Cost Comparison of 2 Mass Vaccination Campaigns Against Influenza A H1N1 in New York City

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Objectives. We estimated and compared total costs and costs per dose administered for 2 influenza A 2009 monovalent vaccine campaigns in New York City: an elementary school–located campaign targeting enrolled children aged 4 years and older, and a community-based points-of-dispensing campaign for anyone aged 4 years and older.

Methods. We determined costs from invoices or we estimated costs. We obtained vaccination data from the Citywide Immunization Registry and reports from the community points of dispensing.

Results. The school campaign delivered approximately 202 089 vaccines for $17.9 million and $88 per dose. The community campaign delivered 49 986 vaccines for $7.6 million and $151 per dose. At projected capacity, the school campaign could have delivered 371 827 doses at $53 each or $13 each when we excluded the value of in-kind resources. The community points of dispensing could have administered 174 000 doses at $51 each or $24 each when we excluded the value of in-kind resources.

Conclusions. The school campaign delivered vaccines at a lower cost per dose than did the community campaign. Had demand been higher, both campaigns may have delivered vaccine at lower, more comparable cost per dose. (*Am J Public Health.* 2012;102:1378–1383. doi:10.2105/AJPH.2011.300363)

The 2009 influenza A H1N1 pandemic raised important, practical questions about how to vaccinate large numbers of people quickly, especially during an emergency, and how to reach vulnerable populations such as children. To accomplish both of these objectives, the New York City Department of Health and Mental Hygiene (DOHMH) conducted one of the nation's largest efforts to deliver influenza A (H1N1) 2009 monovalent vaccine. This effort included an elementary school–located vaccination campaign for children enrolled at that school who were aged 4 years and older and a community-based, mass-vaccination, points-of-dispensing campaign that was initially targeted to people aged 4 to 24 years and pregnant women, then expanded to other priority groups, and finally opened up to anyone in the general population aged 4 years and older for the last weekend. In addition, vaccination was available through private providers, hospitals, community health centers, DOHMH clinics, and pharmacies.

School-located vaccination offers a convenient alternative to medical clinics, especially for children who lack access to preventive care.[1,2] Reaching children is important because children play a critical role in influenza transmission, and improving vaccination coverage among children can lower illness in the population as a whole.[3–6] Organizing community points of dispensing is another way to quickly deliver vaccine to a large number of people and decrease burden on medical providers during an emergency.

Despite the potential value of these vaccination approaches, no studies have compared the resources required to conduct them, because few situations have emerged to allow real-world testing of both approaches simultaneously. In the fall of 2009, DOHMH implemented both approaches to provide 2009 H1N1 vaccine in New York City. We estimated and compared the cost of administering vaccine through schools and community points of dispensing. We also examined how cost per dose would change if each campaign operated at projected capacity. This information can assist public health agencies in selecting approaches for vaccinating children and adults in both routine and emergency circumstances.

METHODS

The school campaign provided vaccination to registered students aged 4 years and older during school hours at 1232 New York City elementary schools with a collective enrollment of approximately 570 000 students. Screening and consent forms were distributed in school to students, who took the forms home to their parents. Parents were asked to return completed forms within 3 days. Parental presence was not required during vaccine administration.

Three models were used to provide the vaccine at school. In schools with an enrollment of less than 400 students, the on-site school nurse vaccinated children; this was in addition to regular duties and largely not done as dedicated clinics. The nurse had 18 available days to complete the first dose of vaccinations and 15 available days to complete second doses for children requiring 2 doses. For schools with 400 to 600 students, a supplemental contract nurse was assigned for 5 to 8 days to assist the school nurse. In schools with more than 600 students, teams of nurses and support staff were assigned for 1 to 2 days per school.

In the community, anyone aged 4 to 24 years, as well as pregnant women, could receive the vaccine at community points of dispensing for the first weekend; the eligibility was gradually expanded to allow anyone aged 4 years and older to be vaccinated by the last weekend. Fifty-eight community points of dispensing were conducted over 5 weekends in November and December 2009. All points of dispensing were staffed by approximately

125 individuals, including contract nurses, volunteers, and city personnel. Screening and consent forms for community points of dispensing were distributed in advance to children in middle and high schools but could also be completed on site. To be vaccinated at community points of dispensing, children younger than 17 years had to be accompanied by a legal guardian. This campaign is described in detail elsewhere.[7]

We obtained vaccination data for the school campaign from New York City's population-based Citywide Immunization Registry, a central electronic system for tracking the immunizations of individual children aged up to 19 years.[8,9] All providers in New York City are required by law to participate in Citywide Immunization Registry (New York City Health Code, section 11.04). Of the 1232 schools that participated in the program, 1134 had data in the registry. We applied the vaccination rate among the enrollees of the 1134 participating schools to the total enrollment of the 98 schools without registry data to estimate vaccinations given at those sites. We obtained vaccination data from community points of dispensing through reports collected at each site, although forms from the community points of dispensing were also scanned into the Citywide Immunization Registry.

Calculating Expenses

We evaluated expenses, including the value of in-kind resources, from the perspective of DOHMH in 2009–2010 US dollars. The DOHMH could incur these costs in future years because there is no guarantee that resources would continue to be provided in-kind, especially if community points of dispensing or school-located campaigns were to be used routinely. Thus, we included the value of in-kind resources to capture the full cost of operating each campaign.

We grouped expenses into the following categories: personnel, supplies and equipment, logistics (e.g., transportation and storage of materials), and overhead (e.g., cost of space, utilities, computer workstations, and administration). We obtained costs from invoices or we estimated them as described in the sections that follow.

Most expenses were assigned to 1 of the 2 campaigns, but some expenses, such as vaccine storage and delivery, were allocated to each campaign according to the ratio of vaccines administered in each setting. Although the Centers for Disease Control and Prevention (CDC) provided 2009 H1N1 vaccine and supplies at no cost, these expenses would likely be incurred in future years. Further, the Vaccines for Children Program (VFC)[10] may provide vaccines for eligible children at no cost, but accounting for the percentage of VFC-eligible children would prohibit comparison of community and school-located campaign cost per dose because an estimated 60% of those that visited community points of dispensing were aged 19 years or older. Therefore, we valued the vaccine at $9 per dose based on the CDC price of injectable influenza vaccine, and ancillary supplies, such as the syringe and needle, at $0.30 per dose.[11] These unit costs were multiplied by the number of doses delivered plus 10% to account for wastage, spoiled vaccine, and surplus supplies that may not have been recouped.

Most staff in the school-located campaign were city employees. (In addition to DOHMH, staff for the vaccination campaigns came from the New York City Departments of Aging, Citywide Administrative Services, Design and Construction, Education, Environmental Protection, Finance, Fire, Homeless Services, Housing Preservation and Development, Information Technology and Telecommunications, Law, Parks and Recreation, Police, Probation, Social Services/Human Resources Administration, and Transportation, as well as the New York City Housing Authority, Office of Emergency Management, and Administration for Children's Services.) We determined the value of their labor through estimated time worked and salary. For personnel whose labor was not documented with time cards, we relied on the supervisor or employee to provide start date, end date, and percentage of time worked.

We obtained salaries from each city agency. We included the personnel hours spent planning the campaigns, as well as hours spent executing the campaigns. We also included school principals' time, which we estimated to be 5 hours, and school planning staffs' time, which we estimated was 10 hours at schools when the school health nurse vaccinated, 25 hours when the nurse and contract nurse vaccinated, and 20 hours when the team vaccinated. This was multiplied by an average hourly salary estimate for school principals and staff. Personnel estimates did not include weekday overtime. The school-located campaign also relied on contract nurses; their costs were taken directly from vendor invoices.

Because all community points of dispensing occurred on weekend dates, employees were paid overtime in accordance with their title, salary, and union contract, if applicable, which in some cases was higher than their base pay. We obtained the overtime paid to eligible DOHMH employees from payroll and financial records, and other city agencies sent invoices. We determined the value of overtime worked by those ineligible for compensation by multiplying their hourly salaries by their time worked at community points of dispensing. Two emergency medical technicians were also at each community site; we estimated their labor cost by using the starting salary for emergency medical technicians in New York City.[12] Fringe benefits expenses for all city personnel were included by using a rate of 37.7%.

The DOHMH also relied on New York City Medical Reserve Corp members, health professionals who volunteer during emergencies, and lay volunteers from New York City Community Emergency Response Teams. Because most of the participating Medical Reserve Corp volunteers were nurses, we calculated the value of their labor by multiplying their hours worked by $50.15, the mean base rate plus fringe benefits cost for a DOHMH public health nurse. To estimate the value of Community Emergency Response Team labor, we assigned a cost of $24.40 per hour, the mean base rate plus fringe benefits cost for a DOHMH public health assistant. We selected this rate because tasks performed by Community Emergency Response Team volunteers at community points of dispensing were performed by public health assistants in school settings.

We included the value of other overhead costs, such as space, utilities, computer hardware, and day-to-day supplies, by multiplying the agency's annual per-capita overhead cost of $32 618 by the number of full-time equivalents used in the campaign. This overhead cost also included the value of services provided by support personnel in departments such as finance, general counsel, and information technology. We used the hours worked by all city personnel to calculate the full-time equivalents used in the campaign.

Projected Capacity

Parental consent rates at schools and turnout at community points of dispensing varied by site. Many of the community points of dispensing had lower-than-expected turnout, and this was also the case in some schools. Because both campaigns could have administered more vaccines had demand been higher, we examined how cost per dose administered would change if demand matched the projected capacity of the existing campaign infrastructure and staffing to deliver vaccine.

To determine this, we calculated the number of doses administered per nurse per available day. We assumed that nurses in each model had delivered vaccinations at different rates because, for example, ancillary staff on teams assisted with paperwork whereas school nurses at smaller schools did not have designated ancillary staff. School nurses that operated at the 90th percentile conducted 8 vaccinations per available day, school nurses working with contract nurses conducted 12 vaccinations per day assigned to the school, and team nurses conducted 63 vaccines per day assigned to the school. We chose not to use the 100th percentile because the absolute maximum achievable by 1 nurse may not have been realistically possible for other nurses. Also, nurses in the top decile could have reflected those with additional undocumented help from other staff, as last minute changes in staff were largely undocumented, and the number of vaccinations conducted per available day tended to exponentially increase above the 90th percentile (see Appendix A, available as a supplement to the online version of this article at http://www.ajph.org).

For each school, we multiplied the 90th percentile of vaccinations performed per day by the number of nurses assigned and days available at each school to calculate the total vaccinations that could have been given at that school if demand had been higher. We included the incremental cost of the vaccine and supplies to meet the additional demand to determine the revised cost per dose administered.

For community points of dispensing, 1 site had a queue throughout both days of operation and was therefore assumed to have operated at capacity. The approximate number of doses administered per day at this site (n=3000) was assumed to represent the potential capacity of any community point of dispensing because all sites were staffed with the same model and, therefore, were assumed to have the same capacity. We calculated the projected capacity of the entire community campaign by multiplying 3000 by the number of points of dispensing conducted. Then we estimated the cost per dose if capacity had been reached by dividing the total campaign cost, including the incremental cost for vaccine and supplies needed to meet this demand, by the projected capacity.

The projected capacity for both the school and community campaigns reflects the maximum projected capacity of the infrastructure and staffing as it existed had turnout been higher. This analysis does not reflect the costs, for example, if more nurses had been hired or if campaign duration had been extended. With the existing infrastructure and staffing, the only additional cost to operate at capacity was the incremental increase for the extra vaccine ($9) and the ancillary supplies to deliver the vaccine ($0.30).

Because personnel costs and number of doses were the likely main determinants of cost per dose administered, we also conducted a sensitivity analysis that varied these parameters. We examined cost per dose if projected capacity was higher or lower by 20% while concurrently increasing and decreasing personnel costs by 20%.

RESULTS

From October 2009 to March 2010, DOHMH visited 1232 schools and provided an estimated 202 089 vaccinations, which included second doses of vaccine for those who were eligible. The first-dose vaccination rate among children enrolled in participating schools was 21.5%. The total estimated cost to operate the school-located campaign was $17.9 million (Table 1) resulting in a cost of $88 per vaccine administered (Table 2). This included $13 million in in-kind resources. In addition to contract nurses, more than 3500 city staff, including 800 school health nurses, contributed more than 200 000 hours of labor (see Appendix B, available as a supplement to the online version of this article at http://www.ajph.org). Personnel made up the majority of costs (59%), followed by supplies and equipment (17%). Within personnel expenses, 38% of the cost was for vaccinators.

A total of 49 986 vaccinations were administered at community points of dispensing. The total cost of the community campaign was $7.6 million (Table 1), resulting in a cost per dose of $151 (Table 2). This included more than $3.4 million in in-kind resources. In addition to contract nurses, more than 2500 city staff and 200 volunteers were estimated to have contributed more than 70 000 hours of labor. Personnel made up 64% of the costs of community points of dispensing. Overhead costs were approximately 16% of costs for both campaigns.

To estimate the projected capacity of the school campaign, we analyzed 1011 of the 1232 schools that had complete information to determine the rate at which vaccinations were given. If all nurses operated at the 90th percentile, and with adjustment for the vaccine doses that were given at excluded schools and for second doses, the total number of vaccines that could have been given at all schools was 371 827. In this scenario, the total cost per dose would decrease to $53 (Table 2). When we excluded the value of in-kind resources, the cost per dose at projected capacity would be $13. The sensitivity analysis demonstrated that the cost per dose at projected capacity ranged from $41 to $70.

The projected capacity of community points of dispensing was 174 000 vaccinations. In this scenario, the total cost per dose, including in-kind costs, would decrease to $51 (Table 2). When we excluded the value of in-kind resources, the cost per dose at projected capacity would be $24. The sensitivity analysis demonstrated that the cost per dose for a community points-of-dispensing campaign that operated at projected capacity ranged from $39 to $68. In both the school and community campaigns, projected capacity was a greater determinant of cost per dose than were personnel costs.

DISCUSSION

Successful implementation of both school-located vaccination and mass vaccination

TABLE 1—Breakdown of Costs for Influenza A H1N1 Vaccination Campaigns in New York City: 2009–2010

	School-Located Campaign (202 089 Vaccines Delivered)				Points of Dispensing (49 986 Vaccines Delivered)			
	Incurred, $	In-Kind, $	Total Cost, $	% of Total Cost	Incurred, $	In-Kind, $	Total Cost, $	% of Total Cost
Personnel	2 443 919	8 124 868	10 568 787	59.1	3 163 507	1 666 429	4 829 936	63.9
Planning staff	...	518 721	518 721	2.9	...	249 321	249 321	3.3
Department of Health operational staff	...	1 309 573	1 309 573	7.3	942 785	36 788	979 573	13.0
Other city agency operational staff[a]	...	658 698	658 698	3.7	1 130 848	...	1 130 848	15.0
Onsite school staff	...	1 797 496	1 797 496	10.1	...	...	...	0.0
Vaccinators	2 443 919	1 615 924	4 059 843	22.7	653 605	9097	662 702	8.8
Police	...	...	...	0.0	436 269	...	436 269	5.8
Emergency medical technicians	...	...	...	0.0	...	10 100	10 100	0.1
Volunteers[a]	...	...	...	0.0	...	110 491	110 491	1.5
Fringe	...	2 224 455	2 224 455	12.4	...	1 250 633	1 250 633	16.5
Overhead costs	...	2 775 236	2 775 236	15.5	...	1 267 813	1 267 813	16.8
Supplies and equipment	917 988	2 101 865	3 019 853	16.9	686 460	511 357	1 197 817	15.8
Vaccine	...	2 000 680	2 000 680	11.2	...	494 861	494 861	6.5
Ancillary supplies	327 628	101 185	428 813	2.4	76 284	16 495	92 779	1.2
Refrigerators and thermometers	169 700	...	169 700	0.9	...	...	...	0.0
Printed materials	402 168	...	402 168	2.3	281 370	...	281 370	3.7
Other	18 492	...	18 492	0.1	328 807	...	328 807	4.3
Logistics and support services	1 508 739	...	1 508 739	8.4	264 362	...	264 362	3.5
Transportation and storage	1 058 192	...	1 058 192	5.9	73 879	...	73 879	1.0
Translation of materials	11 857	...	11 857	0.1	22 144	...	22 144	0.3
Disposal of medical waste	52 000	...	52 000	0.3	12 938	...	12 938	0.2
Consent form tracking and scanning	352 338	...	352 338	2.0	76 019	...	76 019	1.0
Advertising	...	...	...	0.0	78 302	...	78 302	1.0
Other	34 353	...	34 353	0.0	1080	...	1080	0.0
Total	4 870 646	13 001 968	17 872 614	100.0	4 114 329	3 445 599	7 559 929	100.0

Note. Ellipses indicate that there were no costs.
[a]For community points of dispensing, these personnel could have served as vaccinators as well.

clinics required investment of significant resources. As conducted, the cost per dose administered was lower for the school-located campaign than for the community points of dispensing. However, had turnout been higher, community points of dispensing could have vaccinated people at a comparable cost per dose. For both campaigns, the cost per dose could have been lower if vaccination capacity had better matched demand (i.e., if demand had been higher or if the campaigns had been smaller).

The cost per dose for both campaigns was higher than other published cost estimates.[13,14] However, unlike other studies, our analysis included the costs of fringe benefits, overhead, and staff time for planning. Our estimates also included the value of school staff time, which was critical to the collection of consents and managing the day of vaccination. These costs included the value of in-kind resources, which were important to include as it is unlikely that the same level of in-kind resources would be available in the future, especially if either effort were to be implemented as an ongoing program. When we excluded this value, the actual incurred cost per dose dropped significantly to $13 for the school campaign and $24 for the community campaign at projected capacity ($24 for the school campaign and $82 for the community campaign at actual demand). These costs cannot be directly compared because the school campaign used a greater proportion of in-kind resources than did the community campaign.

In addition, the costs in this study were incurred during an emergency. Certain expenses, such as materials distribution, would likely be lower in more routine circumstances, because less overtime would be required. Furthermore, because health care is not routinely delivered through schools or community points of dispensing, limited infrastructure existed to support operations. However, once investment is made, such as in information technology systems and refrigeration capacity for vaccine storage, it could be amortized over subsequent years of operation. Also, because this was a new effort, planning and training time could decrease in future years.

Even at projected capacity and if some of the vaccine costs were eliminated to account for free vaccine available through the Vaccines for Children Program, the total cost of providing each dose is higher than New York State's Medicaid reimbursement for administration rate ($17.85) for vaccinating eligible children, which is already higher than in most

TABLE 2—Cost Per Dose in School-Located Campaign and Community Points of Dispensing, as Occurred and in Projected Capacity Scenario: Influenza A H1N1 Vaccination Campaigns, New York City, 2009–2010

	School-Located Campaign	Points of Dispensing
As campaigns occurred		
Total cost, $	17 872 614	7 559 929
Vaccines administered, no.	202 089	49 986
Cost per dose administered, $	88	151
Projected capacity scenario		
Total cost, $	19 609 032	8 828 592
Vaccines administered, no.	371 827	174 000
Cost per dose administered, $	53	51

other states.[15] In addition, vaccine costs made up only a small portion of overall cost. This makes it unlikely that any health department can support these vaccination approaches without additional funding or in-kind resources, even if costs were 50% lower. Pediatricians have also identified cost barriers to vaccinating children.[16] Although the goal of health care reform is to increase access to preventive services such as routine vaccinations, lack of financial incentive for providers and public health agencies may be a barrier to their provision. Less than 20% of billed claims were collected and, even with the higher Medicaid reimbursement rate in New York, the costs of the campaign greatly outweighed the reimbursement collected.

Although we attempted to capture planning costs, previous investment in emergency preparedness activities was critical. With the support of the CDC Public Health Emergency Preparedness cooperative agreement, in particular the Cities Readiness Initiative funding, DOHMH has invested heavily in preparedness and response infrastructure. Many of the costs of these preparations were not included in our estimates but were leveraged for these campaigns.

Limitations

There were limitations to our cost calculations. Salaries in New York City may be higher than those in other jurisdictions and were based on personnel's existing salary and not necessarily on job function during the campaign. The value of overtime and benefits could not be separated from our salary costs; these compensation rates may also be lower in other jurisdictions. We calculated overhead and fringe benefits costs by using DOHMH rates even though some personnel were from other agencies and many staff worked at non-DOHMH locations. However, we felt inclusion of these easily overlooked expenses more accurately captured the true cost of providing vaccine.

Our estimates of projected capacity were based on assumptions, and actual capacity may be higher or lower than estimated. Furthermore, we did not include costs to recruit more people in the projected capacity scenario in our analysis. For simplicity, we based the value of in-kind vaccine provided by the US government on the price of injectable vaccine even though the nasal spray form was also used. We did not include postcampaign costs, such as evaluation, although these activities are an integral component. There was also a minority of personnel for whom time or salary estimates could not be obtained. The campaigns targeted different demographics, which is a limitation in the ability to compare cost per dose—vaccinating children, for example, could have required more time.

Vaccinating in schools or mass vaccination clinics averts a provider visit. We did not estimate these cost savings, which may be especially important during a pandemic when medical capacity is stretched. We also did not address the societal benefits of vaccination, which includes decreased hospital admissions, absenteeism from work and school, and household illness, although these would have to be balanced with indirect costs, such as lost instructional time in schools.[17,18] These campaigns also expanded access—many of the children vaccinated in these campaigns had never previously received influenza vaccine, a benefit to which values are difficult to assign.[19] However, these campaigns did not reach children younger than 4 years who were not eligible for either program.

Overall, cost per dose could have been significantly lower if demand had matched the projected capacity of both campaigns and, thus, the ability to forecast demand is important for keeping costs low. However, in the context of H1N1, this was particularly difficult. For future campaigns, approaches that could be taken are to have consent materials distributed and returned early to allow supplies and staffing to be tailored to individual school consent rates. For community points of dispensing, using a reservation system might help to predict demand, or, in this case, having clearly defined protocols for releasing staff that were not needed would have helped to reduce costs.

Conclusions

The recent recommendation by the Advisory Committee on Immunization Practice to vaccinate all persons aged 6 months or older,[20] along with the evidence that vaccinating children can reduce household transmission, raises the question of how children can be reached annually. Both vaccination approaches assessed in this study are promising. The school campaign reached a larger percentage of the target audience and should be considered as a worthwhile public health program for continued investment. Third-party payers should consider mass vaccination to be a viable strategy to increase influenza vaccination rates for both children and adults, and should adequately reimburse for these services while efforts are made to conduct them as efficiently as possible to prepare for future threats. ■

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This article was accepted July 6, 2011.

Contributors

S.M. Kansagra and M.D. McGinty contributed to the conceptualizing, design, analysis of data, and drafting and revision of content. M.L. Marquez, A. Rosselli-Fraschilla, and B. Maldin Morgenthau contributed to data analysis and interpretation of data, and drafting and revision of content. J.R. Zucker and T.A. Farley contributed to the conceptualization and design of the study and drafting and revision of content.

Acknowledgments

The campaigns described in this study were supported by the Public Health Emergency Preparedness Cooperative Agreement (grant 5U90TP221298-08) and the Public Health Emergency Response Grant (funding opportunity CDC-RFA-TP09-902-H1N109) from the Centers for Disease Control and Prevention (CDC). Four of the authors (M.D.M., B.M.M., M.L.M., A.R.F.) are funded by the Public Health Emergency Preparedness Cooperative Agreement (grant 5U90TP221298-08W1) from the CDC.

The authors thank Betty Duggan, Jeffrey Hunter, Peter Jhon, Stephanie Keating, Adriana Lawrence, Sergiy Legkodukh, Linda May, Matt Motherwell, Heather Narciso, Vassiliki Papadouka, Preeti Pathela, Nora Puffett, Anne Rinchiuso, Diana Rodela, Allison Scaccia, David Starr, and Rosanna Volpe for their assistance in providing data used in this article. We thank James Hadler and Thomas Gift for their insight and review of the article, as well as Leslie Laurence for assistance in article preparation.

Note. The funding agent had no role in the design and conduct of the study, or collection, management, analysis, and interpretation of the data. Because the article includes a CDC author (J.R.Z.), it did undergo review and approval by the CDC. The contents of this article are solely the responsibility of the authors and do not necessarily represent the official views of CDC.

Human Participant Protection

This study is an evaluation of a public service program and, therefore, did not require institutional review board review.

References

1. 2009 H1N1 influenza school-located vaccination (SLV): information for planners [US Centers for Disease Control and Prevention Web site]. Available at: http://www.cdc.gov/h1n1flu/vaccination/slv/planners.htm. Accessed June 17, 2010.

2. Cawley J, Hull HF, Rousculp MD. Strategies for implementing school-located influenza vaccination of children: a systematic literature review. *J Sch Health.* 2010;80(4):167–175.

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

4. 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.

5. 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.

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

7. 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.

8. Citywide Immunization Registry, New York City Health Code, §11.04. Available at: http://www.nyc.gov/html/doh/downloads/pdf/cir/healthcode2005.pdf. Accessed February 22, 2011.

9. 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.

10. US Centers for Disease Control and Prevention. Vaccines for Children Program. Available at: http://www.cdc.gov/vaccines/programs/vfc/default.htm. Accessed July 22, 2010.

11. Centers for Disease Control and Prevention. Vaccine price list. Available at: http://www.cdc.gov/vaccines/programs/vfc/cdc-vac-price-list.htm#pediatric. Accessed June 16, 2010.

12. New York City Fire Department. Benefits and salary for EMS members. Available at: http://www.nyc.gov/html/fdny/html/community/ems_salary_benefits_042607.shtml. Accessed August 20, 2010.

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

14. Effler PV, Chu C, He H, 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.

15. State of New York Department of Health. Medicaid coverage and reimbursement policy for seasonal flu, pneumococcal and H1N1 vaccines. *New York State Medicaid Update.* 2009. Available at: http://www.health.ny.gov/health_care/medicaid/program/update/2009/2009-10spec.htm. Accessed November 16, 2011.

16. Freed GL, Cowan AE, Clark SJ. Primary care physician perspectives on reimbursement for childhood immunizations. *Pediatrics.* 2008;122(6):1319–1324.

17. Nichol KL, Margolis KL, Wuorenma J, Von Sternberg T. The efficacy and cost effectiveness of vaccination against influenza among elderly persons living in the community. *N Engl J Med.* 1994;331(12):778–784.

18. White T, Lavoie S, Nettleman MD. Potential cost savings attributable to influenza vaccination of school-aged children. *Pediatrics.* 1999;103(6):e73.

19. Kansagra SM, Papadouka V, Geevarughese A, Hansen M, McGinty MD, Zucker JR. Where children receive influenza vaccine: importance of school-located vaccination. Poster presented at: American Public Health Association Conference; November, 7, 2010; Denver, CO. Available at: http://apha.confex.com/apha/138am/webprogram/Paper233510.html. Accessed April 2, 2011.

20. Centers for Disease Control and Prevention. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices, 2009. *MMWR Morb Mortal Wkly Rep.* 2009;58(RR08):1–52.

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1. Susan M. Kansagra, Vikki Papadouka, Anita Geevarughese, Michael A. Hansen, Kevin J. Konty, Jane R. Zucker. 2014. Reaching Children Never Previously Vaccinated for Influenza Through a School-Located Vaccination Program. *American Journal of Public Health* **104**:1, e45-e49. [Abstract] [Full Text] [PDF] [PDF Plus]