Preventing Influenza: Vaccine Systems and Practices in the Southeast

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SYNOPSIS

Objectives. The purpose of this study was to determine from state and local health departments: (1) how they purchase, distribute, and fund influenza vaccine; (2) whether they experienced a shortage in 2003/04; (3) how the shortages were handled; and (4) how they prepared for distribution in 2004/05.

Methods. A web-based survey was completed from June to August 2004 in eight Southeastern states.

Results. Data were obtained from each state and 222 local health departments. Major differences between and within states were found with regard to purchasing, distributing, and funding influenza vaccine. Although the majority of health departments experienced periods of shortages in 2003/2004, surpluses of vaccine remained at the end of the season. There was little evidence of interaction between the public and private sectors to share vaccine resources in response to shortages. Tracking systems for redistribution of vaccine or follow-up were often not in place. Entering the 2004/05 season, 25% of states and 11% of counties were not developing any special procedures to deal with shortages beyond what was in place earlier.

Conclusions. Better systems and funding are needed, especially for adult influenza vaccine delivery and for redistribution of influenza vaccine in response to shortages.

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The last three influenza seasons (2003/04, 2004/05, and 2005/06) have been associated with vaccine supplies that were inadequate to meet demand, resulting in the need to prioritize and distribute vaccines equitably to reach populations in greatest need. The 2003/04 influenza vaccination season started with a vaccine supply considered sufficient to meet the needs based on usage patterns in prior years; however, influenza struck earlier than usual, peaking in November. At the same time, intense media attention was given to deaths from influenza of previously healthy children. This sparked a surge in demand in late November that could not be covered by existing supplies.¹ In contrast, the 2004/05 season was characterized by a supply considerably lower than normal. As of late December 2003, the Centers for Disease Control and Prevention (CDC) reported that it was receiving 1,000 calls a day on influenza alone.² While the 2003/04 season's shortage was due to a late surge in demand, the 2004/05 shortage was due to manufacturing difficulties, when one of the two manufacturers of trivalent inactivated vaccine for the U.S. market was prohibited by the Food and Drug Administration from distributing the vaccine, in effect reducing the projected supply by about 50%.³

There was a substantial delay in vaccine availability for the 2005/06 season, as one of the licensed manufacturers delivered late in the typical vaccination season with reduced quantities compared to early projections. Because of the need to plan influenza vaccine activities often well in advance, a delay in receipt of vaccine can be viewed as another form of shortage by the end users.

These three seasons highlight the vulnerability of the influenza vaccine supply and the need to be prepared for shortages in future years. Influenza vaccine is the only vaccine that tends to change from year to year, is recommended for targeted groups annually, and is administered during a short vaccination season, usually October–November. Unused vaccine from one season cannot be used in the following season.

These recent experiences indicate the need to understand how influenza vaccine is distributed and administered to help determine capacities for redistribution in the event of shortages in some areas. In the United States, influenza vaccine is distributed through both the private and public sectors. The Vaccines for Children (VFC) program finances recommended childhood vaccines for eligible children and covers approximately 40% of children in the United States.⁴ State immunization programs order vaccine through the CDC and ship it to participating VFC providers in the public and private sectors who administer them. In October 2003, the Advisory Committee on Immuniza-

tion Practices (ACIP) recommended influenza vaccination for children 6 to 23 months of age starting in the 2004/05 season, after having “encouraged” it for the 2002/03 season.⁵ This encouragement led to the negotiation of VFC covering influenza vaccine for the first time in the 2003/04 season.⁶ For adults, the majority of influenza vaccine administered is privately purchased. Nationally it is estimated that 10%–15% of vaccinated adults were vaccinated with publicly purchased vaccine. Most state and local immunization programs have extremely limited adult programs and no dedicated federal funding to develop these programs. (Personal communication, Pascale Wortley, CDC, 2005.)

The quantity of vaccine that manufacturers produce each year is a function of the anticipated demand. Influenza vaccine is recommended for about 185–188 million Americans annually;⁶ in the 2002/03 and 2003/04 seasons, 83 million doses of vaccine were manufactured, and an estimated 70–75 million were administered. (Personal communication, Pascale Wortley, CDC, 2005.) Because of delays in vaccine production in 2000 and to a lesser extent in 2001, a tiered approach to vaccination was recommended by the CDC to ensure vaccine availability first for those at highest risk of severe illness and complications. CDC recommended that individuals with high risk conditions (e.g., those 65 years of age or older, and individuals with chronic disorders of the pulmonary or cardiovascular system) and health care workers who care for these people be vaccinated first. Second, CDC recommended that the rest of the population not be vaccinated until November.⁷ In 2003, it was determined that because there were no anticipated vaccine supply problems, such tiering would be unnecessary.⁸ The projected vaccine supply of 83 million doses was thought to be adequate to meet the usual demand for vaccine.⁸ However, the unusually early onset of influenza activity resulted in a sudden increase in demand for the vaccine in late November and early December, months when demand for vaccination typically decreases, which contributed to shortages reported throughout the United States during the 2003/04 season.^{2,9} Furthermore, the change in ACIP recommendation, intended for the 2004/05 season but announced in October 2003, shortly before the recognition of substantial childhood deaths from influenza, may have also contributed to the late season surge in demand.

In response to the influenza vaccine shortage in 2003/04, the National Association of County and City Health Officials (NACCHO) conducted a brief, seven-question, web-based survey in December 2003 to rapidly assess whether local public health agencies (LPHAs) were experiencing vaccine shortages and identify any

steps they were taking to address the shortage (e.g., reallocation of vaccine across facilities, prioritization of patients).¹⁰ NACCHO initially e-mailed 1,762 local public health agencies, and 31% ($n=538$) of eligible agencies responded. Among the 538 LPHA respondents, approximately one-third indicated they had experienced a shortage of influenza vaccine.

The overall goal of this project was to better understand how state and local health departments manage influenza vaccine services and how they responded to the late season surge in demand for influenza vaccine in November and December 2003. Specifically, we sought to learn from state and local health departments: (1) how they purchased, distributed, and funded influenza vaccine; (2) whether they experienced a shortage in vaccine; (3) how the shortages were handled; and (4) how they prepared for distribution in the 2004/05 season.

METHODS

Study sites and study population

This study was conducted in eight southeastern states: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee. Information was obtained from both state and county health departments, with a focus on public health clinics providing influenza vaccinations. Of the eight states participating, two (Mississippi and South Carolina) have a centralized system governing their public health clinics. For these two states, a single survey was sent to the state office regarding vaccine ordering, supply problems, public information services, and other topics. The remaining six states provided lists of county or regional health departments and the number of clinics offering vaccine in each county. Initial information indicated that the majority of counties in these states were single-clinic units. The number of public health clinics offering vaccination services in five of the states ranged from 67 to 135, with Georgia being an outlier with 226 clinics. A minimum of 20–25 respondents per state was sought. Anticipating a response of 70%, we chose a simple random sample of 50% of clinics in six of the states. In Georgia, because of the large number of clinics, we selected a 25% simple random sample. In Kentucky, which has both regional and county-level health departments, we selected a simple random sample of county health departments. In addition, we chose one randomly selected clinic from each regional department. All random selections were made using the SAS Surveyselect procedure, version 9.1.¹¹

Data collection

Prior to beginning the study, an invitation letter was sent to each state health department to solicit input on the sampling plan and survey instrument. The research team worked closely with each state health department contact to identify the eligible clinics and the appropriate contact (i.e., someone responsible for immunizations) at each clinic to complete the survey.

Three web-based survey instruments were developed:¹² one for each state health department contact, one for the county/clinic contacts, and one for the two states with centralized systems (a combination of the state- and county-level survey instruments). The survey instruments were developed by key leaders in immunizations from Emory University, CDC, NACCHO, and the Association of Immunization Managers. This study was approved as exempt from human subjects review by the Emory University Institutional Review Board.

A pilot test of the county survey document was conducted prior to launching the full study. Pilot sites were identified through contacts at NACCHO and were local health departments that were not eligible for participation in our study (i.e., states not located in the southeast).

The survey was distributed and completed in all eight states from June to August 2004. A detailed survey and tracking protocol plan was developed based on standard guidelines (available upon request from the lead author).¹³ This plan specified the exact timing for survey administration and follow-up as well as provided sample text for consistent follow-up. Up to six attempts were made to contact non-responding clinics and encourage completion of the web-based survey.

The surveys consisted of mostly multiple-choice questions with some fill-in-the-blank and open-ended questions (surveys available upon request from the lead author). The surveys consisted of from 38 to 65 questions (depending on skip patterns/responses) and included the following broad topic areas: influenza vaccine coverage, purchasing, distribution, administration, usage, tracking process, and lessons learned. The surveys were estimated to take 20 to 30 minutes to complete.

Analysis

Univariate analyses were conducted for each state for each survey question. All results are presented separately for the eight state-level respondents. Since two of the states (Mississippi and South Carolina) have a centralized system, only county-level data are presented for the other six participating states. All county-level estimates were prepared using SUDAAN,¹⁴

a statistical program that adjusts appropriately for the sample design. Weights were calculated as follows: final weight = selection weight $\times$ nonresponse adjustment $\times$ post-stratification adjustment. The selection weight was the number of clinics in the county divided by the number selected for the sample. The nonresponse adjustment was the number selected divided by the number responding. The post-stratification adjustment was used when the respondent answered for clinics that were not in our original list of clinics. For example, in Florida our sampling frame was a list of county health departments rather than a list of clinics. When the county health department contained more than one clinic and the respondent answered for more than one clinic, the weight was adjusted so that the responses would be on a per clinic basis and reduce error. Moreover, when responses seemed unusual or inconsistent, or items needed for weighting purposes were missing, we re-contacted the respondent to confirm their answers, thus also reducing potential measurement error. However, it became apparent during data collection that the sampling frames were less than complete, which could introduce some undercoverage error in the estimate.

RESULTS

The clinic response rate ranged from 79% to 97% by state (Table 1), resulting in 222 completed surveys representing 235 clinics, and the state response rate was 100%. Item nonresponse was less than 10% for all questions. The majority of respondents within each state completed the survey after the first attempt or only one follow-up reminder.

State-level influenza vaccine coverage, purchase, distribution, and funding

Information obtained from the state-level survey in the eight participating states indicated that as of the 2003/04 season, most states estimated that the public sector provided a fairly large portion of the influenza vaccines used for children, ranging from 0%–20% to as high as 61%–80% in Mississippi (Table 2). However, the estimates of the percentage of adults who received influenza vaccine via the public sector were all at 40% or less. Responses from the states also indicated differences in how influenza vaccine is purchased and distributed. For example, states vary in *who* decides how much influenza vaccine to order—a state immunization director or VFC coordinator, or the decision is left to local health department officials, depending on whether the target population is children or adults. For half of the states, there was no difference in who decides for children vs. adults. States also vary in *ordering decisions* for influenza vaccine. Ordering decisions for the childhood population were determined by prior usage, available funding, and/or population estimates of children eligible for VFC. Influenza vaccine ordering decisions for adults usually were based on prior usage. The *distribution* of influenza vaccine also varied by state and whether the vaccine was for a childhood or adult vaccine program. For example, some states distributed influenza vaccine directly to local clinics or VFC providers, while others involved a central pharmacy or a third party distributor. Five of the states indicated there was no legislative authority to redistribute vaccine from one provider to another, with two indicating that vaccines could be redistributed only in an emergency.

Table 1. Response rates, Influenza Vaccine Lessons Project, 2004

	Number of counties	Number of public clinics in sampling frame	Number selected to sample	Number of responding clinics	Response rate (percent)
Alabama	67	76	38	37	97
Florida	67	67	34	27	79
Georgia	159	226	55 ^a	52	95
Kentucky	120	135 ^b	28	26	93
Mississippi ^c	82	106	NA	NA	NA
North Carolina	100	100	50	43	86
South Carolina ^c	46	71	NA	NA	NA
Tennessee	95	103	52	50	96

^aFifty-seven were selected, two were found to be ineligible (did not provide influenza vaccines).

^bIncludes 41 counties (each with one clinic), plus 15 districts that have a total of 94 clinics (94+41=135 clinics); we selected 20 counties (with one clinic) and eight districts for our sample.

^cOnly one combined state/county/clinic level survey was completed since the state has a centralized system.

Table 2. Influenza vaccine coverage, system, and funding of participating state health departments, Influenza Vaccine Lessons Project, 2004

	AL	FL	GA	KY	MS	NC	SC	TN
Estimate of proportion of children/adults who receive influenza coverage in public sector ^a								
Percent children	0-20	21-40	21-40	41-60	61-80	21-40	0-20	0-20
Percent adults	0-20	0-20	21-40	21-40	21-40	21-40	21-40	0-20
Who decides amount to order	Immunization Director	Childhood: VFC Coordinator Adults: CHD or Director of Nurses at county level	Childhood: State Vaccine Manager Adults: Local level	Childhood: VFC Coordinator Adults: Local HD Flu Vaccine Coordinator	Immunization Director and Director of Communicable Diseases	Childhood: Vaccine Manager Adults: Only for uninsured pregnant women	Immunization Director	VFC Manager; Regional Health Officer
Basis of ordering decision	Prior usage, available funding	Childhood: Available funding, estimate of percent high-risk children 0-18 years for VFC Adults: Prior usage	Childhood: Prior usage, population estimates Adults: Purchased at local level	Prior usage	Childhood: Prior usage, population estimates Adults: Prior usage	Prior usage, local level estimate no. pregnant women (only adults covered)	Childhood: Population estimates Adults: Prior usage	Prior usage and orders
How influenza vaccine is distributed within state	State vaccine distribution center to 11 PHA offices; area Immunization Managers transport vaccine to each CHD; VFC vaccine for private VFC providers is shipped via courier to the clinics	Childhood: State pharmacy to CHDs and VFC clinic offices Adults: Direct to CHD	Childhood: Central pharmacy to private providers, hospitals, and federal qualifying centers; vaccines for public HD are shipped to district pharmacy and then each site Adults: Purchased and received from manufacturer at local level	Childhood: Central third party distributors Adults: Manufacturer to local HDs or other public health clinics	All vaccine (pediatric and adult) is distributed from a central pharmacy by courier to each local health department	Third party distributor to each site	Childhood: State to VFC providers Adults: State to CHD for adult	Regional order and ship to local HDs VFC goes to regions who ship to county HDs

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Table 2 (continued). Influenza vaccine coverage, system, and funding of participating state health departments, Influenza Vaccine Lessons Project, 2004

	AL	FL	GA	KY	MS	NC	SC	TN
Is there legislative authority to redistribute vaccine among providers? (If yes, who has authority?)	Yes; Governor has authority in an emergency	No	Yes; state Immunization Program and Office of Pharmacy	No	No	No	Yes; state HD Commissioner in an emergency	No
Total population	4,447,100	15,982,378	8,186,453	4,041,769	2,844,658	8,049,313	4,012,012	5,689,283
Total funding per capita ^b (dollars)								
2002/03	0.20	0.12	NA	0.26	0.19	0.02	0.25	0.06
2003/04	0.37	0.18	0.01	0.32	0.42	0.15	0.28	0.16
2004/05 (spent) ^c	0.51	0.61	0.28	0.48	0.40	0.32	0.62	0.34

NOTE: State funding amounts reflect only state spending (do not include separate purchases by counties). It is likely that the funding amounts may not have included some funding for adult influenza vaccination since some of the adult purchases are reported separately in some states.

^aEstimate of coverage based on VFC shipments and use, population estimates, BRFSS data; estimate by HD staff.

^bCensus data, 2000

^cAmount spent or projected to spend for 2004/05 at the time of completing the survey (from June to August 2004)

ACIP = Advisory Committee on Immunization Practices

CHD = county health director or department

HD = health department

PHA = public health agency

VFC = Vaccines for Children

Finally, *funding* levels differed between states and between influenza seasons. On a per capita basis, influenza vaccine expenditures ranged from \$0.02–\$0.26 in 2002/03, to \$0.01–\$0.42 in 2003/04 and \$0.28–\$0.62 in 2004/05. Even though funding amounts for the 2004/05 season were projected as of the date the respondent completed the survey (from June to August 2004), spending had already exceeded 2003/04 levels. Despite the differences among states in funding amounts, each state indicated an increasing trend for funding. It is likely that these funding amounts mostly reflect differences in per capita funds spent on childhood influenza vaccine as vaccine for adult purchases occur separately (i.e. at the county level) in some states.

Influenza vaccine shortage experience in 2003/04 season

From 60% to 89% of clinics indicated that they experienced a period of shortage (demand exceeded supply) in 2003/04 (Table 3). To address the transfer of influenza vaccine between clinics during the 2003/04 shortage, we asked whether the local clinics *requested/received* additional vaccine from other public health clinics or from the private sector. Results indicated that clinics more commonly made requests of other public health agencies than the private sector (54% vs. 37%). Of the 54% of counties requesting vaccines from public health agencies, 39% received all that they requested, 43% received some, and 18% requested but did not receive any requested vaccine. Of the 37% of the clinics

Table 3. Vaccine shortage, redistribution, and left over during 2003/04 influenza season, Influenza Vaccine Lessons Project, 2004 (weighted responses from county clinics and responses from states with centralized systems)

	AL	FL	GA	KY	NC	TN	Total	MS	SC
Experienced shortage in 2003/04 season	60%	60%	89%	84%	89%	67%	79%	Yes	Yes
Requested/received additional vaccine from:									
Public Health Agency									
No	37%	57%	35%	60%	39%	51%	46%	X	
Yes	63%	43%	65%	40%	61%	49%	54%		
Received all	57%	41%	37%	0%	43%	43%	39%		
Received some	43%	45%	20%	70%	27%	42%	43%		X
Received none	0%	14%	37%	30%	30%	14%	18%		
Private sector									
No	70%	81%	69%	31%	57%	91%	63%	X	
Yes	30%	19%	31%	69%	43%	9%	37%		
Received all	10%	5%	42%	6%	25%	33%	19%		
Received some	90%	95%	16%	87%	63%	56%	65%		X
Received none	0%	0%	42%	7%	12%	11%	16%		
Others requested vaccine from you:									
Public Health Agency									
No	63%	59%	46%	59%	39%	60%	53%	X	
Yes	37%	41%	54%	41%	61%	40%	47%		
Provided all	24%	2%	4%	2%	0%	50%	4%		
Provided some	51%	37%	22%	34%	23%	47%	32%		X
Could not provide	25%	61%	74%	62%	77%	3%	64%		
Private sector									
No	84%	72%	56%	75%	46%	83%	68%	X	
Yes	16%	18%	44%	25%	54%	17%	32%		
Provided all	0%	0%	0%	0%	6%	100%	0%		
Provided some	6%	78%	16%	12%	33%	0%	22%		X
Could not provide	94%	22%	84%	88%	61%	0%	78%		
Left over vaccine, 2002/03 vs. 2003/04 season									
Increase	71%	50%	49%	20%	23%	41%	40%	X	
Decrease	21%	30%	32%	56%	54%	24%	38%		X
Same	8%	20%	19%	24%	23%	35%	22%		

NOTE: Total values presented for Mississippi and South Carolina.

requesting additional vaccine from the private sector, 19% received some. We also asked if other public health clinics or private practices were requesting vaccines from the clinic surveyed. Slightly less than half (47%) of clinics indicated that they were contacted by other public health clinics seeking additional vaccine supplies. Of these, 4% provided all doses requested, 32% provided some, and 64% indicated they could not provide any. One-third of clinics received requests for vaccine from the private sector, and of those, only 22% provided some vaccine. Finally, when we asked county-level respondents the number of doses left over at the end of the season, 40% of counties indicated they had more left over in the 2003/04 season than in the 2002/03 season despite the late season surge in demand during the 2003/04 season.

Tracking systems

Tracking systems in the public sector for receipt, administration, and redistribution of influenza vaccine, as well as follow-up for second doses (for children receiving their first influenza vaccine) were also assessed (Table 4). Among both states and counties, 89% had a tracking system for documenting the procurement of influenza vaccines. All of the states and 94% of county clinics had tracking systems in place for vaccine administration. However, tracking systems for redistribution or follow-up for second doses were often not in place. These systems varied in terms of whether they were the same or different systems for childhood vs. adult. The majority used the same systems for childhood and adult vaccine. Very few had only adult or only childhood tracking in place. Additional data (not shown) indicated that 90% of the state-level systems were computerized, but many county clinics (ranging from 17%–92% of county clinics) were using paper-based tracking systems, and the majority updated data within two days. Finally, almost all of the tracking systems were established prior to the 2003/04 shortage.

Preparations for 2004/05 influenza season

Preparations for the 2004/05 season differed for state and county respondents (Table 5). All of the states and about half of the local health departments indicated they were buying more vaccines for the 2004/05 than for the previous season. Most of the states (88%) were making attempts to improve communication with providers and consumers. Three-quarters (75%) of the states were encouraging providers to order earlier and 63% of states were training staff to deal with vaccine shortages. Slightly more than one-third (38%) of states were ordering vaccines earlier and 25% were establishing systems to monitor inventories. For all

Table 4. Tracking systems, Influenza Vaccine Lessons Project, 2004, state and county (weighted) responses

Type of tracking system	State	County	
	Percent	Percent	Range
Procured vaccine			
No	13	11	1%–37%
Yes	87	89	
Same for childhood and adults	50	67	45%–82%
Two systems	25	18	7%–38%
Childhood only	13	2	0–7%
Adults only	0	2	0–5%
Administrated vaccine			
No	0	6	0–14%
Yes	100	94	
Same for childhood and adults	88	73	58%–84%
Two systems	0	18	10%–36%
Childhood only	13	1	0–6%
Adults only	0	2	0–9%
Vaccine redistribution			
No	25	29	7%–68%
Yes	75	71	
Same for childhood and adults	25	61	23%–74%
Two systems	13	9	4%–14%
Childhood only	38	<1	0–6%
Adults only	0	<1	0–2%
Follow-up for second doses (pediatric vaccine)			
No	50	60	36%–75%
Yes	50	40	25%–64%

categories of what they were doing differently for the 2004/05 season, counties reported fewer changes than at the state level. However, several of the counties indicated that limited personnel and resources hindered their ability to change current practices. Entering the 2004/05 season, one-quarter of states and 11% of counties were developing any special procedures to deal with shortages beyond what was in place earlier. None of the states and 3% of counties were planning on creating their own stockpiles to deal with late season demand. No state was planning new tracking systems for vaccines distributed to the private sector, nor asking information of manufacturers or distributors about vaccines sent into their jurisdictions.

When asked about the role of the federal government in supporting the state influenza program, all or most of the states indicated that the federal government should be involved with funding support, assuring supplies, and providing clear guidance and recommendations, but they do not want the federal government to

Table 5. Preparation for 2004/05 Season, Influenza Vaccine Lessons Project, 2004, state and county (weighted)

<i>Doing differently for 2004/05 season</i>	<i>State</i>	<i>County</i>	<i>Range</i>
Buying more influenza vaccines this year	100%	54%	14%–77%
Improving communication with providers and/or consumers	88%	24%	12%–42%
Encouraging providers to order earlier	75%	7%	0–31%
Training staff	63%	19%	10%–28%
Ordering influenza vaccine earlier	38%	27%	6%–58%
Establishing systems to monitor inventories	25%	10%	4%–19%
Developing procedures to respond to future shortages	25%	11%	6%–25%
Considering purchasing and holding vaccines for late in the season if needed to meet a late surge in demand	0	3%	0–9%
Developing tracking systems with private sector	0	1%	0–3%
Asking groups to provide information on doses being shipped to our localities	0	3%	0–9%
Considering legislation to help in tracking of inventories and redistributing vaccines	0	0	0–9%

participate directly in the administration or distribution of vaccines within their states.

Key lessons learned by state and local health officials are noted in the Figure. These open-ended comments from respondents generally fell under four broad categories: (1) the important role of media in amplifying the demand for vaccine; (2) the need for improvements in distribution systems, particularly to meet fluctuations in demands; (3) the need for funding to improve the current system; and (4) the need for improved communication, both with the private sector of vaccine providers and with consumers.

CONCLUSIONS

To the best of our knowledge, this is the most comprehensive study to examine how state and county health departments responded to the late season surge in influenza vaccine demand during the 2003/04 season and how state and local health departments purchase, distribute, and track influenza vaccine. Understanding the public sector role in routine influenza vaccination and its capacities in responding to this shortage has some lessons for dealing with more significant shortages such as those that occurred during the 2004/05 influenza season as well as the supply delays that occurred in the 2005/06 season.

Results from our study indicated that inability to meet late season vaccine demands was widespread among local health departments in the Southeast during the 2003/04 season (79% of respondents in the eight states). This proportion was substantially greater than that reported from a national survey of LPHAs conducted by NACCHO during the shortage.¹¹ In that

survey, only about one-third of respondents indicated they had experienced a shortage of influenza vaccine. A likely reason for the higher proportion reporting shortages here is that this survey was administered later, thus more counties would have had the opportunity to experience a shortage. Other possible reasons include the lower response rate (31%) in the NACCHO survey or regional differences between the Southeast (the focus of our survey) and other regions in the United States.

As these eight states report, the role of the public sector in adult influenza vaccination delivery is limited, which presents challenges for dealing with shortages. Another marker of the public role in adult vaccination is adult vaccine purchase, which would provide information about state ability to respond to vaccine shortages, including how easily states might redirect vaccine to providers in need in the event of a shortage. Because the data we collected do not provide a complete picture of adult influenza vaccine purchase by the private and public sectors combined, further study is needed to better define the proportion of adult influenza vaccine controlled by the public sector in these eight states.

In contrast to adult vaccine purchase for influenza, the purchase data do provide a more complete picture of public purchase of influenza vaccine for children. The increasing trend of funding for childhood influenza vaccine over the three seasons studied correlates well with the implementation of expanded childhood recommendations for influenza vaccine and is consistent across all eight states, despite the vaccine shortages encountered in the 2003/04 and 2004/05 seasons. Moreover, the increase in investment in childhood

Figure. Key lessons learned, Influenza Vaccine Lessons Project, 2004, state and county responses

Role of media

- Severe health outcomes from influenza portrayed in the media can markedly and rapidly increase demand.

System (manufacturing, distribution, administration, and ordering)

- Need for better tracking of vaccine supplies including identifying clinics, manufacturers, and distributors with available supplies.
- Manufacturing capacity not adequate to meet surge demands. Early and accurate forecasting essential.
- Late ordering of vaccines (e.g., for vaccines to be delivered in January) usually not productive because demand usually very limited by that time.
- Focus vaccination efforts on early season vaccination.
- Schedule clinics only when vaccine supply is confirmed.
- Train nurses and other providers to report unused inventories.

Funding

- More public funding is needed for influenza vaccine.
- Need financial security from the federal government so that states will not have to absorb the risk for purchased vaccines that go unused.

Communication

- Need clear guidelines on which populations should receive highest priority for vaccination.
- Need to clearly inform the public and providers concerning what is known about the shortages and what steps are being taken to address the problem.
- Communication needs to be improved between public health staff and private providers.
- Need to be better prepared to deal with public demands for vaccine.

influenza vaccine purchase suggests that the public sector plays a substantial role in implementation of childhood influenza vaccination.

Despite the shortage in the 2003/04 season, all states were left with some surplus vaccine. This information supports the lesson that late season ordering typically does not result in increased use of the vaccine and raises the question of how we can mitigate these surpluses and better utilize our resources. Again in 2004/05, vaccine made available late in the season went unused. Given that influenza disease typically peaks in February, understanding how to convey the message that vaccination is worthwhile later in the season is an important aspect of increasing vaccination rates. There clearly are many opportunities to enhance vaccine sharing/distribution between the public and private sectors.

Because the majority of adult vaccination takes place in the private sector with privately purchased

vaccine, public health can exert little influence over allocation of influenza vaccine for adults, and tracking vaccine is particularly challenging. The 2003/04 shortage highlighted this situation, a preview to the much more serious shortage experienced in 2004/05. Unprecedented efforts, made possible in large part by the willingness of manufacturers to share proprietary information, were made in 2004/05 to help states redirect vaccine to individuals with high risk conditions. Establishing such systems on a routine basis, however, is difficult for a number of reasons. These experiences have demonstrated that, in shortage situations, some degree of public control of vaccine supply is desirable, an important point in relation to planning for the distribution of vaccine in a pandemic scenario where vaccine shortages will heighten the importance of targeting vaccination to priority groups.

The data support a stronger federal role in influenza vaccine supply. None of the states and only 3% of the counties were planning on holding a quantity of vaccine in reserve to be used to meet late season surges in demand, which undoubtedly in large part reflects lack of funding for adult vaccination. Given the reluctance of states to develop their own stockpiles, a reserve, if it is to be established, may need to be supported by the federal government, with the knowledge that the vaccine could go to waste. Erring on the side of over- rather than undersupply is common in industries that use perishable goods and that budget for some sort of potential loss in the event of a surplus, reflecting the importance of avoiding undersupply and the attendant adverse business consequences. (Personal communication, Frank Sloan, Duke University, 2005.)

To our surprise, the preparations states and counties undertook following the supply problems of the 2003/04 season to mitigate future shortages were limited. None were seeking legislation for increased redistribution authority in an emergency, though they may not perceive legislation as critical, as emergency powers may allow them to achieve the same result. None were seeking more information on vaccine doses going to the private sector. Perhaps because the 2003/04 season was viewed as an aberration since the overall supply was compatible with usual demands, special efforts did not receive a high priority. In addition, developing such systems would be costly and, given level program funding, would come at the expense of other program activities. Nevertheless, the 2004/05 season with its marked shortage highlighted the importance of identifying ways to track doses, defining priorities clearly, and collaborating with the private sector, issues that were defined as important during the 2003/04 season.

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