Reaching Children Never Previously Vaccinated for Influenza Through a School-Located Vaccination Program

Susan M. Kansagra, MD, MBA, Vikki Papadouka, PhD, MPH, Anita Geevarughese, MD, MPH, Michael A. Hansen, MPH, Kevin J. Konty, MA, MS, and Jane R. Zucker, MD, MSc

Objectives. We determined the success of the school-located vaccination (SLV) program, implemented in 2009 in New York City to deliver pandemic influenza A (H1N1) monovalent vaccine (pH1N1), versus provider offices in reaching children who had never previously received influenza vaccine.

Methods. We compared the immunization history of children vaccinated in school versus provider offices. We included records in the Citywide Immunization Registry with pH1N1 administered between October 2009 and March 2010 to elementary school-aged children.

Results. In total, 96 524 children received pH1N1 vaccine in schools, and 102 933 children received pH1N1 vaccine in provider offices. Of children vaccinated in schools, 34% had never received seasonal influenza vaccination in the past, compared with only 10% of children vaccinated at provider offices ($P < .001$). Children vaccinated in schools were more likely to have received a second dose of pH1N1 in 2009–2010 than those vaccinated in provider offices (80% vs 45%).

Conclusions. The SLV program was more successful at reaching children who had never received influenza immunization in the past and should be considered as a strategy for delivering influenza vaccine in routine and emergency situations. (*Am J Public Health.* 2014;104:e45–e49. doi:10.2105/AJPH.2013.301671)

Improving vaccination coverage in children may lead to decreased morbidity and mortality in the general population, including decreasing influenza deaths and illness in adults.[1–4] In 2006, the Advisory Committee on Immunization Practices recommended influenza vaccine for healthy children aged 6 months to 4 years[5] and expanded their recommendation in subsequent years to include children aged 5 to 18 years.[6] The goal of vaccinating all children annually raises a significant operational question of how to target children most effectively.

Pediatricians provide the majority of immunizations given to children. However, after the 4- to 6-year-old well child visits, children may not visit medical providers regularly. School-located vaccination (SLV) offers a convenient alternative because it reaches the majority of children regardless of their access to medical care,[7] and schools have been successfully used for hepatitis B vaccination administration in the past.[8,9] SLV also offers parents the convenience of not having to make a trip to the provider's office or even be present. Jurisdictions such as Hawaii have routinely offered influenza vaccine through schools and have achieved vaccination rates as high as 46% in children aged 5 to 13 years.[10]

Despite the potential advantages of SLV, to our knowledge, whether it successfully reaches children who otherwise would have gone unvaccinated is unknown. We examined this issue in New York City (NYC) in 2009 when the NYC Department of Health and Mental Hygiene offered pandemic influenza A (H1N1) monovalent vaccine (pH1N1) through an elementary school–located campaign. During this influenza season, because of a late-emerging strain of novel H1N1, pH1N1 vaccine was developed and offered separately from routine seasonal influenza vaccination. Using data on pH1N1 vaccination from the Citywide Immunization Registry (CIR), the NYC Department of Health and Mental Hygiene's Immunization Information System, we compared the demographic characteristics and immunization history of children vaccinated through the SLV campaign with those of children vaccinated in medical provider offices. We examined the proportion of children in each setting for whom the pH1N1 vaccine was the first influenza vaccine ever received to determine the potential for SLV programs to effectively reach children who have not previously received an influenza vaccination and who therefore might be unlikely to get vaccinated in the current season as well. We also predicted the probability of being vaccinated at schools controlling for demographic characteristics and immunization history.

METHODS

From October 2009 through March 2010, free pH1N1 vaccination was offered to children in public and private elementary schools throughout NYC. A total of 1232 schools participated—all 925 public elementary schools and half of private (307 of 652) elementary schools. A letter about the campaign and a consent form were sent home to parents. In addition, media coverage of the campaign was extensive, and the materials were available on the Internet. After being immunized, children received a letter with details of the vaccine received that could be shared with the medical provider. Furthermore, the vaccine information was available to the provider in the CIR. A second dose of vaccine was offered to children aged 4 to 9 years. Seasonal influenza vaccine was not offered through the SLV program (8 schools administered seasonal influenza through a separate program). A detailed description of campaign operations, vaccination rates, and costs is described in detail elsewhere.[11,12]

pH1N1 vaccine distribution to medical providers began in early October. Seasonal influenza vaccine was available at medical provider offices as early as August 2009 and was provided in early October 2009 through the Vaccines for Children (VFC) program,[13]

a federal program providing vaccines free of charge to qualified children.

Data Source

We extracted the data analyzed for this study from the CIR, a population-based information system that collects and consolidates a child's immunization record regardless of which provider administered the vaccine in NYC and tracks the immunization status of individual children.[14] The CIR was created in 1997 when local public health law required that all immunizations administered to any individual aged 18 years or younger in NYC must be reported to the registry within 14 days of administration.[15] As of December 2009, CIR had immunization data for at least 85% of NYC's children and adolescents. About 90% of childhood providers who administered vaccines to children reported immunizations to the CIR within a 6-month period, and we queried the CIR more than a year after the SLV program ended.[16] Also, on the basis of a survey conducted in spring 2012, we estimated that pediatric providers reported 93% of the vaccine they administered. Medical providers were required to report pH1N1 doses in the same manner as they reported other childhood immunizations. Information on immunizations administered through the SLV was reported through paper consent and medical record forms that were collected and uploaded into the CIR.

Study Population

We examined CIR records of pH1N1 immunizations administered between October 2009 and March 2010 in elementary schools or medical provider offices to children born between January 1, 1999, and December 31, 2004, which correspond to the typical enrollment ages for elementary school children (aged 4–10 years) in NYC at the time of the program. We excluded children receiving pH1N1 influenza vaccine in more than 1 setting (e.g., first dose at SLV site and second dose at provider office) or vaccinated at weekend vaccination clinics, known as "points of dispensing," which were set up throughout the city and reached a small number of children. This campaign is described in detail elsewhere.[17]

We also excluded children who did not have at least 1 additional immunization record in the CIR, because the risk that the pH1N1-containing record for a child vaccinated in school would not merge with their previous CIR record was higher because the provider field, a commonly used element of the CIR used in its existing algorithm for matching records, differed from that of the child's usual provider. Therefore, including these children in the analysis would have overestimated the percentage receiving influenza vaccination for the first time.

Analysis

Of the children receiving pH1N1 in either schools or provider offices, we determined the number and percentage who had ever received influenza vaccine in the past. We also determined the percentage of children who received seasonal vaccine in the 2009–2010 influenza season, indicating access to a medical provider because schools did not offer seasonal vaccine. Because the 2009–2010 influenza season received significant media attention as a result of the emergence of novel pH1N1 and demand for seasonal influenza vaccine was high, we also examined the percentage of children who received seasonal vaccination in the 2008–2009 season or prior.

Additionally, as a proxy for low socioeconomic status, we examined children who received at least 1 dose of publicly funded vaccine at any time, either through the VFC program or through the New York State's Children's Health Insurance Program.[13,18] As an alternative measure to health care access and care-seeking behavior, we calculated the number of immunizations administered over the child's lifetime and determined whether children in each setting were considered up to date by age 35 months, defined as receiving 4 doses of diphtheria and tetanus toxoids and acellular pertussis vaccine; 3 doses of poliovirus vaccine; 1 dose of measles, mumps, and rubella vaccine; 4 doses of *Haemophilus influenzae* type B conjugate vaccine; 3 doses of hepatitis B vaccine; and 1 dose of varicella vaccine. We also examined second-dose completion rates for children aged 4 to 9 years for whom a second pH1N1 dose was recommended. For children vaccinated at provider offices for pH1N1, we determined the percentage who received seasonal influenza vaccine the same day.

We used the χ^2 test to compare the characteristics of children in both settings, including age, gender, VFC eligibility status, and previous vaccination history. We used the *t* test to compare the mean number of immunizations on record for these groups. We also constructed a multivariate logistic regression model that estimated the probability that an individual was vaccinated at school by demographic characteristics and immunization history. Demographic characteristics included gender and age because we expected younger children to have a lower probability of being immunized in school and this age group is more likely to have routine visits to a medical provider. To control for this, the model contained linear and quadratic age terms as a continuous variable. In addition, the model controlled for VFC program participation, immunization up-to-date status, and seasonal influenza vaccination history. We conducted all analyses using SPSS version 18 (PASW, Chicago, IL) and SAS version 9 (SAS Institute, Cary, NC).

RESULTS

A total of 209 595 children born between January 1, 1999, and December 31, 2004, were vaccinated against pH1N1 in NYC between October 2009 and March 2010; this figure represents approximately one third of NYC children in that age range on the basis of 2009 census population estimates. We excluded from the analysis children who received a dose at more than 1 site (n = 7149; 3.4%) or received a dose at points of dispensing (n = 2989; 1.4%). More than 96 000 children were vaccinated in schools, and more than 102 000 children were vaccinated through provider offices (Table 1). We excluded an additional 11 762 children from the school-located group and 2140 children from the provider group because their records did not match to a previous record in CIR. The final analysis included 84 762 children in the school-located group and 100 793 children in the provider group.

Of children vaccinated in schools, 34% had never been vaccinated against influenza and 10% had been vaccinated through provider offices. During the 2009–2010 season, 31% of children vaccinated against pH1N1 at

TABLE 1—Demographic Characteristics and Immunization History of Children Vaccinated with Influenza A (H1N1) 2009 Vaccine (pH1N1) by Setting: New York City; October 2009–March 2010

Variable	School-Located Vaccination, No. (%) or Mean	Provider Offices, No. (%) or Mean	Totals, No. (%) or Mean
Total children born between 1999 and 2004 immunized with pH1N1	96 524 (100)	102 933 (100)	199 457 (100)
Total children born between 1999 and 2004 immunized with pH1N1 and with 1 additional immunization in the registry	84 762 (87.8)	100 793 (97.9)	185 555 (93.0)
Male	42 036 (49.6)	52 090 (51.7)	94 126 (50.7)
4–6 y old at time of first pH1N1 vaccine	30 505 (36.0)	40 414 (40.1)	70 919 (38.2)
7–10 y old at time of first pH1N1 vaccine	54 257 (64.0)	60 379 (59.9)	114 636 (61.8)
No seasonal influenza immunization history	29 090 (34.3)	10 382 (10.3)	39 472 (21.3)
Seasonal influenza immunization in 2009–2010	26 569 (31.3)	75 579 (75.0)	102 148 (55.0)
Seasonal influenza immunization in 2008–2009	27 368 (32.3)	48 123 (47.7)	75 491 (40.7)
Completed second dose of pH1N1[a]	58 449 (79.8)	39 630 (44.9)	98 079 (60.7)
Received seasonal vaccine at same visit	NA	38 252 (38.0)	38 252 (20.6)
Up-to-date on childhood immunizations[b]	38 791 (45.8)	50 520 (50.1)	89 311 (48.1)
Immunization records in registry	24.4	26.6	25.6
At least 1 vaccine given through Vaccines for Children or State Children's Health Insurance Program	56 409 (66.5)	77 632 (77.0)	134 041 (72.2)

Note. NA = not applicable. All comparisons between school-located vaccination and provider offices were significant at $P < .001$.
[a]Of 73 286 children vaccinated in schools and 88 183 vaccinated at providers who were 4–9 y old at time of first immunization and therefore were eligible for a second immunization.
[b]Defined as receiving 4 doses of diphtheria and tetanus toxoids and acellular pertussis vaccine; 3 doses of poliovirus vaccine; 1 dose of measles, mumps, and rubella vaccine; 4 doses of *Haemophilus influenzae* type B conjugate vaccine (or complete for the series); 3 doses of hepatitis B vaccine, and 1 dose of varicella vaccine by 35 mo of age.

schools also received a seasonal influenza vaccine elsewhere, and 75% of children vaccinated at provider offices also received seasonal influenza vaccine ($P < .001$). Children vaccinated through the school-located pH1N1 program were also less likely to have received seasonal influenza vaccine in 2008–2009 than those vaccinated at provider offices (32% vs 48%; $P < .001$). On the contrary, children aged 4 to 9 years who were vaccinated in schools were almost twice as likely to receive a second dose of pH1N1 than were those vaccinated at provider offices (80% vs 45%; $P < .001$).

Of children vaccinated at provider offices, a greater proportion received seasonal vaccination in 2009–2010 than in 2008–2009 (75% vs 48%; $P < .001$), whereas the vaccination rate for these 2 seasons was stable for children vaccinated through the school-located program (31%–32%). Of children vaccinated with pH1N1 at provider offices in 2009–2010, 38% received a seasonal vaccine at the same visit.

Children who received pH1N1 vaccine through the school-located program were more likely to be older, were less likely to have been up to date on their childhood immunizations at age 35 months (46% vs 50%; $P < .001$), and had a smaller mean number of immunizations recorded in the CIR (24 vs 27; $P < .001$). Children vaccinated in schools were also less likely to have had 1 dose given through the VFC or Children's Health Insurance Program than children vaccinated at provider offices (67% vs 77%; $P < .001$).

The number of school-vaccinated children who did not have additional records in the CIR (12%) was higher than that for children vaccinated at provider offices (2%). We performed a closer inspection on a random sample of 100 of these excluded records to determine the percentage of children who may have had additional vaccination records in the CIR that did not merge to the H1N1 reported record and if inclusion of these children would have altered our findings. Of 100 randomly selected records excluded from the analysis, we found 39% had additional records in the CIR that the system did not match to the H1N1 record. Of these, 72% (SD = 8.8% at the 95% confidence level) had received an influenza vaccine in the past, a percentage not significantly different from our main finding that 66% of children vaccinated at schools had received an influenza vaccine in the past.

In the multivariate logistic regression model, age was highly significant and predicted higher probability of school vaccination. Adjusted odds ratios for all variables are presented in Table 2. After controlling for other factors, children who had no seasonal influenza immunization history were 7 times as likely to receive vaccination in school (95% CI = 6.83, 7.25), and children with no history in the preceding 2 years but who did have vaccination in the past were more than 6 times as likely to receive vaccination in school (95% CI = 6.18, 6.61). Children who had no vaccines given through public programs were also more likely to receive vaccination in school (adjusted odds ratio = 1.40, 95% CI = 1.37, 1.43). Smaller but significant effects were also seen for girls and children not up to date on their vaccines.

DISCUSSION

The results of this study demonstrate that the pH1N1 SLV program was more effective than provider offices at reaching children who

TABLE 2—Adjusted Odds Ratios for Receiving pH1N1 Immunization at School; New York City; October 2009–March 2010

Variable	AOR (95% CI)
Demographics	
Male (Ref)	1.00
Female	1.08 (1.06, 1.10)
Age	1.30 (1.23, 1.38)
Age squared	0.99 (0.98, 0.99)
Vaccines for Children Program	
No vaccines given through VFC or State Children's Health Insurance Program	1.40 (1.37, 1.43)
Vaccines given through VFC or State Children's Health Insurance Program (Ref)	1.00
Up-to-date[a] immunization status	
Not up to date	1.05 (1.03, 1.07)
Up to date (Ref)	1.00
Seasonal immunization history	
No seasonal influenza immunization history	7.04 (6.83, 7.25)
Seasonal influenza immunization before 2008–2009	6.39 (6.18, 6.61)
Seasonal influenza immunization in 2008–2009, none in 2009–2010	4.63 (4.48, 4.79)
Seasonal influenza immunization in 2009–2010, none in 2008–2009	1.00 (0.97, 1.03)
Seasonal influenza immunization history in 2008–2009 and 2009–2010 (Ref)	1.00

Note. AOR = adjusted odds ratio; VFC = Vaccines for Children.
[a]Defined as receiving 4 doses of diphtheria and tetanus toxoids and acellular pertussis vaccine; 3 doses of poliovirus vaccine; 1 dose of measles, mumps, and rubella vaccine; 4 doses of *Haemophilus influenzae* type B conjugate vaccine (or complete for the series); 3 doses of hepatitis B vaccine; and 1 dose of varicella vaccine by 35 months of age.

had never received influenza vaccine in the past and suggest that SLV reached children who might otherwise have gone unvaccinated; this relationship held true even when controlling for other factors including age.

Specifically, 34% of children vaccinated through the school-located program were never immunized for influenza previously, compared with only 10% of the children vaccinated at their provider's office. In addition, children vaccinated with pH1N1 at school were less likely to have received seasonal influenza vaccination in both the 2009–2010 and the 2008–2009 flu seasons than children vaccinated in a provider's office, underscoring the idea that children vaccinated through the school-located program would have gone unvaccinated without such a program.

The SLV program was also successful in reaching a greater percentage of children needing a second dose of pH1N1 vaccine. This is not surprising because the SLV program was designed to conduct 2 rounds of vaccination, knowing that children in this age range would need a second dose of pH1N1, thus saving 2 visits to the provider. These results also indicate that during a public health emergency, if 2 doses of vaccine are necessary, SLV would be a more effective approach.

Although most children have access to some medical care, as demonstrated by the 98.8% compliance with childhood immunizations required for school enrollment,[19] some parents may consider a visit to the provider for a recommended, but not required, vaccine unnecessary. Therefore, schools may have offered a convenient alternative. Furthermore, as they get older, children may not be visiting providers for routine care because no additional immunizations are required until age 11 years. Our results support this hypothesis because older age predicted vaccination at school.

Our findings also revealed that, contrary to expectation, children vaccinated at provider offices were more likely to have received publicly funded vaccine in their lifetime. This finding may reflect the effectiveness of the VFC program in eliminating the cost barrier, a notion that has been supported by other studies.[20,21] At the same time, it is possible that children vaccinated at schools were of families of higher socioeconomic status, more involved in their child's school activities, and more aware and trusting of the school vaccination campaign. However, the fact that they were less likely to have received influenza vaccine in the past and were less up to date with immunizations suggests barriers to accessing care despite their presumably higher socioeconomic status that may be attributable to higher out-of-pocket costs, less frequent access to care, or more vaccine hesitancy.

In the provider group, seasonal influenza vaccination coverage significantly increased between the 2008–2009 and 2009–2010 seasons, which could have been attributable to heightened media attention surrounding H1N1. However, among the SLV group, we found no increase in seasonal influenza vaccination rate between seasons, but the coverage rate was lower in both seasons compared with the provider group. Again, this finding suggests that families of children in the school-located group may have a different tendency to seek care or have different access to care. Convenience may also have played a role because children vaccinated by providers with pH1N1 could have received seasonal influenza at the same visit.

Our study is subject to several limitations. Data for approximately 5% of schools participating in the H1N1 vaccination program and data for 5% to 10% of records of schools that were loaded into CIR were rejected because of data quality issues. Given the large number of children involved, however, it is unlikely that the results would be different if these records were included. Furthermore, although 12% of records did not match to a previous record in CIR, our analysis of 100 records showed that exclusion of these records would not have affected our main findings. Also, it is possible that children vaccinated at providers' offices had more complete records in the CIR: Because the H1N1 vaccine was reported by the provider, that same provider was likely to report other administered vaccines. This bias would result in higher routine vaccine coverage as well as prior influenza vaccination among the provider group. This bias was methodologically addressed by

comparing only children whose H1N1 report matched an existing CIR record. Furthermore, to the extent that it affects the results, it is unlikely that it would wholly explain the 24% point difference in prior flu vaccination between the school- and provider-vaccinated groups. As with any (observational) study that relies on registry data, potential data quality issues may have had some effect on our analysis. These issues include misclassification and missing information within the variables available and the possible lack of inclusion of variables that may modify our observed effects.

The main finding of this study was that the SLV program reached a higher percentage of children who received influenza vaccine for the first time. Although most children have some degree of access to a health care provider, the recommendation to expand influenza vaccination to universal vaccination for children may place additional burden on the medical system and make access for some children more difficult if there is not enough capacity to meet this extra demand. Schools can serve as an alternative means of reaching children. In a pandemic setting, SLV can be essential to the delivery of potentially lifesaving immunization services to children who may otherwise go unprotected. Children immunized through schools were also more likely to complete second doses, an important advantage in scenarios in which 2 doses are required. More broadly, SLV is an important example of how the provision of clinical preventive services in community settings can effectively complement the work of office-based clinicians in reaching population-wide targets for prevention. ■

About the Authors

Susan M. Kansagra, Vikki Papadouka, Anita Geevarughese, and Kevin J. Konty are with and Michael A. Hansen was with the New York City Department of Health and Mental Hygiene, New York City, NY. Jane R. Zucker is with the Immunization Services Division, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, assigned to the Bureau of Immunization, New York City Department of Health and Mental Hygiene, New York, NY.

Correspondence should be sent to Susan M. Kansagra, New York City Department of Health and Mental Hygiene, 42-09 28th Street, 9th Floor, Queens, NY 11101 (e-mail: skansagr@health.nyc.gov). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints" link.

This article was accepted September 8, 2013.

Contributors

S. M. Kansagra conceptualized the study, wrote the initial draft, and revised the article for critical content. V. Papadouka assisted with conception and design, helped with analysis and interpretation of data, and revised the article for critical content. A. Geevarughese assisted with conceptualization, analyzed the data, and revised the article for critical content. M. A. Hansen assisted with analysis and interpretation of data and revised the article for critical content. K. J. Konty provided statistical support, analyzed the data, and revised the article for critical content. J. R. Zucker supervised the conceptualization and analysis and revised the article for critical content.

Acknowledgments

All phases of this study were supported by the Public Health Emergency Preparedness Cooperative Agreement (grant no. 5U90TP221298-08) and the Public Health Emergency Response Grant (funding opportunity no. CDC-RFA-TP09-902-H1N109) from the Centers for Disease Control and Prevention (CDC).

We thank Lesley Stalvey for editorial assistance.

Note. The contents of this article are solely the responsibility of the authors and do not necessarily represent the official views of the CDC. The funder had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the article.

Human Participant Protection

Institutional review board approval was not needed because this article involved program evaluation.

References

1. Weycker D, Edelsberg J, Halloran ME, et al. Population-wide benefits of routine vaccination of children against influenza. *Vaccine.* 2005;23(10):1284–1293.

2. Ghendon YZ, Kaira AN, Elshina GA. The effect of mass influenza immunization in children on the morbidity of the unvaccinated elderly. *Epidemiol Infect.* 2006; 134(1):71–78.

3. Reichert TA, Sugaya N, Fedson DS, Glezen P, Simonsen L, Tashiro M. The Japanese experience with vaccinating schoolchildren against influenza. *N Engl J Med.* 2001;344(12):889–896.

4. Loeb M, Russell ML, Moss L, et al. Effect of influenza vaccination of children on infection rates in Hutterite communities: a randomized trial. *JAMA.* 2010;303 (10):943–950.

5. Centers for Disease Control and Prevention. Prevention and control of influenza: recommendations of the Advisory Committee on Immunization Practices (ACIP), 2006. *MMWR Morb Mortal Wkly Rep.* 2006; 55(1):1–5.

6. Fiore AE, Shay DK, Broder K, et al.; Centers for Disease Control and Prevention. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP), 2009. *MMWR Recomm Rep.* 2009;58(RR-08):1–52.

7. Centers for Disease Control and Prevention. 2009 H1N1 influenza school-located vaccination (SLV): information for planners. 2009. Available at: http://www.cdc.gov/h1n1flu/vaccination/slv/planners.htm. Accessed August 1, 2012.

8. Dobson S, Scheifele D, Bell A. Assessment of universal, school-based hepatitis B vaccination program. *JAMA.* 1995;274(15):1209–1213.

9. Krahn M, Guasparini R, Sherman M, Detsky AS. Costs and cost-effectiveness of a universal, school-based hepatitis B vaccination program. *Am J Public Health.* 1998;88(11):1638–1644.

10. Effler PV, Chu C, Gaynor K, et al. Statewide school-located influenza vaccination program for children 5-13 years of age, Hawaii, USA. *Emerg Infect Dis.* 2010;16(2):244–250.

11. Kansagra SM, McGinty MD, Morgenthau BM, et al. Cost comparison of two mass vaccinations campaigns against influenza A H1N1 in New York City. *Am J Public Health.* 2012;102(7):1378–1383.

12. Narciso HE, Pathela P, Morgenthau BM, et al. Description of a large urban school-located 2009 pandemic H1N1 vaccination campaign, New York City 2009-2010. *J Urban Health.* 2012;89(2):317–328.

13. Center for Disease Control and Prevention. Vaccines for Children program. Available at: http://www.cdc.gov/vaccines/programs/vfc/index.html. Accessed November 30, 2012.

14. Metroka AE, Hansen MA, Papadouka V, Zucker JR. Using an immunization information system to improve accountability for vaccines distributed through the Vaccines for Children program in New York City: 2005-2008. *J Public Health Manag Pract.* 2009;15(5): E13–E21.

15. New York State Public Health Law 2164.2.b. Available at: http://public.leginfo.state.ny.us/LAWSSEAF.cgi?QUERYTYPE=LAWS+ampQUERYDATA=$$PBH2164$$@TXPBH02164+ampLIST=LAW+ampBROWSER=EXPLORER+ampTOKEN=59252407+ampTARGET=VIEW. Accessed November 30, 2012.

16. New York City Department of Health and Mental Hygiene, Immunization Information System Annual Report 2009. Submitted to Program Operations Branch, Immunization Services Division, Centers for Disease Control and Prevention, May 30, 2010.

17. Rinchiuso-Hasselmann A, McKay RL, Williams CA, et al. Protecting the public from H1N1 through points of dispensing (PODs). *Biosecur Bioterror.* 2011;9(1):13–21.

18. New York State Department of Health. Child Health Plus. Available at: http://www.health.ny.gov/health_care/child_health_plus. Accessed November 30, 2012.

19. *Automate The Schools (ATS) System.* New York, NY: New York City Department of Education; 2009–2010 academic year.

20. Fairbrother G, Friedman S, Hanson KL, Butts GC. Effect of the Vaccines for Children program on inner-city neighborhood physicians. *Arch Pediatr Adolesc Med.* 1997;151(12):1229–1235.

21. Smith PJ, Lindley MC, Rodewald LE. Vaccination Coverage Among US Children Aged 19-35 Months Entitled by the Vaccines for Children Program, 2009. *Public Health Rep.* 2011;126(suppl 2):109–123.