Diabetes has long been perceived to be associated with an increased risk of infection and worse health outcomes. The rate of infection arising from many common viral and bacterial etiologies has been shown to occur more frequently in patients with diabetes (1–4). The odds of developing acute hepatitis B are estimated to be more than double in patients with diabetes compared with those without (4). The incidence of hospitalization and odds of death are consistently elevated in people with diabetes compared with those without, during both influenza epidemic and nonepidemic years (5,6). Studies have suggested that patients with diabetes who develop pneumococcal pneumonia are more likely than those without diabetes to progress to systemic bacteremia (7–9).

This apparent susceptibility to infection has been attributed to abnormalities in host defense mechanisms, including deficiencies in antibody response, cell-mediated immunity, leukocyte function, and colonization rates (9–11). The higher risk of infection may also be explained by the large burden of chronic disease in this population and associated organ dysfunction. Despite the potential for impaired immune function, most people with diabetes are capable of generating an adequate humoral response and sufficient antibody titers from vaccination (12–14).

Morbidity and mortality associated with influenza and pneumonia are reduced in people who have received appropriate vaccination for each of these infectious diseases (9,15–17). The Advisory Committee on Immunization Practices (ACIP) and the American Diabetes Association both recommend annual vaccination with the influenza vaccine and at least one lifetime vaccination with the 23-valent pneumococcal polysaccharide vaccine (PPSV23) for individuals with diabetes or other conditions that increase the risk of complications from infection (18–22). As part of the Healthy People 2020 initiative, the U.S. Department of Health and Human Services has designated goal
vaccination coverage rates for high-risk adults aged 18–64 years of 90% annually for the influenza vaccine and 60% for PPSV23 (22). Data from the 2011 National Health Interview Survey indicated that only 16.6% of these high-risk individuals had ever received the PPSV23 (23). Coverage with the influenza vaccine for the 2012–2013 season was estimated to be 47% for high-risk individuals (24). Substantial improvement will be required to meet coverage goals for these vaccines.

Data from the Emerging Infections Program for the period of 2009–2010 indicated a higher case fatality rate among people with diabetes with acute hepatitis B virus infection than among those without the infection (4). Progression from acute to chronic hepatitis B infection occurs in ~5% of healthy individuals (25) but is thought to occur more frequently in people with diabetes (26). Hepatitis B infection can be prevented through administration of the three-dose vaccination. Based on data supporting the cost-effectiveness of this vaccine, ACIP released a recommendation in October 2011 that adults with diabetes between the ages of 19 and 59 years be vaccinated against hepatitis B as soon as possible after being diagnosed with diabetes (21). A baseline estimate of coverage with the hepatitis B vaccine for adults with diabetes was formulated using the 2011 National Health Interview Survey; the percentage of people aged 19–59 years with diabetes who reported having received at least one dose was low (26.9%) (23).

**Objective**

This study was designed to assess adherence to national guidelines for the immunization of people with diabetes and to evaluate predictors of vaccination.

**Design and Methods**

This was a cross-sectional analysis of data extracted from the electronic medical record (EMR) system at Kent Hospital, a 359-bed public teaching hospital in Warwick, RI. Data were collected retrospectively through chart review. The study was conducted from 5 September 2013 to 26 January 2014. All patients admitted to the care of the internal medicine teaching service during this period were eligible for chart review. The index date was established as the date of admission.

Patients included in the analysis were required to be ≥19 years of age, to have a diagnosis of either type 1 or type 2 diabetes recorded in the EMR at the time of hospital admission, and to have confirmed use of at least one chronic medication for the treatment of diabetes before admission. Data collected for analysis included patients’ age, ethnicity, sex, height, weight, smoking status, outpatient diabetes medication regimen, diabetes type, most recent A1C within the past 12 months, drug and nondrug allergies, and documented history of respiratory, cardiovascular, mental health, oncological, cerebrovascular, hepatic, and autoimmune comorbidities. Diagnoses for new comorbidities during the index hospitalization were not included because the impact of undiagnosed comorbid disease on immunization history would be unclear. However, values for A1C, a marker of recent glycemic control, were included even if obtained during the index hospital stay.

EMR entries for the patients were reviewed for nursing screening and intervention documentation from previous inpatient admissions to determine immunization history. Screening is performed by nursing staff at the time of patients’ admission to a specific nursing unit. The screening protocol assesses all previous tetanus, PPSV23, and hepatitis B immunizations, as well as influenza immunization within the past year. The EMR also contained outpatient prescription claims information obtained through contracts with pharmacy benefits providers. The prescription claims data were reviewed for evidence of outpatient immunization.

| Vaccine   | People With Diabetes Assessed for Adherence (n) | ACIP Recommendation (18–21)* | Healthy People 2020 Vaccine Coverage Goal (22) (%) | Adherence Rate (%) |
|-----------|-----------------------------------------------|-----------------------------|---------------------------------|-------------------|
| Influenza | 100                                           | Annual vaccination of all patients ≥6 months of age | 90                              | 41                |
| PPSV23    | 100                                           | One-time vaccination before the age of 65 years; revaccination after age 65 if ≥5 years have passed since the previous vaccination | 60 (for those aged 18–64 years) | 37                |
|           |                                               |                             | 90 (for those aged ≥65 years)   |                   |
| Hepatitis B | 39                                           | Vaccination of patients aged 19–59 years; vaccination at clinical discretion for those >59 years of age | Increase in the percentage of coverage for high-risk populations | 0                 |

*ACIP recommendations are identical to those published by the Centers for Disease Control and Prevention and the American Diabetes Association.
Adherence to the ACIP recommendations for influenza and pneumococcal vaccinations was assessed for all patients. Precautions related to or contraindications for vaccination, including allergies or severe hypersensitivities to vaccine components and a history of Guillain-Barré syndrome, were recorded. Immunization history comprised 12 months from the admission date for the influenza vaccination, with receipt of the vaccination within that time period representative of adherence to the annual influenza vaccination recommendation. Immunization history for the pneumococcal and hepatitis B vaccinations included all documented doses received. Adherence to recommendations for the pneumococcal vaccine was determined based on patients’ age and the timing of previous vaccinations. Patients <65 years of age must have received at least one dose to be considered adherent. Patients ≥65 years of age who had received one dose since turning 65 were considered adherent. Patients who were ≥65 years of age who had received a vaccination before turning 65 were considered adherent if that vaccination was received within the past 5 years or if they had received another vaccination since turning 65. Patients between the ages of 19 and 59 years were evaluated for previous immunization with the hepatitis B vaccine. Patients documented as having received at least three doses of the hepatitis B vaccine were considered adherent. Patients having received at least one dose of the vaccine but less than three were considered nonadherent and labeled as “vaccine series incomplete.” Patients who had not received any doses were considered nonadherent.

Primary data analyses evaluated predictors of adherence to recommendations for each of the three vaccines. The Student’s t test was used to compare the means of continuous variables with equal variance. Satterthwaite’s approximate t test was used to compare means of continuous variables with unequal variance. χ² analysis was used to compare cat-

### Table 2. Demographic Characteristics of Patients With Diabetes and the Associated Bivariate Odds of Adherence With Immunization Guidelines

| Characteristic          | Adherent With Influenza Vaccine (n = 41) | Nonadherent With Influenza Vaccine (n = 59) | Adherent With Pneumococcal Vaccine (n = 37) | Nonadherent With Pneumococcal Vaccine (n = 63) |
|-------------------------|------------------------------------------|---------------------------------------------|--------------------------------------------|---------------------------------------------|
| Age (years)             | Mean (SD)                                | P                                           | Mean (SD)                                  | P                                           |
|                         | 67.98 (16.95)                            | 0.34                                        | 65.57 (19.65)                              | 0.85                                        |
| Sex                     | % (n)                                    | % (n) OR (95% CI)                           | % (n)                                     | % (n) OR (95% CI)                           |
| Male                    | 51.22 (21)                               | 45.95 (17)                                 | 45.95 (17)                                 | 52.38 (33)                                 |
| Female                  | 48.78 (20)                               | 54.05 (20)                                 | 47.62 (30)                                 | 1.29 (0.57–2.92)                            |
| BMI                     | Mean (SD)                                | P                                           | Mean (SD)                                  | P                                           |
|                         | 30.99 (7.93)                             | 0.19                                        | 32.11 (8.46)                               | 0.78                                        |
| Comorbid diseases*      | % (n)                                    | % (n) OR (95% CI)                           | % (n)                                     | % (n) OR (95% CI)                           |
| Respiratory             | 19.51 (8)                                | 0.60 (0.23–1.56)                           | 35.14 (13)                                 | 19.05 (12)                                 |
| Cardiovascular          | 51.22 (21)                               | 0.89 (0.40–1.97)                           | 64.86 (24)                                 | 46.03 (29)                                 |
| Cancer                  | 17.07 (7)                                | 1.01 (0.35–2.91)                           | 8.11 (3)                                   | 2.22 (14)                                  |
| Mental illness          | 31.71 (13)                               | 1.64 (0.67–4.05)                           | 35.14 (13)                                 | 20.63 (13)                                 |
| Hepatic                 | 9.76 (4)                                 | 1.17 (0.29–4.64)                           | 16.22 (6)                                  | 4.76 (3)                                   |
| Cerebrovascular         | 7.32 (3)                                 | 0.50 (0.13–2.03)                           | 16.22 (6)                                  | 7.94 (5)                                   |
| Autoimmune              | 14.63 (6)                                | 2.36 (0.62–8.95)                           | 16.22 (6)                                  | 6.35 (4)                                   |
| Total comorbidities     | Mean (SD)                                | P                                           | Mean (SD)                                  | P                                           |
|                         | 1.51 (0.81)                              | >0.99                                       | 1.92 (1.28)                                | 1.27 (0.90)                                |
| Smoking status          | % (n)                                    | % (n) OR (95% CI)                           | % (n)                                     | % (n) OR (95% CI)                           |
| Never smoker            | 48.78 (20)                               | 48.65 (18)                                 | 42.86 (27)                                 | Reference                                  |
| Former smoker           | 31.71 (13)                               | 29.73 (11)                                 | 36.51 (23)                                 | 0.72 (0.28–1.83)                           |
| Current smoker          | 19.51 (8)                                | 21.62 (8)                                  | 20.63 (13)                                 | 0.92 (0.32–2.67)                           |

*Reference was absence of the comorbid disease.
egorical data if all cells contained values >5. Fisher’s exact test was used for the comparison of categorical data involving at least one cell with a value ≤5. Bivariate odds of adherence were calculated for each level of categorical data if all cells contained values >5. Fisher’s exact test was used for the comparison of categorical data involving at least one cell with a value ≤5. Bivariate odds of adherence were calculated for each level of categorical variables. SAS version 9.3 (SAS Institute, Cary, N.C.) was used for the statistical analyses. The statistical significance level was set a priori at α = 0.05. This study was approved by the Kent Hospital institutional review board.

Results
During the study period, 364 records were reviewed, and 100 patients with diabetes were identified as eligible for inclusion. Vaccine coverage rates and Healthy People 2020 vaccine coverage goals are reported in Table 1. The number of patients deemed appropriate to have received the hepatitis B vaccine was 39 (39%). Of these, none had initiated or completed the three-dose vaccination series. Immunization adherence rates were 41% for the influenza vaccine, 37% for the pneumococcal vaccine, and 19% for both vaccines. The odds ratio (OR) for adherence to the influenza or pneumococcal vaccination recommendation was 1.97 (95% CI 0.86–4.50) if patients were also adherent to the other vaccination recommendation. No complete contraindications to vaccination were recorded, although two patients had documented egg allergies.

Patients’ demographic characteristics, diabetes-related variables, and the corresponding bivariate odds of adherence to vaccination recommendations are presented in Table 2 and Table 3. The groups did not differ significantly with regard to sex, age, or BMI. The most common ethnicity was white (92%). The majority of patients (79%) were current or former smokers, and 60% of patients had used insulin as an outpatient before admission. Patients with better glycemic control as indicated by an A1C value <7% were slightly more likely to have received an influenza vaccination, although this finding did not reach statistical significance (P = 0.11). The presence of individual comorbid diseases and an increasing total comorbid disease burden failed to predict adherence to influenza vaccination recommendations (P >0.99). The odds of adherence to the pneumococcal vaccination recommendation were nonsignificantly increased in the presence of individual comorbid diseases, with the exception of cancer, for which the odds decreased (OR 0.31 [95% CI 0.082–1.61]). The mean number of comorbid diseases present was significantly greater for patients adherent to the pneumococcal vaccination recommendation (P<0.01).

Discussion
This study found that patients at high risk for infection and infectious disease complications because of their history of diabetes were largely nonadherent to ACIP immunization recommendations. The coverage rate of 41% for the influenza vaccine in this population is less than the estimated 47% rate in high-risk individuals (defined as having either diabetes, asthma, or cardiovascular disease)
aged 18–64 years nationally for the 2012–2013 season (24). The influenza vaccination rate in this study was also substantially less than the 66.2% rate reported for adults ≥65 years of age during the same time period (24). The pneumococcal vaccine coverage rate of 37% in this study approximated an average of 2011 national estimates of 66.5% for white adults ≥65 years of age and 20.1% for high-risk adults aged 18–64 years (23). The absence of any patients adherent to recommendations for the hepatitis B vaccination in this study is inconsistent with the 26.9% national coverage estimate or people with diabetes from 2011 (23). Immunization rates for all three vaccines failed to meet targets established by the Healthy People 2020 initiative (22).

The greater odds of pneumococcal vaccination associated with an increasing burden of comorbid disease aligns with other studies evaluating predictors of pneumococcal vaccination (27,28). In this study, patients with comorbid diseases, including chronic heart, lung, and liver disease, as well as cigarette smoking, had multiple indications for pneumococcal vaccination, and providers may have been more likely to identify such patients as vaccination candidates. Unlike previous predictive analyses, increasing age did not increase the odds of having received either vaccination. Adherence to influenza vaccination recommendations was consistent across comorbid disease burden. This, in conjunction with lower mean BMI and A1C levels in adherent patients, suggests that influenza vaccination may be associated with other positive health management decisions.

The most noteworthy result of this study is the failure to immunize patients with diabetes with the hepatitis B vaccine. This indicates that many providers may be unaware of the 2011 ACIP hepatitis B vaccination recommendation for this population. Expanding coverage for the influenza and pneumococcal vaccines has been a nationwide health goal since the original Healthy People initiative began in 1979 (29). Annual increases in pneumococcal and influenza vaccination rates were sustained throughout much of the past few decades (30,31) but have slowed in recent years (23,32). Drivers of the increase in vaccination coverage include the use of health information technology for identification of unvaccinated patients, protocols for screening and administration, and extension of access to larger patient populations by increasing the number of immunizing providers and locations where vaccination services are available. Increased coverage of preventive services under the Affordable Care Act also promises to reduce the cost-associated barriers to vaccination. Health plans created after 23 September 2010 must provide full reimbursement without a patient copayment for ACIP-recommended immunizations (33).

Pharmacists in all 50 states are now permitted to administer vaccinations (34,35). Limitations differ among states regarding which vaccinations may be administered, whether a prescription or protocol is required, and the age of eligible patients. The influenza vaccination may be administered to patients ≥19 years of age by pharmacists in all 50 states. All states, with the exception of South Dakota, allow pharmacist administration of the pneumococcal vaccine. In 45 states, any vaccination, including the hepatitis B vaccine, may be administered by pharmacists. Pharmacy interns who have completed the immunization certificate training program and who are operating under the supervision of a pharmacist may administer vaccinations in 38 states (34,35). Thus, using pharmacists to screen, educate, and immunize patients is an intervention amenable to multiple care settings.

The results of this study underscore the need for continued expansion of vaccination efforts to attain national goals for immunization coverage for the influenza, pneumococcal, and hepatitis B vaccines. This study is believed to be the first to examine rates of hepatitis B vaccination in patients with diabetes since the release of the ACIP recommendation in October 2011. Further research is required to assess changes in national coverage for the vaccination since that time. The use of data from an EMR in this study enabled the evaluation of a multitude of potential demographic and health-related predictors of vaccination. Access to outpatient pharmacy claims records contributed to the completeness of the immunization history.

Previous investigations have evaluated immunization rates in patient populations presenting to an emergency department (ED) and confirmed the feasibility of immunizing eligible patients during emergency visits (36,37). One prospective, cross-sectional study (37) conducted in an urban ED found that only 16 and 18% of presenting high-risk patients were up to date on influenza and pneumococcal vaccinations, respectively. Eligible patients were offered vaccinations during the ED visit, and the percentage of patients who were adherent on leaving the ED was improved to 83% for the influenza vaccine and 84% for the pneumococcal vaccine.

In contrast to ED interventions, our study evaluated immunization histories obtained at hospital admission, which would prompt subsequent offers for influenza or pneumococcal vaccination in eligible populations through a standing order protocol. Other studies have demonstrated the effectiveness of standing order protocols involving nurse, physician, and pharmacy practitioners in institutional settings for both the pneumococcal and influenza vaccines (38). Prioritizing screening and administration of vaccinations during all points of patient contact can increase immunization coverage for ACIP-recommended vaccines in patients with diabetes and is an attain-
able goal for emergency, inpatient, and outpatient health care providers.

Limitations
One limitation of this study was the unavailability of comprehensive outpatient immunization records. Immunization history was ascertained from hospital records and patient self-reports. Self-reported immunization history is subject to recall bias, with the potential for interviewer bias also to be present because of variability among practitioners in the meticulousness of their questioning of patients regarding past vaccinations. As a result, there is a possibility that some patients who were uncertain of or misrepresented their vaccination history were misclassified. The generalizability of this study is limited by its single-hospital design and lack of ethnic and geographic diversity in the patient population. Although the results are comparable to studies examining immunization rates and predictors of vaccination in nationally representative populations, vaccination procedures may differ markedly among regions and institutions.

Conclusion
In this study, rates of adherence to ACIP recommendations for influenza, pneumococcal, and hepatitis B immunization of patients with diabetes were all below national coverage estimates. Increasing burden of comorbid disease predicted pneumococcal vaccination, whereas no significant predictors of influenza vaccination were identified. Allocation of health care resources to increase vaccine coverage should remain a priority, with a focus on spreading awareness of the ACIP hepatitis B vaccine recommendation for people with diabetes.

Duality of Interest
No potential conflicts of interest relevant to this article were reported.

References
1. Shah BR, Hux JE. Quantifying the risk of infectious diseases for people with diabetes. Diabetes Care 2003;26:510–513
2. Muller LM, Gorter KJ, Hae E, et al. Increased risk of common infections in patients with type 1 and type 2 diabetes mellitus. Clin Infect Dis 2005;41:281–288
3. Joshi N, Caputo GM, Weitkamp MR, Karchmer AW. Infections in patients with diabetes mellitus. N Engl J Med 1999;341:1906–1912
4. Reilly ML, Poissant T, Vonderwahl CW, Gerard K, Murphy TV. Incidence of acute hepatitis B among adults with and without diabetes, 2009–2010 [Abstract]. Presented at the 49th annual meeting of the Infectious Disease Society of America and the HIV Medicine Association, Boston, Mass., 2011. Available from https://idsa.confex.com/idsa/2011/webprogram/Paper34044.html. Accessed 11 September 2013
5. Housworth J, Langmuir AD. Excess morbidity from epidemic influenza, 1957–1966. Am J Epidemiol 1974;100:40–48
6. Bouter KP, Diepersloot RJ, van Romunde LK, et al. Effect of epidemic influenza on ketoacidosis, pneumonia and death in diabetes mellitus: a hospital register survey of 1976–1979 in the Netherlands. Diabetes Res Clin Pract 1991;12:61–68
7. Fedson DS, Chiarello LA. Previous hospital care and pneumococcal bacteremia: importance for pneumococcal immunization. Arch Intern Med 1983;143:885–889
8. Finkelstein MS, Petkus WM, Freedman ML, Antopol SC. Pneumococcal bacteremia in adults: age-dependent differences in presentation and in outcome. J Am Geriatr Soc 1983;31:19–27
9. Smith SA, Poland GA. Use of influenza and pneumococcal vaccines in people with diabetes. Diabetes Care 2000;23:95–108
10. Chaudhry PT, Chandler SD. Pathogenic carrier rate in diabetes mellitus. Am J Med Sci 1977;273:259–265
11. Casey JJ. Host defense abnormalities in diabetic patients. In Diabetes Mellitus. Vol. 5. Rifkin H, Raskin N, Eds. Bowie, Md., American Diabetes Association, 1976, p. 219–223
12. Beam TR Jr, Crigler ED, Goldman JK, Schiffman G. Antibody response to polyvalent pneumococcal polysaccharide vaccine in diabetics. JAMA 1980;244:2621–2624
13. Schiffie SF, Spradling PR, Murphy TV. Immune response of hepatitis B vaccine among persons with diabetes: a systematic review of the literature. Diabetes Care 2012;35:2690–2697
14. Frasca D, Diaz A, Romero M, et al. Young and elderly patients with type 2 diabetes have optimal B cell responses to the seasonal influenza vaccine. Vaccine 2013;31:3603–3610
15. Rodriguez-Blanco T, Vila-Corcoles A, de Diego C, et al. Relationship between annual influenza vaccination and winter mortality in diabetic people over 65 years. Hum Vaccin Immunother 2012;8:363–370
16. Wang JK, Lin CL, Chang YC, et al. Effectiveness of influenza vaccination in elderly diabetic patients: a retrospective cohort study. Vaccine 2013;31:718–724
17. Shapiro ED, Berg AT, Austrian R, et al. The protective efficacy of polyvalent pneumococcal polysaccharide vaccine. N Engl J Med 1991;325:1453–1460
18. Centers for Disease Control and Prevention. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices—United States, 2013–2014. MMWR Recomm Rep 2013;62(RR-07):1–43
19. Centers for Disease Control and Prevention. Use of 13-valent pneumococcal conjugate vaccine and 23-valent pneumococcal polysaccharide vaccine for adults with immunocompromising conditions: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR 2012;61:816–819
20. American Diabetes Association. Standards of medical care in diabetes—2014. Diabetes Care 2014;37(Suppl 1):S14–S80
21. Centers for Disease Control and Prevention. Use of hepatitis B vaccination for adults with diabetes mellitus: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR 2011;60:1709–1711
22. HealthyPeople.gov. Immunization and infectious diseases. Available from http://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases/objectives. Accessed 10 September 2013
23. Centers for Disease Control and Prevention. Noninfluenza vaccination coverage among adults—United States, 2011. MMWR 2013;62:66–72
24. Centers for Disease Control and Prevention. Flu vaccination coverage. Available from http://www.cdc.gov/flu/fluview/coverage-12estimates.htm. Accessed 14 January 2014
25. Hyams KC. Risks of chronicity following acute hepatitis B virus infection: a review. Clin Infect Dis 1995;20:992–1000
26. Mast EE, Weinbaum CM, Fiore AE, et al.; Advisory Committee on Immunization Practices, Centers for Disease Control and Prevention. A comprehensive immunization strategy to eliminate transmission of hepatitis B virus infection in the United States: recommendations of the Advisory Committee on Immunization Practices (ACIP) part II: immunization of adults. MMWR 2006;55(RR-16):1–33
27. Krueger P, St. Amant O, Loeb M. Predictors of pneumococcal vaccination among older adults with pneumonia: findings from the Community Acquired Pneumonia Impact Study. BMC Geriatr 2010;10:441–5
28. Jackson LA, Baxter R, Nalayaw AL, Belongia EA, Bagg J. Patterns of pneumococcal vaccination and revaccination in...
elderly and non-elderly adults: a Vaccine Safety Datalink study. BMC Infect Dis 2009;9:37:1–7
29. Healthy People: The Surgeon General’s Report on Health Promotion and Disease Prevention. Washington, D.C., U.S. Government Printing Office, 1979 (DHHEW publ. no. PHS 79-55071)
30. Centers for Disease Control and Prevention. Influenza vaccination coverage trends (NHIS) 1989–2008. Available from http://www.cdc.gov/flu/fluaxview/trends.htm. Accessed 14 January 2014
31. Centers for Disease Control and Prevention. Pneumococcal vaccination coverage (NHIS) 1989–2008. Available from http://www.cdc.gov/flu/fluaxview/trends.htm. Accessed 14 January 2014
32. Lu PJ, Santibanez TA, Williams WW, et al.; Centers for Disease Control and Prevention. Surveillance of influenza vaccination coverage—United States, 2007–08 through 2011–12 influenza seasons. MMWR Surveill Summ 2013;62:1–28
33. The Patient Protection and Affordable Care Act (PPACA): Sec. 2713. Coverage of Preventive Health Services. Pub. L. No. 111-148, 124 Stat. 131, 2010. Available from http://www.gpo.gov/fdsys/pkg/PLAW-111publ148/content-detail.html. Accessed 9 September 2013
34. Skelton JB; American Pharmacists Association; Academy of Managed Care Pharmacy. Pharmacist-provided immunization compensation and recognition: white paper summarizing APhA/AMCP stakeholder meeting. J Am Pharm Assoc (2003) 2011;51:704–712
35. American Pharmacists Association. Types of vaccines that pharmacists are authorized to administer. Available from http://www.pharmacist.com/types-vaccines-pharmacists-are-authorized-administer. Accessed 15 January 2014
36. Slobodkin D, Zielske PG, Kitlas JL, McDermott MF, Miller S, Rydman R. Demonstration of the feasibility of emergency department immunization against influenza and pneumococcus. Ann Emerg Med 1998;32:537–543
37. Rimple D, Weiss SJ, Brett M, Ernst AA. An emergency department-based vaccination program: overcoming the barriers for adults at high risk for vaccine-preventable diseases. Acad Emerg Med 2006;13:922–930
38. McKibben LJ, Stange PV, Sneller VP, Strikas RA, Rodewald LE; Advisory Committee on Immunization Practices. Use of standing orders programs to increase adult vaccination rates. MMWR Recomm Rep 2000;49(RR-1):15–16

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