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**LEARNING OBJECTIVES** After studying the literature presented in this issue, participants will be able to:

- Describe the potential benefits and limitations of a school-based influenza immunization program with the live attenuated influenza vaccine (LAIV)
- Explain the cost savings with school-based influenza immunization with LAIV

**TARGET AUDIENCE** This educational activity is designed for pediatricians, primary care physicians, pediatric and family nurse practitioners, neonatologists, infectious disease specialists, allergists, pulmonologists, immunologists, and other healthcare professionals involved in the care and management of pediatric respiratory patients.

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# PEDIATRIC RESPIRATORY CARE

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## Vaccine Coverage With a School-Based Influenza Immunization Program

Children experience high morbidity due to influenza and are important sources of influenza in the community. Prevention strategies include vaccination with the live attenuated influenza vaccine (LAIV) and the trivalent inactivated influenza vaccines (TIVs), which offer protection against influenza A and B viruses. School-based influenza vaccination programs may offer community protection against influenza. Recently, Carpenter and colleagues evaluated the feasibility and outcomes associated with a large, school-based influenza vaccination program.

From October to December 2005, on-site LAIV administration was offered free of charge to all students  $\geq 5$  years of age in kindergarten through the 12th grade and to all staff members in a large metropolitan public school system in Knox County, Tennessee. All staff members who were not eligible for LAIV were offered TIV. Recipients of LAIV were required to be between the ages of 5 and 49 years, and not have any contraindications to the vaccine. Students aged  $< 9$  years who had not previously received an influenza vaccine were offered 2 LAIV doses. As part of this study, vaccine coverage levels, resources expended, and physician and parent attitudes and knowledge were assessed.

*Results of this study suggest that coverage levels similar to those achieved in small pilot campaigns can be achieved in large school systems.*

Of 53,420 public school students in 81 schools, 24,198 (45%) were vaccinated with at least 1 dose of LAIV at school. Among 5,841 school staff members, 3,626 (62%) were vaccinated—1,464 (40%) received LAIV, and 2,162 (60%) were administered TIV. The proportions of students vaccinated among elementary, middle, and high schools were 56%, 45%, and 30%, respectively. Vaccine coverage levels were lower in high school students and in schools with larger proportions of black or low-income families. There were no reported severe adverse reactions to LAIV. During the 2-month vaccination campaign, 6,900 person-hours were expended by the health department and school system, and various health department clinics were closed for a total of 84 half days.

Questionnaires were mailed to 622 primary care physicians, and 331 (53%) responded. In general, community physicians expressed support for the campaign. Among the 196 physicians who had given patients advice regarding the campaign, 185 (94%) had advised  $\geq 1$  patients to participate and 103 (53%) had advised  $\geq 1$  patients against participation. Reasons for not recommending participation included asthma (cited by 74% of respondents), immunocompromised patient status (34%),

*Continued*

### Disclosures:

Dr Piedra is professor of pediatrics and molecular virology and microbiology at Baylor College of Medicine, Houston, Texas. He has indicated that he receives grant/research support from Juvaris BioTherapeutics, Inc., MedImmune, Inc., Sanofi Pasteur, and Novartis Pharmaceuticals; is a speaker for MedImmune, Inc.; and is an ad hoc consultant for MedImmune, Inc., Sanofi Pasteur, Novartis Pharmaceuticals, Hoffmann-La Roche Inc., and Merck & Co., Inc.

Dr Fergie is associate professor of pediatrics, Texas A&M University, College Station, Texas. He has indicated that he is a member of the speakers bureau, receives grant/research support from, and is an advisory board member for MedImmune Inc.; he is also a member of the speakers bureau for Sanofi Pasteur.

PPS Staff: Barbara Guidos, senior managing editor; Mark Palangio, senior medical writer; Terri Setteducato, senior program director; Luis Pichardo, program manager; and Wadee'ah Terry, CME program manager, have indicated no relevant financial relationships.





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### Vaccine Coverage With a School-Based Influenza Immunization Program (Continued)

immunocompromised status of a close contact (34%), presence of a chronic metabolic disease (32%), and egg allergy or history of Guillain-Barré syndrome (27%). The questionnaire also revealed that some physicians had misunderstandings regarding LAIV contraindications. Additionally, common reasons for lack of student participation included concerns about adverse effects, having asthma, negative physician advice, and nonparticipation in any vaccination program.

This school-based influenza vaccination campaign with LAIV achieved 45% coverage of students in kindergarten through 12th grade in a large, diverse, metropolitan school system.

Certain groups, such as high school students, black students, and students in schools with low family income, need educational campaigns to improve influenza vaccination coverage. This school-based influenza vaccination campaign required a substantial resource commitment from the local health department. The results of this study suggest that coverage levels similar to those achieved in small pilot campaigns can be achieved in large school systems.

Carpenter LR, Lott J, Lawson BM, et al. Mass distribution of free, intranasally administered influenza vaccine in a public school system. *Pediatrics*. 2007;120(1):e172-e178.

### COMMENTARY

**JAIME E. FERGIE, MD, Associate Professor of Pediatrics, Texas A&M University College Station, Texas.**

*Considering the logistical challenges associated with the yearly administration of the influenza vaccine, it is important to consider the advantages of alternative vaccine administration venues. Using the school environment to provide influenza vaccines to a large number of students should not diminish the importance of the medical setting for the administration of immunizations. The article by Schmier et al (see below) uses data acquired from the large effectiveness clinical trial conducted by King et al,<sup>1</sup> which demonstrated the benefits of vaccinating school children at schools by comparing health utilization between schools that were offered intranasal live attenuated influenza vaccine (LAIV) and those that were not. King et al not only demonstrated reduction in influenzalike symptoms in the students but also in adults whose children attended the schools where the vaccine was offered. The study was able to demonstrate this difference despite the fact that only 47% of the children attending the schools that were offered LAIV received it (2% of the children in the other schools also received the vaccine).*

*Using conservative estimates that undervalued the benefits of immunization, Schmier et al found that school-based influenza immunization with LAIV is cost saving over the influenza season. Using a societal perspective, their study incorporated the economic benefits to the household. Although these findings are supportive of school-aged children influenza immunization based on cost savings, we should not overvalue this parameter in deciding the value of any immunization, as it is uncommon for most medical interventions to result in cost savings.*

*The recently released recommendations of the Advisory Committee on Immunization Practices on prevention and control of influenza now states that annual vaccination be administered to all children aged 6 months to 18 years.<sup>2</sup> This is certainly another important step in reaching the ideal goal of recommending influenza immunization for every person every year.*

1. King JC Jr, Stoddard JJ, Gaglani MJ, et al. Effectiveness of school-based influenza vaccination. *N Engl J Med*. 2006;355(24):2523-2532.

2. Fiore AE, Shay DK, Broder K, et al; Advisory Committee on Immunization Practices (ACIP). Prevention and control of influenza: recommendations of the Advisory Committee on Immunization Practices (ACIP), 2008. *MMWR Recomm Rep*. 2008;57(RR-7):1-60.

### Reductions in Costs With a School-Based Influenza Immunization Program

**I**nfluenza mortality and morbidity remain excessively high despite vaccination recommendations that had focused on immunizing high-risk individuals. In February 2008, the Advisory Committee on Immunization Practices

recommended universal vaccination of children aged 6 months through 18 years. Because children propagate the spread of influenza, immunizing children at school offers an effective approach for preventing infection.

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The PRCI is a multicomponent educational program on pediatric respiratory disorders designed for pediatricians, primary care physicians, pediatric and family nurse practitioners, neonatologists, infectious disease specialists, allergists, pulmonologists, immunologists, and other healthcare professionals involved in the care and management of pediatric respiratory patients. PRCI programs address issues concerning asthma, respiratory syncytial virus, and other respiratory tract infections and disorders. Methods to prevent, control, and treat respiratory illnesses in children are also evaluated.

## Reductions in Costs With a School-Based Influenza Immunization Program (Continued)

Schmier and associates recently performed a cost-consequence analysis of a large, multistate, school-based influenza immunization program. Data for this analysis were derived from a cluster-controlled trial involving >15,000 school children (*N Engl J Med.* 2006;355(24):2523). In that study, there was a statistically significant reduction in influenzalike symptoms among children attending schools where live attenuated influenza vaccine (LAIV) was offered (intervention schools) compared with children attending schools where an influenza vaccine was not offered (control schools).

Self-reported survey results were used to compare vaccination costs, direct influenza costs, and indirect (productivity and time loss) influenza costs among households with children in intervention and control schools. Primary outcome measures included the incremental costs per household during the peak week and the entire season. Costs were adjusted to 2006 US dollars. Average household size was 4.59 members, which comprised 2.59 children and 2.0 adults.

In the intervention schools, 47% of children received LAIV, whereas in the control schools, 2% of children reported receiving LAIV outside of school. In the intervention group, 17% of households had a child with influenzalike illness versus 26% of households in the control schools.

Projected over the entire season, the average vaccination cost per household was \$41.66 for the intervention schools and \$5.58 for the control schools. Among intervention-school households, vaccine acquisition was the largest contributor

to vaccination costs. During the peak week, the average direct influenza cost per household was \$57.63 for intervention schools and \$75.50 for control schools. The average indirect cost per household associated with illness and caregiving during the peak week was \$64.48 for intervention schools and \$81.97 for control schools. For both intervention and control schools, work loss (missed workdays and presenteeism) constituted 76% of indirect costs, with time loss from usual activities accounting for the remaining costs. During the peak week, total costs per household were similar for intervention and control schools (\$163.76 vs \$163.05, respectively). The peak week accounted for 17% of influenza cases during the influenza season. Projected over the entire influenza season, total costs were lower among intervention households than among control households (\$759.92 vs \$931.88, respectively). For the entire influenza season, the incremental cost savings was \$171.96 per household. Sensitivity analyses demonstrated the robustness of the model over a broad range of parameters.

This study demonstrated that a school-based influenza immunization program with LAIV reduces the incidence of influenzalike illness among children and adults while decreasing influenza-associated costs over the entire season.

Schmier J, Li S, King JC Jr, Nichol K, Mahadevia PJ. Benefits and costs of immunizing children against influenza at school: an economic analysis based on a large-cluster controlled clinical trial. *Health Aff (Millwood)*. 2008;27(2):w96-w104.

## Clinical Insights® in Pediatric Respiratory Care Post-Test

- In the study by Carpenter et al, what level of vaccine coverage was achieved with a school-based influenza vaccination program with LAIV in students in kindergarten through 12th grade?
  - 5%
  - 25%
  - 45%
  - 65%
- In the study by Schmier et al, a school-based influenza immunization program with LAIV was associated with which of the following?
  - An increase in total influenza-associated costs per household during the peak week
  - A decrease in total influenza-associated costs per household during the peak week
  - An increase in total influenza-associated costs per household projected over the entire season
  - A decrease in total influenza-associated costs per household projected over the entire season

## ANSWERS

**Question 1 answer:** c. The school-based influenza vaccination program with LAIV achieved 45% coverage of students in kindergarten through 12th grade in a large, diverse, metropolitan school system.  
**Question 2 answer:** d. Projected over the entire influenza season, total costs were lower among households with children attending schools that took part in the immunization program versus households with children attending schools where an influenza vaccine was not offered (\$759.92 vs \$931.88, respectively).

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