Objective: To compare the completion rate of hepatitis B vaccination among adolescents who receive primary care at 2 comprehensive high school–based health centers (SBHCs) and a hospital-based adolescent health center (AHC) to assess predictors for successful immunization.

Methods: A retrospective chart review of patients seen for comprehensive history and physical examinations from September 1997 to March 1998 at 2 SBHCs and an AHC was conducted to determine the immunization status for hepatitis B. One SBHC (SBHC-A) had previously implemented an outreach strategy consisting of advertising through the school’s loudspeaker, whereas the other SBHC (SBHC-B) and the AHC did not. Completion rates were assessed among all students requesting comprehensive history and physical examinations. A subset analysis among those without prior immunizations was performed.

Results: Of 510 records reviewed, 406 had documented data for hepatitis B immunization status, and 191 (37 for SBHC-A, 59 for SBHC-B, 95 for AHC) did not have any prior hepatitis immunizations. The completion rate of hepatitis B vaccination was significantly higher at SBHC-A (76%) compared with the other 2 sites (29% for SBHC-B and 24% for AHC) (P<.001).

Conclusion: Patients with access to SBHC services that strongly emphasize outreach were more likely to complete the hepatitis B vaccination series.

MATERIALS AND METHODS

CLINICAL SETTINGS

School-based health center A (SBHC-A) was established in 1983. It receives approximately 2800 visits per year (including medical and reproductive health, mental health, and health education) and is staffed by a nurse practitioner who works 30 hours per week and is supervised by an adolescent medicine subspecialist pediatrician. SBHC-A serves a population of students who range in age from 13 to 19 years and are mostly interested in pursuing a college education. Most students (80%) are enrolled in this SBHC.

Loudspeaker announcements were made at SBHC-A advertising “senior hepatitis B day,” when 12th-grade students could walk into the center and receive their first dose of the vaccine. This program was conducted in 2 days in November and 1 day in December in 1994, 1995, and 1996. Students who received their first dose but missed a subsequent vaccination appointment were sent a letter providing a new scheduled hepatitis B vaccination appointment.

School-based health center B (SBHC-B) was established in 1984 and received approximately 3500 visits (including medical and reproductive health, mental health, and health education) per year. It is staffed by a physician assistant who works 30 hours per week and is supervised by an adolescent medicine subspecialty-trained pediatrician. SBHC-B serves a heterogeneous population of students who range in age from 13 to 19 years, with a large proportion of students who are recent immigrants. Similar to SBHC-A, 80% of the students are enrolled participants in the health clinic. In contrast to SBHC-A, loudspeaker announcements advertising hepatitis vaccinations were not made to students. Rather, immunization histories were obtained during a comprehensive physical examination (CPE), and, if needed, the first dose was administered. Appointments for subsequent visits were made in advance, but there were no reminder letters sent or letters rescheduling missed appointments.

The Mount Sinai Adolescent Health Center (AHC) is an urban, high-volume, university-based, multidisciplinary clinic that receives approximately 48,000 visits per year (including medical and reproductive health, mental health, and health education). Medical services that constitute half of the total visits are provided by 10 subspecialty-trained adolescent medicine physicians, 3 nurse practitioners, 3 fellows and rotating residents, and medical students. The AHC serves an ethnically diverse population that ranges in age from 10 to 21 years. Similar to SBHC-B, an immunization history is obtained during the CPE. If the patient does not report an immunization history for hepatitis B, the first dose is administered. Routinely, patients are sent a letter rescheduling a missed appointment, but the letter does not specify that the appointment was for missing the second or third vaccination dose.

In all settings, the vaccination and the medical visits are provided regardless of the patients’ ability to pay. All patients without prior immunizations are offered the hepatitis B vaccination series and are provided with an appointment to return in 4 to 6 weeks for the second vaccine dose.

STUDY DESIGN

After obtaining institutional review board approval, a retrospective review was performed of the medical records of teens (ages 13 to 19 years) who presented for a routine CPE to SBHC-A and SBHC-B between September 1997 and March 1998 and a random sample of 205 medical records of adolescents seen for a CPE during the same period at the AHC. These SBHCs and the AHC were chosen based on convenience, since all are administered through The Mount Sinai School of Medicine and Mount Sinai New York University Health System.

Data collected from each medical record included the following: age, sex, ethnicity, education level, date of CPE, previous documented vaccination for hepatitis B, and exact dates of first, second, and third hepatitis B vaccines. In addition, we identified a subset of patients who had no history of hepatitis B immunizations to evaluate the difference in hepatitis B vaccination completion rates among the 3 sites and to identify predictors of successful completion.

Completion of hepatitis B vaccination was defined as successful if the subject’s medical record indicated 3 delivered dosages independent of the time parameter. Although at the time of this study the most commonly used hepatitis B vaccination dosing schedule was 0, 1, and 6 months, we did not enforce this time parameter to satisfy successful completion. We considered students who may have completed their hepatitis B vaccination at other settings to be “not successful completers.”

DATA ANALYSIS

To begin, we compared demographic characteristics and completion rates of hepatitis B vaccination among the 3 groups. Then we assessed the association between setting and hepatitis B vaccination completion rates using χ² analysis with no history of hepatitis B immunizations. For each site, we calculated relative risks for successful completion of immunization. Finally, logistic regression was used with the patient subset with no hepatitis B immunizations, and analyses included adjustments for covariates (age, ethnicity, and education level). The level of significance for these analyses was .05.

68% among black students. Another Louisiana study using student, patient, and faculty education as well as incentives reported a completion rate of 65% of 654 students in a middle school setting.

Unfortunately, immunization completion rates vary considerably among hospital- and community-based health centers. For example, a study of an adolescent health clinic, which was part of a prepaid health maintenance organization, demonstrated an 11% completion rate among a small sample of teenagers. Another study using a hospital-based adolescent clinic reported a hepatitis B vaccination completion rate of 85%. Most recently, a prospective study by Middleman et al examined the completion rates between school-based and hospital-based populations and factors affecting completion time of hepatitis B vaccination. These researchers found no differences in completion rates between these 2 settings. Moreover, times to completion of hepatitis B vaccination by site of care (ie, hospital vs SBHC) were not significantly different. However, having higher mean household income, being white and female, and not having smoked cigarettes were independent predictors of shorter times to completion.
The purpose of this study was 2-fold. First, we considered hepatitis B vaccination completion rates among 2 SBHC settings and an urban hospital-based center to determine whether differences existed among these 3 settings. Second, we identified a subset of patients who presented at each of these health care settings with no history of HBV immunization to examine completion rates among health care sites and to examine variables associated with successful completion.

**RESULTS**

Of the 510 medical records reviewed (106 for SBHC-A, 199 for SBHC-B, 205 for AHC), only 406 (98 for SBHC-A, 129 for SBHC-B, 179 for AHC) had documented data for hepatitis B immunizations.

**Table 1. Demographic Characteristics of Entire Sample of 406 Patients With Initial Immunization Information Stratified by Setting**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>SBHC-A (n = 98)</th>
<th>SBHC-B (n = 129)</th>
<th>AHC (n = 179)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD (range), y‡</td>
<td>15.6 ± 1.3 (13-19)</td>
<td>15.6 ± 1.2 (13-19)</td>
<td>16.1 ± 2.5 (10-21)</td>
</tr>
<tr>
<td>Female, %†</td>
<td>54.1</td>
<td>60.5</td>
<td>57.0</td>
</tr>
<tr>
<td>Ethnicity, %‡</td>
<td>Hispanic</td>
<td>63.3</td>
<td>50.0</td>
</tr>
<tr>
<td>African American</td>
<td>32.7</td>
<td>31.1</td>
<td>29.2</td>
</tr>
<tr>
<td>White</td>
<td>1.0</td>
<td>1.6</td>
<td>3.9</td>
</tr>
<tr>
<td>Other§</td>
<td>3.1</td>
<td>17.2</td>
<td>3.9</td>
</tr>
</tbody>
</table>

*SBHC-A indicates high school–based health center A; SBHC-B, high school–based health center B; and AHC, adolescent health center.
†P < .05.
‡For ethnicity, n = 374 (98 for SBHC-A, 122 for SBHC-B, and 154 for AHC).
§Counts are not shown for data with missing values.
§P < .001.

**Table 2. Vaccination Data of Entire Sample of 406 Patients With Initial Immunization Information Stratified by Setting**

<table>
<thead>
<tr>
<th>Vaccination Data</th>
<th>SBHC-A (n = 98)</th>
<th>SBHC-B (n = 129)</th>
<th>AHC (n = 179)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous vaccines, %</td>
<td>None†</td>
<td>34.7</td>
<td>41.9</td>
</tr>
<tr>
<td>1 Dose</td>
<td>11.2</td>
<td>15.5</td>
<td>14.5</td>
</tr>
<tr>
<td>2 Doses†</td>
<td>12.2</td>
<td>18.6</td>
<td>8.9</td>
</tr>
<tr>
<td>3 Doses‡</td>
<td>41.8</td>
<td>20.2</td>
<td>26.3</td>
</tr>
<tr>
<td>Prior disease‡</td>
<td>0.0</td>
<td>3.9</td>
<td>0.0</td>
</tr>
<tr>
<td>Completion rate, %§</td>
<td>85</td>
<td>59</td>
<td>51</td>
</tr>
</tbody>
</table>

*SBHC-A indicates high school–based health center A; SBHC-B, high school–based health center B; and AHC, adolescent health center.
†P < .05.
‡P < .01.
§Completion rates were regardless of timing or prior inoculations.
Counts are not shown for data with missing values.
§P < .001 for comparison of all 3 centers. There is no significant difference among the ages at the SBHCs.
‡For ethnicity, n = 172 (37 for SBHC-A, 57 for SBHC-B, and 78 for AHC).
Counts are not shown for data with missing values.
§P < .05 for comparison among all centers and for comparison of the SBHCs. (For overall ethnicity, P < .10 for comparison of all 3 centers, and P < .05 for comparison of SBHCs).

**Table 3. Demographic Characteristics of Subset of 191 Patients With No Prior Hepatitis B Vaccination History Stratified by Setting**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>SBHC-A (n = 37)</th>
<th>SBHC-B (n = 59)</th>
<th>AHC (n = 95)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD (range), y†</td>
<td>15.3 ± 1.1 (14-18)</td>
<td>15.3 ± 1.2 (13-18)</td>
<td>16.5 ± 2.6 (10-21)</td>
</tr>
<tr>
<td>Female, %†</td>
<td>54.1</td>
<td>45.9</td>
<td>47.4</td>
</tr>
<tr>
<td>Ethnicity, %‡</td>
<td>Hispanic</td>
<td>64.9</td>
<td>45.6</td>
</tr>
<tr>
<td>African American</td>
<td>35.1</td>
<td>36.8</td>
<td>34.6</td>
</tr>
<tr>
<td>White</td>
<td>0.0</td>
<td>3.5</td>
<td>6.4</td>
</tr>
<tr>
<td>Other§</td>
<td>0.0</td>
<td>14.0</td>
<td>5.1</td>
</tr>
</tbody>
</table>

*SBHC-A indicates high school–based health center A; SBHC-B, high school–based health center B; and AHC, adolescent health center.
†P < .001 for comparison of all 3 centers. There is no significant difference among the ages at the SBHCs.
‡For ethnicity, n = 172 (37 for SBHC-A, 57 for SBHC-B, and 78 for AHC).
Counts are not shown for data with missing values.
§P < .05 for comparison among all centers and for comparison of the SBHCs. (For overall ethnicity, P < .10 for comparison of all 3 centers, and P < .05 for comparison of SBHCs).

The completion rate of hepatitis B vaccination was significantly higher at SBHC-A (76%) compared with the other 2 sites (29% for SBHC-B, 24% for AHC) (P < .001). There were no significant differences for the completion rate of hepatitis B vaccination between the SBHC-B and the AHC (Table 4).

Logistic regression found no significant predictors for successful immunization. However, a favorable trend for hepatitis B vaccination completion was found for subjects reporting Hispanic ethnicity and female sex (P < .10).

**COMMENT**

Prevention of hepatitis B by universal immunization is considered very important in the teenage population, particularly because of the high-risk behaviors of adolescents. In fact, the proposed goals for adolescent hepatitis B vacci-
they will complete the vaccine series. The cost of the vaccine would have not interfered with the completion rates, since the medical visits and the vaccines were free and, therefore, not considered a limitation.

Our data support that school-based programs provide a unique opportunity to afford required immunizations to adolescents, especially when vaccination efforts are coordinated with educational and motivational approaches to encourage student participation. In addition to innovative outreach strategies, providing students who may have missed subsequent vaccination appointments with a new scheduled hepatitis B vaccination appointment appears beneficial. It is likely that missed vaccine doses can be more easily completed, because within an SBHC additional health care visits or parental involvement is not required and this setting minimizes school absenteeism.† Although SBHCs have potential limitations to successful vaccination completions, such as student transfer or suspension, the 8- to 9-month school year allows ample time to complete a 3-dose vaccination series with adequate outreach and follow-up.

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Table 4. Vaccination Data for Subset of 191 Patients With No Prior Hepatitis B Vaccination History Stratified by Setting*

<table>
<thead>
<tr>
<th>Dosage</th>
<th>SBHC-A (n = 37)</th>
<th>SBHC-B (n = 59)</th>
<th>AHC (n = 95)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None, %†</td>
<td>0.0</td>
<td>0.0</td>
<td>7.4</td>
</tr>
<tr>
<td>Received 1 dose, %‡</td>
<td>10.8</td>
<td>32.3</td>
<td>38.9</td>
</tr>
<tr>
<td>Received 2 doses, %‡</td>
<td>13.5</td>
<td>39.0</td>
<td>29.5</td>
</tr>
<tr>
<td>Received 3 doses, %§</td>
<td>75.7</td>
<td>28.8</td>
<td>24.2</td>
</tr>
</tbody>
</table>

* SBHC-A indicates high school-based health center A; SBHC-B, high school-based health center B; and AHC, adolescent health center.
†P<.05.
‡P<.01.
§P<.001.

REFERENCES