Objectives: To determine if the Advisory Committee on Immunization Practices hepatitis B screening, vaccination, and prophylaxis recommendations were being followed in North Carolina, and to establish a baseline hepatitis B seroprevalence rate.

Design: A survey of mother and infant birthing facility medical records.

Setting: Four birthing facilities selected from each of the 7 districts in North Carolina (a total of 28 facilities).

Participants: A probability proportional to size survey design was used to select 4763 mother-infant record pairs. All records came from the 1996 birth cohort.

Main Outcome Measures: Maternal hepatitis B screening status, infant vaccination status, infants prophylaxis status, hepatitis B seroprevalence rate, demographic and clinical predictors for maternal infection, failure to receive prenatal care or for whom status was unknown, failure to screen, and failure to vaccinate.

Results: Ninety-two percent of pregnant women were screened for hepatitis B surface antigen. Eighty-six percent of infants received dose 1 of the hepatitis B vaccine. Four of the 9 infants with mothers who were hepatitis B surface antigen–positive did not receive both vaccine and hepatitis B immune globulin. The hepatitis B seroprevalence rate was 0.2%. Mothers who were not screened for infection were 3.4 times more likely to have infants who were not vaccinated. White mothers were twice as likely not to have their child vaccinated as mothers of other races.

Conclusions: Not all infants with hepatitis B–infected mothers were receiving vaccine and hepatitis B immune globulin as recommended. Seroprevalence of hepatitis B infection may be lower in North Carolina than in other states. Hepatitis B laboratory test results should be included in every mother’s medical record.


Editor’s Note: There’s no excuse for not screening mothers and vaccinating infants for hepatitis B. They’re both a captive (hospitalized) audience. Don’t let them escape!

Catherine D. DeAngelis, MD

HEPATITIS B is the world’s most common blood-borne viral infection.¹ Eighty percent of all primary liver cancer worldwide is attributed to chronic hepatitis B infection, and 25% of those chronically infected die of liver disease or liver cancer.²,³ In the United States, an estimated 1 to 1.25 million people are chronically infected, and an additional 15,000 to 20,000 people become infected annually.⁴,⁵ Chronic infection is diagnosed using the hepatitis B surface antigen (HBsAg) test. Surface antigen is detectable within 1 to 2 weeks following exposure. Test sensitivity and specificity are estimated at 98% to 99%.⁶,⁷

Infants of HBsAg-positive mothers have a 10% to 85% chance of infection depending on the mother’s E antigen status.² Ninety percent of infants who are infected develop chronic infection.² Fewer than 5% of infants show any signs of acute infection.⁸

Two vaccines are currently used for the prevention of hepatitis B infection. Both are based on recombinant DNA technology and both have been available since the mid to late 1980s. Vaccine effectiveness is estimated at 80% to 100%.²,⁹,¹⁰ Protection against infection lasts some 9 to 13 years on completion of the 3-dose series.⁵,⁶,¹⁰ Risk for perinatal transmission of hepatitis B in-
PARTICIPANTS AND METHODS

A probability proportional to size survey design was used to select both birthing facilities and medical records from within each facility. This type of design helps to ensure a more representative sample by increasing the chances of obtaining more data from larger facilities where greater numbers of patients receive care (as opposed to giving equal weight to all facilities regardless of size). The state was first divided into 7 distinct regions based on differences in sociodemographic characteristics. Four hospitals were chosen from each region for a total of 28 facilities (approximately 25% of all birthing facilities in the state). Five percent of all the medical records for infants born in the year 1996 were then reviewed (4763 records). This large sampling of records was necessary if a baseline HBsAg seroprevalence rate was to be established. It was anticipated that the infant’s medical record would not contain all the needed data, so the mother’s records were reviewed as well.

A letter explaining survey intent and objectives was sent to birthing facility medical records directors. Instructions on methods and procedures were reviewed with data abstraction staff prior to data collection. Data were collected between October 1997 and January 1998.

Data were collected on age, race, prenatal care history, maternal HBsAg screening results, vaccination status, whether the infant received HBIG, and elapsed times from birth to vaccination or administration of HBIG. Prenatal care was defined as 1 or more visits made to a health care facility prior to delivery excluding visits for purposes other than pregnancy follow-up.

Hepatitis B screening test results had to be specific for surface antigen.

Three multivariate logistic models were run to identify predictors for infants who did not receive prenatal care or whose prenatal care status was unknown, mothers who were not screened, and infants who were not vaccinated, respectively. The reference group for each of these outcomes was persons without the characteristic of interest, eg, unscreened mothers compared with HBsAg-screened mothers. Similarly, the reference group for persons of a particular race was all other persons not of that race, eg, Hispanic compared with non-Hispanic. The strength of a relationship between a predictor and an outcome characteristic was quantified using an odds ratio (OR). Significant relationships had 95% confidence intervals (CI) that excluded a value of 1.0%. The modeling allowed ORs describing predictor and outcome associations to be adjusted for the influence of other predictors. Small sample size prevented the use of modeling for identifying predictors of HBsAg seropositivity. Thus, ORs describing predictors of HBsAg seropositivity are unadjusted. For some variables, such as age or elapsed time to vaccination, a t test was performed.

To examine regional variation for infants who did not receive prenatal care or whose prenatal care status was unknown, for mothers who were not screened, and for infants who were not vaccinated, suitability analysis was performed. The prevalence of each characteristic was divided into quartile scores ranging from 1 to 4. The higher the score, the greater the prevalence of that characteristic. Quartile scores were then summed across the 3 different characteristics, creating an overall risk index that ranged between 3 and 12.

RESULTS

All 28 birthing facilities chosen for the study agreed to participate and each provided all of the requested records. There was a greater proportion of minority race members in the sample of chosen study participants (34%) relative to the proportion of women of childbearing age in the state overall (28%).

Ninety-two percent of pregnant women were screened for HBsAg (Table 1). Twelve percent of these women were screened at the birthing facility where they gave birth. Eighty-six percent of infants were vaccinated (Table 2). On average, infants were vaccinated 24 hours after birth. Thirty-three infants (0.7%) were not vaccinated owing to parental refusal. Another 15 infants (0.3%) were not vaccinated owing to premature delivery or illness. Eleven infants received HBIG, but it was uncertain how many infants were eligible to receive HBIG because clinicians may treat infants presumptively depending on what information is available at the time of treatment. Average time to HBIG administration was 4.3 hours.

Nine women (0.2%) tested positive for HBsAg. Seropositivity rates varied by race ranging from 0.10%
for African Americans to 4.6% for Asian/Pacific Islanders. Asian/Pacific Islanders were 32 times more likely to test positive for HBsAg than women of other races (OR = 32.2; CI = 13.4%-77.2%). Seven (78%) of the 9 infants with HBsAg-positive mothers received the hepatitis B vaccine. Five (56%) of the infants received HBIG, and 5 (56%) received both. Infants who were immunized received the vaccine sooner after birth compared with infants of HBsAg-negative mothers. On average, infants of HBsAg-positive mothers were about 2 hours old when they received the hepatitis B vaccine and infants of HBsAg-negative mothers were 23 hours old.

One hundred forty-five mothers (3.0%) had no history of prenatal care or their care status was unknown. Hispanic women were 4.9 times more likely to have received no prenatal care or have an unknown prenatal care status prior to delivery (Table 3). In contrast, white women were one third as likely to have no history of prenatal care relative to women of minority races. Mothers with no prenatal care or unknown care were 6 times more unlikely to have been screened for hepatitis B infection (OR = 6.0, CI = 4.1%-8.9%).

Three hundred eighty-six women (8.1%) were not screened for HBsAg. Mothers who were not screened were 3.4 times more likely to have infants who were not vaccinated. Infants of unscreened mothers also took significantly longer to vaccinate. On average, more than 1 day would pass (32 hours) before infants of unscreened mothers were vaccinated compared with 23 hours for infants of HBsAg-screened mothers (t test, P = .025).

Six hundred six infants (13%) did not receive the hepatitis B vaccine. Mothers of these infants were twice as likely to be white as any other race. Mothers of unvaccinated infants tended to be older. On average, mothers of unvaccinated infants were 29 years old compared with 26 years for mothers of vaccinated infants (t test P<.001).

The risk scores used for suitability analysis ranged from 1.5 to 3.25 for the characteristic of no prenatal care or care status unknown. For failure to screen, scores ranged from 1.5 to 4.0, and for failure to vaccinate, scores ranged from 1.75 to 3.5. Overall risk indices for the 3 measures combined ranged from 5.5 to 10.25. The lowest risk scores occurred along the southeast regions of the state (Figure). Regions 1 and 2 had lower levels of no prenatal care (score was 1.5), while region 5 had lower levels of failure to vaccinate (score was 1.75). Regions 3, 6, and 7 all had intermediate risk scores ranging from 2.25 to 3.25 for each characteristic. Region 4 in the north central region of the state stood out with a failure to screen score of 4.0 and a failure to vaccinate score of 3.5. The overall index score for region 4 was 10.25, which was 2 points higher than the next closest index score.

**COMMENT**

Most providers screened mothers and vaccinated infants as recommended by the ACIP. A screening rate of 92% and vaccination rate of 86% were consistent with that observed in other states.19,15

### Table 1. Hepatitis B Perinatal Survey: Maternal Characteristics*

<table>
<thead>
<tr>
<th>Maternal Characteristic</th>
<th>No. of Mothers (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Race</strong></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>3131 (66.3)</td>
</tr>
<tr>
<td>African American</td>
<td>1157 (24.5)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>183 (3.9)</td>
</tr>
<tr>
<td>American Indian</td>
<td>120 (2.5)</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>71 (1.5)</td>
</tr>
<tr>
<td>Other</td>
<td>64 (1.4)</td>
</tr>
<tr>
<td><strong>Prenatal care</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4510 (96.9)</td>
</tr>
<tr>
<td>No or unknown</td>
<td>145 (3.1)</td>
</tr>
<tr>
<td><strong>HBsAg infection status</strong></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>4347 (91.7)</td>
</tr>
<tr>
<td>Positive</td>
<td>9 (0.2)</td>
</tr>
<tr>
<td>Unknown</td>
<td>386 (8.1)</td>
</tr>
<tr>
<td><strong>Source of HBsAg data</strong></td>
<td></td>
</tr>
<tr>
<td>Hospital test results</td>
<td>518 (11.5)</td>
</tr>
<tr>
<td>Prenatal records</td>
<td>3981 (88.5)</td>
</tr>
</tbody>
</table>

*Mean age of mothers was 26.6 years each. HBsAg indicates hepatitis B surface antigen.

### Table 2. Hepatitis B Perinatal Survey: Infant Characteristics

| Infant Characteristics No. of Infants (%) |
|------------------------------------------|----------------|
| Hepatitis B vaccination status           |                |
| Vaccinated; mean time to vaccination 23.7 h | 4101 (86.2) |
| Not vaccinated                           | 606 (12.7)    |
| HBIG status                              |                |
| Received HBIG; mean time of HBIG admin 4.3 h | 11 (0.2)    |

*HBIG indicates hepatitis B immune globulin.

Previous investigations estimating HBsAg seropositivity rates have varied from 0.12% to 2.0%.1,9,16-23 An earlier North Carolina survey involving local health departments found that the average HBsAg seroprevalence rate was 0.17%. There was some concern that the estimate of 0.17% may have been less reliable, but the estimate of 0.20% from this investigation would seem to indicate that chronic infection with hepatitis B among pregnant women is less of a problem in North Carolina compared with other states or regions.

Some groups were at high risk for not being in compliance with ACIP recommendations. Only 56% of infants with HBsAg-positive mothers received both vaccine and HBIG. Previous studies estimated that 75% to 100% of infants with HBsAg-positive mothers receive the appropriate prophylaxis.20,21,24,25 One possible explanation for the observed disparity may be inaccurate documentation. One hundred forty tests (3%) contained test results that were not specific enough to be interpreted as HBsAg test results. An HBsAg screening test may have actually been conducted, but results were sometimes recorded as “hepatitis B negative” or “hepatitis negative.” Such responses were considered too vague for the purposes of this study. Additional possibilities include that the test result was overlooked, or that the positive status was acknowledged but that there
was confusion regarding what prophylactic measures needed to be taken.

In this study, unscreened mothers were more likely to have infants who were not vaccinated. Thus, should a mother’s test results prove to be HBsAg positive, her status as such would not be recognized, and the infant in need of prophylaxis would be at greater risk for incurring infection in the absence of receiving the vaccine.

Higher risk for failure to vaccinate among whites was in contrast to previous findings. Twenty-six Percent of mothers who refused to have their infants vaccinated were white. These refusals came from hospitals spanning the entire state, suggesting that refusals were not a function of hospital-specific policy or practice.

The most notable limitation of this study was data reliability. Some of the information collected from medical records such as HBsAg test results came from printouts of laboratory test results, but some of the data came from less reliable sources such as handwritten notes recorded within the progress notes.

While findings from this investigation are specific to North Carolina, other states may be experiencing similar roadblocks for ensuring appropriate screening, vaccination, and prophylaxis. It is recommended that birthing facilities require all maternal medical records to include a copy of HBsAg test results from the laboratory. If a copy cannot be obtained in a timely manner, then an HBsAg screening test should be performed regardless of whether a test had been conducted. Reliance on handwritten notes is too risky. While this recommendation poses some financial burden, the risk for improperly identifying the HBsAg status of women about to give birth is too high to leave to chance.

We also suggest that prenatal care providers and birthing facilities designate staff members that are responsible for reporting HBsAg-positive test results to the local health department. At present only an estimated 40% of HBsAg-positive mothers are identified through current surveillance systems. Some states and organizations have successfully implemented supplemental tracking systems to ensure follow-up. Such tracking systems are certainly endorsed, but for providers without this option, the local health department is an excellent resource for helping to ensure appropriate follow-up for HBsAg-positive mothers and their infants.

Further investigation is needed on factors that influence hepatitis B coverage rates. In this study, coverage rates varied by race, age, and geographic location. These demographic characteristics are probably markers for underlying sociobehavioral risk factors. A better understanding of the circumstances and attitudes behind why individuals would choose not to have their children vaccinated could lead to more effective strategies for ensuring that every infant is protected against hepatitis B infection.

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