A comprehensive patient assessment and physician reminder tool for adult immunization: Effect on vaccine administration

Daniel B. Fishbein a,*, Bayo C. Willis b, William M. Cassidy b, Dale Marionoeaux b, Carla A. Winston a

Centers for Disease Control and Prevention, Health Services Research and Evaluation Branch, Immunization Services Division, National Immunization Program, Atlanta, GA 30333, United States

Louisiana State University Health Sciences Center, Baton Rouge, LA, United States

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Abstract
We determined if a patient-self assessment/provider reminder tool (A/R) would increase administration of the eight vaccines that may be indicated for adults. In three family practice clinics, the A/R was completed by intervention patients and given to their provider. Control patients received an exercise reminder. On the day of the intervention, influenza, pneumococcal polysaccharide, and tetanus–diphtheria (Td) vaccines were administered significantly (P<0.01) more commonly to intervention patients in one clinic, Td in the second, and none in the third. There were no additional significant differences during one year of follow-up. A number of barriers to comprehensive vaccination were encountered.

Keywords: Influenza vaccine; Pneumococcal vaccine; Measles, mumps, rubella vaccine; Tetanus vaccine; Hepatitis A vaccine; Hepatitis B vaccine; Meningococcal polysaccharide vaccine; Varicella vaccine; Reminder; Self-assessment; Education

1. Introduction
There are many recommended preventive and curative health services, and the extent to which they are delivered varies widely [1]. Even when only clinical preventive services are considered, a recent investigation suggested that practitioners lack the time to deliver the most strongly recommended services [2]. Included in the recommended clinical preventive services are up to eight different vaccines (influenza, pneumococcal polysaccharide [PPV], tetanus–diphtheria [Td], measles–mumps–rubella [MMR], hepatitis A, hepatitis B, varicella, and meningococcal polysaccharide) [3]. Determining which of the vaccines is indicated can be complex and time consuming since it requires knowledge about the patient’s demographics, health conditions, occupation, avocations, travel plans, sexual behaviors, use of street-drugs, as well as the age and health condition of family members [4]. The provider must also determine if the patient has already received the correct number of doses at the appropriate intervals.

Patient/provider reminders are widely recommended to increase immunization coverage for those vaccines recommended for adults in specific ages groups [5,6]. However, as far as the authors can determine, previous evaluations of patient/provider reminders included only one [7–17] or two [18–21] and never more than three [22,23] of the eight recommended vaccines. Although provider reminders are almost always successful at increasing the use of a single vaccine [24,25], some studies have reported less effectiveness when more than one vaccine was indicated [23,26]. Combinations of interventions appear necessary to increase immunization coverage for people whose vaccination needs are defined

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by risk for or exposure to disease, as opposed to age group [27].

To simplify the process of assessing patients for all indicated vaccines, we developed and evaluated a patient self-assessment provider reminder (A/R) tool [28]. The tool uses patient-supplied responses to a series of yes/no questions to determine which of the eight vaccines for adults may be needed. By educating the patient about vaccines and reminding providers about the indicated vaccines, we hoped that it would effectively increase the coverage of vaccines targeting specific age groups as well as risk groups. In this paper, we report the results of a controlled study in which we evaluated the ability of the tool to increase immunization coverage.

2. Methods

This study was approved by the Institutional Review Boards of the Centers for Disease Control and Prevention and Louisiana State University Health Sciences Center. Sites which did not have their own institutional review boards obtained federal wide assurance numbers and completed an authorization agreement saying that they would rely on the Centers for Disease Control’s Institutional Review Board for review of the protocol.

2.1. Setting

The A/R tool was evaluated in three family practice settings—a two provider private clinic in Georgia, a six provider Federal Qualified Health Center look-alike (an organization that meets all of the federally funded Community Health Center program expectations, but does not receive federal operating grants under the Section 330 Public Health Service Act) in New Mexico, and a six provider clinic affiliated with Louisiana State University in Baton Rouge, Louisiana. Patients who received care at the clinic in Georgia were mostly covered by a variety of health care plans with varying co-payments. More patients in New Mexico were covered by Medicaid, Medicare, and other state programs. All the patients in Louisiana were covered by Medicaid, Medicare, or subsidized by the state programs for the poor; no co-payments were required.

2.2. Assessment of immunization status using the A/R tool

The A/R tool (Appendix A also available at http://www.cdc.gov/nip/recs/adult-schedule.htm#avacs) was adapted from the Immunization Action Coalition’s ‘Do I need any vaccinations today?’ (http://www.immunize.org/catg/d/403fneed.htm) [28]. The A/R tool assesses a patient’s immunization needs by simplifying ACIP recommendations for each of the eight vaccines most commonly recommended for persons 18 years of age and older (influenza, PPV, hepatitis A, hepatitis B, MMR, Td, varicella and meningococcal polysaccharide) into a series of yes/no questions. The tool’s function is four-fold: (1) assess the patient’s vaccination risk factors and history, (2) educate the patient regarding vaccines and their indications, (3) facilitate the provider’s review of indications and vaccination history, and (4) remind the provider to administer or further evaluate the need for vaccine.

In Georgia, we used a version of the A/R tool that included all eight ACIP recommended vaccines and was readable at a sixth grade literacy level. In Louisiana and New Mexico, providers requested that three changes be made to the original A/R tool. First, the wording was modified so that it was readable at a fourth grade literacy level. Second the providers requested that two vaccines, varicella and meningococcal polysaccharide, be excluded because they believed that serologic testing for varicella was too costly and that the number of people who required meningococcal vaccine did not justify its inclusion. Finally, they suggested that a summary form be developed (Appendix B). The summary form allowed paramedical personnel to summarize the results of the A/R tool in a single face sheet, which had the name of each vaccine and a column to show whether the vaccine appeared indicated or not (according to the A/R tool). The provider could thereby obtain information without reviewing the responses to specific questions on the A/R tool. The summary form also requested the providers to report the reason why vaccines that were indicated according to the A/R tool were not administered.

2.3. Design

Since the proportion of patients with indications for each vaccine and the proportion who were already vaccinated varied considerably, it was not possible to apply a single threshold for sample size in statistical power calculations. A convenience sample of 200 patients (100 control and 100 intervention) was therefore selected in each site. Sample sizes of 100 were chosen because they allow for estimation of immunization coverage ±10 percentage points with 95% confidence. Control patients were enrolled before intervention patients to prevent provider experience with the A/R tool leading to administration of vaccines to the control group (due to increase knowledge of and attention to vaccine recommendations). This sequential enrollment allowed unbiased evaluation of the effect of the patient self-assessment and physician-reminder tool on the day of the intervention, but did not eliminate the possibility of a cross over effect during a one-year follow-up period.

Patients were eligible to participate if they were 18 years of age or older, not acutely ill, and gave written informed consent. Patients were approached in the waiting room or upon check-in for their primary care visits and invited to participate in an adult immunization study. Patients in the study intervention group were asked to complete the A/R tool and control group patients were given a fact sheet on physical activity. Investigators briefed providers about the study and the A/R tool and answered any questions they had. The A/R tool (and,
In New Mexico and Louisiana, the summary sheet was subsequently placed in the front of the patient’s chart before the patient was seen by the provider. No additional prompting was given to providers during the clinical encounter.

In Georgia, the first half of the control group was enrolled between June 24 and July 9, and the second half between July 16 and July 22. Information about indications for influenza vaccination and previous history of influenza vaccination were collected, but the vaccine could not be administered on the day of the intervention because the vaccine was not available during the summer. The intervention group was enrolled between July 9 and July 16, and again between July 22 and July 29. In New Mexico, the control group was enrolled between November 23 and December 4, and the intervention group between December 4 and December 10. The study was conducted during the influenza vaccination season and influenza vaccination on the day of the intervention was possible. In Louisiana, the control group was enrolled between November 6 and November 20, while the intervention group was enrolled between January 8 and January 24, after the clinic had exhausted influenza vaccine supply, so vaccine was borrowed from another clinic.

2.4. Assessment of immunization status using patients’ medical records

Retrospective medical record reviews were conducted on or shortly after the day of the intervention and one-year after the intervention. Demographic information (date of birth, gender, race, ethnicity) and medical, vocational, and occupational history and the dates of all immunizations were recorded and entered into Adult Clinical Assessment Software Application (ACASA, Version 2.0, 2003). Race/ethnicity was not available in the charts in Georgia. Information regarding administration of vaccines was classified according to whether administration occurred: (1) before the intervention, (2) on the day of intervention, and (3) during a one-year period following the intervention. The chart review was conducted without knowledge of the responses on the A/R tool.

Assessment of influenza vaccine included only vaccinations administered before March 31 of the influenza vaccination season (to exclude vaccinations administered during the follow-up period, or in the Georgia site at any time. The proportion of patients in the two groups who had received influenza vaccine. There were no significant differences between the intervention and control patients for any other vaccinations administered to intervention groups on the day of or after the intervention ranged from 39% (influenza vaccine in New Mexico) to 0% (hepatitis A in all

3. Results

The demographic characteristics of intervention and control patients are shown in Table 1. Although the characteristics of patients differed between study sites, there were no significant differences between intervention and control groups within any of the sites. Before the intervention, there were no significant differences in the proportion of intervention and control patients immunized with any of the study vaccines (Table 2) except in Louisiana, where control patients (enrolled in November) were less likely to receive influenza vaccine than intervention patients (enrolled in January).

Table 2 shows the number and proportion of patients with indications for each study vaccine and the number of vaccinations administered before the intervention, on the day of the intervention and during the one-year period following the intervention. Overall, Td vaccine was the vaccine most commonly indicated, followed by influenza, MMR, and pneumococcal vaccines. On the day of the intervention, no single vaccine was administered significantly more commonly to intervention than control patients in all three clinics. One vaccine – Td – was administered more commonly to intervention patients in two sites, New Mexico (18%) of 88 versus 1 (1%) of 81, P < 0.001) and Louisiana (21% of 98 versus 0 (0%) of 100, P < 0.0001. In addition, influenza and PPV vaccination were administered significantly more often to intervention than control patients in New Mexico (influenza: 16 (39%) of 41 versus 6 (15%) of 41, P = 0.01) and PPV: 11 (35%) of 31 versus 1 (3%) of 29 (P < 0.01). Influenza vaccine was administered significantly more commonly to intervention patients in Louisiana than control patients before the intervention and more commonly to control patients on the day of the intervention. By the end of the one-year follow-up period, there was no difference in the proportion of patients in the two groups who had received influenza vaccine. There were no significant differences between the intervention and control patients for any other indicated vaccinations in New Mexico or Louisiana on the day of the intervention, for any vaccines during the follow-up period, or in the Georgia site at any time. The proportion of indicated vaccines administered to intervention groups on the day of or after the intervention ranged from 39% (influenza vaccine in New Mexico) to 0% (hepatitis A in all
Table 1
Demographics of the study population

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<th>Site</th>
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<th>Control (n = 100)</th>
<th>Intervention (n = 100)</th>
<th>Control (n = 100)</th>
<th>Intervention (n = 100)</th>
<th>Control (n = 100)</th>
<th>Intervention (n = 300)</th>
<th>Control (n = 300)</th>
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Table 2
Number of patients in target groups for each vaccine and number vaccinated before, during, and after intervention

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<th>During intervention</th>
<th>After intervention</th>
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<td>0 (0)</td>
<td>12 (10)</td>
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<td>0 (0)</td>
<td>13 (10)</td>
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<td>Td</td>
<td>300</td>
<td>84 (28)</td>
<td>40 (22)§</td>
<td>19 (11)</td>
<td>151 (50)§</td>
<td></td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>90 (30)</td>
<td>10 (5)</td>
<td>13 (7)</td>
<td>113 (38)</td>
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</tr>
<tr>
<td>Hep A</td>
<td>12</td>
<td>0 (0)‡</td>
<td>1 (8)</td>
<td>0 (0)</td>
<td>1 (8)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>1 (11)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (11)</td>
<td></td>
</tr>
<tr>
<td>Hep B</td>
<td>15</td>
<td>3 (20)</td>
<td>1 (8)</td>
<td>2 (18)</td>
<td>6 (40)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>2 (7)</td>
<td>1 (4)</td>
<td>0 (0)</td>
<td>3 (11)</td>
<td></td>
</tr>
<tr>
<td>All vaccines</td>
<td>750</td>
<td>199 (26)</td>
<td>99 (13)§</td>
<td>50 (11)</td>
<td>348 (46)§</td>
<td></td>
</tr>
<tr>
<td></td>
<td>738</td>
<td>197 (27)</td>
<td>50 (9)</td>
<td>50 (10)</td>
<td>207 (40)</td>
<td></td>
</tr>
</tbody>
</table>

* P < 0.01.
# P < 0.05.
† P < 0.001.
‡ P < 0.0001.
what less than most other studies, which demonstrated that a third site. The changes in vaccine administration are some-
increased 12% in one site, 6% in another, and decreased 5% in 
site, and none of the study vaccines in a third site. The mag-
ifications that were indicated according to medical record review 
during the day of the intervention. Physicians supplied information regarding the reasons that 
patients did not receive 122 (30.7%) of the 397 vaccina-
tions that were indicated according to medical record review 
(Table 3). Most explanations were classified as final decisions 
not to administer a vaccine (as opposed deferral to a later 
date) and were made by the provider. Acute or chronic ill-
ness, cost, previous side effects, and disagreement with ACIP 
recommendations were all reported by providers as affecting 
the decision to not administer vaccines.

4. Discussion

On the day of the intervention, administration of the A/R 
tool significantly increased the proportion of three indicated 
vaccines in one study site, a single vaccine in one other study 
site, and hepatitis B and MMR in two of the three sites). 
When we examined the data using correlated measures 
analyses accounting for the fact that multiple vaccines could 
be indicated, statistically significant results did not change 
and no results that were not significant became significant.

Over the remainder of the follow up period, very few 
additional vaccinations were recorded and there were no 
significant differences between the intervention and con-
trol groups for any individual indicated vaccine during the follow-
up period. Combining the results of the individual sites and considering all vaccinations given before, during, 
and after the intervention, intervention patients were signific-
antly more likely to be up-to-date only for Td 50% versus 
38% (P < 0.0001). Over 60% of patients with indications for influenza and pneumococcal vaccinations in both groups 
were up to date but the trends toward statistical significance 
were not significant. Very few of the indicated MMR, hep-
atitis A, and hepatitis B vaccines were given. Combining all 
immunizations administered before, during and up to one 
year after the intervention, intervention patients received sig-
nificantly more vaccinations than control patients only in 
New Mexico (Table 2), with virtually all the effect due to 
vaccines administered during the day of the intervention. 

Physicians supplied information regarding the reasons that 
patients did not receive 122 (30.7%) of the 397 vaccina-
tions that were indicated according to medical record review 
(Table 3). Most explanations were classified as final decisions 
not to administer a vaccine (as opposed deferral to a later 
date) and were made by the provider. Acute or chronic ill-
ness, cost, previous side effects, and disagreement with ACIP 
recommendations were all reported by providers as affecting 
the decision to not administer vaccines.
The intervention group began. In Louisiana, the influenza vaccine was readily available until enrollment of the small emergency supply of tetanus vaccine. It was not aware study in New Mexico began 6 months later, the clinic had a attention on this vaccine as opposed to others. Although the after an 18 month shortage, possibly focusing extraordinary interfered with the study in a number of ways. Just before the results. In spite of efforts to assure adequate supply of vac-

 Were providers unable or unwilling to comply with ACIP recommendations? Providers flatly stated that they were not willing to consider all eight vaccinations. The number of vaccines was reduced to six at two of the three sites, with varicella vaccination excluded because of perceived inconvenience and cost of the serological testing recommended for patients with no or uncertain history of disease, and meningococcal polysaccharide excluded because it was indicated for so few patients. However, providers still stated that they did not have time to consider all the vaccines. Initial comments focused on time to review the A/R tool. When the summary form was added, time constraints focused on the need to review the chart and discuss this vaccination with patients. One provider stated that there was no problem with the A/R tool but she lacked the time to review the medical record to determine if patient provided information was accurate. Although an extra few minutes per patient may not seem prohibitive, we believe the extra few minutes per patient to review and discuss vacc-

Lack of sustained effect (no significant difference in the intervention and control group over the one year period fol-

Lack of sustained effect is consistent with previous studies that suggest reminders to physicians are most effective when they are provided repeatedly until action is taken or at every appropriate patient encounter [30]. However, this would have required additional efforts on the part of clinic staff. A solu-

A number of limitations of the study may have influenced the results. In spite of efforts to assure adequate supply of vac-

In spite of these limitations, our findings are consistent with, and extend those of a recent study which demonstrated that recommended clinical preventive services (including vaccination) require impractical amounts of provider time to implement and suggest that the number and complexity of adult vaccination recommendations may hamper provider’s ability to implement them [2]. However, the alternative courses of action are not obvious. The number of vaccines recommended is in large part a function of effectiveness and utility of vaccines that are developed and licensed. Recommendations attempt to reach the people who will benefit most from vaccination while not vaccinating those unlikely to benefit. For vaccines that have broad benefits, such as influenza vaccine, complexity was decreased by expanding recommendations for 50–64-year olds from only those who had specific risk factors to everyone in the age group [32]. There is a distinct possibility that providers in our study favored Td vaccination because it is a universal recommendation, with no need to invoke age or underlying disease status. Focus on only one, or at most two, vaccines might have led to improved effectiveness for individual vaccines, as would more sustained use of the A/R tool. Rec-

Evidence-based methods which take into account effectiveness, safety, implementation, and cost could be used to develop
recommendations of varying strength, allowing providers to focus on vaccines that are most strongly recommended.

Acknowledgements

The authors thank the staff of the clinics where the studies were conducted: Michael Baron, Kathie Guthrie, Vicki Duke, Maxine Small, Lloyd White, Veronica Nwadeyi, Brenda Swann, Linda Franklin, Holley Galland, Jule Assercq, Toan Hau, John Howe, Sharon Werner, Yihong Zheng, Phyllis Saucier, Helen Funderburk, Alan Firestone, Geoff Steffens, Nancy Guinn, Carmen Rodriguez, Darri Harrison, Josh Firestone, Celina Padilla, and Anna Stryker. We also thank Leigh Ann Strawn and William Atkinson for help in developing the self-assessment form and Glenn Jones, Mary McCauley, Abigail Shefer and Jeanne Santoli for their helpful editorial comments.

Appendix A

ADULT VACCINATION SCREENING FORM

Adults need to stay up-to-date on getting vaccines, but it can be hard to keep up with what you need. This form will help you and your doctor find out which vaccines might be important for you. Please take a minute to fill out this form.

FLU SHOT

Please circle "Yes" or "No" for each statement—

1. I have had a flu vaccine shot in the last 12 months.
   - Yes
   - No

   If you circled "Yes", please go to the next page.
   If you circled "No", please answer the statements below.

2. I am 50 years old or older.
   - Yes
   - No

3. I have one or more of the following conditions:
   - Diabetes mellitus (sugar)
   - Lung disease, including asthma
   - Heart or kidney disease
   - Sickle cell disease
   - Cancer or HIV/AIDS
   - May be pregnant during the flu season (November–March)
   - Take steroids (such as prednisone)
   - Yes
   - No

4. One or more of the following apply to me:
   - I live with someone who is over 65 years old or older and has one of the conditions listed in Statement 3 above
   - I live with or care outside the home for a child less than 2 years old
   - I am a health care worker
   - I provide essential community services
   - Yes
   - No

If you circled "Yes" to one or more of statements 2–4, you may need the flu vaccine shot during the flu season (November–March).

Please go to the next page.
PNEUMONIA (PNEUMOCOCCAL) SHOT

1. I have had a pneumonia (pneumococcal) vaccine shot in the last 5 years.
   - Yes
   - No
   If you circled "Yes", please go to the next page.
   If you circled "No", please answer the statements below.

2. I am American Indian or Alaska Native.
   - Yes
   - No

3. I am 65 years old or older and have never had a pneumonia vaccine shot.
   - Yes
   - No

4. I have one or more of the following conditions:
   - Diabetes mellitus (sugar)
   - Lung disease, not just asthma
   - Heart, kidney, or liver disease
   - Drinking problem (alcoholism)
   - Sickle cell disease
   - Cancer or HIV/AIDS
   - Do not have a spleen
   - Spinal fluid leak
   - Take steroids (such as prednisone)
   - Yes
   - No

5. I am 65 years old or older and both the following apply to me:
   - I had a pneumonia shot when I was younger than 65
   - I have had 5 years or more since I had that vaccine shot
   - Yes
   - No

If you circled "Yes" to one or more of statements 2–5, you may need the pneumonia (pneumococcal) vaccine shot.

Please go to the next page.

HEPATITIS A SHOT

1. I have had hepatitis A infection or 2 hepatitis A vaccine shots.
   - Yes
   - No
   If you circled "Yes", please go to the next page.
   If you circled "No", please answer the statement below.

Please circle "Yes" or "No" for statement 2—

2. One or more of the following apply to me:
   - I plan to visit a foreign country (except: Canada, Japan, Australia or Western Europe)
   - I take drugs bought on the street (use needles or syringes)
   - I am a man who has sex with men
   - I have had liver disease for a long time or I have hepatitis C
   - I have had bleeding disease with clotting factor infusions
   - Yes
   - No

If you circled "Yes" to statement 2, you may need the hepatitis A vaccine shot.
Please go to the next page.
Hepatitis B Shot

Please circle "Yes" or "No" for statement 1—
1. I have had hepatitis B infection or 3 hepatitis B vaccine shots.
   - Yes
   - No
   If you circled "Yes", please go to the next page.
   If you circled "No", please answer the statements below.

Please circle "Yes" or "No" for each statement —
2. I am under 20 years old.
   - Yes
   - No

3. One or more of the following apply to me:
   - I am a health care or public safety worker who could be exposed to blood or body fluids
   - I recently had or was treated for a sexually transmitted disease
   - I had more than one sex partner during the last 6 months
   - I am a man who has sex with men
   - I have sex or live with a person with hepatitis B
   - I have had liver disease for a long time or I have hepatitis C
   - I shoot drugs with needles
   - I have had kidney disease
   - I provide direct services for people with developmental disabilities
   - I still live in Asia or Africa for more than 6 months
   - I come from Asia or the Pacific Islands
   - I have a blood clotting disease
   - Yes
   - No

If you circled "Yes" to one or both of statements 2–3, you may need the hepatitis B vaccine shot.

Please go to the next page.

Tetanus Shot

Please circle "Yes" or "No" for statement 1—
1. I have had a tetanus booster shot in the last 10 years.
   - Yes
   - No
   If you circled "Yes", please go to the next page.
   If you circled "No", see below.

You may need a tetanus booster shot.

Please go to the next page.
Please circle "Yes" or "No" for statement 1—
1. I have had at least 1 Measles-Mumps-Rubella (MMR) vaccine shot.
   Yes  No
   If you circled "Yes", please go to the next page.
   If you circled "No", please answer the statements below.

Please circle "Yes" or "No" for each statement—
2. I was born in 1957 or later.
   Yes  No

3. I am a woman who was born outside of the US who could become pregnant.
   Yes  No

4. One or more of the following apply to me:
   - I am a health care worker
   - I am entering college or a trade school
   - I have HIV/AIDS
   - I plan to visit foreign countries in the future

   Yes  No

If you circled "Yes" to one or more of statements 2–4, you may need the Measles-
Mumps-Rubella (MMR) vaccine shot.

Please go to the next page.

---

Please circle "Yes" or "No" for statement 1—
1. I have had "Chickenpox" disease
   Yes  No

If you circled "Yes", please go to the next page. If you circled "No", please see below.
You may need the "Chickenpox" (Varicella) vaccine shot. Please go to the next page.
Appendix B

Supplementary form developed to summarize vaccines indicated according to the A/R form.

<table>
<thead>
<tr>
<th>This Patient May Need: (according to A/R form)</th>
<th>Recommended by provider (if no, please explain)</th>
<th>Ordered by provider</th>
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</thead>
<tbody>
<tr>
<td>Influenza</td>
<td>Yes No</td>
<td>Yes No</td>
</tr>
<tr>
<td>Pneumococcal</td>
<td>Yes No</td>
<td>Yes No</td>
</tr>
<tr>
<td>Tetanus-diphtheria</td>
<td>Yes No</td>
<td>Yes No</td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>Yes No</td>
<td>Yes No</td>
</tr>
<tr>
<td>MMR</td>
<td>Yes No</td>
<td>Yes No</td>
</tr>
</tbody>
</table>

References


