

A National Survey of Physician Practices Regarding Influenza Vaccine

Matthew M. Davis, MD, MAPP, Shawn R. McMahon, MD, MPH, Jeanne M. Santoli, MD, MPH, Benjamin Schwartz, MD, Sarah J. Clark, MPH

OBJECTIVE: To characterize U.S. physicians' practices regarding influenza vaccine, particularly regarding the capacity to identify high-risk patients, the use of reminder systems, and the typical period of administration of vaccine.

DESIGN: Cross-sectional mail survey administered in October and November 2000.

PARTICIPANTS: National random sample of internists and family physicians ($N = 1,606$).

RESULTS: Response rate was 60%. Family physicians are significantly more likely than internists to administer influenza vaccine in their practices (82% vs 76%; $P < .05$). Eighty percent of physicians typically administer influenza vaccine for 3 to 5 months, but only 27% continue administering vaccine after the typical national peak of influenza activity. Only one half of physicians said their practices are able to generate lists of patients with chronic illnesses at high risk for complications of influenza, and only one quarter had used mail or telephone reminder systems to contact high-risk patients. Physicians working in a physician network (including managed care organizations) are more than twice as likely to use reminders as physicians in other practice settings (odds ratio, 2.04; 95% confidence interval, 1.17 to 3.55).

CONCLUSIONS: Over three quarters of U.S. internists and family physicians routinely administer influenza vaccine, but few continue immunization efforts past the typical national peak of influenza activity. Many physicians may be limited by their practice data systems' capacity to identify high-risk patients. Despite the known effectiveness and cost-effectiveness of reminder systems, few physicians use reminders for influenza vaccination efforts. These findings raise concerns about meeting domestic influenza vaccination goals—especially for individuals with chronic illness and during periods of delayed vaccine availability—and the possibility of increased morbidity and mortality attributable to influenza as a result.

KEY WORDS: influenza vaccine; reminders; chronic illness; general internist; family physician; geriatrician.
J GEN INTERN MED 2002;17:670–676.

Infections with influenza virus result in approximately 110,000 hospitalizations and 20,000 deaths annually in

the United States.¹ Vaccination against influenza is the primary method for preventing the illness.² Delayed availability of influenza vaccine during the 2000–2001 and 2001–2002 influenza seasons^{3–5} has placed a premium on physicians' capabilities and efforts to identify and administer vaccine to individuals at increased risk for the complications of influenza. However, little is known about U.S. physicians' general practices regarding influenza vaccination.

Healthy People 2000 established vaccination coverage objectives of 60% for noninstitutionalized elderly persons (aged 65 years and older) and chronically ill individuals younger than 65 years who are at increased risk for the complications of influenza.⁶ Recent influenza vaccination rates among the elderly (67% in 1999) have exceeded that goal,⁷ and the coverage objective for the elderly in *Healthy People 2010* has been raised to 90%.⁸ In comparison, vaccination coverage among adults younger than 65 years of age with underlying medical conditions is less than 30%.⁹ Moreover, among adults with diabetes, asthma, coronary artery disease, and kidney disease, influenza vaccination rates are significantly lower among 18- to 49-year-olds than among 50- to 64-year-olds.²

Practice strategies such as reminder systems, in which patients and/or physicians are informed when vaccinations are due, are known to increase vaccination rates significantly and to be cost-effective in preventing the complications of influenza.^{10–13} However, a survey of family physicians in 1992 regarding childhood vaccinations indicated that only a small proportion (10%) used reminder systems.¹⁴ The proportions of internists and family physicians who use such strategies for influenza vaccination among adults are not known.

Delays in production and distribution of influenza vaccine during the 2000–2001^{3,4} and 2001–2002⁵ influenza seasons have highlighted the importance of identifying high-risk individuals and administering vaccine throughout the entire period in which immunization can prevent influenza. We conducted a national survey of family physicians and internists prior to the 2000–2001 influenza season to determine their usual practices regarding influenza vaccination.

METHODS

Sample

The study was approved by the Institutional Review Board of the University of Michigan Medical School. National random samples of 700 general family physicians and 606 general internists were drawn from the American Medical Association Masterfile through a contracted vendor

Received from the Division of General Internal Medicine (MMD) and Division of General Pediatrics (MMD, SJC), University of Michigan, Ann Arbor, Michigan; and the National Immunization Program, Centers for Disease Control and Prevention (SRM, JMS, BS), Atlanta, Ga.

Address correspondence and requests for reprints to Dr. Davis: University of Michigan, 300 North Ingalls Building, 6C23, Ann Arbor, MI 48109-0456 (e-mail: mattdav@med.umich.edu).

(Medical Marketing Services, Wood Dale, Ill). Additional samples of 100 family physicians and 200 internists who self-identified their subspecialty as "geriatrics" were drawn from the same source. Excluded from the sampling frame were physicians with other specialty board listings, physicians 70 years of age or older, and resident physicians. Physicians' year of graduation from medical school and board certification status were obtained from the Masterfile.

Survey Design

A 2-page survey was designed to collect information on 2 principal topic areas: usual practices regarding influenza vaccine in previous years, and anticipated practices for the 2000–2001 influenza season. Items regarding usual influenza vaccination practices asked physicians about the months in which they typically administer influenza vaccine, the proportions of vaccine typically delivered to specific patient populations (healthy, chronically ill, elderly), their practices' capacity to identify individual high-risk patients, and their prior experience with mail or telephone reminder systems to contact high-risk patients. An item regarding the 2000–2001 season asked how likely physicians were to administer vaccine after local influenza activity had begun (measured on a 5-point Likert-type scale).

Survey Administration

Surveys were sent via first-class mail on September 27, 2000, accompanied by a personalized cover letter and a business reply envelope. A second mailing was sent to nonrespondents on October 25, 2000 that included a \$2 incentive.

Data Analysis

Surveillance data regarding national peak influenza activity for the influenza seasons 1982–1983 through 1999–2000 were provided by the Centers for Disease Control and Prevention (CDC). Typical peak influenza activity was calculated as the mean week of peak activity over the last 18 years, and this was compared to respondents' vaccination practices.

Univariate and bivariate analyses were conducted in SAS (version 6.12; SAS Institute, Cary, NC), and tests of significance were computed using likelihood ratio χ^2 . Multivariable logistic regression models were used to analyze the associations between several predictor variables and use of reminder systems as the outcome variable. Physicians' use of reminder systems is likely related to factors that affect physicians' general emphasis on immunizations and preventive health, and to constraints (e.g., computer databases) that affect physicians' capacity to implement reminders.¹³ Therefore, we examined a model of provider characteristics (Model 1: subspecialty, practice setting, board certification, and year of graduation from medical school) and a model of practice characteristics specific to influenza vaccine (Model 2: duration of vaccine

administration, whether vaccination typically continues past national peak activity, proportion of doses administered to patients with chronic conditions, and practices' capacity to generate lists of high-risk patients on the basis of age or underlying disease).

RESULTS

Survey Response

The original national sample consisted of 1,606 U.S. physicians. Survey responses returned by November 27, 2000, were included in the analysis ($n = 969$; response rate, 60%). Response rates differed slightly between family physicians and internists (62% vs 59%), and between geriatricians and generalists (64% vs 60%), but these differences were not statistically significant. Respondents were more likely than nonrespondents to be board certified in their specialties (81% vs 73%; $P < .001$), but did not differ from nonrespondents with respect to year of graduation from medical school.

Characteristics of Physicians Administering Influenza Vaccine

Among respondents, 17 were ineligible because of retirement or other lack of current clinical activity. Of the remaining 952 physicians, 756 (79%) reported that they typically administer influenza vaccine in their practices. Family physicians are significantly more likely than internists to administer influenza vaccine (82% vs 76%; $P < .05$).

Practice characteristics of the 756 respondents who typically administer influenza vaccine appear in Table 1. Most physicians were board certified in their self-identified field, one third had graduated from medical school more than 20 years ago, and more than half worked in private, independent practice; these proportions did not differ significantly between internists and family physicians. Geriatricians were significantly more likely than generalists to work in university-based (14% vs 3%; $P < .001$) or hospital-affiliated practices (23% vs 15%; $P < .05$), and were significantly less likely to work in private, independent practice (44% vs 62%; $P < .001$).

Respondents in private, independent practice were significantly more likely than physicians in other settings to have graduated from medical school more than 20 years ago (37% vs 27%; $P < .005$); overall, they constituted two thirds of all physicians who graduated more than two decades ago. Providers in private, independent sites were also significantly less likely to be board certified than physicians working in other practice settings (78% vs 87%; $P < .005$).

Typical Influenza Vaccine Administration Practices

Physicians reported providing the vast majority of influenza vaccine doses to individuals at high risk for complications of influenza—those with chronic illnesses and those 65 years of age or older. Only 7% of physicians said that they provided over half their doses to healthy

Table 1. Characteristics of Physicians Who Typically Administer Influenza Vaccine

	Physicians, <i>n</i> (<i>N</i> = 756)	Proportion of Sample, %
Self-identified specialty/ subspecialty		
Family medicine	400	53
Internal medicine	356	47
Generalists	612	81
Geriatricians	144	19
Board certification*		
Board certified	611	81
Not board certified	140	19
Years since medical school graduation*		
0–10	208	28
11–20	293	39
21–30	177	23
>30	73	10
Practice ownership/ affiliation†		
Private, independent	429	59
Hospital/medical center	123	17
Physician network‡	77	10
Public	50	7
University	37	5
Other	16	2

* Five physician records did not have board specialty or medical school graduation information.

† Twenty-four physicians did not report practice ownership/affiliation.

‡ Includes physicians who listed their practice affiliation as a managed care organization.

patients not at increased risk. The proportion of high-risk patients to whom respondents administer influenza vaccine did not differ significantly by physician specialty or subspecialty, practice setting, years since medical school graduation, or board certification status.

Respondents most often initiate annual influenza vaccination in September (21%) and October (75%), and most physicians typically finish administering influenza vaccine in December (31%), January (30%), or February (20%). The typical duration of vaccine administration ranges from 1 to 8 months, with 80% of respondents administering vaccine for 3 to 5 months. Respondents did not differ significantly by specialty or subspecialty in their duration of vaccine administration.

Based on CDC influenza surveillance data since 1982, the typical peak of influenza activity occurs in the fourth week of January. Comparing historical national influenza activity with physicians' reported vaccine administration periods, 43% of respondents stop vaccinating before January 1, i.e., before the typical national peak. Only 27% of respondents indicated that they typically continue influenza vaccination past the typical peak, into February and later. Family physicians were significantly more likely than internists to continue vaccinating past the typical national peak (31% vs 21%; $P < .005$), as were physicians

practicing in a public clinic compared to respondents in other clinical settings (40% vs 27%; $P < .005$).

Capacity to Contact High-risk Patients

Physicians varied in their practices' capacity and experience in identifying and contacting patients at high risk for complications of influenza. Over 90% of physicians reported that they relied—in whole or in part—on office visits to target high-risk patients. Half of physicians thought their practices were able to generate lists of patients with specific chronic illnesses, and 75% thought their practices were able to generate lists of patients aged 65 and older. However, only 26% of physicians had used mail or telephone reminders in the past to contact high-risk patients regarding influenza vaccination. Internists were slightly more likely than family physicians to have had experience with reminder systems (28% vs 24%), and geriatricians were somewhat more likely than generalists to have used reminders (32% vs 25%), but these differences were not statistically significant.

Physicians who described their practice settings as a physician network (e.g., staff-model managed care organizations or multi-site group practices) are significantly more likely to have used reminders than physicians who work primarily in private independent practices, university- or hospital-affiliated settings, or public clinics (41% vs 24%; $P < .005$). Use of reminders did not differ significantly by board certification status or years since graduation from medical school.

We used multivariable logistic regression models to compare the effect sizes of variables associated with use of reminder systems (Table 2). Controlling for subspecialty, board certification, and years since graduation from medical school, physicians practicing in a physician network were twice as likely to use reminders as physicians in other clinical settings. In the same model, geriatricians appeared more likely than generalists to use reminder systems, but this trend was not statistically significant.

In a model regarding practice characteristics specific to influenza vaccine (Table 2), use of reminders was significantly more common among physicians whose practices could generate lists of chronically ill patients or elderly patients, when controlling for duration of vaccination period, proportion of doses for chronically ill patients, and continuation of vaccine administration beyond the typical national peak. Respondents who typically continue vaccinating past the national peak of influenza activity appeared more likely to use reminders than those who stop vaccinating at or before the peak, but this association was not statistically significant.

Reluctance to Administer Influenza Vaccine during the Influenza Season

Physicians were asked whether they would be hesitant to administer influenza vaccine after local

Table 2. Multivariable Logistic Regression Models of Use of Reminder Systems

Regression Models of Use of Reminders	Odds Ratios (95% Confidence Intervals)
Model 1: provider characteristics*	
Network practice setting	2.04 (1.17 to 3.55)
Geriatrics specialty	1.45 (0.95 to 2.19)
Independent private practice setting	0.82 (0.56 to 1.21)
Not board certified	0.98 (0.62 to 1.52)
Graduated >20 years ago from medical school	1.17 (0.81 to 1.68)
Model 2: vaccine practice characteristics†	
Administer vaccine for 4 mo	1.28 (0.85 to 1.94)
Administer vaccine for 5 mo	0.58 (0.24 to 1.30)
Administer vaccine for ≥6 mo	0.65 (0.22 to 1.82)
Continue vaccinating past national peak activity	1.69 (0.73 to 4.16)
>50% of doses to chronically ill patients	0.96 (0.68 to 1.37)
Able to generate list of elderly patients	2.69 (1.55 to 4.85)
Able to generate list of patients with chronic illness	1.70 (1.15 to 2.53)

* Comparison group for Model 1: generalist; not practicing in network or independent private setting; board certified; graduated from medical school ≤20 years ago.

† Comparison group for Model 2: administer vaccine for 3 months or less; stop vaccinating at or before typical national peak of influenza activity; provide ≤50% of vaccine doses to chronically ill patients; not able to generate lists of either chronically ill or elderly patients.

influenza activity had begun. Nearly half (43%) of physicians reported they were hesitant or neutral (“hesitant providers”) about administering vaccine in this circumstance.

As expected, providers hesitant to administer vaccine after the onset of local influenza disease activity were significantly more likely to report that they typically end vaccine administration prior to the national peak of influenza activity (53% vs 35%; $P = .001$). Hesitant providers were also significantly more likely to report shorter typical vaccine administration periods: they comprised 51% of all physicians with durations of 3 months or less, but only 38% of physicians who usually administer vaccine for 4 months or longer ($P < .001$).

The proportion of hesitant providers was not significantly different across specialty or subspecialty groups, and did not differ by year of medical school graduation or by use of reminder systems. However, physicians who are not board certified were significantly more likely to be hesitant than board-certified providers (57% vs 40%; $P < .001$). In addition, physicians who typically administer 20% or more of their vaccine doses to standard-risk individuals were significantly more likely to be hesitant than physicians who provide the bulk of their doses to high-risk patients (47% vs 40%; $P < .05$).

DISCUSSION

Findings from this national random sample of internists and family physicians are both encouraging and concerning. Physicians provide the vast majority of doses they administer to individuals at high risk for influenza complications, but only three quarters of physicians have the capacity to use their practice database to contact elderly patients, and only one half report the capacity to target individuals with chronic illness. Furthermore, only one quarter of physicians have experience with mail or telephone reminder systems that might take advantage of such database capacity to contact high-risk patients. Physicians with the capacity to use their databases to contact high-risk patients and physicians working as part of practice networks are most likely to use reminder systems.

More than three quarters of physicians who responded to the survey routinely administer influenza vaccine. However, nearly half of physicians were hesitant about administering vaccine after local influenza activity has begun, despite recommendations that vaccination is an effective means of prophylaxis for unexposed individuals after the onset of influenza activity.¹⁵ Comparison of family physicians and internists reveals that significantly lower proportions of internists routinely administer influenza vaccine, and that internists are also less likely to continue vaccinating past the typical national peak of influenza activity.

These findings suggest physician practice-related explanations for influenza vaccination coverage below domestic goals for individuals with chronic illness.⁹ Our results also raise significant concerns about the ability to meet coverage objectives in future influenza vaccine campaigns, particularly during a pandemic flu situation or periods of delayed vaccine availability when efficient delivery of vaccine to high-risk individuals is essential.

Identifying Individuals at High Risk

Some authors have suggested that physicians' reluctance to use reminders may be attributable to a lack of computerized medical records that would facilitate a reminder system,¹³ but our findings indicate that many physicians who have the capacity to generate lists of high-risk patients do not use them for the purposes of reminders. Other possible barriers include physician concerns about cost-effectiveness, patient objections, and lack of physician incentive to meet practice benchmarks regarding influenza vaccination. The effectiveness and cost-effectiveness of reminder strategies have been established,¹⁰⁻¹³ as has patients' approval of reminder systems.¹⁶ Physicians practicing in a network were twice as likely to use reminders as physicians working in other settings, which may reflect economies of scale in implementing reminder systems or quality-of-care benchmarks involving influenza vaccine in such networks. A recent

study of Medicare beneficiaries found that managed care enrollees were more likely than those with fee-for-service to have received influenza vaccination,¹⁷ suggesting that the greater likelihood of using reminders in managed care settings may contribute to higher vaccination rates.

Overall, physicians appear to rely to a large extent on the likelihood that individuals at high risk for the complications of influenza will make an office visit sometime before or during influenza season, at which time the vaccine may be administered. While this strategy may work reasonably well for the noninstitutionalized elderly—as evident in national vaccination coverage rates that have recently exceeded the prior domestic goal of 60%—it is likely not sufficient to achieve *Healthy People 2010* coverage objectives for individuals younger than 65 years of age with chronic illness. Moreover, heavy reliance on early autumn office visits as the primary opportunity for influenza vaccination may prove problematic during seasons in which the majority of vaccine doses reach physicians' offices in late October and afterward.⁵ However, if physicians must rely on encounter-based approaches rather than reminder systems, strategies such as standing orders for influenza vaccine during influenza season either in the outpatient¹² or the inpatient¹⁸ setting may improve vaccination rates. We did not inquire specifically about standing-order policies in this study.

Among persons aged 50 to 64 years, 24% to 32% have 1 or more chronic medical conditions that place them at high risk for influenza-related hospitalization and death.¹ Recognizing that age-based targeting strategies have proven more successful than strategies based on medical conditions,¹⁹ CDC's Advisory Committee on Immunization Practices added all persons aged 50 to 64 years to the primary target group for annual influenza vaccination, beginning with the 2000–2001 season.¹ Our findings regarding practices' database capacities suggest that physicians may indeed find it easier to identify patients of specific ages, rather than individuals with specific conditions. An important caveat is that limited supplies of influenza vaccine in the future may force public health authorities and physicians to prioritize doses for individuals in the previously identified high-risk groups and postpone vaccination for otherwise healthy 50- to 64-year-olds, as was recommended during the 2000–2001 season.⁴

Administering Influenza Vaccine: Who, When, and for Whom?

We found that family physicians are significantly more likely than internists to administer influenza vaccine and to continue vaccinating past the typical national peak of influenza activity in late January, and these findings have implications for individuals at increased risk for influenza complications. Although there were no significant differences in the share of vaccine doses administered to

different patient risk groups among the physician categories in the study, general internists may see more patients with chronic illness than do general family physicians. If general internists less frequently vaccinate against influenza and—when they do offer the vaccine—administer influenza vaccine for a shorter time period, then specific vaccine administration initiatives targeting general internists might improve coverage rates among individuals with chronic conditions. Given the large number of general internists (approximately 80,000 board certified according to data from the American Board of Internal Medicine²⁰), such initiatives might be effectively delivered through professional organizations such as the American College of Physicians, and may reach even more physicians if implemented through state public health agencies whose registries of licensed physicians are not membership based.

General internists may also be more likely than general family physicians to share medical care with subspecialists for individuals with chronic conditions, and therefore may appear less active in the vaccination of such individuals in our study because they anticipate that subspecialists will administer influenza vaccine. The dynamic of vaccination between generalists and subspecialists was beyond the scope of this study, and is an area for future research.

Another factor that may impede improvement in influenza vaccination rates is that nearly half the physicians reported that they were hesitant to administer vaccine after the start of local influenza activity. Vaccination against influenza provides immunity within 2 weeks,¹ and therefore immunization remains an effective form of prophylaxis after the onset of local influenza activity.¹⁵ Although the optimal time to administer influenza vaccine is October through mid-November to assure vaccination well before substantial national influenza activity, in circumstances of vaccine delay, immunization is recommended for high-risk and standard-risk groups into December and later, as long as vaccine is available.⁴ Physician-directed educational efforts that emphasize the effectiveness of influenza vaccination after the onset of local influenza activity may encourage hesitant physicians to continue vaccinating later into the influenza season than they have done previously, thereby making influenza vaccine available to more individuals.

The relative importance of physician versus nonphysician sources of influenza vaccination must also be considered. Data from the 1998–1999 influenza season suggest that about one half of all influenza vaccine doses overall and nearly two thirds of doses for individuals 65 years of age or older are administered in physicians' offices. About 20% of doses overall are administered at workplaces. Stores, community centers, and local public health clinics and health departments each account for another 5% to 10% of doses.²¹ Although physicians are directly responsible for administering only 1 of every 2 doses overall, it is also likely

that individuals obtain influenza vaccine elsewhere after a recommendation or reminder from a physician.

Barriers to physician adoption of routine influenza vaccination remain an obstacle to increasing national immunization rates. Physician behavior regarding vaccines has been conceptualized as a 4-step process that begins with awareness of recommendations, then proceeds to acceptance, adoption, and finally adherence.²² Our findings suggest that the majority of physicians nationally have adopted influenza vaccine recommendations and are adhering to guidelines in administering the vast majority of doses to persons at high risk for complications. However, 18% of family physicians and 24% of internists have not yet adopted the recommendations.

While it is theoretically possible that some U.S. physicians are unaware of influenza vaccination recommendations, it seems more likely that physicians who do not administer influenza vaccine routinely have not accepted the recommendations. Their lack of acceptance may be attributable to inertia of previous practice, lack of agreement with the recommendations, lack of self-efficacy, or external barriers related to patients.²³ Practice inertia and lack of agreement or self-efficacy may be addressed through communicating to physicians the effectiveness of vaccination in preventing complications of influenza in high-risk and standard-risk populations.^{2,24,25} Patient-related barriers, such as the cost of the vaccine or lack of patient acceptance of the vaccine, have been the focus of multiple interventions reviewed by Briss et al.¹²

Study Limitations

Our response rate of 60% is comparable to rates in other mail surveys of physicians,^{26,27} but does raise concerns about the generalizability of our results. Response rates did not differ significantly by specialty, but the likelihood of response may have differed depending on physicians' interest in influenza vaccination issues. Physicians who routinely administer influenza vaccine may have been more likely to respond, and therefore actual administration rates in the community may be lower than rates we observed.

The retrospective nature of the survey may have led to error in physician recall regarding past experiences of administering influenza vaccine. In addition, we did not ask physicians to indicate their patterns of vaccine administration, which may have illuminated differences among physicians who administer the majority of doses early versus those who administer doses evenly throughout the autumn and winter months. Such patterns may indicate why some physicians are hesitant to continue vaccinating into January and others are not, and may also suggest potential problems for "early" vaccinators in adjusting their practices to delayed vaccine distribution. We did not explore physicians' perceived barriers to implementing reminder systems for influenza vaccination, and this is an area of continuing investigation.

Conclusions

In summary, over three quarters of U.S. physicians routinely administer influenza vaccine and focus their efforts on individuals at high risk for complications of influenza. However, insufficient database infrastructure, minimal experience with reminder systems, and hesitancy to administer vaccine after the onset of influenza activity may substantially limit physicians' abilities to identify and protect high-risk individuals in future influenza seasons. These barriers to increasing vaccination coverage may be magnified during seasons with delays in influenza vaccine availability.

If we are to achieve the full potential benefit of national influenza immunization efforts through reductions in morbidity and mortality, more physicians must adopt routine influenza vaccination strategies that target and reach high-risk persons, particularly those with chronic medical conditions. Physician barriers to influenza vaccination must be elucidated further, in order to develop educational campaigns that enhance community vaccination rates through greater physician adherence to recommendations.

The authors are grateful for the contributions of James Singleton of the Centers for Disease Control and Prevention in development of the survey instrument.

This work was funded by the Centers for Disease Control and Prevention through a cooperative agreement with the Association of Teachers of Preventive Medicine.

REFERENCES

1. Centers for Disease Control and Prevention. Prevention and control of influenza recommendations of the Advisory Committee on Immunization Practices (ACIP). *Morb Mortal Wkly Rep.* 2000;49:1-38.
2. Centers for Disease Control and Prevention. Influenza, pneumococcal, and tetanus toxoid vaccination of adults - United States, 1993-1997. *Morb Mortal Wkly Rep.* 2000;49:39-62.
3. Centers for Disease Control and Prevention. Delayed supply of influenza vaccine and adjunct ACIP influenza vaccine recommendations for the 2000-01 influenza season. *Morb Mortal Wkly Rep.* 2000;49:619-22.
4. Centers for Disease Control and Prevention. Updated recommendations from the Advisory Committee on Immunization Practices in response to delays in supply of influenza vaccine for the 2000-01 season. *Morb Mortal Wkly Rep.* 2000;49:888-92.
5. Centers for Disease Control and Prevention. Delayed influenza vaccine availability for 2001-02 season and supplemental recommendations of the Advisory Committee on Immunization Practices. *Morb Mortal Wkly Rep.* 2001;50:582-5.
6. US Department of Health and Human Services. *Healthy people 2000: National Health Promotion and Disease Prevention Objectives.* Washington, DC: Public Health Service; 1991.
7. Centers for Disease Control and Prevention. Influenza and pneumococcal vaccination levels among persons aged ≥ 65 years - United States, 1999. *Morb Mortal Wkly Rep.* 2001;50:532-7.
8. US Department of Health and Human Services. *Healthy people 2010: Objectives for Improving Health.* Washington, DC: Public Health Service; 2000.
9. Singleton JA, Lu PJ, Strikas RA. Progress toward the *Healthy*

- People 2000 influenza vaccination objective, United States, 1997. In: Abstracts of the 34th National Immunization Conference, Atlanta, GA, 2000. Atlanta, GA: Centers for Disease Control and Prevention; 2000.
10. Smith DM, Zhou X-H, Weinberger M, Smith F, McDonald RC. Mailed reminders for area-wide influenza immunization: a randomized controlled trial. *J Am Geriatr Soc.* 1999;47:1-5.
 11. Kellerman RK, Allred CT, Frisch LE. Enhancing influenza immunization: postcard and telephone reminders and the challenge of immunization site shift. *Arch Fam Med.* 2000;9:368-72.
 12. Briss PA, Rodewald LR, Hinman AR, et al. Reviews of evidence regarding interventions to improve vaccination coverage in children, adolescents, and adults. *Am J Prev Med.* 2000;18: 97S-140S.
 13. Szilagyi PG, Bordley C, Vann JC, et al. Effect of patient reminder/recall interventions on immunization rates. *JAMA.* 2000;284: 1820-7.
 14. Szilagyi PG, Rodewald LE, Humiston SG, et al. Immunization practices of pediatricians and family physicians in the United States. *Pediatrics.* 1994;94:517-23.
 15. Centers for Disease Control and Prevention. Influenza activity—United States, 2000-01 season. *Morb Mortal Wkly Rep.* 2000;49: 1085-7.
 16. Baker AM, McCarthy B, Gurley VF, Yood MU. Influenza immunization in a managed care organization. *J Gen Intern Med.* 1998;13: 469-75.
 17. Schneider EC, Cleary PD, Zaslavsky AM, Epstein AM. Racial disparity in influenza vaccination: does managed care narrow the gap between African-Americans and whites? *JAMA.* 2001;286: 1506-9.
 18. Centers for Disease Control and Prevention. Missed opportunities for pneumococcal and influenza vaccination of Medicare pneumonia inpatients—12 western states, 1995. *Morb Mortal Wkly Rep.* 1997;46:919-23.
 19. Fedson DS. Adult immunization: summary of the National Vaccine Advisory Committee report. *JAMA.* 1994;272:1133-7.
 20. American Board of Internal Medicine. Diplomates certified by state, as of January 22, 2001. Available at: <http://www.abim.org/info/states.htm>. Accessed March 1, 2002.
 21. Poel AJ, Singleton JA, Wooten K. Where adults reported receiving influenza vaccination, US, 1998/1999. In: Abstracts of the 35th National Immunization Conference. Atlanta, Ga: Centers for Disease Control and Prevention; 2001.
 22. Pathman DE, Konrad TR, Freed GL, Freeman VA, Koch GG. The awareness-to-adherence model of the steps to clinical guideline compliance. *Med Care.* 1996;34:873-89.
 23. Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA.* 1999;282:1458-65.
 24. Davis JW, Lee E, Taira D, Chung R. Influenza vaccination, hospitalizations, and costs among members of a Medicare managed care plan. *Med Care.* 2001;39:1273-80.
 25. Bridges CB, Thompson WW, Meltzer MI, et al. Effectiveness and cost-benefit of influenza vaccination of healthy working adults. A randomized controlled trial. *JAMA.* 2000;284:1655-63.
 26. Asch DA, Jedrzewski K, Christakis NA. Response rates to mailed surveys published in medical journals. *J Clin Epidemiol.* 1997;50: 1129-36.
 27. Cummings SM, Savitz LA, Konrad TR. Reported response rates to mailed physician questionnaires. *Health Serv Res.* 2001;35: 1347-55.