbreak countries or regions (Archer et al. 2009; CDC 2009a; Dawood et al. 2009; Fielding et al. 2009; Fraser et al. 2009; Gianella et al. 2009; Gilsdorf and Poggensee 2009; Health Protection Agency et al. 2009; Kelly and Grant 2009; Munayco et al. 2009; Nishiura et al. 2009; WHO 2009a; Wu et al. 2010a). Large school outbreaks have been reported (Calatayud et al. 2010; CDC 2009b; Dawood et al. 2009; Kawaguchi et al. 2009). The Hong Kong H1N1 influenza surveillance data in Year 2009 also showed an earlier and extensive outbreak in younger population (Wu et al. 2010b). The pattern of infection age distribution was believed to be caused by a higher susceptibility of younger population (Dawood et al. 2009; Mermel 2009; WHO 2009a).

School-age population was identified to have a significant impact on influenza pandemic (Kar-Purkayastha et al. 2009; WHO 2009b) and it has received a great intention for related interventions, such as school-age children vaccination (White et al. 1999; Hurwitz et al. 2000; Reichert et al. 2001; Jefferson et al. 2005; Longini and Halloran 2005; Weycker et al. 2005;

E-mail: liyg@hku.hk