Hepatitis B:

What Hospitals Need to Do to Protect Newborns

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Immunization Action Coalition

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American College of Obstetricians and Gynecologists
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ENDORSEMENTS FOR THE UNIVERSAL HEPATITIS B BIRTH DOSE

Dear Hospital or Birth Center Decision-Maker: July 2013

The Advisory Committee on Immunization Practices (ACIP) of the Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics, the American Academy of Family Physicians, and the American College of Obstetricians and Gynecologists recommend that the first dose of hepatitis B vaccine be administered prior to hospital discharge for every newborn in the United States. In addition, the birth dose coverage rate has been adopted as a measure of hospital quality by the National Quality Forum.

This birth dose of hepatitis B vaccine is the first step in creating a vaccine safety net that will protect infants from hepatitis B infection and from the development of chronic hepatitis B infection if acquired through contact with an infected mother, household member, or caregiver. Data from the July 2011–June 2012 National Immunization Survey (NIS) found that 70% of U.S. newborns received a dose of hepatitis B vaccine by 3 days of age. The NIS data show a marked amount of variability by state in the use of the birth dose, ranging from 88% all the way down to only 29%. This variability indicates that it is feasible for most states to do substantially better on their birth dose coverage, and that all states need to improve the use of the birth dose of hepatitis B vaccine to enhance protection of newborn infants.

An estimated 800 U.S. newborns are still becoming chronically infected with hepatitis B each year from exposure at birth or during the first months of life. We are encouraging all hospitals to have policies in place to protect newborns from this important cause of liver failure and liver cancer.

The Immunization Action Coalition (IAC), a nonprofit 501(c)(3) organization, has been working to promote ACIP hepatitis B vaccination recommendations for nearly 20 years. We are providing these resource materials to assist hospitals that do not already have a written policy to implement hepatitis B prevention protocols that ensure all newborns receive a birth dose of hepatitis B vaccine. These resources can help your hospital establish policies, procedures, and standardized admission orders to include hepatitis B vaccine as part of the medical management for all newborns delivered in the hospital. The resources include background information about perinatal hepatitis B transmission and educational materials for parents and staff.

If you have questions about any of the materials, do not hesitate to contact the Immunization Action Coalition. In addition, every state, territory, and many large city health departments have perinatal hepatitis B coordinators on staff. The coordinator in your city or state will be a great resource to help you implement hospital policies to protect all infants born in your hospital. Contact information is included with these materials.

We appreciate your interest in protecting infants born in your hospital from contracting hepatitis B virus. Please make sure your hospital has implemented the nationally recommended policies to assure that every newborn in your facility receives their first dose of hepatitis B vaccine before hospital discharge.

Sincerely,

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Acknowledgements

July 2013

Dear Supporters of Giving the Hepatitis B Birth Dose,

This comprehensive guide was made possible by the insights and expertise of the individuals listed here. Those marked with an asterisk (*) have made exceptional contributions to its success.

All of us are heartened by your efforts to protect newborns from hepatitis B.

Best wishes to you in your important work.

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Medical Disclaimer

The information contained in this collection of hepatitis B birth dose materials has been compiled by the Immunization Action Coalition (IAC) for the purpose of assisting hospitals implement national recommendations to give the first dose of hepatitis B vaccine to newborns prior to discharge from the hospital. IAC is solely responsible for its accuracy.

These materials are not intended as medical advice and IAC's liability for them extends only to making every effort to correct mistakes and update their online versions.

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1 Preventing Hepatitis B in Newborns: What's Needed

- Hepatitis B: What Hospitals Need to Do to Protect Newborns – Executive Summary
- Measuring Hepatitis B Vaccination for Newborns Prior to Hospital Discharge Is Endorsed by the National Quality Forum (NQF)

Hepatitis B: Executive Summary

What Hospitals Need to Do to Protect Newborns

Background on Hepatitis B

- Hepatitis B is a liver disease caused by the hepatitis B virus (HBV). HBV is found in the blood and certain body fluids (such as serum, semen, saliva, and vaginal secretions) of people infected with the virus. An infected mother can transmit HBV to her baby at birth. An infant can also acquire HBV from a chronically infected member of their household.
- HBV can cause acute infection and chronic infection. Approximately 90% of children who are infected at birth or during the first year of life will become chronically infected; only 4% of newly infected adults become chronically infected.
- Most morbidity (e.g., liver cancer and liver failure) and mortality from HBV occurs in people with *chronic* HBV infection. Thus, the primary goal of administering hepatitis B vaccine at birth (i.e., the "birth dose") is the first step to prevent chronic HBV infection.
- Post-exposure prophylaxis of newborns born to chronically infected mothers is 85%–95% effective when administered within 12 hours of birth. Timing of the birth dose is critical to achieve the highest rates of protection. Prophylaxis consists of hepatitis B vaccine **along with** hepatitis B immune globulin (HBIG). Hepatitis B vaccine alone starting at birth will prevent transmission of the virus in 70%–95% of infants born to chronically infected mothers.

The Problem

- Each year in the United States, more than 24,000 infants are born to mothers who are chronically infected with HBV. If none of these infants were to receive prophylaxis at birth, it is estimated that almost 10,000 would become chronically infected with HBV, and 2,500 would eventually die of liver failure or liver cancer as early as the second decade of life.
- All infants of HBV-infected mothers should be reported to their local health department for case management to ensure timely completion of the vaccination series and resulting protection; however, only about half of the 24,000 infants are reported.
- Although most infants could be protected if hospitals routinely provided a dose of hepatitis B vaccine to all newborns, the most recent CDC survey found that only 70% of U.S. infants received a dose of hepatitis B vaccine within 3 days of birth.
- Based on average rates of newborn hepatitis B vaccination in hospitals and on vaccine efficacy, CDC estimates that more than 800 newborns become chronically infected with HBV each year.

The Hospital's Role

- All hospitals should implement the recommended "universal birth dose policy" to ensure that every newborn receives the first dose of hepatitis B vaccine at birth, or no later than hospital discharge. This will provide a safety net to prevent HBV infection for any at-risk newborn, including infants not identified because the mother did not receive prenatal care; because of errors made by healthcare professionals in ordering, recording, or communicating lab tests results to determine a mother's hepatitis B status; or because of exposure to chronically infected members of the household (many people do not know they are infected).
- All hospitals should follow national recommendations for prophylaxis of newborns born to women with chronic HBV infection.

See pages 41–74 of this booklet for the recommendations of CDC's Advisory Committee on Immunization Practices titled *A Comprehensive Immunization Strategy to Eliminate Transmission of Hepatitis B Virus Infection in the United States*.

Measuring Hepatitis B Vaccination for Newborns Prior to Hospital Discharge Is Endorsed by the National Quality Forum (NQF)

The National Quality Forum (NQF) is a widely looked to standards-setting organization for health-care facilities. In response to a submission by the Centers for Disease Control and Prevention, the NQF endorsed as a standard the reporting of "Hepatitis B Coverage Among All Live Newborn Infants Prior to Hospital or Birthing Facility Discharge."

Specifically, NQF Measure #0475 recommends that hospitals measure and report the "percent of live newborn infants that receive hepatitis B vaccination before discharge at each single hospital/birthing facility during given time period (one year)," excluding infants whose parents refuse vaccination.

Hospitals that adopt this measure will be taking an important step to ensure that no baby born to an HBsAg-positive mother slips through the cracks and becomes infected.

▶ For more information on the NQF hepatitis B birth dose endorsement, visit **www.qualityforum.org/MeasureDetails.aspx?actid=0&SubmissionId=287#k=0475.**

2 Reducing Medical Errors: Case Reports

- States Report Hundreds of Medical Errors in Perinatal Hepatitis B Prevention
- Unprotected Infant Dies of Fulminant Hepatitis B
- Medical Errors Put Infants at Risk for Chronic Hepatitis B Virus Infection – Six Case Reports
- Two More Infants Chronically Infected with Hepatitis B Virus . . . the Medical Errors Continue
- Give the Birth Dose . . . Hepatitis B Vaccine at Birth Saves Lives!

States Report Hundreds of Medical Errors in Perinatal Hepatitis B Prevention

Avoid tragic mistakes – vaccinate newborns against HBV in the hospital

By **Teresa A. Anderson, DDS, MPH,** and **Deborah L. Wexler, MD***

On two annual surveys conducted by the Immunization Action Coalition covering the period from July 1999 to October 2002 (see first entry in "Related Resources" on page 13), state and local hepatitis coordinators reported more than 500 medical errors regarding perinatal hepatitis B prevention. Examples of types of errors included:

- not properly prophylaxing infants born to HBsAg-positive mothers with both hepatitis B vaccine and hepatitis B immune globulin (HBIG) within 12 hours of birth
- not giving hepatitis B vaccine to infants born to mothers of unknown HBsAg status within 12 hours of birth
- misinterpreting or mistranscribing hepatitis B screening test results, or failing to communicate results to or within the hospital
- ordering the wrong hepatitis B screening test for pregnant women

Because of these types of errors, many children are now chronically infected with hepatitis B virus (HBV) and at least one infant has died. Children infected when less than one year of age have a 90% chance of developing chronic HBV infection with all its serious potential sequelae, such as cirrhosis and liver cancer.

Consider the following examples of medical errors reported by the nation's hepatitis coordinators where infants were needlessly put at risk for perinatal HBV infection.

Medical Error Type #1

Infants born to HBsAg-positive mothers did not receive both hepatitis B vaccine and HBIG within 12 hours of birth.

Recommendation of the Centers for Disease Control and Prevention (CDC), American Academy of Pediatrics (AAP), American Academy of Family Physicians (AAFP), and the American College of Obstetricians and Gynecologists (ACOG): All infants of HBsAg-positive mothers (including premature infants) should receive hepatitis B vaccine and HBIG within 12 hours of birth.

Case report examples

"The mother had been diagnosed with chronic hepatitis B in 1994. In her prenatal record she was documented to be HBsAg and HBeAg positive, and this information appeared in several places on the record that was sent to the hospital. Despite this, her baby did not receive HBIG or the first dose of hepatitis B vaccine in the hospital. In fact, the hepatitis B vaccine order was crossed out in the infant's chart. Follow-up with the pediatrician on day six indicated that the baby still had not received any prophylaxis. The first dose of vaccine was given when the infant was three weeks of age, the second dose three months after the first, and the third dose six months after the first. The child's current status is unfortunate. Diagnosed HBsAg-positive at 19 months of age, the child is now being followed by a liver specialist for chronic hepatitis B."

"We have two cases where infants born to carrier mothers received the first dose of hepatitis B vaccine three weeks after birth and no HBIG. In one of the cases, a resident interviewed the mother who claimed she was not HBsAg positive."

"In 2000, we had 25 cases where the babies of positive moms did not receive HBIG at birth. Three of these babies are now infected. In one of the cases, the mother's status was erroneously

marked as unknown, another was marked as negative, and in one the status was correctly marked, but the HBIG was still not given."

"In 2000, there were eight infants of HBsAg-positive mothers who never received HBIG and six who did not get hepatitis B vaccine within 12 hours of birth. This is despite letters to the hospital and to the OB/GYN prior to the birth."

"In one case in a rural hospital, the mother's positive hepatitis B status was documented in her chart and the infant's chart, which were seen by many nurses and three pediatricians, but no prophylaxis was ever initiated."

"For 1999 and 2000, of the 771 infants born to HBsAg–positive women in our state, 30 did not receive HBIG at birth, 10 did not receive the first dose of vaccine, and 9 didn't receive either."

Medical Error Type #2

Infants born to mothers of unknown HBsAg status were not properly prophylaxed.

Recommendation of CDC, AAP, AAFP, and ACOG: If the mother's HBsAg status is unknown, infants must receive hepatitis B vaccine within 12 hours of birth. For premature infants weighing less than 2 kg (4.4 lb), HBIG is also given. [Authors' note: It's not recommended to wait for the HBsAg lab result to determine your course of action. Order hepatitis B vaccine from the pharmacy and give it immediately – within 12 hours of birth.]

CASE REPORT EXAMPLES

"The mother's positive lab result was not received before she was discharged, and the hospital did not have a universal hepatitis B birth dose policy. The infant did not receive HBIG or the first dose of vaccine within the recommended time frame."

"During a hospital audit, I found one case where the vaccine had been withheld for 25 hours while the staff awaited the results of the 'stat' HBsAg blood work on a mother of unknown status."

"In one case a mother came in with no prenatal care. The intern did not think she looked high risk. She turned out positive. Her child did not receive vaccine."

"The mother was known to be HBsAg positive with a previous pregnancy; however, with this pregnancy the woman did not receive prenatal care and reported to a different hospital in active labor. HBIG and hepatitis B vaccine were not given until two days after birth, when the mother was found to be HBsAg positive."

"The mother's status was unknown at birth. She left the hospital without the baby being vaccinated. She gave a fictitious address."

"This mom had no prenatal care, knew she was a carrier, but gave no indication of her HBsAg status when admitted. The hospital ran tests on mom at delivery, but it wasn't until two days later when the lab results came back positive that the baby was treated with HBIG and hepatitis B vaccine."

"My survey found 36 women unscreened in a six-month period. Ten infants did not get vaccine."

Medical Error Type #3

Screening test results were misordered, misinterpreted, mistranscribed, or miscommunicated.

To avoid these types of errors, CDC recommends that a copy of the mother's original HBsAg lab report be sent to the birthing hospital as part of the prenatal record. Labor and delivery units and nursery units should carefully review this original lab report to determine the appropriate course of action. Do not rely on transcribed results!

CASE REPORT EXAMPLES

"We had a mom who was reported to the hospital as HBsAg negative by the prenatal care provider. Unfortunately, this woman was actually HBsAg positive. The baby did not receive HBIG or the birth dose of hepatitis B vaccine, and by three months of age developed fulminant hepatitis B and died."

"In June 2002, a situation occurred where an infant born to an HBsAg-positive mother at a large teaching hospital was not appropriately treated with hepatitis B vaccine and HBIG at birth. A full investigation was launched, and it was found that although the mother's HBsAg status was clearly marked on the prenatal record as 'reactive,' a resident at the hospital mistranscribed the mother's HBsAg status onto the hospital chart as 'negative.'"

"On an average, we receive ten newborn screening forms each month that indicate a misinterpreted or mistranscribed maternal hepatitis B status."

"We find that doctors' offices sometimes have a positive result in the mother's chart and neglect to look at it. Or they order labs and neglect to notice that they were never drawn."

"Three infants were born to HBsAg-positive mothers where the hospital record erroneously indicated that the mothers were negative for HBsAg. The babies were not prophylaxed within 12 hours with HBIG and hepatitis B vaccine."

"In two cases, the mothers were tested prenatally and the mothers' charts showed positive HBsAg test results. However, the HBsAg test result was documented as negative in the infants' charts, resulting in neither HBIG nor hepatitis B vaccine being given. In two other cases, the positive results were transcribed incorrectly in the mothers' charts as negative."

"The hospital nursery claimed they had a record of the mother being HBsAg negative. The baby was not immunized at time of birth, although the health department had a copy of the lab slip indicating that mom was HBsAg positive. The OB's office claimed that they did not have this lab slip in the patient's chart but later confirmed that mom was HBsAg positive."

"We have two cases due to transcription error. The children are now positive."

"Concerning an HBsAg-positive mom, I was told by both the doctor and nurse that this meant that the woman had hepatitis B antibodies."

"The physician's interpretation of a mother's prenatal HBsAg–positive lab was 'hepatitis B negative.' This infant was not given HBIG or vaccine prior to hospital discharge. The hospital records recorded the physician's interpretation of the lab rather than the actual lab results. This child is now HBsAg positive."

Medical Error Type #4

Pregnant women were screened using the incorrect hepatitis B test.

Recommendation of CDC, ACOG, AAP, and AAFP: The hepatitis B screening test to order for each and every pregnancy is HBsAg (hepatitis B surface antigen). [Authors' note: The standard screening test is NOT antibody to hepatitis B surface antigen (anti-HBs or HBsAb), antibody to hepatitis B core antigen (anti-HBc or HBcAb), HBeAg, anti-HBe, or HBV-DNA. These tests are easily confused and often misordered since some differ only by a single letter. Ordering the wrong lab test can be a fatal error.]

Case Report Examples

"We have examples of approximately 25 such cases: we ask for copies of the labs and we find that anti-HBs has been frequently ordered."

"We get reports of the wrong screening test ordered, including HBcAb and HBV-DNA."

"Two maternal records were found to have anti-HBc documented instead of HBsAg. In one hospital, cord blood was used to test mother's HBsAg status."

"We see anti–HBs erroneously ordered in clinics and hospitals for unscreened women. We also see HBsAg ordered correctly in the hospitals but sent to the labs requesting an anti–HBs test. These appear to be errors and lack of knowledge on the part of the physicians and other hospital staff. Most disturbing is that it has never been noticed by the physicians, lab staff, or nursing staff until it is brought to their attention by health department staff. We also see physicians who only order HBsAg screening for the first pregnancy and none of the following pregnancies, and also those who order only anti–HBs when their patient has had the vaccine series."

Conclusion

As these examples demonstrate, medical errors in perinatal hepatitis B prevention can occur at any time – beginning with the woman's first prenatal visit and extending beyond the mother's and infant's hospital discharge. The errors described in this article are only the "tip of the iceberg." Most errors remain undiscovered. CDC estimates that annually about 12,500 HBsAg-positive women are not reported to their state's perinatal hepatitis B program and therefore do not benefit from case management. Only about half of the expected infants born to HBsAg-positive mothers are identified for case management. In terms of a "safety net" for these infants, a 2010 CDC survey found that nationwide, only 70% of infants received the first dose of hepatitis B vaccine within three days of birth. Putting these numbers together, one can conclude that many high-risk infants are not being identified and protected against HBV infection.

Errors are made by a broad range of perinatal healthcare workers including obstetricians, family physicians, pediatricians, nurses, lab technicians, and clerical staff, and these errors occur in hospitals as well as in primary care settings. While you may be following the national recommendations for the patients under your care, you can't be certain about everyone else. Human error will never be eliminated.

Only a universal hepatitis B vaccine birth dose policy in every hospital will optimize the protection of all infants from human error and chronic HBV infection. If your hospital isn't vaccinating every infant against hepatitis B virus infection prior to discharge, IAC urges you to work together with your hospital, your medical staff, and your local and/or state health departments to institute this lifesaving policy in your hospital. The words of one hepatitis coordinator (whose state experienced an infant death from fulminant hepatitis B) make the case for this policy: "Life is messy, and giving the birth dose is the best way to avoid worst-case scenarios."

Related Resources

For resources and ideas to help you, including all responses to IAC's 2001 and 2002 birth dose surveys, related journal articles, and more, visit the Immunization Action Coalition's birth dose web pages at www.immunize.org/birthdose.

A Comprehensive Immunization Strategy to Eliminate Transmission of Hepatitis B Virus Infection in the United States. Source: *MMWR*, 12/23/05, Vol. 54 (RR16). Online at www.cdc.gov/mmwr/pdf/rr/rr5416.pdf

Guidance for Developing Admission Orders in Labor & Delivery and Newborn Units to Prevent Hepatitis B Virus Transmission. Source: IAC. Online at www.immunize.org/protect-newborns/guide/chapter3/guidance-orders.pdf

Give the Birth Dose…Hepatitis B Vaccine at Birth Saves Lives! Source: IAC. Online at www.immunize.org/protect-newborns/guide/chapter2/give-birth-dose.pdf

Recommended Childhood & Adolescent Immunization Schedule. Source: CDC. Online at www.cdc.gov/vaccines/schedules/hcp/child-adolescent.html

General Recommendations on Immunization. Source: *MMWR*, 1/28/11, Vol. 60(RR2). Online at www.cdc.gov/mmwr/PDF/rr/rr6002.pdf

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Deborah L. Wexler, MD, a family physician, is the founder and executive director of the Immunization Action Coalition (IAC). The Coalition provides practical immunization education materials to health professionals and patients. IAC promotes the recommendation to give hepatitis B vaccine to every newborn no later than hospital discharge.

Unprotected Infant Dies of Fulminant Hepatitis B

The Immunization Action Coalition (IAC) publishes ***Unprotected People Reports*** *about people who have suffered or died from vaccine-preventable diseases. Nancy Fasano, formerly of the Michigan Department of Community Health, submitted the following case report to IAC. Serious medical errors occurred in this case resulting in the death of a 3-month-old infant. Take measures to make certain that errors such as these do not occur in your practice or hospital. Up to 95% of perinatal infections can be prevented by post-exposure prophylaxis given within 12 hours of birth. Tragically, many babies are exposed to hepatitis B at birth but do not receive appropriate postexposure prophylaxis. Prevent tragedies like these by administering the first dose of hepatitis B vaccine to all newborns at birth, no later than hospital discharge.*

Protect EVERY newborn from hepatitis B virus infection!

Give the first dose of hepatitis B vaccine before hospital discharge.

Case Report

On December 13, 1999, a previously healthy 3-month-old infant of Southeast Asian descent was brought to a local Michigan hospital emergency department and was admitted following a 5-day history of fever, diarrhea, and jaundice.

Upon admission to the hospital, hepatitis B serology was obtained along with liver function tests and liver enzymes. Laboratory results revealed that the infant was hepatitis B surface antigen (HBsAg) positive and IgM core antibody (IgM anti-HBc) positive with elevated total bilirubin 16.6, direct bilirubin 4.7, ALT 693, and AST 203. The infant's test results were reported to the local health department on December 14, 1999. The infant's mother was tested at the same time and was found to be HBsAg positive and anti-HBc positive.

Investigation revealed that the infant's mother had tested positive for HBsAg during her pregnancy but that the test result was communicated incorrectly as "hepatitis negative" to the hospital where the baby was born.

A diagnosis of hepatic failure due to hepatitis B virus (HBV) infection was made and the infant was transferred to another hospital on December 16 for possible liver transplantation. After transfer, the infant developed seizures and her condition deteriorated rapidly. She died on December 17.

Investigation revealed that the infant's mother had tested positive for HBsAg during her pregnancy but that the test result was communicated incorrectly as "hepatitis negative" to the hospital where the baby was born. Neither the laboratory nor the prenatal care provider reported the HBsAg-positive test results to the local health department as required by state law. The infant received no hepatitis B vaccine and no hepatitis B immune globulin (HBIG) at the time of birth.

The hospital where the infant was born had suspended administration of hepatitis B vaccine to all newborns during the summer of 1999 due to the concern about the presence of thimerosal used as a preservative in hepatitis B vaccine. The first dose of hepatitis B vaccine wasn't administered to this infant until two months of age. **This tragedy could have been averted.**

▶ A DISCUSSION FOLLOWS ON THE NEXT PAGE

Discussion

Serious medical errors occurred in this case resulting in the death of the infant. The following errors occurred:

1. The HBsAg-positive test result was not conveyed to the pregnant woman by her physician.
2. The physician failed to report the HBsAg-positive test result to the local health department as mandated by state law.
3. The laboratory that performed the test did not notify the local health department of the positive result.
4. The HBsAg test result was transcribed incorrectly on the prenatal record which was sent to the hospital. A copy of the original lab report did not accompany the prenatal record.
5. The HBsAg test result was not verified by the perinatal staff; they did not review a copy of the actual lab report.
6. There was no hospital protocol in place to vaccinate infants who live in communities at high risk for early HBV exposure.

Take measures to assure that errors such as these do not occur in your practice or hospital.

– Nancy Fasano
past Manager, Outreach and Education Section, Division of Immunization, State of Michigan Department of Community Health

This article was originally published in Needle Tips, *Vol. 10, No. 1, July 2000.*

Make sure that a tragedy like this never happens again!

If you provide prenatal care

- Test every pregnant woman during each pregnancy for HBsAg, regardless of her hepatitis B vaccination status.
- Send a copy of the original lab report along with other prenatal records to the hospital where the woman will deliver.
- Notify the local or state health department* of any positive HBsAg test result in a pregnant woman.
- Counsel the pregnant woman about the implications of her positive HBsAg test result (e.g., the need for her to receive ongoing medical evaluation and the need for household and sexual contacts to be tested and vaccinated).
- Communicate the woman's positive HBsAg status to the clinician who will provide pediatric care to the newborn.

If you work in a hospital labor & delivery unit or newborn nursery

- Know the HBsAg status of every woman giving birth in your facility. A copy of the original lab report should be part of the prenatal record.
- Don't let any infant slip through the cracks. Administer the first dose of hepatitis B vaccine in the hospital to all newborns.
- Develop hospital policies to assure that all mothers are screened for HBsAg and all newborns are appropriately managed to prevent HBV infection.

If you provide pediatric care to newborns

- Know the HBsAg status of mothers of all infants for whom you provide care.
- Help assure that no babies are infected due to a medical error. Make sure that all newborns under your care receive the first dose of hepatitis B vaccine at birth, before hospital discharge.
- Know the risk groups for HBV infection.

* If you do not know whom to contact at the state/local health department, contact the perinatal hepatitis B coordinator for your state. Contact information can be found at www.cdc.gov/vaccines/vpd-vac/hepb/perinatal-contacts.htm.

Medical Errors Put Infants at Risk for Chronic Hepatitis B Virus Infection – Six Case Reports

Since 1990, New York state has had a law mandating hepatitis B surface antigen (HBsAg) testing of all pregnant women, reporting of positive HBsAg results, and treatment of infants born to HBsAg-positive women. Compliance with these mandates and current Centers for Disease Control and Prevention recommendations for perinatal hepatitis B prevention is closely monitored through routine visits to birthing hospitals to conduct record reviews and provide education for hospital staff. Despite these efforts, medical errors continue to be made that put infants at risk for chronic hepatitis B virus (HBV) infection. These errors underscore the importance of administering the first dose of hepatitis B vaccine at birth, before discharge from the hospital.

Although 85%–95% percent of perinatal hepatitis B virus infections can be prevented by appropriate prophylactic treatment, many newborns don't receive such prophylaxis. Approximately 90% of infants who become infected will develop chronic HBV infection with all its serious potential sequelae, including possible cirrhosis and liver cancer later in life. To better protect newborns against chronic HBV infection, the New York State Department of Health Immunization Program provides state-funded hepatitis B vaccine, free of charge, to any birthing hospital that institutes a universal hepatitis B birth dose policy.

The following six cases from New York were reported in April 2005 by Elizabeth J. Herlihy, RN, BSN, MS, who was the New York State Department of Health's hepatitis B coordinator at that time. The cases illustrate a variety of medical errors that led to high-risk newborns not receiving the recommended hepatitis B prophylaxis (0.5 mL hepatitis B vaccine and 0.5 mL hepatitis B immune globulin [HBIG] within 12 hours of birth).

Case Report #1

A woman known to be chronically infected with HBV delivered her third infant a month early at a birthing hospital. Unfortunately, her HBsAg status was incorrectly recorded in her hospital record as negative. The hospital did not have a universal birth dose policy, so the infant received no hepatitis B vaccine at birth. The mother assumed that the baby was vaccinated because her other two infants had been treated appropriately. A few weeks later (at the time of the mother's original due date), the public health department contacted her to make sure the infant had been vaccinated. They discovered the mother had not been given a shot record for her newborn upon discharge, nor had vaccines ever been discussed with her at the hospital. The hospital was contacted, and it was discovered that the infant had not received any prophylaxis. The first dose of vaccine was immediately administered, but by then the infant was already one month old.

Case Report #2

A woman in labor presented to a suburban birthing hospital. The hospital staff found that she had not been tested for HBsAg this pregnancy because her family practice physician said she was negative two years ago so "not to worry about it." The hospital correctly ordered a test, but did not ask the test to be done as quickly as possible and did not give the infant hepatitis B vaccine dose #1 within 12 hours of birth as recommended. The infant was discharged two days after birth; the mother's HBsAg test came back positive three days after birth. That same day, public health representatives tracked down the family and made sure the infant immediately received vaccine dose #1 and HBIG. Hepatitis vaccine doses #2 and #3 were given according to the recommended schedule.

Case Report #3

An infant born to an HBsAg-positive mother at a birthing hospital received HBIG at birth but not hepatitis B vaccine. Upon investigation, it was learned that the physician forgot to write an order for the vaccine. The hospital did not have standing orders in effect for the universal hepatitis B birth dose, so the infant did not routinely receive hepatitis B vaccine. Public health staff uncovered the error when the infant was two weeks of age, and the infant was immediately vaccinated.

Case Report #4

Staff from the New York State Department of Health conducted a perinatal hepatitis B record review at a birthing hospital. The hospital had failed a record review the prior year, and one of the corrective actions recommended was to include a hard copy of the maternal HBsAg test result in the record. Upon review, it was discovered that the wrong hepatitis test (hepatitis B surface antibody [HBsAb], rather than hepatitis B surface antigen [HBsAg]) had been ordered in three out of the 35 records reviewed. Furthermore, this same error had been made by three different ob-gyn physicians. The obstetrics department head was very surprised to learn of this error and immediately issued a memorandum of clarification to the physicians that HBsAg must be ordered for all pregnant women.

Case Report #5

A woman known to be chronically infected with HBV delivered her second infant five weeks prematurely. Her first infant had received appropriate prophylaxis, and postvaccination serology revealed that child to be immune. The woman was tested during her current pregnancy and again found to be HBsAg positive. She was referred to a gastroenterologist who ordered further serology including hepatitis B e antigen and viral load tests. The e antigen was non-reactive and the viral load was low (which is often the case in persons chronically infected with HBV). The infant was born five weeks early and transferred to the neonatal intensive care unit (NICU). The neonatologist at the NICU consulted the mother's gastroenterologist. The two decided that the infant did not need to receive hepatitis B prophylaxis, even though it was clearly documented on the hospital record that the mother was HBsAg positive. Neither HBIG nor hepatitis B vaccine was given to the infant. The hospital did not have a universal birth dose policy, so vaccine was not routinely administered. The county health department, assuming the appropriate treatment had been given at birth, discovered this error when following up to make sure the infant was scheduled to receive a second dose of vaccine. The infant's pediatrician was not aware that the mother was chronically infected with HBV and was very disturbed to learn that the infant had not received prophylaxis at birth. The infant was immediately seen in the pediatric office and given the first dose of vaccine at two months of age.

Case Report #6

A multipara woman sought late prenatal care for her current pregnancy. She had been HBsAg positive during all prior pregnancies, but her current HBsAg test result was negative. Suspecting this could be a false negative HBsAg result, the provider ordered another specimen to be drawn and sent to the state laboratory. Before the results were known, the woman delivered at a birthing hospital that had been sent the prenatal file, which included negative HBsAg results. Since the mother was incorrectly thought to be HBsAg negative, no HBIG was administered to the infant. Fortunately, the hospital recently had adopted a universal hepatitis B birth dose policy, so the infant was administered a routine birth dose of hepatitis B vaccine.

The medical errors described in cases 1–5 would have been circumvented had these hospitals had policies in place to administer hepatitis B vaccine to all newborns. Hepatitis B vaccine is the safety net that protects newborns from HBV infection and its complications.

Two More Infants Chronically Infected with Hepatitis B Virus…the Medical Errors Continue

Approximately 24,000 women with chronic hepatitis B virus (HBV) infection give birth in the United States each year. Although 85%–95% of perinatal HBV infections can be prevented by post-exposure prophylaxis (hepatitis B vaccine and hepatitis B immune globulin [HBIG]) given within 12 hours of birth, many high-risk newborns (infants of HBsAg-positive mothers) don't receive this recommended postexposure prophylaxis, or even hepatitis B vaccine alone which will prevent 70%–90% of perinatal HBV infections.

Unfortunately, children who become infected when they are younger than one year of age have a 90% chance of developing chronic hepatitis B virus infection with all its serious potential sequelae, including an up to 25% risk of death from cirrhosis or liver cancer later in life.

The following two cases from Colorado illustrate how easily unprotected babies can become chronically infected children.

Case Report #1

This case occurred in December 1999. The mother was of Hmong ethnicity, born in Thailand. She had been diagnosed with chronic HBV infection in 1994 during her first pregnancy; this pregnancy was her third. In her prenatal record she was documented to be HBsAg and HBeAg positive, and this information appeared in several places on the record that was sent to the hospital. Despite this, her baby did not receive HBIG or the first dose of hepatitis B vaccine in the hospital. As a matter of fact, the hepatitis B vaccine order was crossed out in the newborn's chart. Follow-up with the pediatrician at six days of age indicated that the baby still had not received any prophylaxis. The first dose of vaccine was given when the infant was three weeks of age, the second three months after the first, and the third six months after the first.

Upon contacting the hospital where the baby was delivered to determine why HBIG and hepatitis B vaccine were not given within 12 hours of birth, the state health department representative was told that it was unclear how this baby was missed and perhaps it was because the hospital had no hepatitis B vaccine at the time of delivery. They indicated that the infant was to receive the first dose of vaccine at the pediatrician's office. However, this did not happen until the baby was three weeks of age, and only after the office was contacted by the state health department to request that it be done. The child's current status is unfortunate. Diagnosed HBsAg-positive at 19 months of age, the child is being followed by a liver specialist for chronic HBV infection.

Case Report #2

This case occurred in August 2001, in a different hospital and city. The mother was also of Asian descent (Indonesian) and had tested positive for HBsAg midway through her pregnancy. The HBsAg lab result was recorded on the prenatal record, which was sent to the hospital. The hospital staff also recorded the HBsAg-positive test result on the hospital's obstetrical evaluation sheet. It was not acted upon by either the delivering physician or the labor and delivery staff, nor was the mother's HBsAg-positive test result communicated to or noted by the newborn nursery. The hospital did not have a policy in place to address management of babies born to HBsAg-positive mothers or to mothers of unknown status. The infant received neither HBIG nor hepatitis B vaccine at birth. In fact, the high-risk infant did not receive the first dose of hepatitis B vaccine until two months of age. Unfortunately, this child has also tested HBsAg positive.

In reviewing the case, a staff member at the state health department acknowledges that the baby should have been followed more closely. Part of the problem was that the health department field investigator didn't contact the hospital before the birth to ensure appropriate care would take place. Additionally, after the birth, the hospital sent the state an inaccurate report, stating that the child had received prophylaxis in the hospital. The investigator did not review the hospital record or call the physician to verify that the information was accurate.

In summary, don't let infants go unprotected against hepatitis B virus infection because of avoidable human errors. Give every infant a dose of hepatitis B vaccine no later than hospital discharge. It's the safety net that will protect all newborns.

Such errors are not unique to Colorado. The Immunization Action Coalition (IAC) surveyed state and local hepatitis B coordinators about perinatal hepatitis B practices in 2001 and again in 2002. The coordinators' responses contain hundreds of examples of children who were unprotected or inadequately protected because health professionals, clinic staff, or hospital staff failed to order or misordered the hepatitis B blood test or misinterpreted, mistranscribed, or miscommunicated the test results of the infants' mothers.*

* To read the survey results, or to view or download related resources and recommendations, visit the Immunization Action Coalition's birth dose web page at www.immunize.org/birthdose/birthdosesurvey.asp.

Give the Birth Dose…

Hepatitis B Vaccine at Birth Saves Lives!

By **Deborah L. Wexler, MD**
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In December 2005, CDC issued updated recommendations on hepatitis B vaccination for infants. The recommendations strongly support (1) giving the hepatitis B vaccine birth dose to every newborn prior to hospital discharge and (2) using standardized admission orders for administering the birth dose. In addition, it is recommended that a copy of the ***original*** *maternal hepatitis B lab report be sent to the hospital –* ***not*** *a transcribed result. The recommendations also state that the hepatitis B vaccine birth dose may be delayed until after hospital discharge only "in rare circumstances." When doing so, a physician's order to withhold the birth dose and a copy of the original lab report indicating that the mother was HBsAg negative during this pregnancy should be placed in the infant's medical record. The most recent CDC estimates indicate only 70% of newborns receive the hepatitis B vaccine birth dose by 3 days of age. Clearly, there is much work left to do to fully protect newborns.*

Healthcare professionals:
Urge your patients to protect their newborns with hepatitis B vaccine before hospital discharge.

Your recommendation to vaccinate is a strong patient motivator!

The birth dose saves lives!

To obtain CDC's recommendations for hepatitis B immunization of infants, children, and adolescents, see pages 41–74.

Leading health organizations – CDC, AAP, AAFP, and ACOG – recommend that all hospitals and healthcare professionals protect newborns from hepatitis B virus (HBV) infection by administering the first dose of hepatitis B vaccine to every baby at birth, no later than hospital discharge.

Approximately 24,000 women with chronic HBV infection give birth in the U.S. each year, and many do not know they are infected. Up to 95% of perinatal infections can be prevented by post-exposure prophylaxis given within 12 hours of birth. Tragically, many babies are exposed to HBV at birth and do not receive appropriate postexposure prophylaxis. Infants infected at birth have a 90% chance of becoming chronically infected with HBV. Chronic HBV infection in infants leads to liver cancer, cirrhosis, and liver failure in up to 25% of these infants when they become adults.

State perinatal hepatitis B coordinators provided hundreds of reports of newborns who were unprotected or inadequately protected because of medical errors.

Why is a universal birth dose policy necessary in hospitals?

Following are some of the ways newborns can be infected if they do not receive a dose of hepatitis B vaccine, ideally within 12 hours of birth:

- The pregnant woman is tested and found to be hepatitis B surface antigen (HBsAg) positive, but her "infected" status is not communicated to the newborn nursery. The infant receives neither hepatitis B vaccine nor hepatitis B immune globulin (HBIG) protection at birth.
- A chronically infected pregnant woman receives the wrong test. For example, antibody to hepatitis B surface antigen (antiHBs) is ordered in error, instead of HBsAg. This can happen because some labs use the confusing abbreviation HBsAb instead of anti-HBs. This misordering of a test is relatively common since the two abbreviations (HBsAg and HBsAb) differ by only one letter. However, when her incorrectly ordered test comes back "negative," the woman may actually be HBsAg positive and her infant would not receive appropriate postexposure prophylaxis.

- The pregnant woman is HBsAg positive, but her test results are misinterpreted or mistranscribed into her prenatal record or her infant's chart. As a result, her infant does not receive HBIG or hepatitis B vaccine.
- The pregnant woman is not tested for HBsAg either prenatally or in the hospital at the time of delivery. In one study, women who didn't receive prenatal care were eight times more likely to be HBsAg positive than women who received prenatal care. When a woman does not receive prenatal care and is not tested at the time of delivery, her infant is in danger of being infected with HBV at birth – unless he or she is born in a hospital that adheres to a policy of administering hepatitis B vaccine within 12–24 hours of birth to every newborn **without fail**. This provides the greatest effectiveness in preventing HBV infection.
- She develops HBV infection later in pregnancy, but it is not clinically detected. Because her initial HBsAg test result is negative, she is not retested later in pregnancy as CDC recommends for high-risk women, and her infant does not receive hepatitis B vaccine or HBIG at birth.
- The mother is HBsAg negative, but the infant is exposed to HBV postnatally from another family member or caregiver. This occurs in two-thirds of the cases of childhood transmission.

In 2001, 2002, and 2008, the Immunization Action Coalition surveyed perinatal hepatitis B coordinators at every state health department, as well as at city and county CDC projects to assess their views about providing hepatitis B vaccine in the hospital. Their responses contained hundreds of reports of newborns who were unprotected or inadequately protected because healthcare professionals failed to order or misordered hepatitis B blood tests or misinterpreted, mistranscribed, or miscommunicated the test results of the children's mothers. (See *States Report Hundreds of Medical Errors in Perinatal Hepatitis B Prevention*, pages 10–13.)

State perinatal hepatitis B coordinators surveyed overwhelmingly endorsed providing the birth dose.

These state coordinators' reports tell us that no matter how well healthcare providers think they are doing in screening all pregnant women for HBsAg, mistakes continue to occur. Newborns are unnecessarily being exposed without the benefit of postexposure prophylaxis. At least one baby has died of fulminant hepatitis B; hundreds have become chronically infected and are doomed to preventable hepatocellular carcinoma or cirrhosis later in life. To overcome these failures, perinatal hepatitis B vaccine coordinators overwhelmingly endorse providing a hepatitis B vaccine birth dose as the first step in developing a safety net to protect all infants from HBV infection, regardless of the circumstances.

To maximally protect every newborn, CDC, AAP, AAFP, and ACOG recommend all infants be vaccinated with a hepatitis B vaccine birth dose prior to hospital discharge. Delaying hepatitis B vaccination until a follow-up office visit will be too late to prevent perinatal HBV transmission.*

Hepatitis B vaccine is a highly effective vaccine. Studies have shown that infants of the most highly infectious mothers (women who are both HBsAg and HBeAg positive) who receive postexposure prophylaxis with hepatitis B vaccine alone (without HBIG) at birth are protected in 70%–95% of cases. Please read the hepatitis coordinators' survey results (www.immunize.org/birthdose/birthdosesurvey.asp), including descriptions of their experiences with failures of the system – failures that largely will be prevented by administering hepatitis B vaccine to infants before they go home from the hospital, ideally within 12 hours of birth.

Your support for providing a birth dose to newborns while they are still in the hospital will protect and save lives that are now being put at risk.

** For subsequent doses of hepatitis B vaccine in infants, use monovalent hepatitis B vaccine or hepatitis B-containing combination vaccines. If using a hepatitis B-containing combination vaccine, you will be giving 3 more doses of hepatitis B vaccine. Giving a total of 4 doses of hepatitis B vaccine to infants is acceptable practice according to CDC, AAP, and AAFP. These vaccine doses are covered under the Vaccines For Children (VFC) program for VFC-eligible children.*

3 Addressing the Problem: Practical Tools

MATERIALS FOR HOSPITALS

- Guidance for Developing Admission Orders in Labor & Delivery and Newborn Units to Prevent Hepatitis B Virus Transmission
- Sample Text for Developing Admission Orders in Newborn Units for the Hepatitis B Vaccine Birth Dose

MATERIALS FOR PARENTS

- About Hepatitis B Vaccine Information Statements
- English-language Hepatitis B Vaccine Information Statement
- Spanish-language Hepatitis B Vaccine Information Statement
- About the Parent Handout *Hepatitis B Shots Are Recommended for All New Babies*
- *Hepatitis B Shots Are Recommended for All New Babies*
- Childhood Immunization Record Cards

Guidance for Developing Admission Orders in Labor & Delivery and Newborn Units to Prevent Hepatitis B Virus Transmission

The guidelines in this document were developed to help hospitals establish policies and standing orders in their labor and delivery (L&D) and newborn units.

During 2005, the Centers for Disease Control and Prevention (CDC) published updated recommendations of the Advisory Committee on Immunization Practices (ACIP) for prevention of hepatitis B virus (HBV) infections in children which includes the recommendation to administer hepatitis B vaccine to all newborns before hospital discharge. The American Academy of Pediatrics, American Academy of Family Physicians, and American College of Obstetricians and Gynecologists have all endorsed the birth dose recommendation. A copy of the complete CDC recommendations for the use of hepatitis B vaccine in children is available on pages 41–74.

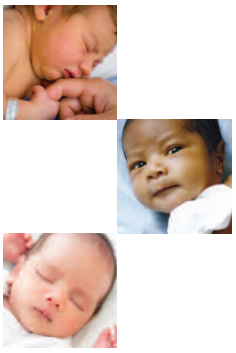
To protect infants from HBV infection, CDC recommends that all delivery hospitals institute standing orders or admission orders and protocols to ensure healthcare professionals do the following:

1. Administer hepatitis B vaccine to **all newborns** before they are discharged from the hospital.
2. Identify all infants born to mothers who are hepatitis B surface antigen (HBsAg) positive or to mothers with unknown HBsAg status. Administer appropriate immunoprophylaxis to these infants.

Admission Orders and Procedures for Women Admitted to a Birthing Facility

For pregnant women who have a HBsAg lab report included in their prenatal records, do the following:

1. Examine a copy of the original laboratory report of the pregnant woman's HBsAg[1] test result to verify that the correct test (i.e., HBsAg) was performed and to verify that the testing date was during this pregnancy not a previous one. *Do not rely on a handwritten or transcribed HBsAg test result!*
2. Place a copy of the original HBsAg lab report into (1) the pregnant woman's L&D record and (2) the infant's hospital record.
3. If the pregnant woman is HBsAg positive, alert the nursery staff that the newborn is high risk and will need postexposure prophylaxis – both hepatitis B immune globulin (HBIG) and hepatitis B vaccine – within 12 hours of birth.
4. Perform a repeat blood test for HBsAg[1] if the pregnant woman was HBsAg negative during a prenatal visit but was at risk for acquiring HBV infection during this pregnancy (e.g., not in a long-term, mutually monogamous relationship; had an HBsAg-positive sex partner; had evaluation or treatment for a sexually transmitted disease; currently uses or recently used injection drugs).
5. Instruct the laboratory to call L&D and the nursery with the HBsAg test result ASAP.



For pregnant women who do not have a HBsAg lab report on their prenatal record, do the following:

1. Perform HBsAg[1] testing ASAP on women who do not have a copy of an original HBsAg laboratory report from the current pregnancy included in their prenatal record.
2. Instruct the lab to call L&D and the nursery units with the newly obtained HBsAg test result ASAP.

Admission Orders and Procedures for Newborns

Hospital procedures to follow for ALL newborns

1. Review a copy of the mother's *original* HBsAg[1] lab report to ensure that the correct serologic test was ordered and that it was ordered during this pregnancy.
2. Determine if the newborn needs immediate postexposure prophylaxis within 12 hours of birth. To do this you must know the mother's HBsAg status and the newborn's birth weight. If the newborn weighs less than 2 kg (4.4 lb), see the guidance below and footnotes 2, 5, 6.
3. Prior to vaccination, give parent a Hepatitis B Vaccine Information Statement.

For newborns of HBsAg-negative mothers

1. Administer single-antigen hepatitis B vaccine (0.5 mL, IM) before hospital discharge to **all** newborns weighing 2 kg (4.4 lb) or more at birth.[2, 3, 4]
2. Document the hepatitis B vaccine dose in the newborn's medical record, including the date, time, and site of administration, as well as the vaccine lot number. Notify the regional immunization registry, if one is available.
3. Give the mother an immunization record card that includes the hepatitis B vaccination date. Explain the importance of completing the hepatitis B vaccine series to protect her baby. Remind her to bring the immunization record card with her each time her baby sees a provider.

For newborns of mothers with unknown HBsAg status, do the following:

1. Administer single-antigen hepatitis B vaccine (0.5 mL, IM) within 12 hours of birth.[3, 5] Do not wait for test results to return before giving this dose of vaccine.
2. Document the hepatitis B vaccine dose in the newborn's medical record, including the date, time, and site of administration, as well as the vaccine lot number. Notify immunization registry.
3. Give the mother an immunization record card that includes the hepatitis B vaccination date. Explain the importance of completing the hepatitis B vaccine series to protect her baby. Remind her to bring the immunization record card with her each time her baby sees a provider.
4. Confirm that the laboratory has received blood for the mother's HBsAg[1] test.
5. Verify when the mother's HBsAg result will be available and that it will be reported to L&D and the newborn unit ASAP.
6. If the nursery does not receive the report of the mother's HBsAg test at the expected time, call the laboratory for the result.
7. If the laboratory test indicates the mother's HBsAg[1] test result is positive, do the following:
   a. Administer HBIG (0.5 mL, IM) to the newborn ASAP. (Hepatitis B vaccine should have been given within 12 hours of birth.)
   b. Document the HBIG dose in the newborn's medical record. There is little benefit in administering HBIG to the newborn if more than 7 days have elapsed since birth.
   c. Alert the mother's and newborn's physician(s) of the test result.
   d. Follow the instructions below "For newborns of HBsAg-positive mothers," steps 3–7.
8. If the newborn must be discharged before the mother's HBsAg result is known:
   a. Document the parents' contact information (e.g., addresses, telephone numbers, emergency contacts) in case further treatment is needed for the infant.

b. Obtain the name, address, and phone number of the mother's and the newborn's healthcare providers.

c. Notify the mother's and newborn's healthcare providers that the mother's HBsAg test result is pending.

For newborns of HBsAg-positive mothers

1. Administer HBIG (0.5 mL, IM) and single-antigen hepatitis B vaccine[3,6] (0.5 mL, IM) at separate injection sites within 12 hours of birth.
2. Document the hepatitis B vaccine and HBIG dose in the newborn's medical record, including the date, time, and site of administration, as well as the vaccine lot number. If an immunization registry is available, notify it of both doses.
3. Give the mother an immunization record card that includes the hepatitis B vaccination and HBIG dates. Explain the importance of completing the hepatitis B vaccine series to protect her baby. Remind her to bring the immunization record card with her each time her baby sees a provider.
4. Notify the local or state health department of the infant's birth and the date and time of administration of HBIG and hepatitis B vaccine doses.
5. Obtain the name, address, and phone number of the newborn's primary care provider.
6. Notify the provider of the newborn's birth, the date and time of HBIG and hepatitis B vaccine doses administered, and the importance of additional on-time vaccination and postvaccination testing of the infant for HBsAg and antibody to HBsAg after completion of the hepatitis B vaccine series.
7. Provide advice to mother. Tell her the following:
   a. That she may breast-feed her infant upon delivery, even before hepatitis B vaccine and HBIG are given;
   b. That it is critical for her infant to complete the full hepatitis B vaccine series on the recommended schedule;
   c. That blood will need to be drawn from the infant after completion of at least 3 doses of the hepatitis B vaccine series at age 9–18 months (usually done at a well-child visit) to determine if the child developed a protective immune response to vaccination or needs additional management;
   d. About modes of HBV transmission and the need for testing and vaccination of susceptible household, sexual, and needle-sharing contacts;
   e. That she needs to have a medical evaluation for chronic hepatitis B, including an assessment of whether she is a candidate for antiviral treatment.

FOOTNOTES

1. Be sure the correct test for HBsAg (hepatitis B surface antigen) was/is ordered. The HBsAg test should not be confused with other hepatitis B serologic tests, including antibody to HBsAg (anti-HBs or HBsAb) or antibody to hepatitis B core antigen (anti-HBc or HBcAb).
2. Infants weighing less than 2 kg (4.4 lb) at birth and whose mothers are documented to be HBsAg negative should receive the first dose of vaccine 1 month after birth or at hospital discharge, whichever comes first. The mother's HBsAg test result must be part of the infant's medical record.
3. Federal law requires that you give parents a Hepatitis B Vaccine Information Statement (VIS) before vaccine administration. To obtain a VIS, download it from the IAC website at www.immunize.org/vis or see page 29.
4. According to the CDC recommendations, exceptions to administering the birth dose of hepatitis B vaccine are allowed on a case-by-case basis and only in rare circumstances. If the hepatitis B vaccine birth dose is not administered, a copy of the mother's negative HBsAg test result from the current pregnancy must be placed in the newborn's medical record and the attending physician must write a specific order directing staff not to administer the birth dose in the hospital. Infants who do not receive the first dose of hepatitis B vaccine before hospital discharge should receive the first dose no later than age 2 months.
5. An infant weighing less than 2 kg (4.4 lb) whose mother's HBsAg status is unknown should receive HBIG and hepatitis B vaccine within 12 hours of birth. Do not count the hepatitis B vaccine dose as the first dose in the vaccine series. Reinitiate the full hepatitis B vaccine series at age 1–2 months.
6. An infant weighing less than 2 kg (4.4 lb) whose mother is HBsAg positive should receive the first dose of hepatitis B vaccine and HBIG within 12 hours of birth. Do not count the hepatitis B vaccine dose as the first dose in the vaccine series. Reinitiate the full hepatitis B vaccine series at age 1–2 months.

Sample Text for Developing Admission Orders in Newborn Units for the Hepatitis B Vaccine Birth Dose

General orders for all newborns

1. Review a copy of the mother's original lab report to ensure that the correct serologic test (HBsAg) was ordered and that it was ordered during this pregnancy. Perform a repeat HBsAg blood test on the pregnant woman (mother) if she was HBsAg negative during a prenatal visit but was at risk for acquiring HBV infection during this pregnancy (e.g., not in a long-term, mutually monogamous relationship; had an HBsAg-positive sex partner; had evaluation or treatment for a sexually transmitted disease; currently uses or recently used injection drugs).
2. Determine if the newborn is high risk and needs immediate postexposure prophylaxis within 12 hours of birth. The infant is high risk if the mother's HBsAg status is positive or unknown.

For routine newborn hepatitis B vaccination: the mother is HBsAg negative

1. Administer single-antigen hepatitis B vaccine, pediatric, 0.5 mL, intramuscular (IM), in anterolateral thigh at any time prior to hospital discharge. Prior to vaccination, give parent a Hepatitis B Vaccine Information Statement and obtain verbal consent to vaccinate. Give parent a record of the vaccination. If a regional immunization registry is available, notify it of the vaccination. If parent is unwilling to give consent, notify physician ASAP. Document vaccine administration or vaccine refusal in hospital record.

For highest-risk infants: the mother is HBsAg positive

1. Administer Hepatitis B Immune Globulin (HBIG), 0.5 mL, IM, in anterolateral thigh in the delivery room or ASAP within 12 hours of birth. Document HBIG administration in hospital record. Give parent a record of the HBIG dose.
2. At same time and in opposite anterolateral thigh, administer single-antigen hepatitis B vaccine, pediatric, 0.5 mL, IM, ASAP within 12 hours of birth. Document vaccine administration in hospital record. Give parent a record of the vaccination. If a regional immunization registry is available, notify it of both doses.
3. Prior to administering both HBIG and hepatitis B vaccine, give parent a Hepatitis B Vaccine Information Statement and obtain verbal consent to vaccinate. If parent is unwilling to give consent, notify physician ASAP. Consider notifying Child Protective Services if parent continues to refuse despite discussion with physician.
4. Notify local or state health department of the infant's birth and the date and time of administration of HBIG and hepatitis B vaccine doses.
5. Obtain the name, address, and phone number of the newborn's primary care provider.
6. Notify primary care provider of newborn's birth, the date and time that HBIG and hepatitis B vaccine doses were administered, and the importance of additional on-time vaccination (infants weighing less than 2 kg [4.4 lbs] will require 4 doses of vaccine as the first dose does not "count") and post-vaccination testing of the infant for HBsAg and antiHBs (antibody to HBsAg) after completion of the hepatitis B vaccine series at age 9–18 months.

7. Provide advice to the mother. Tell her the following:
   a. She may breast-feed her infant upon delivery, even before hepatitis B vaccine and HBIG are given;
   b. It is critical for her infant to complete the full hepatitis B vaccine series on the recommended schedule;
   c. Blood will need to be drawn from the infant following completion of the hepatitis B vaccine series (usually done at a well-child visit at age 9–18 months) to determine if the infant developed a protective immune response to vaccination or needs additional management;
   d. About modes of HBV transmission and the need for testing and vaccination of susceptible household, sexual, and needle-sharing contacts;
   e. She and other infected contacts need to have medical evaluations for chronic hepatitis B, including assessments to determine if they are candidates for antiviral treatment.

For high-risk infants: the mother's HBsAg status is unknown

1. Administer single-antigen hepatitis B vaccine, pediatric, 0.5 mL, IM, within 12 hours of birth. For infants weighing less than 2 kg (4.4 lbs) at birth, also administer HBIG, 0.5 mL, IM, within 12 hours. Do not wait for test results to return before giving this dose of vaccine (and HBIG for infants weighing less than 2 kg [4.4 lb]). Document vaccine administration in the hospital record. Give the parent a record of the vaccination. If a regional immunization registry is available, notify it of the vaccination.
2. Confirm that the laboratory has received blood for the mother's HBsAg test.
3. Verify when the mother's HBsAg result will be available and that it will be reported to the newborn unit ASAP.
4. If the laboratory test indicates the mother's HBsAg test result is positive, do the following:
   a. Administer HBIG, 0.5 mL, IM, ASAP, to the newborn weighing 2 kg (4.4 lb) or more ASAP. (Those weighing less than 2 kg [4.4 lb] at birth should have already received HBIG.) (Hepatitis B vaccine should have been given within 12 hours of birth to all infants of mothers with unknown HBsAg status.)
   b. Follow steps 4–7 of previous section (The Mother Is HBsAg Positive)

For additional detailed information about text that you might incorporate into newborn admission orders, including orders for premature infants, refer to *Guidance for Developing Admission Orders in Labor & Delivery and Newborn Units to Prevent Hepatitis B Virus Transmission* available on pages 23–25 of this booklet.

REFERENCE *A Comprehensive Immunization Strategy to Eliminate Transmission of Hepatitis B Virus Infection in the United States.* Part 1: Immunization of Infants, Children and Adolescents. *MMWR*, December 23, 2005, Vol. 54(RR-16):1–39. A complete copy of this reference is available on pages 41–74 of this booklet.

About Hepatitis B Vaccine Information Statements

VACCINE INFORMATION STATEMENT

Hepatitis B Vaccine

What You Need to Know

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1 What is hepatitis B?

Hepatitis B is a serious infection that affects the liver. It is caused by the hepatitis B virus.

- In 2009, about 38,000 people became infected with hepatitis B.
- Each year about 2,000 to 4,000 people die in the United States from cirrhosis or liver cancer caused by hepatitis B.

Hepatitis B can cause:

Acute (short-term) illness. This can lead to:
- loss of appetite
- diarrhea and vomiting
- tiredness
- jaundice (yellow skin or eyes)
- pain in muscles, joints, and stomach

Acute illness, with symptoms, is more common among adults. Children who become infected usually do not have symptoms.

Chronic (long-term) infection. Some people go on to develop chronic hepatitis B infection. Most of them do not have symptoms, but the infection is still very serious, and can lead to:

- liver damage (cirrhosis)
- liver cancer
- death

Chronic infection is more common among infants and children than among adults. People who are chronically infected can spread hepatitis B virus to others, even if they don't look or feel sick. Up to 1.4 million people in the United States may have chronic hepatitis B infection.

Hepatitis B virus is easily spread through contact with the blood or other body fluids of an infected person. People can also be infected from contact with a contaminated object, where the virus can live for up to 7 days.

- A baby whose mother is infected can be infected at birth;
- Children, adolescents, and adults can become infected by:
  - contact with blood and body fluids through breaks in the skin such as bites, cuts, or sores;
  - contact with objects that have blood or body fluids on them such as toothbrushes, razors, or monitoring and treatment devices for diabetes;
  - having unprotected sex with an infected person;
  - sharing needles when injecting drugs;
  - being stuck with a used needle.

2 Hepatitis B vaccine: Why get vaccinated?

Hepatitis B vaccine can prevent hepatitis B, and the serious consequences of hepatitis B infection, including liver cancer and cirrhosis.

Hepatitis B vaccine may be given by itself or in the same shot with other vaccines.

Routine hepatitis B vaccination was recommended for some U.S. adults and children beginning in 1982, and for all children in 1991. Since 1990, new hepatitis B infections among children and adolescents have dropped by more than 95% – and by 75% in other age groups.

Vaccination gives long-term protection from hepatitis B infection, possibly lifelong.

3 Who should get hepatitis B vaccine and when?

Children and Adolescents

- Babies normally get 3 doses of hepatitis B vaccine:
  1st Dose: Birth
  2nd Dose: 1-2 months of age
  3rd Dose: 6-18 months of age

Some babies might get 4 doses, for example, if a combination vaccine containing hepatitis B is used. (This is a single shot containing several vaccines.) The extra dose is not harmful.

- Anyone through 18 years of age who didn't get the vaccine when they were younger should also be vaccinated.

Adults

- All unvaccinated adults at risk for hepatitis B infection should be vaccinated. This includes:
  - sex partners of people infected with hepatitis B,
  - men who have sex with men,
  - people who inject street drugs,
  - people with more than one sex partner,
  - people with chronic liver or kidney disease,
  - people under 60 years of age with diabetes,
  - people with jobs that expose them to human blood or other body fluids,
  - household contacts of people infected with hepatitis B,
  - residents and staff in institutions for the developmentally disabled,
  - kidney dialysis patients,
  - people who travel to countries where hepatitis B is common,
  - people with HIV infection.
- Other people may be encouraged by their doctor to get hepatitis B vaccine; for example, adults 60 and older with diabetes. Anyone else who wants to be protected from hepatitis B infection may get the vaccine.
- Pregnant women who are at risk for one of the reasons stated above should be vaccinated. Other pregnant women who want protection may be vaccinated.

Adults getting hepatitis B vaccine should get 3 doses — with the second dose given 4 weeks after the first and the third dose 5 months after the second. Your doctor can tell you about other dosing schedules that might be used in certain circumstances.

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

4 Who should not get hepatitis B vaccine?

- Anyone with a life-threatening allergy to yeast, or to any other component of the vaccine, should not get hepatitis B vaccine. Tell your doctor if you have any severe allergies.
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- Anyone who is moderately or severely ill when a dose of vaccine is scheduled should probably wait until they recover before getting the vaccine.

Your doctor can give you more information about these precautions.

Note: You might be asked to wait 28 days before donating blood after getting hepatitis B vaccine. This is because the screening test could mistake vaccine in the bloodstream (which is not infectious) for hepatitis B infection.

5 What are the risks from hepatitis B vaccine?

Hepatitis B is a very safe vaccine. Most people do not have any problems with it.

The vaccine contains non-infectious material, and cannot cause hepatitis B infection.

Some mild problems have been reported:

- Soreness where the shot was given (up to about 1 person in 4).
- Temperature of 99.9°F or higher (up to about 1 person in 15).

Severe problems are extremely rare. Severe allergic reactions are believed to occur about once in 1.1 million doses.

A vaccine, like any medicine, could cause a serious reaction. But the risk of a vaccine causing serious harm, or death, is extremely small. More than 100 million people in the United States have been vaccinated with hepatitis B vaccine.

6 What if there is a moderate or severe reaction?

What should I look for?

- Any unusual condition, such as a high fever or unusual behavior. Signs of a serious allergic reaction can include difficulty breathing, hoarseness or wheezing, hives, paleness, weakness, a fast heart beat or dizziness.

What should I do?

- **Call** a doctor, or get the person to a doctor right away.
- **Tell** your doctor what happened, the date and time it happened, and when the vaccination was given.
- **Ask** your doctor, nurse, or health department to report the reaction by filing a Vaccine Adverse Event Reporting System (VAERS) form. Or you can file this report through the VAERS web site at **www.vaers.hhs.gov**, or by calling **1-800-822-7967**.

VAERS does not provide medical advice.

7 The National Vaccine Injury Compensation Program

The National Vaccine Injury Compensation Program (VICP) was created in 1986.

Persons who believe they may have been injured by a vaccine can learn about the program and about filing a claim by calling **1-800-338-2382** or visiting the VICP website at **www.hrsa.gov/vaccinecompensation**.

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Vaccine Information Statement (Interim)
Hepatitis B Vaccine
2/2/2012
42 U.S.C. § 300aa-26

English- and Spanish-language versions of the hepatitis B Vaccine Information Statement (VIS) are available on the next four pages. VISs are information sheets developed by the Centers for Disease Control and Prevention to inform vaccine recipients – or their parents or legal representatives – about the benefits and risks of vaccines.

Federal law requires that hepatitis B VISs, and other VISs, be handed out before the vaccine is administered. English- and Spanish-language hepatitis B VISs are shown on the following pages.

- For more information about how to use VISs, visit **www.immunize.org/vis**.
- For hepatitis B VISs in many languages, visit **www.immunize.org/vis/vis_hepatitis_b.asp**.

VACCINE INFORMATION STATEMENT

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DECLARACIÓN DE INFORMACIÓN SOBRE VACUNAS

Vacuna contra la hepatitis B

Lo que usted necesita saber

Muchas de las declaraciones informativas sobre vacunas están disponibles en español y otros idiomas. Consulte www.immunize.org/vis.
Las hojas de información sobre vacunas están disponibles en español y en muchos otros idiomas. Visite http://www.immunize.org/vis.

1 ¿Qué es la hepatitis B?

La hepatitis B es una infección grave que afecta al hígado y que es causada por el virus de la hepatitis B.

- En 2009, alrededor de 38,000 personas se infectaron con hepatitis B.
- Cada año entre 2,000 y 4,000 personas mueren en los Estados Unidos de cirrosis o cáncer hepático causado por hepatitis B.

La hepatitis B puede causar:

Enfermedad aguda (a corto plazo). Esto puede dar lugar a:

- pérdida del apetito
- cansancio
- dolor en los músculos, en las articulaciones y en el estómago
- diarrea y vómitos
- ictericia (coloración amarilla de la piel o los ojos)

La enfermedad aguda, con síntomas, es más común entre los adultos. Los niños que se infectan con frecuencia no presentan síntomas.

Infección crónica (a largo plazo). Algunas personas llegan a desarrollar infección crónica de hepatitis B. La mayoría de ellas no tienen síntomas, pero aún así la infección es muy grave y puede resultar en:

- daño hepático (cirrosis)
- cáncer hepático
- muerte

La infección crónica es más común entre bebés y niños que entre adultos. Las personas que tienen una infección crónica pueden contagiar el virus de la hepatitis B a otras personas, incluso aunque no se vean o no se sientan enfermas. Hasta 1.4 millones de personas en los Estados Unidos pueden tener una infección crónica de hepatitis B.

El virus de la hepatitis B se puede diseminar fácilmente a través de contacto con la sangre o con otros fluidos corporales de una persona infectada. Las personas también se pueden infectar por medio del contacto con un objeto contaminado, en donde el virus puede vivir hasta 7 días.

- Un bebé cuya madre esté infectada puede contagiarse al nacer;
- Los niños, adolescentes y adultos se pueden infectar por:
  - contacto con sangre y fluidos corporales a través de cortadas en la piel como mordidas, cortes o úlceras;
  - contacto con objetos que tengan sangre o fluidos corporales en ellos como cepillos de dientes, navajas de rasurar, o dispositivos de monitoreo y tratamiento para la diabetes;
  - tener relaciones sexuales sin protección con una persona infectada;
  - compartir agujas al inyectarse drogas;
  - pincharse con una aguja usada.

2 Vacuna contra la hepatitis B: ¿Por qué es necesario vacunarse?

La vacuna contra la hepatitis B puede prevenir la hepatitis B y las graves consecuencias de la infección por hepatitis B, incluyendo el cáncer hepático y la cirrosis.

La vacuna contra la hepatitis B puede administrarse sola o con otras vacunas en la misma inyección.

La recomendación de la aplicación rutinaria de la vacuna contra la hepatitis B para algunos adultos y niños en los EE. UU. comenzó en 1982, y para todos los niños en 1991. Desde 1990, las infecciones nuevas por hepatitis B entre niños y adolescentes han disminuido en más del 95%, y en 75% en otros grupos de edad.

La vacuna ofrece protección a largo plazo contra la infección por hepatitis B, posiblemente de por vida.

3 ¿Quién debe vacunarse contra la hepatitis B y cuándo?

Niños y adolescentes

- Los bebés normalmente reciben 3 dosis de la vacuna contra la hepatitis B:

1ª dosis:	Nacimiento
2ª dosis:	1-2 meses de edad
3ª dosis:	6-18 meses de edad

Algunos bebés podrían recibir 4 dosis, por ejemplo, si se utiliza una vacuna combinada que contenga la de hepatitis B (esta es una sola inyección que contiene varias vacunas). La dosis adicional no es perjudicial.

- Cualquier persona hasta los 18 años de edad que no haya recibido la vacuna cuando era más joven también debe vacunarse.

Adultos

- Todos los adultos que no estén vacunados y estén en riesgo de una infección por hepatitis B deben vacunarse. Esto incluye a:
  - parejas sexuales de personas infectadas con hepatitis B,
  - hombres que tienen relaciones sexuales con hombres,
  - personas que se inyectan drogas ilegales,
  - personas con más de una pareja sexual,
  - personas con una enfermedad hepática o renal crónica,
  - personas menores de 60 años de edad con diabetes,
  - personas cuya actividad laboral las expongan a sangre humana o a otros fluidos corporales,
  - integrantes del hogar de personas infectadas con hepatitis B,
  - residentes y miembros del personal en instituciones para discapacidades relacionadas a problemas de desarrollo,

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Centers for Disease Control and Prevention

- pacientes con diálisis renal,
- personas que viajan a países en donde la hepatitis B es común,
- personas con infección por VIH.

- Otras personas pueden ser alentadas por sus médicos para aplicarse la vacuna contra la hepatitis B; por ejemplo, los adultos de 60 años y mayores que padecen de diabetes. Cualquier otra persona que quiera estar protegida contra la infección por hepatitis B puede aplicarse la vacuna.
- Las mujeres embarazadas que estén en riesgo por una de las razones antes mencionadas deben vacunarse. Otras mujeres embarazadas que quieran protección pueden vacunarse.

Los adultos que se vacunen contra la hepatitis B deben ponerse 3 dosis, con la segunda dosis administrada 4 semanas después de la primera y la tercera dosis 5 meses después de la segunda. Su médico puede hablarle de otros esquemas de administración que podrían emplearse en ciertas circunstancias.

4 ¿Quién no debe aplicarse la vacuna contra la hepatitis B?

- Cualquier persona con alergia a la levadura que pueda poner en peligro la vida o que sea alérgica a cualquier otro componente de la vacuna, no debe ponerse la vacuna contra la hepatitis B. Informe a su médico si ha tenido alguna alergia severa.
- Cualquier persona que haya tenido una reacción alérgica que pueda poner en peligro la vida a una dosis anterior de la vacuna contra la hepatitis B no debe aplicarse otra dosis.
- Cualquier persona con una enfermedad moderada o severa en el momento de aplicarse una dosis de la vacuna probablemente deba esperar hasta que esté recuperada antes de aplicarse la vacuna.

Su médico puede ofrecerle más información acerca de estas precauciones.

Nota: tal vez le pidan que espere 28 días antes de donar sangre después de aplicarse la vacuna contra la hepatitis B. Esto se debe a que la prueba de detección podría confundir la vacuna en el torrente sanguíneo (que no es infecciosa) con la infección por hepatitis B.

5 ¿Cuáles son los riesgos de la vacuna contra la hepatitis B?

La vacuna contra la hepatitis B es muy segura. La mayoría de las personas no tienen problemas con ella.

La vacuna contiene material no infeccioso y no puede causar una infección por hepatitis B.

Se han reportado algunos problemas leves:

- Dolor en el lugar donde se aplicó la inyección (hasta 1 de cada 4 personas).
- Temperatura de 37.7 °C (99.9 °F) o superior (hasta 1 de cada 15 personas).

Los problemas severos son extremadamente raros. Se cree que las reacciones alérgicas severas ocurren aproximadamente una vez en 1.1 millones de dosis.

Una vacuna, como cualquier medicamento, puede provocar una reacción grave. Sin embargo, el riesgo de que la vacuna ocasione un daño grave, o la muerte, es extremadamente pequeño. Más de 100 millones de personas en los Estados Unidos han sido vacunadas contra la hepatitis B.

6 ¿Qué hago si ocurre una reacción moderada o severa?

¿De qué debo estar pendiente?

- De todo signo inusual, como fiebre alta o comportamiento inusual. Los signos de una reacción alérgica grave pueden incluir dificultad para respirar, ronquera o jadeo, urticaria, palidez, debilidad, pulso acelerado o mareos.

¿Qué debo hacer?

- **Llame** a un médico o lleve a la persona al médico de inmediato.
- **Dígale** al médico lo que ocurrió, la fecha y la hora en la que ocurrió, y cuándo le pusieron la vacuna.
- **Pida** al médico, al personal de enfermería o al departamento de salud que reporten la reacción presentando un formulario del Sistema de reporte de eventos adversos derivados de las vacunas (Vaccine Adverse Event Reporting System, VAERS). O puede presentar este reporte a través del sitio web de VAERS: **www.vaers.hhs.gov** o llamando al **1-800-822-7967**.

El VAERS no ofrece consejos médicos.

7 Programa Nacional de Compensación por Lesiones ocasionadas por Vacunas

En 1986 se creó el Programa Nacional de Compensación por Lesiones Ocasionadas por Vacunas (National Vaccine Injury Compensation Program, VICP).

Las personas que consideren que pueden haber tenido lesiones ocasionadas por una vacuna pueden informarse sobre el programa y sobre cómo presentar una reclamación llamando al **1-800-338-2382** o visitando el sitio web del VICP en: **www.hrsa.gov/vaccinecompensation**.

8 ¿Dónde puedo obtener más información?

- Consulte a su médico, él puede proporcionarle el folleto informativo de la vacuna o sugerirle otras fuentes de información.
- Llame al departamento de salud local o estatal.
- Comuníquese con los Centros para el Control y la Prevención de Enfermedades (Centers for Disease Control and Prevention, CDC):
  - Llame al **1-800-232-4636 (1-800-CDC-INFO)** o
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About the Parent Handout *Hepatitis B Shots Are Recommended for All New Babies*

Hepatitis B Shots Are Recommended for All New Babies

Hepatitis B vaccine helps protect your baby's future!

What is hepatitis B and why do I need to protect my baby now?

Hepatitis B is a serious disease caused by the hepatitis B virus. The virus can enter the bloodstream, attack the liver, and cause serious damage. When babies get infected, the virus usually remains in the body for a lifetime (this is called chronic hepatitis B). About 1 out of 4 infected babies will die of liver failure or liver cancer as adults. Hepatitis B is a deadly disease – but it's preventable with vaccination.

How is hepatitis B virus spread?

Anyone can become infected with hepatitis B virus at anytime during their lives. Hepatitis B virus is spread by contact with an infected person's blood or certain body fluids. For example, babies can get hepatitis B virus from their infected mothers at birth, and children can get it if they live with or are cared for by an infected person, or even if they share personal care items (e.g., toothbrush) with an infected person.

Currently, about 1 out of 20 people in the United States have been infected with the hepatitis B virus.

How many people have hepatitis B?

In the United States, tens of thousands of people get infected with the hepatitis B virus each year. About one million people in the U.S. are already infected. Every year, about 3,000 Americans die from liver failure or liver cancer caused by hepatitis B. Worldwide, 350 million people are infected.

Hepatitis B is preventable! Make sure your baby gets vaccinated in the hospital at birth.

It is impossible to know if a person is infected with the hepatitis B virus by looking at them. Most people have no symptoms, do not feel sick, and don't know they are infected. As a result, they can spread the virus to others without knowing it. The only way to know if a person is infected is with a blood test.

Is there a cure for hepatitis B?

No. Although there are several medicines to help people who have life-long hepatitis B virus infection, there is no medicine that "cures" it. The good news is that hepatitis B can be prevented by vaccination.

Who recommends that all babies get hepatitis B vaccination at birth?

Medical groups such as the American Academy of Pediatrics, the American Academy of Family Physicians, the American College of Obstetricians and Gynecologists, and the Centers for Disease Control and Prevention recommend that every baby get hepatitis B vaccine at birth, before leaving the hospital. These are the same groups that recommend babies get vaccinated against whooping cough (pertussis), measles, tetanus, polio, and other serious diseases.

Why does my baby need a hepatitis B shot at birth?

It is important to vaccinate babies at birth so they will be protected as early as possible from any exposure to the hepatitis B virus. Babies and young children are not able to fight off hepatitis B virus infection as well as older people. A baby who gets infected with the hepatitis B virus during the first five years of life has a 15% to 25% risk for premature death from liver disease, including liver failure or liver cancer. Hepatitis B vaccine is your baby's "insurance policy" against being infected with the hepatitis B virus.

Experts recommend vaccination against hepatitis B as a routine part of a newborn's hospital care, just like checking the baby's hearing.

How could my baby come in contact with the hepatitis B virus?

In many cases, the hepatitis B virus passes from mother to baby during birth when the mother does not know she is infected. In other cases, the virus is spread to the baby during close contact with an infected family member, caregiver, or friend. Most people who are infected with hepatitis B do not feel sick and have no idea they carry this virus. They are surprised when they are told they are infected. Many people have no idea how they became infected with the virus in the first place. To protect your baby from infection with the hepatitis B virus, make sure your baby receives the first dose of hepatitis B vaccine before leaving the hospital.

Everyone needs vaccinations! If you can't afford a visit to the doctor, call your local health department.

Won't my baby just recover from hepatitis B?

Babies are not able to fight off hepatitis B as well as adults. About 9 out of 10 babies who get infected in the first year of life will stay infected for life.

How many doses of hepatitis B vaccine will my baby receive?

The basic series is 3 or 4 doses. The first dose should be given in the hospital (at birth), the second dose 1–2 months later, and the third dose at age 6 months or later. Because many healthcare providers choose to use certain combination vaccines during well baby check-ups, some infants will receive 4 doses of hepatitis B vaccine. Either alternative is considered routine and acceptable.

How effective is hepatitis B vaccine?

Very effective. More than 95% of infants, children, and adolescents develop immunity to the hepatitis B virus after 3 doses of properly spaced vaccine.

Is hepatitis B vaccine safe?

Yes. Hepatitis B vaccine has been shown to be very safe when given to people of all ages. More than one billion hepatitis B shots have been given worldwide. In the United States, more than 120 million people, including infants, children, and adults have received hepatitis B vaccine. The most common side effects from hepatitis B vaccine are soreness at the injection site or slight fever. Serious side effects are rare.

Some parents worry that their baby's immune system is immature and cannot handle vaccination at such a young age. Actually, as soon as they are born, babies start effectively dealing with trillions of bacteria and viruses. The challenge to their immune systems from vaccines is tiny compared to the everyday challenges from living!

Why does my baby need so many vaccinations?

It's true that little babies get lots of shots, which can cause temporary discomfort. The good news is that more vaccines mean more protection from serious diseases than in the past. Like hepatitis B, many of these diseases such as rotavirus, whooping cough, and meningitis can result in severe illness, hospitalization, and even death.

Make sure your baby gets all his or her vaccines at the recommended ages. It's the safest and surest way to protect children from deadly infectious diseases. Your baby is counting on you!

***If you have questions about vaccines**, contact your healthcare provider, your local health department, or call the CDC-INFO Contact Center at 800-232-4636.*

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www.immunize.org/protect-newborns

Hospital staff who need to explain to parents why a dose of hepatitis B vaccine is given at birth may find the educational handout on the next two pages helpful. Easy-to-read Q&As explain how the virus is spread, how serious hepatitis B infection is, and why the first dose of vaccine at is given at birth.

- Double-sided, tri-fold versions of this handout are available in Spanish, Arabic, Chinese, French, Korean, Turkish, and Vietnamese at **www.immunize.org/handouts/hepatitis-b-vaccines.asp.**

Hepatitis B Shots Are Recommended for All New Babies

Hepatitis B vaccine helps protect your baby's future!

What is hepatitis B and why do I need to protect my baby now?

Hepatitis B is a serious disease caused by the hepatitis B virus. The virus can enter the bloodstream, attack the liver, and cause serious damage. When babies get infected, the virus usually remains in the body for a lifetime (this is called chronic hepatitis B). About 1 out of 4 infected babies will die of liver failure or liver cancer as adults. Hepatitis B is a deadly disease – but it's preventable with vaccination.

How is hepatitis B virus spread?

Anyone can become infected with hepatitis B virus at anytime during their lives. Hepatitis B virus is spread by contact with an infected person's blood or certain body fluids. For example, babies can get hepatitis B virus from their infected mothers at birth, and children can get it if they live with or are cared for by an infected person, or even if they share personal care items (e.g., toothbrush) with an infected person.

Currently, about 1 out of 20 people in the United States have been infected with the hepatitis B virus.

How many people have hepatitis B?

In the United States, tens of thousands of people get infected with the hepatitis B virus each year. About one million people in the U.S. are already infected. Every year, about 3,000 Americans die from liver failure or liver cancer caused by hepatitis B. Worldwide, 350 million people are infected.

Hepatitis B is preventable! Make sure your baby gets vaccinated in the hospital at birth.

It is impossible to know if a person is infected with the hepatitis B virus by looking at them. Most people have no symptoms, do not feel sick, and don't know they are infected. As a result, they can spread the virus to others without knowing it. The only way to know if a person is infected is with a blood test.

Is there a cure for hepatitis B?

No. Although there are several medicines to help people who have life-long hepatitis B virus infection, there is no medicine that "cures" it. The good news is that hepatitis B can be prevented by vaccination.

Who recommends that all babies get hepatitis B vaccination at birth?

Medical groups such as the American Academy of Pediatrics, the American Academy of Family Physicians, the American College of Obstetricians and Gynecologists, and the Centers for Disease Control and Prevention recommend that every baby get hepatitis B vaccine at birth, before leaving the hospital. These are the same groups that recommend babies get vaccinated against whooping cough (pertussis), measles, tetanus, polio, and other serious diseases.

Why does my baby need a hepatitis B shot at birth?

It is important to vaccinate babies at birth so they will be protected as early as possible from any exposure to the hepatitis B virus. Babies and young children are not able to fight off hepatitis B virus infection as well as older people. A baby who gets

infected with the hepatitis B virus during the first five years of life has a 15% to 25% risk for premature death from liver disease, including liver failure or liver cancer. Hepatitis B vaccine is your baby's "insurance policy" against being infected with the hepatitis B virus.

Experts recommend vaccination against hepatitis B as a routine part of a newborn's hospital care, just like checking the baby's hearing.

How could my baby come in contact with the hepatitis B virus?

In many cases, the hepatitis B virus passes from mother to baby during birth when the mother does not know she is infected. In other cases, the virus is spread to the baby during close contact with an infected family member, caregiver, or friend. Most people who are infected with hepatitis B do not feel sick and have no idea they carry this virus. They are surprised when they are told they are infected. Many people have no idea how they became infected with the virus in the first place. To protect your baby from infection with the hepatitis B virus, make sure your baby receives the first dose of hepatitis B vaccine before leaving the hospital.

Everyone needs vaccinations! If you can't afford a visit to the doctor, call your local health department.

Won't my baby just recover from hepatitis B?

Babies are not able to fight off hepatitis B as well as adults. About 9 out of 10 babies who get infected in the first year of life will stay infected for life.

How many doses of hepatitis B vaccine will my baby receive?

The basic series is 3 or 4 doses. The first dose should be given in the hospital (at birth), the second dose 1–2 months later, and the third dose at age 6 months or later. Because many healthcare providers choose to use certain combination vaccines during well baby check-ups, some infants will receive 4 doses of hepatitis B vaccine. Either alternative is considered routine and acceptable.

How effective is hepatitis B vaccine?

Very effective. More than 95% of infants, children, and adolescents develop immunity to the hepatitis B virus after 3 doses of properly spaced vaccine.

Is hepatitis B vaccine safe?

Yes. Hepatitis B vaccine has been shown to be very safe when given to people of all ages. More than one billion hepatitis B shots have been given worldwide. In the United States, more than 120 million people, including infants, children, and adults have received hepatitis B vaccine. The most common side effects from hepatitis B vaccine are soreness at the injection site or slight fever. Serious side effects are rare.

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www.immunize.org/protect-newborns

Childhood Immunization Record Cards

An immunization record should be given to a parent every time their child receives a vaccine, including at birth. Parents should receive a printout or other record of the vaccinations administered to their infant before the infant leaves the hospital.

Official immunization record cards can be obtained from many state health departments free of charge.

- Phone numbers of state immunization programs are listed online at **www.immunize.org/coordinators**.
- Childhood immunization record cards (see image below) are also available for purchase from the Immunization Action Coalition at **www.immunize.org/shop/record-cards.asp**. Sample record cards are available upon request.

CHILD & TEEN IMMUNIZATION RECORD

Always carry this record with you and have your healthcare professional or clinic keep it up to date.

Last name First name M.I.

Birthdate: (mo.) – (day) – (yr.)

Patient Number:

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Medical notes (e.g., allergies, vaccine reactions):

Healthcare provider: List the mo/day/yr for each vaccination given. Record the generic abbreviation (e.g., PCV13, DTaP-HepB-IPV) or the trade name. For combination vaccines, fill in a row for each separate antigen in the combination.

Item #P3003

Vaccine	Type of vaccine	Date given mo/day/yr	Healthcare professional or clinic	Date next dose due
Hepatitis B (HepB, Hib-HepB, DTaP-HepB-IPV, HepA-HepB)				
Diphtheria, Tetanus, Pertussis (DTaP, DTP, DT, Td, Tdap, DTaP-HepB-IPV, DTaP-IPV/Hib, DTaP-IPV, DTaP/Hib)				
Other				

To learn more about vaccines, visit www.immunize.org or www.vaccineinformation.org

Last name First name M.I. Birthdate (mo.) (day) (yr.)

Vaccine	Type of vaccine	Date given mo/day/yr	Healthcare professional or clinic	Date next dose due
H. influenzae type b (Hib, Hib-HepB, DTaP-IPV/Hib, DTaP/Hib)				
Polio (IPV, OPV, DTaP-HepB-IPV, DTaP-IPV/Hib, DTaP-IPV)				
Pneumococcal (PCV7, PCV13, PPSV23)				
Rotavirus (RV5 [RotaTeq], RV1 [Rotarix], RV [unknown])				

Vaccine	Type of vaccine	Date given mo/day/yr	Healthcare professional or clinic	Date next dose due
Measles, Mumps, Rubella (MMR, MMRV)				
Varicella (VAR, MMRV)				
Hepatitis A (HepA, HepA-HepB)				
If combo				
Meningococcal (MCV4, MPSV4)				
Human papillomavirus (HPV4 [Gardasil], HPV2 [Cervarix])				
Influenza (TIV, LAIV)				

Get vaccinated against influenza each year to protect yourself and others around you.

4 Obtaining Support: Helpful Contacts

- Your State or Local Perinatal Hepatitis B Coordinator Can Help Implement the Hepatitis B Birth Dose
- How the Vaccines For Children (VFC) Program Can Help Your Hospital

Your State or Local Perinatal Hepatitis B Coordinator Can Help Implement the Hepatitis B Birth Dose

Every state, territory, and some large city health departments have a perinatal hepatitis B coordinator. This coordinator works with birthing hospitals and healthcare providers to help ensure all newborns are protected against hepatitis B virus (HBV) infection.

Perinatal hepatitis B coordinators can assist hospitals in numerous ways. Your coordinator can

- help you develop model standing orders and policies to assist with implementation or continuation of universal hepatitis B vaccine birth dose practices,
- assist your facility in learning about the VFC program and determining if your facility could receive hepatitis B vaccine at no cost for eligible children,
- facilitate case management of babies born to HBsAg-positive women to help ensure that babies receive the CDC-recommended follow-up medical care, and
- answer any questions you have about implementing or enhancing your hospital's hepatitis B prevention policies to protect newborns.

State and large city coordinators' names and phone numbers can be found on the Centers for Disease Control and Prevention's website at **www.cdc.gov/vaccines/vpd-vac/hepb/perinatal-contacts.htm.**

How the Vaccines For Children (VFC) Program Can Help Your Hospital

Vaccines For Children (VFC) is a federal entitlement program that provides vaccines at no cost to eligible children. To qualify for VFC, children must be 18 years of age or younger and meet at least one of the following criteria:

- Medicaid-eligible (or covered)
- American Indian or Alaska Native
- Uninsured
- Underinsured (i.e., has insurance but it does not cover the cost of vaccine) and receiving services at a federally qualified health center or rural health clinicThe VFC program helps hospitals by providing vaccines at no cost for their VFC-eligible patients. Hepatitis B vaccine for newborns is covered under the VFC program along with all routinely recommended vaccines for children and teens.

There is no charge for a hospital to become a VFC provider.

All states, territories, and the District of Columbia have VFC coordinators who can answer questions about enrolling in the program. To find contact information for your area's VFC coordinator, visit the Centers for Disease Control and Prevention website at **www.cdc.gov/vaccines/programs/vfc/contacts-state.html**.

5 Appendix: Authoritative Resources

- A Comprehensive Immunization Strategy to Eliminate Transmission of Hepatitis B Virus Infection in the United States. *MMWR*, December 23, 2005, Vol. 54 (RR16): 1–33
- Gaps in Hospital Policies and Practices to Prevent Perinatal Transmission of Hepatitis B Virus. *Pediatrics*, April 2010, Vol. 125(4):704–711
- Additional Resources

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Morbidity and Mortality Weekly Report

Recommendations and Reports December 23, 2005 / Vol. 54 / No. RR-16

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 1: Immunization of Infants, Children, and Adolescents

MMWR WITH ERRATA CORRECTIONS

This document incorporates the errata published by CDC in *MMWR* on February 17, 2006, and December 7, 2007. Corrections have been made to text and tables appearing on pages numbered (at the top) 2, 8, 9, 27, 28, and 29 of this document.

The original report is available online at www.cdc.gov/mmwr/pdf/rr/rr5416.pdf.

YELLOW HIGHLIGHTING ADDED TO ORIGINAL ARTICLE

Certain information in this document has been highlighted in yellow, because it provides precise guidance for administration of hepatitis B vaccine to all newborns at birth, *prior to hospital discharge.*

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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 1: Immunization of Infants, Children, and Adolescents

Prepared by
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Summary

This report is the first of a two-part statement from the Advisory Committee on Immunization Practices (ACIP) that updates the strategy to eliminate hepatitis B virus (HBV) transmission in the United States. The report provides updated recommendations to improve prevention of perinatal and early childhood HBV transmission, including implementation of universal infant vaccination beginning at birth, and to increase vaccine coverage among previously unvaccinated children and adolescents. Strategies to enhance implementation of the recommendations include 1) establishing standing orders for administration of hepatitis B vaccination beginning at birth; 2) instituting delivery hospital policies and procedures and case management programs to improve identification of and administration of immunoprophylaxis to infants born to mothers who are hepatitis B surface antigen (HBsAg) positive and to mothers with unknown HBsAg status at the time of delivery; and 3) implementing vaccination record reviews for all children aged 11–12 years and children and adolescents aged <19 years who were born in countries with intermediate and high levels of HBV endemicity, adopting hepatitis B vaccine requirements for school entry, and integrating hepatitis B vaccination services into settings that serve adolescents. The second part of the ACIP statement, which will include updated recommendations and strategies to increase hepatitis B vaccination of adults, will be published separately.

Strategy to Eliminate Hepatitis B Virus Transmission

Hepatitis B virus (HBV) is a bloodborne and sexually transmitted virus. Rates of new infection and acute disease are highest among adults, but chronic infection is more likely to occur in persons infected as infants or young children. Before hepatitis B vaccination programs became routine in the United States, an estimated 30%–40% of chronic infections are believed to have resulted from perinatal or early childhood transmission, even though <10% of reported cases of hepatitis B occurred in children aged <10 years (*1*). Chronically infected persons are at increased lifetime risk for cirrhosis and hepatocellular carcinoma (HCC) and also serve as the main reservoir for continued HBV transmission.

The material in this report originated in the National Center for Infectious Diseases, Rima F. Khabbaz, MD, Director, Division of Viral Hepatitis, John W. Ward, MD, Director; and the National Immunization Program, Anne Schuchat, MD, Director, Immunization Services Division, Lance E. Rodewald, MD, Director.
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Hepatitis B vaccination is the most effective measure to prevent HBV infection and its consequences. Since they were first issued in 1982, recommendations for hepatitis B vaccination have evolved into a comprehensive strategy to eliminate HBV transmission in the United States (*2–6*) (Box 1). A primary focus of this strategy is universal vaccination of infants to prevent early childhood HBV infection and to eventually protect adolescents and adults from infection. Other components include routine screening of all pregnant women for hepatitis B surface antigen (HBsAg) and postexposure immunoprophylaxis of infants born to HBsAg-positive women, vaccination of children and adolescents who were not previously vaccinated, and vaccination of unvaccinated adults at increased risk for infection.

To date, the immunization strategy has been implemented with considerable success. Recent estimates indicate that >95% of pregnant women are tested for HBsAg, and case management has been effective in ensuring high levels of initiation and completion of postexposure immunoprophylaxis among identified infants born to HBsAg-positive women (*7*). Hepatitis B vaccine has been successfully integrated into the childhood vaccine schedule, and infant vaccine coverage levels are now equivalent to those of other vaccines in the childhood schedule. During 1990–2004, incidence of acute hepatitis B

BOX 1. Immunization strategy to eliminate transmission of hepatitis B virus (HBV) infection in the United States

- Universal vaccination of infants beginning at birth
- Prevention of perinatal HBV infection through
  - — routine screening of all pregnant women for hepatitis B surface antigen (HBsAg), and
  - — immunoprophylaxis of infants born to HBsAg-positive women and infants born to women with unknown HBsAg status
- Routine vaccination of previously unvaccinated children and adolescents
- Vaccination of previously unvaccinated adults at increased risk for infection

in the United States declined 75%. The greatest decline (94%) occurred among children and adolescents, coincident with an increase in hepatitis B vaccine coverage. As of 2004, among U.S. children aged 19–35 months, >92% had been fully vaccinated with 3 doses of hepatitis B vaccine (*8*). This success can be attributed in part to the established infrastructure for vaccine delivery to children and to federal support for perinatal hepatitis B prevention programs.

Vaccine coverage among adolescents has also increased substantially. Preliminary data demonstrate that 50%–60% of adolescents aged 13–15 years have records indicating vaccination (with 3 doses) against hepatitis B (CDC, unpublished data, 2003). As of November 2005, a total of 34 states require vaccination for middle-school entry (*9*). Certain programs provide hepatitis B vaccine to youth who engage in behaviors that place them at high risk for HBV infection (i.e., injection-drug use, having more than one sex partner, and male sexual activity with other males), and adolescent hepatitis B vaccination is included as a Health Plan Employer Data Information Set (HEDIS) measure (*10*).

Despite these successes, challenges remain. Even with improvements in the management of pregnant women, only approximately 50% of expected births to HBsAg-positive women are identified (on the basis of application of racial/ethnic-specific HBsAg prevalence estimates to U.S. natality data) for case management, which maximizes timely delivery of postexposure immunoprophylaxis (*11*; CDC, unpublished data, 2004). The need for proper management of women without prenatal care, including HBsAg testing at the time of admission for delivery and administration of the first dose of vaccine to infants <12 hours of birth, is underscored by the higher prevalence of HBsAg seropositivity among these women than among women who are screened prenatally (*12*). Even when maternal HBsAg testing does occur, certain infants of HBsAg-positive mothers do not receive postexposure immunoprophylaxis because of testing errors and lapses in reporting of test results (*13*), and infants of women with unknown HBsAg status at the time of delivery often do not receive a birth dose of vaccine (*14*). Birth dose coverage in 2004 was only 46% (National Immunization Survey, unpublished data, 2004), and coverage has not returned to levels from before July 1999 (54%), when recommendations were made to temporarily suspend administration of hepatitis B vaccines at birth until vaccines that do not contain thimerosal as a preservative became available (*15*). Among adolescents, efforts to prevent HBV transmission are hampered by the low rate of health-care visits in this age group compared with that of young children and the frequency of initiation of high-risk behaviors.

To address these remaining challenges and accelerate progress toward elimination of HBV transmission in the United States, the ACIP has updated the hepatitis B immunization recommendations for infants, children, and adolescents and supplemented the recommendations with strategies for implementation. The recommendations and implementation strategies address prevention of perinatal and early childhood transmission and routine vaccination of children and adolescents. A main focus is on universal infant vaccination beginning at birth, which provides a "safety net" for prevention of perinatal infection, prevents early childhood infections, facilitates implementation of universal vaccination recommendations, and prevents infections in adolescents and adults. The second part of the ACIP statement, which includes updated recommendations and implementation strategies to increase hepatitis B vaccination among unvaccinated adults, will be published separately (*16*).

Major Updates to the Recommendations

This report provides updated recommendations and approaches to address challenges in implementing the strategy to eliminate HBV transmission in the United States. These include the following measures:

- **Improve prevention of perinatal and early childhood HBV transmission.** Implement delivery hospital policies and procedures, case-management programs, and laws and regulations to improve identification of infants born to HBsAg-positive mothers and to mothers with unknown HBsAg status at the time of delivery, ensure administration of appropriate postexposure immunoprophylaxis to these infants beginning at birth, and administer a birth dose of hepatitis B vaccine to medically stable infants who weigh ≥2,000 g and who are born to HBsAg-negative mothers.

- **Improve vaccine coverage of children and adolescents who were not previously vaccinated.** Implement immunization record reviews for all children aged 11–12 years and children and adolescents aged <19 years who were born in countries in which HBV endemicity is high or intermediate (Figure 1 and Box 2); adopt hepatitis B vaccine requirements for school entry; and vaccinate all unvaccinated adolescents in settings that provide health-care services to persons in this age group.

Background

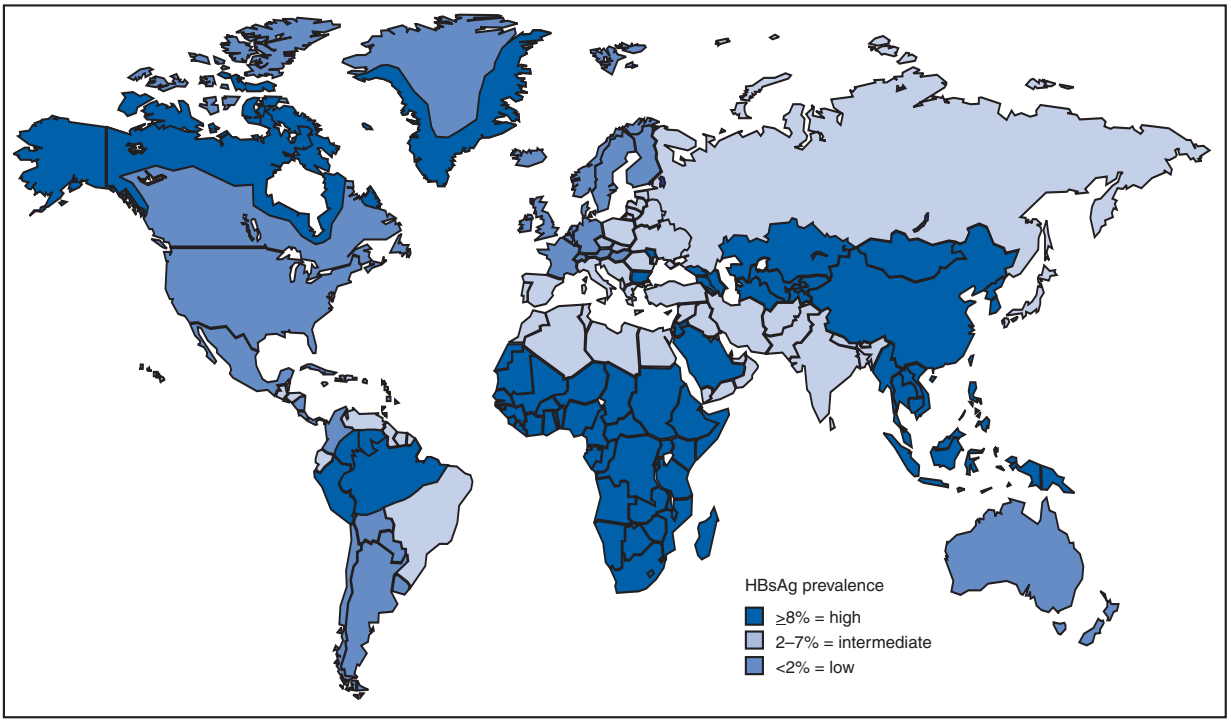
Clinical Features and Natural History of HBV Infection

HBV is a 42-nm DNA virus classified in the *Hepadnaviridae* family. The liver is the primary site of HBV replication. After a susceptible person is exposed, the virus enters the liver via the bloodstream; no evidence exists indicating that the virus replicates at mucosal surfaces. HBV infection can produce either asymptomatic or symptomatic infection. The average incubation period is 90 days (range: 60–150 days) from exposure to onset of jaundice and 60 days (range: 40–90 days) from exposure to onset of abnormal serum alanine aminotransferase (ALT) levels (*17,18*).

The onset of acute disease is usually insidious. Infants and young children (aged <10 years) are typically asymptomatic (*19*). When present, clinical symptoms and signs might include anorexia, malaise, nausea, vomiting, abdominal pain, and jaundice. Extrahepatic manifestations of disease (e.g., skin rashes, arthralgias, and arthritis) also can occur (*20*). The fatality rate among persons with reported acute hepatitis B is 0.5%–1.5%, with highest rates in adults aged >60 years (*21*).

Although the consequences of acute hepatitis B can be severe, the majority of serious sequelae associated with HBV disease occur in persons who are chronically infected. Persons with chronic infection also serve as the major reservoir for continued HBV transmission. Chronic infection occurs in approximately 90% of infected infants, 30% of infected children aged <5 years, and <5% of infected persons aged ≥5 years, with continuing viral replication in the liver and persistent viremia (*19,22–24*). Primary infections also become chronic more fre-

FIGURE 1. Geographic distribution of chronic hepatitis B virus (HBV) infection, 2005*



* For multiple countries, estimates of prevalence of hepatitis B surface antigen (HBsAg), a marker of chronic HBV infection, are based on limited data and might not reflect current prevalence in countries that have implemented routine childhood hepatitis B vaccination. In addition, HBsAg prevalence rates might vary within countries by subpopulation and locality.

BOX 2. Geographic areas with intermediate* and high† hepatitis B virus endemicity

Africa: all countries
South Asia: all countries except Sri Lanka
Western Pacific: all countries and territories except Australia and New Zealand
Middle East: all countries except Cyprus
Eastern Europe: all countries except Hungary
Newly Independent States of the former Soviet Union: all countries
Western Europe: Greece, Italy, Malta, Portugal, and Spain
North America: Alaska Natives and indigenous populations of Northern Canada and Greenland
Central America: Belize, Guatemala, Honduras, and Panama
South America: Argentina, Bolivia, Brazil, Ecuador, Guyana, Suriname, Venezuela, and the Amazonian areas of Colombia and Peru
Caribbean: Antigua and Barbuda, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Puerto Rico, St. Kitts and Nevis, St. Lucia, St. Vincent and Grenadines, Trinidad and Tobago, and Turcs and Caicos

* Hepatitis B surface antigen (HBsAg) prevalence of 2%–7%.
† HBsAg prevalence of ≥8%.

quently in immunosuppressed persons (e.g., hemodialysis patients and persons with human immunodeficiency virus [HIV] infection) (*23,25,26*). On the basis of data from follow-up studies of persons infected with HBV as infants or young children, approximately 25% of those with chronic infection die prematurely from cirrhosis or liver cancer; the majority remain asymptomatic until onset of cirrhosis or end-stage liver disease (*27–29*).

No specific treatment exists for acute hepatitis B. Persons who have chronic HBV infection require medical evaluation and regular monitoring (*30,31*). Therapeutic agents approved by the Food and Drug Administration (FDA) for treatment of chronic hepatitis B can achieve sustained suppression of HBV replication and remission of liver disease in certain persons (*31*). Periodic screening with alfa fetoprotein or imaging studies has been demonstrated to enhance early detection of HCC (*31*). Chronically infected persons with HCC have been reported to have experienced long-term survival after resection or ablation of small HCCs, and persons who were screened had a substantial survival advantage compared with historic controls (*31*).

Reinfection or reactivation of latent HBV infection has been reported among certain groups of immunosuppressed persons, including renal transplant recipients, HIV-infected patients, bone marrow transplant recipients, and patients receiving chemotherapy (*32–35*). The frequency with which this phenomenon occurs is unknown.

Interpretation of Serologic Markers of HBV Infection

The antigens and antibodies associated with HBV infection include HBsAg and antibody to HBsAg (anti-HBs), hepatitis B core antigen (HBcAg) and antibody to HBcAg (anti-HBc), and hepatitis B e antigen (HBeAg) and antibody to HBeAg (anti-HBe). At least one serologic marker is present during the different phases of HBV infection (Table 1) (*18,36*). Serologic assays are commercially available for all markers except HBcAg because no free HBcAg circulates in blood.

The presence of a confirmed HBsAg result is indicative of ongoing HBV infection. All HBsAg-positive persons should be considered infectious. In newly infected persons, HBsAg is the only serologic marker detected during the first 3–5 weeks after infection, and it persists for variable periods at very low levels. The average time from exposure to detection of HBsAg is 30 days (range: 6–60 days) (*17,18*). Highly sensitive single-

TABLE 1. Typical interpretation of serologic test results for hepatitis B virus infection

Serologic marker				
HBsAg*	Total anti-HBc†	IgM§ anti-HBc	Anti-HBs¶	Interpretation
–**	–	–	–	Never infected
+††§§	–	–	–	Early acute infection; transient (up to 18 days) after vaccination
+	+	+	–	Acute infection
–	+	+	–	Acute resolving infection
–	+	–	+	Recovered from past infection and immune
+	+	–	–	Chronic infection
–	+	–	–	False positive (i.e., susceptible); past infection; "low-level" chronic infection;¶¶ passive transfer to infant born to HBsAg-positive mother
–	–	–	+	Immune if concentration is ≥10 mIU/mL,*** passive transfer after hepatitis B immune globulin administration

* Hepatitis B surface antigen.
† Antibody to hepatitis B core antigen.
§ Immunoglobulin M.
¶ Antibody to HBsAg.
** Negative test result.
†† Positive test result.
§§ To ensure that an HBsAg-positive test result is not a false positive, samples with repeatedly reactive HBsAg results should be tested with a licensed (and, if appropriate, neutralizing confirmatory) test.
¶¶ Persons positive for only anti-HBc are unlikely to be infectious except under circumstances in which they are the source for direct percutaneous exposure of susceptible recipients to large quantities of virus (e.g., blood transfusion or organ transplant).
*** Milli-International Units per milliliter.

sample nucleic acid tests can detect HBV DNA in the serum of an infected person 10–20 days before detection of HBsAg (*37*). Transient HBsAg positivity has been reported for up to 18 days after vaccination and is clinically insignificant (*38,39*).

Anti-HBc appears at the onset of symptoms or liver test abnormalities in acute HBV infection and persists for life. Acute or recently acquired infection can be distinguished by the presence of the IgM class of anti-HBc, which is detected at the onset of acute hepatitis B and persists for up to 6 months if the disease resolves. In patients who develop chronic hepatitis B, IgM anti-HBc can persist at low levels during viral replication and can result in positive tests for IgM anti-HBc (*40*). In addition, false-positive IgM anti-HBc test results can occur. Because the positive predictive value is low in asymptomatic persons, for diagnosis of acute hepatitis B, testing for IgM anti-HBc should be limited to persons with clinical evidence of acute hepatitis or an epidemiologic link to a case.

In persons who recover from HBV infection, HBsAg is eliminated from the blood, usually within 3–4 months, and anti-HBs develops during convalescence. The presence of anti-HBs typically indicates immunity from HBV infection. Infection or immunization with one genotype of HBV confers immunity to all genotypes. In addition, anti-HBs can be detected for several months after hepatitis B immune globulin (HBIG) administration. The majority of persons who recover from natural infection will be positive for both anti-HBs and anti-HBc, whereas persons who respond to hepatitis B vaccine have only anti-HBs. In persons who become chronically infected, HBsAg and anti-HBc persist, typically for life. HBsAg will become undetectable in approximately 0.5%–2% of chronically infected persons yearly, and anti-HBs will occur in the majority of these persons (*41–44*).

In certain persons, the only HBV serologic marker detected in serum is anti-HBc. Isolated anti-HBc can occur after HBV infection among persons who have recovered but whose anti-HBs levels have waned or among persons in whom anti-HBs failed to occur. Persons in the latter category include those with circulating HBsAg levels not detectable by commercial assays. These persons are unlikely to be infectious except under circumstances in which they are the source for direct percutaneous exposure of susceptible recipients to substantial quantities of virus (e.g., through blood transfusion or following liver transplantation) (*45*). HBV DNA has been detected in the blood of <5% of persons with isolated anti-HBc (*46*). Typically, the frequency of isolated anti-HBc relates directly to the prevalence of HBV infection in the population. In populations with a high prevalence of HBV infection, isolated anti-HBc likely indicates previous infection, with loss of anti-HBs. For persons in populations with a low prevalence of HBV infection, an isolated anti-HBc result often represents a false-positive reaction. The majority of these persons have a primary anti-HBs response after a 3-dose series of hepatitis B vaccine (*47,48*). Infants who are born to HBsAg-positive mothers and who do not become infected might have detectable anti-HBc for ≤24 months after birth from passively transferred maternal antibody.

HBeAg can be detected in the serum of persons with acute or chronic HBV infection. The presence of HBeAg correlates with viral replication and high levels of virus (i.e., high infectivity) (*49,50*). Anti-HBe correlates with the loss of replicating virus and with lower levels of virus, although reversion to HBeAg positivity has been observed (*44*).

Epidemiology of HBV Infection

Transmission

HBV is transmitted by percutaneous (i.e., puncture through the skin) or mucosal (i.e., direct contact with mucous membranes) exposure to infectious blood or to body fluids that contain blood. All HBsAg-positive persons are infectious, but those who are also HBeAg positive are more infectious because their blood contains high titers of HBV (typically 10^7–10^9 virions/mL) (*49,50*). Although HBsAg has been detected in multiple body fluids, only serum, semen, and saliva have been demonstrated to be infectious (*51,52*). HBV is comparatively stable in the environment and remains viable for ≥7 days on environmental surfaces at room temperature (*53*). HBV at concentrations of 10^{2-3} virions/mL can be present on environmental surfaces in the absence of any visible blood and still cause transmission (*53,54*).

For infants and children, the two primary sources of HBV infection are perinatal transmission from infected mothers and horizontal transmission from infected household contacts. Adolescents are at risk for HBV infection primarily through high-risk sexual activity (i.e., sex with more than one partner and male sexual activity with other males) and injection-drug use (*21*). Transmission of HBV via transfusion of blood and plasma-derived products is rare because of donor screening for HBsAg and viral inactivation procedures.

For a newborn infant whose mother is positive for both HBsAg and HBeAg, the risk for chronic HBV infection is 70%–90% by age 6 months in the absence of postexposure immunoprophylaxis (*55–57*). For infants of women who are HBsAg positive but HBeAg negative, the risk for chronic infection is <10% in the absence of postexposure immunoprophylaxis (*58–60*). Rare cases of fulminant hepatitis B among perinatally infected infants also have been reported (*61,62*). Studies suggest that breastfeeding by an HBsAg-

positive mother does not increase the risk for acquisition of HBV infection in the infant (*63*).

Children who are not infected at birth remain at risk from long-term interpersonal contact with their infected mothers. In one study, 38% of infants who were born to HBsAg-positive mothers and who were not infected perinatally became infected by age 4 years (*64*). In addition, children living with any chronically infected persons are at risk for becoming infected through percutaneous or mucosal exposures to blood or infectious body fluids (e.g., sharing a toothbrush, contact with exudates from dermatologic lesions, contact with HBsAg-contaminated surfaces). HBV transmission rates to susceptible household contacts of chronically infected persons have varied (range: 14%–60%) (*65,66*). High rates of infection also have been reported among unvaccinated long-term residents of institutions for the mentally handicapped (*67,68*), and, in rare instances, person-to-person transmission has been reported in child care settings (*69,70*).

Incidence

During 1990–2004, overall incidence of reported acute hepatitis B declined 75%, from 8.5 to 2.1 per 100,000 population. The most dramatic declines occurred in the cohort of children to whom recommendations for routine infant and adolescent vaccination have applied. Incidence among children aged <12 years and adolescents aged 12–19 years declined 94%, from 1.1 to 0.36 and 6.1 to 2.8 per 100,000 population, respectively (Figure 2). Since implementation of routine childhood immunization, an estimated 6,800 perinatal infections and an additional 18,700 infections during the first 10 years of life have been prevented annually in the United States (*71*).

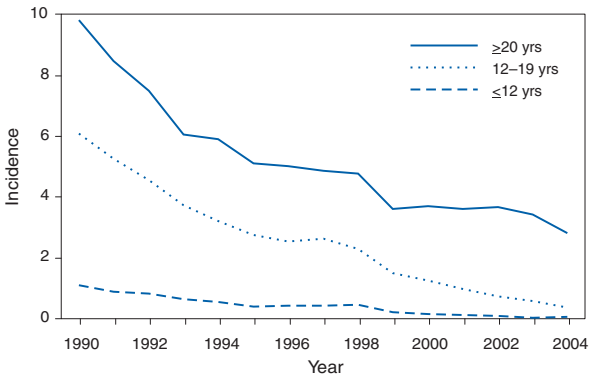
Although infections in infants and children aged <10 years represented <10% of all HBV infections before implementation of childhood immunization programs, childhood infections resulted in an estimated 30%–40% of the chronic HBV infections among persons who acquired their infections in the United States (*1*). In two population-based studies conducted among Asian/Pacific Islander children who were born in the United States before perinatal hepatitis B prevention programs were widely implemented, 61%–66% of the chronic HBV infections occurred in children born to HBsAg-negative mothers (*72,73*). A substantial proportion of these chronic infections would not have been prevented by a selective program of identification and immunization of only infants born to HBsAg-positive mothers.

In addition to declines in incidence among all age groups, racial disparities in hepatitis B incidence among children have been substantially reduced (Figure 3). The reduction of the disparity between Asian/Pacific Islander and other children is consistent with recent observations noting a decline in seroprevalence of HBV infection after successful implementation of routine hepatitis B vaccination among Asians who have recently immigrated to the United States (*74,75*). However, as hepatitis B incidence has declined among U.S.-born children, unvaccinated foreign-born children account for a high proportion of infections. During 2001–2002, of 19 children born after 1991 in whom acute hepatitis B had been verified, eight (42%) were foreign born (*76*).

Prevalence

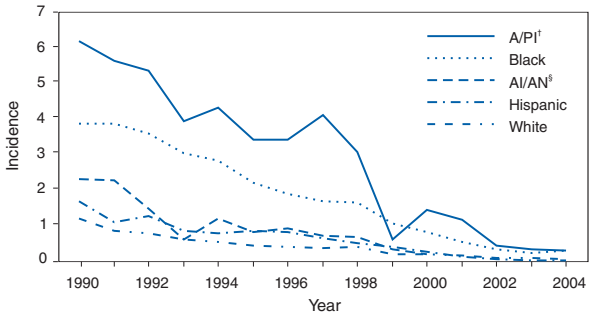
In the U.S. population, the overall age-adjusted prevalence of HBV infection (including persons with chronic infection and those with previous infection) was 4.9% in the third

FIGURE 2. Reported acute hepatitis B incidence,* by age group and year — United States, 1990–2004



* Per 100,000 population.

FIGURE 3. Reported acute hepatitis B incidence* among persons aged <19 years, by race/ethnicity and year — United States, 1990–2004



* Per 100,000 population.
† Asian/Pacific Islander.
§ American Indian/Alaska Native.

National Health and Nutrition Examination Survey (NHANES III, 1988–1994) (*77*). Foreign-born persons (particularly Asian/Pacific Islanders) who have emigrated from countries in which HBV is endemic (Figure 1 and Box 2) contribute disproportionately to the burden of chronic HBV infection in the United States. The prevalence of chronic HBV infection among foreign-born persons immigrating to the United States from Central and Southeast Asia, the Middle East, and Africa varies (range: 5%–15%) and reflects the patterns of HBV infection in the countries and regions of origin for these persons. During 1994–2003, approximately 40,000 immigrants with chronic HBV infection were admitted annually to the United States for permanent residence (*78*; CDC, unpublished data, 2005).

Prophylaxis Against HBV Infection

Hepatitis B Vaccine

HBsAg is the antigen used for hepatitis B vaccination (*79,80*). Vaccine antigen can be purified from the plasma of persons with chronic HBV infection or produced by recombinant DNA technology. Vaccines available in the United States use recombinant DNA technology to express HBsAg in yeast, which is then purified from the cells by biochemical and biophysical separation techniques (*81,82*). Hepatitis B vaccines licensed in the United States are formulated to contain 10–40 μg of HBsAg protein/mL. Since March 2000, hepatitis B vaccines produced for distribution in the United States do not contain thimerosal as a preservative or contain only a trace amount (<1.0 mcg mercury/mL) from the manufacturing process (*83,84*).

Hepatitis B vaccine is available as a single-antigen formulation and also in fixed combination with other vaccines. Two single-antigen vaccines are available in the United States: Recombivax HB® (Merck & Co., Inc., Whitehouse Station, New Jersey) and Engerix-B® (GlaxoSmithKline Biologicals, Rixensart, Belgium). Of the three licensed combination vaccines, one (Twinrix® [GlaxoSmithKline Biologicals, Rixensart, Belgium]) is used for vaccination of adults, and two (Comvax® [Merck & Co., Inc., Whitehouse Station, New Jersey] and Pediarix® [GlaxoSmithKline Biologicals, Rixensart, Belgium]) are used for vaccination of infants and young children. Twinrix contains recombinant HBsAg and inactivated hepatitis A virus. Comvax contains recombinant HBsAg and *Haemophilus influenzae* type b (Hib) polyribosylribitol phosphate conjugated to *Neisseria meningitidis* outer membrane protein complex. Pediarix contains recombinant HBsAg, diphtheria and tetanus toxoids and acellular pertussis adsorbed (DTaP), and inactivated poliovirus (IPV).

HBIG

HBIG provides passively acquired anti-HBs and temporary protection (i.e., 3–6 months) when administered in standard doses. HBIG is typically used as an adjunct to hepatitis B vaccine for postexposure immunoprophylaxis to prevent HBV infection. HBIG administered alone is the primary means of protection after an HBV exposure for nonresponders to hepatitis B vaccination.

HBIG is prepared from the plasma of donors with high concentrations of anti-HBs. The plasma is screened to eliminate donors who are positive for HBsAg, antibodies to HIV and hepatitis C virus (HCV), and HCV RNA. In addition, proper manufacturing techniques for HBIG inactivate viruses (e.g., HBV, HCV, and HIV) from the final product (*85,86*). No evidence exists that HBV, HCV, or HIV ever has been transmitted by HBIG commercially available in the United States. HBIG that is commercially available in the United States does not contain thimerosal.

Vaccination Schedules and Results of Vaccination

Preexposure Vaccination

Infants and Children

Primary vaccination consists of ≥3 intramuscular doses of hepatitis B vaccine (Table 2). Vaccine schedules for infants and children (Tables 3–5) are determined on the basis of immunogenicity data and the need to integrate hepatitis B vaccine into a harmonized childhood vaccination schedule. Although not all possible schedules for each product have been evaluated in clinical trials, available licensed formulations for both single-antigen vaccines produce high (>95%) levels of seroprotection among infants and children when administered in multiple schedules (*87–91*).

The immunogenicity of the combined hepatitis B-Hib conjugate vaccine (Comvax) and the combined hepatitis B-DTaP-IPV vaccine (Pediarix) is equivalent to that of their individual antigens administered separately. However, these vaccines cannot be administered to infants aged <6 weeks; only single-antigen hepatitis B vaccine may be used for the birth dose. Use of 4-dose hepatitis B vaccine schedules, including schedules with a birth dose, has not increased vaccine reactogenicity (*92,93*). Anti-HBs responses after a 3-dose series of hepatitis B-containing combination vaccines among infants who were previously vaccinated at birth with single-antigen hepatitis B vaccine are comparable to those observed after a 3-dose series of combination vaccine without a birth dose (*93*).

TABLE 2. Recommended doses of currently licensed formulations of hepatitis B vaccine, by age group and vaccine type

	Single-antigen vaccine				Combination vaccine					
	Recombivax HB		Engerix-B		Comvax*		Pediarix†		Twinrix§	
Age group	Dose (μg)¶	Volume (mL)	Dose (μg)¶	Volume (mL)	Dose (μg)¶	Volume (mL)	Dose (μg)¶	Volume (mL)	Dose (μg)¶	Volume (mL)
Infants (<1 yr)	5	0.5	10	0.5	5	0.5	10	0.5	NA**	NA
Children (1–10 yrs)	5	0.5	10	0.5	5*	0.5	10†	0.5	NA	NA
Adolescents										
11–15 yrs	10††	1.0	NA	NA	NA	NA	NA	NA	NA	NA
11–19 yrs	5	0.5	10	0.5	NA	NA	NA	NA	NA	NA
Adults (≥20 yrs)	10	1.0	20	1.0	NA	NA	NA	NA	20§	1.0
Hemodialysis patients and other immunocompromised persons										
<20 yrs§§	5	0.5	10	0.5	NA	NA	NA	NA	NA	NA
≥20 yrs	40¶¶	1.0	40***	2.0	NA	NA	NA	NA	NA	NA

* Combined hepatitis B–*Haemophilus influenzae* type b conjugate vaccine. This vaccine cannot be administered at birth, before age 6 weeks, or after age 71 months.
† Combined hepatitis B–diphtheria, tetanus, and acellular pertussis-inactivated poliovirus vaccine. This vaccine cannot be administered at birth, before age 6 weeks, or at age ≥7 years.
§ Combined hepatitis A and hepatitis B vaccine. This vaccine is recommended for persons aged ≥18 years who are at increased risk for both hepatitis B virus and hepatitis A virus infections.
¶ Recombinant hepatitis B surface antigen protein dose.
** Not applicable.
†† Adult formulation administered on a 2-dose schedule.
§§ Higher doses might be more immunogenic, but no specific recommendations have been made.
¶¶ Dialysis formulation administered on a 3-dose schedule at age 0, 1, and 6 months.
*** Two 1.0-mL doses administered at one site, on a 4-dose schedule at age 0, 1, 2, and 6 months.

Birth Dose

Hepatitis B vaccine can be administered soon after birth with only minimal decrease in immunogenicity, compared with administration at older ages, and no decrease in protective efficacy (*87*). Administration of a birth dose of hepatitis B vaccine is required for effective postexposure immunoprophylaxis to prevent perinatal HBV infection. Although infants who require postexposure immunoprophylaxis should be identified by maternal HBsAg testing, administering a birth dose to infants even without HBIG serves as a "safety net" to prevent perinatal infection among infants born to HBsAg-positive mothers who are not identified because of errors in maternal HBsAg testing or failures in reporting of test results (*13*). The birth dose also provides early protection to infants at risk for infection after the perinatal period. Administration of a birth dose has been associated with higher rates of on-time completion of the hepatitis B vaccine series (*15,94*). In certain populations, the birth dose has been associated with improved completion rates for all other infant vaccines (*95*), although findings have not been consistent (*15,94*).

Adolescents

Recommended vaccination schedules for adolescents balance available immunogenicity data with the need to achieve compliance with vaccination in this age group (Tables 2 and 5). Both licensed single-antigen hepatitis B vaccines administered intramuscularly at 0, 1, and 6 months produce a >95% sero-protection rate in adolescents. Equivalent seroprotection rates are achieved among adolescents vaccinated at 0, 1–2, and 4 months and 0, 12, and 24 months. The adult (10 μg) dose of Recombivax-HB administered in a 2-dose schedule to children and adolescents aged 11–15 years at 0 and 4–6 months produces antibody levels equivalent to those obtained with the 5-μg dose administered on a 3-dose schedule (*96,97*). However, no data on long-term antibody persistence or protection are available for 2-dose schedules. No combination vaccines containing hepatitis B vaccine antigen are approved for use in adolescents aged 11–17 years.

Nonstandard Vaccine Schedules

No apparent effect on immunogenicity has been documented when minimum spacing of doses is not achieved precisely. Increasing the interval between the first 2 doses has little effect on immunogenicity or final antibody concentration (*98–100*). The third dose confers the maximum level of seroprotection but acts primarily as a booster and appears to provide optimal long-term protection (*101*). Longer intervals between the last 2 doses result in higher final antibody levels but might increase the risk for acquisition of HBV infection among persons who have a delayed response to vaccination. No differences in immunogenicity have been observed when 1 or 2 doses of hepatitis B vaccine produced by one manufacturer are followed by doses from a different manufacturer (*102*).

TABLE 3. Hepatitis B vaccine schedules for newborn infants, by maternal hepatitis B surface antigen (HBsAg) status*

Maternal HBsAg status	Single-antigen vaccine		Single antigen + combination vaccine	
	Dose	Age	Dose	Age
Positive	1†	Birth (≤12 hrs)	1†	Birth (≤12 hrs)
	HBIG§	Birth (≤12 hrs)	HBIG	Birth (≤12 hrs)
	2	1–2 mos	2	2 mos
	3¶	6 mos	3	4 mos
			4¶	6 mos (Pediarix) or 12–15 mos (Comvax)
Unknown**	1†	Birth (≤12 hrs)	1†	Birth (≤12 hrs)
	2	1–2 mos	2	2 mos
	3¶	6 mos	3	4 mos
			4¶	6 mos (Pediarix) or 12–15 mos (Comvax)
Negative	1†,††	Birth (before discharge)	1†,††	Birth (before discharge)
	2	1–2 mos	2	2 mos
	3¶	6–18 mos	3	4 mos
			4¶	6 mos (Pediarix) or 12–15 mos (Comvax)

* See Table 4 for vaccine schedules for preterm infants weighing <2,000 g.
† Recombivax HB or Engerix-B should be used for the birth dose. Comvax and Pediarix cannot be administered at birth or before age 6 weeks.
§ Hepatitis B immune globulin (0.5 mL) administered intramuscularly in a separate site from vaccine.
¶ The final dose in the vaccine series should not be administered before age 24 weeks (164 days).
** Mothers should have blood drawn and tested for HBsAg as soon as possible after admission for delivery; if the mother is found to be HBsAg positive, the infant should receive HBIG as soon as possible but no later than age 7 days.
†† On a case-by-case basis and only in rare circumstances, the first dose may be delayed until after hospital discharge for an infant who weighs ≥2,000 g and whose mother is HBsAg negative, but only if a physician's order to withhold the birth dose and a copy of the mother's original HBsAg-negative laboratory report are documented in the infant's medical record.

TABLE 4

Hepatitis B Immunization Management of Preterm Infants Weighing <2,000 g, by Maternal Hepatitis B Surface Antigen (HBsAg) Status

Maternal HBsAg status	Recommendation
Positive	• Administer HBIG* + single-antigen hepatitis B vaccine within 12 hrs of birth. • Do not count the birth dose as part of the vaccine series. • Administer 3 additional hepatitis B vaccine doses with - single-antigen vaccine at ages 1, 2–3, and 6 mos, *or* - hepatitis B-containing combination vaccine at ages 2, 4, and 6 mos (Pediarix) or 2, 4, and 12–15 mos (Comvax).† • Test for HBsAg and antibody to HBsAg 1–2 mos after completion of ≥3 doses of a licensed hepatitis B vaccine series (i.e., at age 9–18 mos, generally at the next well-child visit). Testing should not be performed before age 9 mos nor within 4 wks of the most recent vaccine dose.
Unknown	• Administer HBIG + single-antigen hepatitis B vaccine within 12 hrs of birth. • Test mother for HBsAg. • Do not count the birth dose as part of the vaccine series. • Administer 3 additional hepatitis B vaccine doses with - single-antigen vaccine at ages 1, 2–3, and 6 mos, *or* - hepatitis B-containing combination vaccine at ages 2, 4, and 6 mos (Pediarix) or 2, 4, and 12–15 mos (Comvax).†
Negative	• Delay first dose of hepatitis B vaccine until age 1 mo or hospital discharge. • Complete the hepatitis B vaccine series with - single-antigen vaccine at ages 2 mos and 6–18 mos, *or* - hepatitis B-containing combination vaccine at ages 2, 4, and 6 mos (Pediarix) or 2, 4, and 12–15 mos (Comvax).†

* Hepatitis B immune globulin.
† The final dose in the vaccine series should not be administered before age 24 weeks (164 days).

Response to Revaccination

A study of infants born to HBsAg-positive mothers who did not respond to a primary vaccine series indicated that all those not infected with HBV responded satisfactorily to a repeat 3-dose revaccination series (*103*). No data suggest that children who have no detectable antibody after 6 doses of vaccine would benefit from additional doses.

Groups Requiring Different Vaccination Doses or Schedules

Preterm infants. Preterm infants weighing <2,000 g at birth have a decreased response to hepatitis B vaccine administered before age 1 month (*104–106*). By age 1 month, medically stable preterm infants, regardless of initial birth weight or gestational age, have a response to vaccination that is comparable to that of full-term infants (*107–110*).

Hemodialysis patients and other immunocompromised persons. Although data concerning the response of pediatric hemodialysis patients to vaccination with standard pediatric doses are lacking, protective levels of antibody occur in 75%–97% of those who receive higher dosages (20-μg) on either the 3- or the 4-dose schedule (*111–114*). Humoral response to hepatitis B vaccination is also reduced in other children and adolescents who are immunocompromised (e.g., hematopoietic stem cell transplant recipients, patients undergoing chemotherapy, and HIV-infected persons) (*115–119*). Modified dosing regimens, including a doubling of the standard antigen dose or administration of additional doses, might increase response rates (*120*). However, data on response to these alternative vaccination schedules are limited (*121*).

Immune Memory

Anti-HBs is the only easily measurable correlate of vaccine-induced protection. Immunocompetent persons who achieve anti-HBs concentrations ≥10 mIU/mL after preexposure vaccination have virtually complete protection against both acute disease and chronic infection even if anti HBs concentrations subsequently decline to <10 mIU/mL (*122–125*). Although immunogenicity is lower among immunocompromised persons, those who achieve and maintain a protective antibody response before exposure to HBV have a high level of protection from infection.

After primary immunization with hepatitis B vaccine, anti-HBs concentrations decline rapidly within the first

TABLE 5. Hepatitis B vaccine schedules for children, adolescents, and adults*

Age	Schedule
Children (1–10 yrs)	0, 1, and 6 mos†
	0, 2, and 4 mos†
	0, 1, 2, and 12 mos†§
Adolescents (11–19 yrs)	0, 1, and 6 mos†
	0, 1, and 4 mos†
	0, 2, and 4 mos†
	0, 12, and 24 mos†
	0 and 4–6 mos¶**
	0, 1, 2, and 12 mos†¶
Adults (≥20 yrs)	0, 1, and 6 mos**††
	0, 1, and 4 mos**
	0, 2, and 4 mos**
	0, 1, 2, and 12 mos¶**

* Children, adolescents, and adults may be vaccinated according to any of the schedules indicated, except as noted. Selection of a schedule should consider the need to optimize compliance with vaccination

† Pediatric/adolescent formulation.

¶ A 2-dose schedule of Recombivax-HB adult formulation (10 μg) is licensed for adolescents aged 11–15 years. When scheduled to receive the second dose, adolescents aged >15 years should be switched to a 3-dose series, with doses 2 and 3 consisting of the pediatric formulation administered on an appropriate schedule.

§ A 4-dose schedule of Engerix B is licensed for all age groups.

** Adult formulation.

†† Twinrix may be administered to persons aged ≥18 years at 0, 1, and 6 months.

year and more slowly thereafter. Among children who respond to a primary vaccine series with antibody levels ≥10 mIU/mL, 15%–50% have low or undetectable concentrations of anti-HBs (anti-HBs loss) 5–15 years after vaccination (*126–130*). The persistence of detectable anti-HBs after vaccination, in the absence of exposure to HBV, depends on the level of post-vaccination antibody concentration.

Despite declines in anti-HBs to <10 mIU/mL, nearly all vaccinated persons are still protected against HBV infection. The mechanism for continued vaccine-induced protection is thought to be the preservation of immune memory through selective expansion and differentiation of clones of antigen-specific B and T lymphocytes (*131*). Persistence of vaccine-induced immune memory among persons who responded to a primary childhood vaccine series 13–23 years earlier but then had levels of anti-HBs below 10 mIU/mL has been demonstrated by an anamnestic increase in anti-HBs levels in 67%–76% of these persons 2–4 weeks after administration of an additional vaccine dose (*132,133*). Although direct measurement of immune memory is not yet possible, these data indicate that a high proportion of vaccine recipients retain immune memory and would develop an anti-HBs response upon exposure to HBV.

Studies of cohorts of immunocompetent persons vaccinated as children or infants also indicate that, despite anti-HBs loss years after immunization, nearly all vaccinated persons who respond to a primary series remain protected from HBV infection. No clinical cases of hepatitis B have been observed in follow-up studies conducted 15–20 years after vaccination among immunocompetent vaccinated persons with antibody levels ≥10 mIU/mL. Certain studies have documented breakthrough infections (detected by the presence of anti-HBc or HBV DNA) in a limited percentage of vaccinated persons (*130,131*), but these infections are usually transient and asymptomatic; chronic infections have been documented only rarely (*134*). Breakthrough infections resulting in chronic infection have been observed only among vaccinated infants born to HBsAg-positive women.

Limited data are available on the duration of immune memory after hepatitis B vaccination in immunocompromised persons (e.g., HIV-infected patients, dialysis patients, patients undergoing chemotherapy, or hematopoietic stem cell transplant patients). No clinically important HBV infections have been documented among immunocompromised persons who maintain protective levels of anti-HBs. In studies of long-term protection among HIV-infected persons, breakthrough infections occurring after a decline in anti-HBs concentrations to <10 mIU/mL have been transient and asymptomatic (*135*). However, among hemodialysis patients who respond to the vaccine, clinically significant HBV infection has been documented in persons who have not maintained anti-HBs concentrations of ≥10 mIU/mL (*136*).

Postexposure Prophylaxis

Both passive-active postexposure prophylaxis (PEP) with HBIG and hepatitis B vaccine and active PEP with hepatitis B vaccine alone have been demonstrated to be highly effective in preventing transmission after exposure to HBV (*137–140*). HBIG alone has also been demonstrated to be effective in preventing HBV transmission (*141–144*), but with the availability of hepatitis B vaccine, HBIG typically is used as an adjunct to vaccination.

The major determinant of the effectiveness of PEP is early administration of the initial dose of vaccine. The effectiveness of PEP diminishes the longer it is initiated after exposure (*17,145,146*). Studies are limited on the maximum interval after exposure during which PEP is effective, but the interval is unlikely to exceed 7 days for perinatal (*147*) and needlestick (*140–142*) exposures and 14 days for sexual exposures (*122, 138,139,143,144*).

No data are available on the efficacy of HBsAg-containing combination vaccines when used to complete the vaccine series for PEP, but the efficacy of combination vaccines is expected to be similar to that of single-antigen vaccines because the HBsAg component induces a comparable anti-HBs response.

Perinatal HBV Exposure

Passive-active PEP. PEP with hepatitis B vaccine and HBIG administered 12–24 hours after birth, followed by completion of a 3-dose vaccine series, has been demonstrated to be 85%–95% effective in preventing acute and chronic HBV infection in infants born to women who are positive for both HBsAg and HBeAg (*137*). Although clinical trials have evaluated the efficacy of passive-active PEP with hepatitis B vaccine and HBIG administered only within 24 hours of birth, studies of passive immunoprophylaxis have demonstrated that HBIG provided protection when administered as late as 72 hours after exposure. The majority of clinical trials have evaluated the efficacy of passive-active PEP when the second vaccine dose was administered at age 1 month (*137*). Administration of HBIG plus vaccine at birth, 1 month, and 6 months and at birth, 2 months, and 6 months has demonstrated comparable efficacy in prevention of acute and chronic infection among infants born to women who were both HBsAg and HBeAg positive (Cladd E. Stevens, MD, New York Blood Center, personal communication, 1994).

Infants born to HBsAg-positive/HBeAg-negative mothers who receive passive-active PEP with HBIG and hepatitis B vaccine should have the same high degree of protection as infants born to women who are HBsAg positive/HBeAg positive. However, the efficacy of this regimen has not been examined in controlled clinical trials because the low infection rate would require an unattainable sample size.

Active PEP. Active PEP with hepatitis B vaccine alone (i.e., without HBIG) is frequently used in certain remote areas (e.g., Alaska and the Pacific Islands) where implementation of maternal HBsAg testing is difficult because no access exists to a laboratory. In randomized, placebo-controlled clinical trials, administration of hepatitis B vaccine in a 3- or 4-dose schedule without HBIG beginning ≤12 hours after birth has been demonstrated to prevent 70%–95% of perinatal HBV infections among infants born to women who are positive for both HBsAg and HBeAg (*58,148–152*). Population-based studies in areas with a high endemicity of HBV infection have demonstrated that active postexposure vaccination is highly effective in preventing infection when the first dose is administered soon after birth, the second at age 1–2 months, and the third at age 6–8 months (*153–155*).

Vaccine Safety

Hepatitis B vaccines have been demonstrated to be safe when administered to infants, children, adolescents, and adults. Since 1982, an estimated >60 million adolescents and adults and >40 million infants and children have been vaccinated in the United States.

Vaccine Reactogenicity

The most frequently reported side effects among persons receiving hepatitis B vaccine are pain at the injection site (3%–29%) and fever >99.9° F (>37.7° C) (1%–6%) (*156,157*). However, in placebo-controlled studies, these side effects were reported no more frequently among persons receiving hepatitis B vaccine than among persons receiving placebo (*87*). Administration of hepatitis B vaccine soon after birth has not been associated with an increased rate of elevated temperatures or microbiologic evaluations for possible sepsis in the first 21 days of life (*158*).

Adverse Events

A causal association has been established between receipt of hepatitis B vaccine and anaphylaxis (*159*). On the basis of data from the Vaccine Safety Datalink (VSD) project, the estimated incidence of anaphylaxis among children and adolescents who received hepatitis B vaccine is one case per 1.1 million vaccine doses distributed (95% confidence interval = 0.1–3.9) (*160*).

Early postlicensure surveillance of adverse events suggested a possible association between Guillain-Barré syndrome and receipt of the first dose of plasma-derived hepatitis B vaccine among U.S. adults (*161*). However, in a subsequent analysis of Guillain-Barré syndrome cases reported to CDC, FDA, and vaccine manufacturers, among an estimated 2.5 million adults who received ≥1 dose of recombinant hepatitis B vaccine during 1986–1990, the rate of Guillain-Barré syndrome occurring after hepatitis B vaccination did not exceed the background rate among unvaccinated persons (CDC, unpublished data, 1992). A review by persons with clinical expertise concluded that evidence was insufficient to reject or accept a causal association between Guillain-Barré syndrome and hepatitis B vaccination (*159,162*).

Multiple sclerosis (MS) has not been reported after hepatitis B vaccination among children. However, one retrospective case-control study (*163,164*) reported an association between hepatitis B vaccine and MS among adults. Multiple other studies (*165–168*) have demonstrated no association between hepatitis B vaccine and MS. Reviews of these data by panels of persons with clinical expertise have favored rejection of a causal association between hepatitis B vaccination and MS (*169,170*).

Chronic illnesses that have been reported in rare instances after hepatitis B vaccination include chronic fatigue syndrome (*171*), neurologic disorders (e.g., leukoencephalitis, optic neu-

ritis, and transverse myelitis) (*172–174*), rheumatoid arthritis (*175,176*), type 1 diabetes (*177*), and autoimmune disease (*178*). No evidence of a causal association between these conditions or other chronic illnesses and hepatitis B vaccine has been demonstrated (*159,169,170,179–182*).

Reported episodes of alopecia (hair loss) after rechallenge with hepatitis B vaccine suggest that vaccination might, in rare cases, trigger episodes of alopecia (*183*). However, a population-based study determined no statistically significant association between alopecia and hepatitis B vaccine (*184*).

No evidence exists of a causal association between hepatitis B vaccination, including administration of the birth dose, and sudden infant death syndrome (SIDS) or other causes of death during the first year of life (*185–187*). Infant death rates, including rates of SIDS, declined substantially in the United States during the 1990s, coincident with an increase in infant hepatitis B vaccination coverage from <1% to >90% and implementation of efforts to reduce SIDS through infant sleep positioning and separation from other persons in bed (*188*).

The safety of hepatitis B vaccine and other vaccines is assessed continuously through ongoing monitoring of data from VSD, the Vaccine Adverse Events Reporting System (VAERS), and other surveillance systems. Any adverse events after vaccination should be reported to VAERS; report forms and assistance are available from CDC at telephone 1-800-822-7967 or at http://www.vaers.hhs.gov.

Contraindications and Precautions

Hepatitis B vaccination is contraindicated for persons with a history of hypersensitivity to yeast or to any vaccine component (*92,189–191*). Despite a theoretic risk for allergic reaction to vaccination in persons with allergy to *Saccharomyces cerevisiae* (baker's yeast), no evidence exists that documents adverse reactions after vaccination of persons with a history of yeast allergy.

Persons with a history of serious adverse events (e.g., anaphylaxis) after receipt of hepatitis B vaccine should not receive additional doses. As with other vaccines, vaccination of persons with moderate or severe acute illness, with or without fever, should be deferred until the illness resolves (*192*). Vaccination is not contraindicated in persons with a history of MS, Guillain-Barré syndrome, autoimmune disease (e.g., systemic lupus erythematosis or rheumatoid arthritis), or other chronic diseases.

Pregnancy is not a contraindication to vaccination. Limited data indicate no apparent risk for adverse events to developing fetuses when hepatitis B vaccine is administered to pregnant women (*193*). Current vaccines contain noninfectious HBsAg and should cause no risk to the fetus.

Future Considerations

Implementation of the recommendations and strategies in this document should ultimately lead to the elimination of HBV transmission in the United States. New information will have implications for this effort, and adjustments and changes are expected to occur.

Long-Term Protection and Booster Doses

Studies are needed to assess long-term protection after vaccination and the possible need for booster doses of vaccine. The longest follow-up studies of vaccine protection have been conducted in populations with an initially high endemicity of HBV infection (i.e., ≥8% prevalence of chronic infection) (*130*). Implementation of hepatitis B vaccination programs in populations with a high endemicity of HBV infection has resulted in virtual elimination of new HBV infections by providing vaccine-induced immunity to susceptible persons. In these populations, ongoing exposure of vaccinated persons to persons with chronic HBV infection might complicate future efforts to assess long-term hepatitis B vaccine efficacy. Assessment of efficacy provided by hepatitis B immunization after 15–20 years will require studies among populations that continue to have exposures to HBsAg-positive persons (e.g., communities of immigrants from highly endemic countries, populations of injection-drug users, or health-care workers) and studies among populations with a low prevalence of infection.

Immunization Escape Mutants

Mutations in the S gene of HBV can lead to conformational changes in the *a* determinant of the HBsAg protein, which is the major target for neutralizing anti-HBs. These variants have been detected in humans infected with HBV, and concern has been expressed that these variants might replicate in the presence of vaccine-induced anti-HBs or anti-HBs contained in HBIG (*194,195*). Although no evidence suggests that S gene immunization escape mutants pose a threat to existing programs using hepatitis B vaccines (*196*), further studies and enhanced surveillance to detect the emergence of these variants are high priorities for monitoring the effectiveness of current vaccination strategies.

Recommendations for Hepatitis B Vaccination of Infants, Children, and Adolescents

This section outlines updated ACIP recommendations and associated implementation strategies for hepatitis B vaccina-

tion of infants, children, and adolescents. These recommendations have been summarized (Box 3).

Prevention of Perinatal HBV Infection and Management of Pregnant Women

Recommendations

Prenatal HBsAg Testing

- All pregnant women should be tested routinely for HBsAg during an early prenatal visit (e.g., first trimester) in each pregnancy, even if they have been previously vaccinated or tested.
- Women who were not screened prenatally, those who engage in behaviors that put them at high risk for infection (e.g., injection-drug use, having had more than one sex partner in the previous 6 months or an HBsAg-positive sex partner, evaluation or treatment for a sexually transmitted disease [STD], or recent or current injection-drug use) and those with clinical hepatitis should be tested at the time of admission to the hospital for delivery.
- All laboratories that provide HBsAg testing of pregnant women should use an FDA-licensed or -approved HBsAg test and should perform testing according to the manufacturer's labeling, including testing of initially reactive specimens with a licensed neutralizing confirmatory test. When pregnant women are tested for HBsAg at the time of admission for delivery, shortened testing protocols may be used and initially reactive results reported to expedite administration of immunoprophylaxis to infants.
- Women who are HBsAg positive should be referred to an appropriate case-management program to ensure that their infants receive timely postexposure prophylaxis and follow-up (see Case-Management Programs to Prevent Perinatal HBV Infection). In addition, a copy of the original laboratory report indicating the pregnant woman's HBsAg status should be provided to the hospital where delivery is planned and to the health-care provider who will care for the newborn.
- Women who are HBsAg positive should be provided with or referred for appropriate counseling and medical management (Appendix A). HBsAg-positive pregnant women should receive information concerning hepatitis B that discusses
  - — modes of transmission;
  - — perinatal concerns (e.g., infants born to HBsAg-positive mothers may be breast fed);
  - — prevention of HBV transmission to contacts, including the importance of postexposure prophylaxis for the newborn infant and hepatitis B vaccination for household, sexual, and needle-sharing contacts;
  - — substance abuse treatment, if appropriate; and
  - — medical evaluation and possible treatment of chronic hepatitis B.
- When HBsAg testing of pregnant women is not feasible (i.e., in remote areas without access to a laboratory), all infants should receive hepatitis B vaccine ≤12 hours of birth and should complete the hepatitis B vaccine series according to a recommended schedule for infants born to HBsAg-positive mothers (Tables 2 and 3).

Management of Infants Born to Women Who Are HBsAg Positive

- All infants born to HBsAg-positive women should receive single-antigen hepatitis B vaccine (Table 2) and HBIG

BOX 3. Summary of hepatitis B vaccination recommendations for infants, children, and adolescents

Maternal hepatitis B surface antigen (HBsAg) testing
- All pregnant women should be tested routinely for HBsAg.

Vaccination of infants

At birth
- Infants born to mothers who are HBsAg positive should receive hepatitis B vaccine and hepatitis B immune globulin (HBIG) ≤12 hours of birth.
- Infants born to mothers whose HBsAg status is unknown should receive hepatitis B vaccine ≤12 hours of birth. The mother should have blood drawn as soon as possible to determine her HBsAg status; if she is HBsAg positive, the infant should receive HBIG as soon as possible (no later than age 1 week).
- Full-term infants who are medically stable and weigh ≥2,000 g born to HBsAg-negative mothers should receive single-antigen hepatitis B vaccine before hospital discharge.
- Preterm infants weighing <2,000 g born to HBsAg-negative mothers should receive the first dose of vaccine 1 month after birth or at hospital discharge.

After the birth dose
- All infants should complete the hepatitis B vaccine series with either single-antigen vaccine or combination vaccine, according to a recommended vaccination schedule (see Tables 3 and 4).
- Infants born to HBsAg-positive mothers should be tested for HBsAg and antibody to HBsAg after completion of the hepatitis B vaccine series at age 9–18 months.

Vaccination of children and adolescents
- All unvaccinated children and adolescents aged <19 years should receive the hepatitis B vaccine series.

(0.5 mL) ≤12 hours of birth, administered at different injection sites. The vaccine series should be completed according to a recommended schedule for infants born to HBsAg-positive mothers (Table 3). The final dose in the vaccine series should not be administered before age 24 weeks (164 days).

- For preterm infants weighing <2,000 g, the initial vaccine dose (birth dose) should not be counted as part of the vaccine series because of the potentially reduced immunogenicity of hepatitis B vaccine in these infants; 3 additional doses of vaccine (for a total of 4 doses) should be administered beginning when the infant reaches age 1 month (Tables 3 and 4).
- Postvaccination testing for anti-HBs and HBsAg should be performed after completion of the vaccine series, at age 9–18 months (generally at the next well-child visit). Testing should not be performed before age 9 months to avoid detection of anti-HBs from HBIG administered during infancy and to maximize the likelihood of detecting late HBV infection. Anti-HBc testing of infants is not recommended because passively acquired maternal anti-HBc might be detected in infants born to HBV-infected mothers to age 24 months.
  - HBsAg-negative infants with anti-HBs levels ≥10 mIU/mL are protected and need no further medical management.
  - HBsAg-negative infants with anti-HBs levels <10 mIU/mL should be revaccinated with a second 3-dose series and retested 1–2 months after the final dose of vaccine.
  - Infants who are HBsAg positive should receive appropriate follow-up (Appendix A).
- Infants of HBsAg-positive mothers may be breast fed beginning immediately after birth.
- Although not indicated in the manufacturer's package labeling, HBsAg-containing combination vaccines may be used for infants aged ≥6 weeks born to HBsAg-positive mothers to complete the vaccine series after receipt of a birth dose of single-antigen hepatitis B vaccine and HBIG.

Management of Infants Born to Women with Unknown HBsAg Status

- Women admitted for delivery without documentation of HBsAg test results should have blood drawn and tested as soon as possible after admission.
- While test results are pending, all infants born to women without documentation of HBsAg test results should receive the first dose of single-antigen hepatitis B vaccine (without HBIG) ≤12 hours of birth (Tables 2 and 3).
  - If the mother is determined to be HBsAg positive, her infant should receive HBIG as soon as possible but no later than age 7 days, and the vaccine series should be completed according to a recommended schedule for infants born to HBsAg-positive mothers (Table 3).
  - If the mother is determined to be HBsAg negative, the vaccine series should be completed according to a recommended schedule for infants born to HBsAg-negative mothers (Table 3).
  - If the mother has never been tested to determine her HBsAg status, the vaccine series should be completed according to a recommended schedule for infants born to HBsAg-positive mothers (Table 3). Administration of HBIG is not necessary for these infants.
- Because of the potentially decreased immunogenicity of vaccine in preterm infants weighing <2,000 g, these infants should receive both single-antigen hepatitis B vaccine and HBIG (0.5 mL) if the mother's HBsAg status cannot be determined ≤12 hours of birth. The birth dose of vaccine should not be counted as part of the 3 doses required to complete the vaccine series; 3 additional doses of vaccine (for a total of 4 doses) should be administered according to a recommended schedule on the basis of the mother's HBsAg test result (Table 3).

Vaccination of Pregnant Women

- Pregnant women who are identified as being at risk for HBV infection during pregnancy (e.g., having more than one sex partner during the previous 6 months, been evaluated or treated for an STD, recent or current injection-drug use, or having had an HBsAg-positive sex partner) should be vaccinated.
- Pregnant women at risk for HBV infection during pregnancy should be counseled concerning other methods to prevent HBV infection.

Implementation

Delivery Hospital Policies and Procedures

- All delivery hospitals should implement policies and procedures (Box 4) to ensure 1) identification of infants born to HBsAg-positive mothers and infants born to mothers with unknown HBsAg status (see Prenatal HBsAg Testing), and 2) initiation of immunization for these infants). Such policies and procedures should include the following standing orders:
  - for all pregnant women, review of HBsAg test results at the time of admission for delivery;
  - for women who do not have a documented HBsAg test result, HBsAg testing as soon as possible after admission for delivery;

BOX 4. Delivery hospital policies and procedures to prevent perinatal HBV transmission

At time of admission for delivery

- Review hepatitis B surface antigen (HBsAg) status of all pregnant women.
- Record maternal HBsAg test results on both labor and delivery record and on infant's delivery summary sheet.
- Perform HBsAg testing as soon as possible on women who
  - — do not have a documented HBsAg test result,
  - — were at risk for HBV infection during pregnancy (e.g., more than one sex partner in the previous 6 months, evaluation or treatment for a sexually transmitted disease, recent or current injection-drug use, or HBsAg-positive sex partner), or
  - — had clinical hepatitis since previous testing.

After delivery

HBsAg-positive mothers and their infants

- Administer single-antigen hepatitis B vaccine and hepatitis B immune globulin (HBIG) to all infants born to HBsAg-positive mothers ≤12 hours after birth and record date and time of administration of HBIG and hepatitis B vaccine in infant's medical record.
- Provide information regarding hepatitis B to HBsAg-positive mothers, including
  - — advice that they may breast feed their infants upon delivery;
  - — modes of HBV transmission;
  - — need for vaccination of their susceptible household, sexual, and needle-sharing contacts;
  - — need for substance abuse treatment, if appropriate; and
  - — need for medical management and possible treatment for chronic hepatitis B.

Mothers with unknown HBsAg status and their infants

- Administer single-antigen hepatitis B vaccine (without HBIG) to all infants born to mothers with unknown HBsAg status ≤12 hours after birth and record date and time of administration of hepatitis B vaccine on infant's medical record.
- Alert infant's pediatric health-care provider if an infant is discharged before the mother's HBsAg test result is available; if the mother is determined to be HBsAg positive, HBIG should be administered to the infant as soon as possible, but no later than age 7 days.

All mothers and their infants

- Administer a dose of single-antigen hepatitis B vaccine to all infants weighing ≥2,000 g.
- Ensure that all mothers have been tested for HBsAg prenatally or at the time of admission for delivery and document test results.

At time infant is discharged

- Provide infant's immunization record to mother and remind her to take it to the infant's first visit to pediatric health-care provider.
  - — identification and management of all infants born to HBsAg-positive mothers;
  - — identification and management of all infants born to mothers with unknown HBsAg status; and
  - — for all infants, documentation on the infant's medical record of maternal HBsAg test results, infant hepatitis B vaccine administration, and administration of HBIG (if appropriate).
- Delivery hospitals should enroll in the federally funded Vaccines for Children (VFC) program to obtain free hepatitis B vaccine for administration of the birth dose to newborns who are eligible (i.e., Medicaid eligible, American Indian or Alaska Native, underinsured, or uninsured).

Case-Management Programs to Prevent Perinatal HBV Infection

- States and localities should establish case-management programs (Box 5), including appropriate policies, procedures, laws, and regulations, to ensure that
  - — all pregnant women are tested for HBsAg during each pregnancy, and
  - — infants born to HBsAg-positive women and infants born to women with unknown HBsAg status receive recommended case management.
- The location of these programs and the methods by which they operate will depend on multiple factors (e.g., population density and annual caseload of HBsAg-positive women). Programs may be located in state or local health departments, private health-care systems (e.g., health maintenance organizations), or institutions (e.g., correctional facility systems). Program administrators will need to work with prenatal care providers, delivery hospital staff, pediatric care providers, private health-care systems, and health departments.

Universal Vaccination of Infants

Recommendations

- All infants should receive the hepatitis B vaccine series as part of the recommended childhood immunization schedule (Table 5 and Appendix B). (For recommendations on management of infants born to HBsAg-positive mothers and infants born to mothers with unknown HBsAg status, see Prevention of Perinatal HBV Infection and Management of Pregnant Women.)
- For all medically stable infants weighing ≥2,000 g at birth and born to HBsAg-negative mothers, the first dose of vaccine should be administered before hospital discharge. Only single-antigen hepatitis B vaccine should be used for the birth dose.

BOX 5. Components of case-management programs to prevent perinatal hepatitis B virus infection

Test all pregnant women for hepatitis B surface antigen (HBsAg)

- Health-care providers should test all pregnant women for HBsAg during each pregnancy.
- HBsAg testing should be incorporated into standard prenatal testing panels (e.g., blood type, human immunodeficiency virus) infection, Rh factor, rubella antibody titer, and syphilis infection) used by all health-care providers caring for pregnant women.
- Delivery hospitals should ensure that all pregnant or delivering women have been tested for HBsAg before hospital discharge.
- Reporting of HBsAg test status should be included on hospital-based electronic birth certificates or neonatal metabolic screening requests.

Report and track HBsAg-positive women

- All HBsAg-positive pregnant women and all women of childbearing age with HBsAg-positive laboratory results should be reported to state or local perinatal hepatitis B prevention programs.
- All HBsAg-positive pregnant women should be entered into case-management tracking systems.

Provide prenatal HBsAg testing records to delivery hospitals

- HBsAg test results should be included on all forms (hard copy, electronic) used by practitioners to record and transmit information regarding care during pregnancy.
- For all pregnant women, a copy of the original laboratory report of HBsAg test results should be transferred from the prenatal care provider to the delivery hospital.
- Practitioners should document that HBsAg-positive pregnant women have a copy of the original laboratory report, that a copy of the original laboartory report is transferred from the prenatal care provider to the delivery hospital, and that patients are informed of their HBsAg test status and advised to notify delivery staff.

Identify and manage infants born to HBsAg-positive mothers

- Delivery hospitals should implement policies and procedures to ensure identification and initiation of postexposure immunization of infants born to HBsAg-positive mothers (see Delivery Hospital Policies and Procedures).
- Delivery hospitals should document the date and time of birth and the date and time of administration of hepatitis B immune globulin (HBIG) and hepatitis B vaccine for all infants born to HBsAg-positive mothers.

Identify and manage infants born to mothers without HBsAg test results

- Delivery hospitals should implement policies and procedures to ensure identification and initiation of postexposure immunization of infants born to mothers with unknown HBsAg status at delivery (see Delivery Hospital Policies and Procedures).
- Delivery hospitals should document the date and time of birth, date and time of administration of hepatitis B vaccine, and maternal HBsAg test results for all infants born to mothers with unknown HBsAg status at the time of delivery.

Complete the hepatitis B vaccine series

- Practitioners should document the dates of administration of all doses of the hepatitis B vaccine series for all infants born to HBsAg-positive mothers.

Complete postvaccination testing

- Health-care providers should document the results of testing for HBsAg and antibody to hepatitis B surface antigen (anti-HBs) after completion of the hepatitis B vaccine series for all infants born to HBsAg-positive mothers.

Monitor and evaluate the case management program

- Annually, each program should track
  - — the number of HBsAg-positive pregnant women;
  - — the proportion of infants born to HBsAg-positive women receiving postexposure prophylaxis ≤12 hours of birth, third vaccine dose by age 6 months, and postvaccination serologic testing for HBsAg and anti-HBs;
  - — the number of delivering women with unknown HBsAg status; and
  - — the proportion of infants born to mothers with unknown HBsAg status receiving hepatitis B vaccine within 12 hours of birth.
- Programs should determine reasons for
  - — >10% difference between expected and identified number of HBsAg-positive pregnant women;
  - — <90% completion rates for HBIG and hepatitis B vaccine ≤12 hours of birth, third dose by age 6 months, and postvaccination testing for infants born to HBsAg-positive mothers; and
  - — <90% completion rates for hepatitis B vaccine ≤12 hours of birth for infants born to mothers with unknown HBsAg status.

- On a case-by-case basis and only in rare circumstances, the first dose may be delayed until after hospital discharge for an infant who weighs ≥2,000 g and whose mother is HBsAg negative.
  - When such a decision is made, a physician's order to withhold the birth dose and a copy of the original laboratory report indicating that the mother was HBsAg negative during this pregnancy should be placed in the infant's medical record.
  - For infants who do not receive a first dose before hospital discharge, the first dose should be administered no later than age 2 months.
  - Situations in which the birth dose should not be delayed include any high-risk sexual or drug-using practices of the infant's mother during pregnancy (e.g., having had more than one sex partner during the previous 6 months or an HBsAg-positive sex partner, evaluation or treatment for an STD, or recent or current injection-drug use) and expected poor compliance with follow-up to initiate the vaccine series.
- Preterm infants weighing <2,000 g and born to HBsAg-negative mothers should have their first vaccine dose delayed until 1 month after birth or hospital discharge (Table 4). For these infants, a copy of the original laboratory report indicating that the mother was HBsAg negative during this pregnancy should be placed in the infant's medical record.
- The vaccine series should be completed according to a recommended schedule with either single-antigen vaccine or a combination vaccine that contains the hepatitis B vaccine antigen (e.g., Hib-hepatitis B or DTaP-IPV-hepatitis B) (Table 2). The final dose in the vaccine series should not be administered before age 24 weeks (164 days).
- Administration of 4 doses of hepatitis B vaccine to infants is permissible in certain situations (e.g., when combination vaccines are administered after the birth dose).
- In populations with currently or previously high rates of childhood HBV infection (i.e., Alaska Natives; Pacific Islanders; and immigrant families from Asia, Africa, and other regions with intermediate or high endemic rates of infection [Figure 1 and Box 2]), the first dose of hepatitis B vaccine should be administered at birth and the final dose at age 6–12 months.

Implementation

- All delivery hospitals should implement standing orders for administration of hepatitis B vaccination as part of routine medical care of all medically stable infants weighing ≥2,000 g at birth (Box 4).
- All delivery hospitals should implement policies and procedures for management of infants weighing <2,000 g at birth, including the following:
  - ensuring initiation of postexposure immunization of infants born to HBsAg-positive mothers and infants born to mothers not screened for HBsAg prenatally (see Prevention of Perinatal HBV Infection and Management of Pregnant Women), and
  - documentation of maternal HBsAg test results on the infant's medical record.
- Prenatal care education should include information regarding the rationale for and importance of newborn hepatitis B vaccination.
- States are encouraged to adopt regulations or laws that require hepatitis B vaccination for entry into child care and also for entry into kindergarten and/or elementary school to ensure high vaccine coverage among infants and children.

Vaccination of Children and Adolescents Who Were Not Previously Vaccinated

Recommendations

- Hepatitis B vaccination is recommended for all children and adolescents aged <19 years.
- Children and adolescents who have not previously received hepatitis B vaccine should be vaccinated routinely at any age with an appropriate dose and schedule (Tables 2 and 5). Selection of a vaccine schedule should consider the need to achieve completion of the vaccine series. In all settings, vaccination should be initiated even though completion of the vaccine series might not be ensured.

Implementation

- To ensure high vaccination coverage among children and adolescents, the following measures are recommended:
  - All children aged 11–12 years should have a review of their immunization records and should complete the vaccine series if they were not previously vaccinated or were incompletely vaccinated.
  - All children and adolescents aged <19 years (including internationally adopted children) who were born in Asia, the Pacific Islands, Africa, or other intermediate- or high-endemic countries (Figure 1 and Box 2) or who have at least one parent who was born in one of these areas should have a review of their immunization records and should complete the vaccine series if they were not previously vaccinated or were incompletely vaccinated.

— States are encouraged to adopt regulations or laws that require hepatitis B vaccination before entry into middle school or its equivalent.
— Vaccination requirements should be considered for older high school students and for students before college entry, when feasible.
— States are encouraged to expand or implement immunization registries to include adolescents.
— Hepatitis B vaccine should be offered to all unvaccinated adolescents in settings that provide health-care services to this age group (Box 6), particularly those who engage in behaviors that place them at high risk for HBV infection.

BOX 6. Health-care settings in which hepatitis B vaccine should be offered to all unvaccinated children and adolescents

Primary care clinics
Substance abuse treatment facilities
Family planning clinics
Institutions for the developmentally disabled
Juvenile correctional facilities
Nonresidential daycare facilities for the developmentally disabled
Sexually transmitted disease clinics
School-based clinics

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Note: Page 24 in the original *MMWR* article is a blank page. This has been omitted, and the next page is numbered (at the top) 25.

Appendix A

Case Finding and Management of Hepatitis B Surface Antigen (HBsAg)–Positive Persons During Delivery of Vaccination Services

Chronically infected persons are at high risk for chronic liver disease and are a major reservoir of hepatitis B virus (HBV) infection. Foreign-born persons, especially persons from Africa, Asia, and the Pacific Islands, have high* rates of chronic HBV infection. During delivery of recommended hepatitis B vaccination services (e.g., HBsAg screening of pregnant women and serologic testing to assess susceptibility), vaccination providers will identify persons who are HBsAg positive. These persons require counseling and medical management for chronic HBV infection to reduce their risk for chronic liver disease. Their susceptible household, sexual, and needle-sharing contacts also need to be vaccinated against hepatitis B.

Few programs have been implemented to identify HBsAg-positive persons, provide or refer these persons for appropriate medical management, and provide vaccination to their contacts (*1*). Extending these services to persons identified as HBsAg positive will help prevent serious sequelae in chronically infected persons and enhance vaccination strategies for elimination of HBV transmission. This Appendix addresses case finding and management of persons with chronic HBV infection in the context of vaccine delivery. The recommendations are not intended to represent a comprehensive prevention program for chronically infected persons.

Case Finding in the Context of Vaccination Service Delivery

- All foreign-born persons (including immigrants, refugees, asylum seekers, and internationally adopted children) born in Asia, the Pacific Islands, Africa, and other regions with high endemicity of HBV infection (Box A-1) should be tested for HBsAg, regardless of vaccination status.
  - — For all persons born in high-endemic countries who are applying for permanent U.S. residence, HBsAg screening and appropriate follow-up on the basis of HBsAg test results should be included as part of the required overseas premigration and domestic adjustment-of-visa status medical examination process (*2*). HBsAg-positive persons should be considered eligible for migration and adjustment-of-visa status and counseled and recommended for follow-up medical evaluation and management in U.S. resettlement communities.

* Hepatitis B surface antigen prevalence of ≥8%.

BOX A-1. Geographic areas with high* hepatitis B virus endemicity

Africa: all countries except Algeria, Egypt, Lybia, and Tunisia
South Asia: all countries except Afghanistan, Bangladesh, Bhutan, India, Malaysia, Maldives, Nepal, Pakistan, and Sri Lanka
Western Pacific: all countries except Australia, Guam, Japan, and New Zealand
Middle East: Jordan and Saudi Arabia
Eastern Europe and Newly Independent States of the former Soviet Union: Albania, Armenia, Azerbaijan, Bulgaria, Croatia, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, and Uzbekistan
Western Europe: Malta
North America: Alaska Natives and indigenous populations in Northern Canada and Greenland
South America: Amazonian areas of Bolivia, Brazil, Columbia, Peru, and Venezuela

* Hepatitis B surface antigen prevalence of ≥8%.

  - — Providers should identify children born in high-endemic countries and provide HBsAg testing and follow-up in all settings that provide health care. Retesting of persons who were tested for HBsAg in other countries should be considered.
- Other persons who should be tested for HBsAg as part of vaccination services include
  - — all pregnant women (See Prevention of Perinatal HBV Infection and Management of Pregnant Women),
  - — persons who receive prevaccination testing for susceptibility and who test positive for anti-HBc (See Prevaccination Testing for Susceptibility),
  - — hemodialysis patients, and
  - — nonresponders to vaccination (See Appendix B, Postvaccination Testing for Serologic Response).

Management of Persons Identified as HBsAg Positive

- All persons with HBsAg-positive laboratory results should be reported to the state or local health department.
- To verify the presence of chronic HBV infection, HBsAg-positive persons should be retested. The absence of immu-

noglobulin M antibody to HBcAg or the persistence of HBsAg for 6 months indicates chronic HBV infection.

- Persons with chronic HBV infection should be referred for evaluation by a physician experienced in the management of chronic liver disease (*3*). Certain patients with chronic hepatitis B will benefit from early intervention with antiviral treatment or screening to detect hepatocellular carcinoma at an early stage.
- Household, sexual, and needle-sharing contacts of chronically infected persons should be identified. Unvaccinated sex partners and household and needle-sharing contacts should be tested for susceptibility to HBV infection (see Prevaccination Serologic Testing for Susceptibility) and should receive the first dose of hepatitis B vaccine immediately after collection of the blood sample for serologic testing. Susceptible persons should complete the vaccine series using an age-appropriate vaccine dose and schedule (see Tables 2 and 6) Persons who are not fully vaccinated should complete the vaccine series.
- Sex partners of HBsAg-positive persons should be counseled to use methods (e.g., condoms) to protect themselves from sexual exposure to infectious body fluids (e.g., semen or vaginal secretions) unless they have been demonstrated to be immune after vaccination (i.e., anti-HBs $\geq$10 mIU/mL) or previously infected (anti-HBc positive).
- To prevent or reduce the risk for transmission to others, HBsAg-positive persons should be advised concerning the risks for
  - — perinatal transmission to infants born to HBsAg-positive women and the need for such infants to receive hepatitis B vaccine beginning at birth (see Prevention of Perinatal HBV Infection and Management of Pregnant Women) and
  - — transmission to household, sexual, and needle-sharing contacts and the need for such contacts to receive hepatitis B vaccine.
- HBsAg-positive persons should also be advised to
  - — use methods (e.g., condoms) to protect nonimmune sex partners from acquiring HBV infection from sexual activity until the sex partners can be vaccinated and immunity documented;
  - — cover cuts and skin lesions to prevent the spread of infectious secretions or blood;
  - — refrain from donating blood, plasma, tissue, or semen (organs may be donated to HBV-immune or chronically infected persons needing a transplant); and
  - — refrain from sharing household articles (e.g., toothbrushes, razors, or personal injection equipment) that could become contaminated with blood.
- To protect the liver from further harm, HBsAg-positive persons should be advised to
  - — avoid or limit alcohol consumption because of the effects of alcohol on the liver;
  - — refrain from beginning to take any new medicines, including over-the-counter and herbal medicines, without consulting their health-care provider; and
  - — obtain vaccination against hepatitis A if chronic liver disease is found to be present.
- When seeking medical or dental care, HBsAg-positive persons should be advised to inform those responsible for their care of their HBsAg status so they can be evaluated and their care managed appropriately.
- Other counseling messages:
  - — HBV is not spread by breastfeeding, kissing, hugging, coughing, ingesting food or water, sharing eating utensils or drinking glasses, or casual contact.
  - — Persons should not be excluded from school, play, child care, work, or other settings on the basis of their HBsAg status unless they are prone to biting (*4*).
  - — Involvement with a support group might help patients cope with chronic HBV infection.

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Appendix B

Immunization Management Issues

Hepatitis B Vaccine Dose and Administration

- Recommended vaccine doses vary by product, age of recipient, and needs of special populations (see Table 2). Administration of single-antigen or combination vaccine simultaneously with other childhood vaccines produces no clinically significant interference in antibody responses (*1–13*). Although the antigen contents of vaccines differ, vaccines made by different manufacturers are interchangeable, except for the 2-dose schedule used for adolescents aged 11–15 years, for which only Recombivax HB is approved. Combination vaccines are not approved for use as a birth dose because of potential suppression of the immune response to subsequent doses of the *Haemophilus influenzae* type b (Hib) component in Comvax (*14*) and possible decreased immunogenicity of the diphtheria component of Pediarix when administered at birth.
- Hepatitis B vaccine should be administered by intramuscular injection. Injection into the buttock is associated with decreased immunogenicity (*15–18*). Intradermal administration can result in a lower seroconversion rate and final concentration of antibody to hepatitis B surface antigen compared with intramuscular administration; limited data are available to assess long-term protection from this route of administration (*19,20*).
- The anterolateral thigh muscle is the recommended site of administration for neonates (aged <1 month) and infants (aged 1–12 months). For toddlers (aged 1–2 years) and older children, either the anterolateral thigh or the deltoid muscle may be used if the muscle mass is adequate. The deltoid muscle is the preferred site of administration for adolescents.
- For intramuscular injection, the needle should be long enough to reach the muscle mass and prevent vaccine from seeping into subcutaneous tissue, but not so long as to involve underlying nerves and blood vessels or bone (*21*). The appropriate needle length is usually $^{5}/_{8}$" for neonates, $^{7}/_{8}$"–1" for infants, and $^{7}/_{8}$"–1$^{1}/_{4}$" for toddlers, older children, and adolescents. A 22- to 25-gauge needle should be used.
- Hepatitis B vaccine administered by any route or site other than intramuscularly in the anterolateral thigh or deltoid muscle should not be counted as valid and should be repeated unless serologic testing indicates that an adequate response has been achieved (see Postvaccination Testing for Serologic Response).
- Hepatitis B vaccine and other vaccines administered during the same visit should be administered in different injection sites. When more than one injection must be administered in the same limb, the anterolateral thigh is usually the preferred site, with injections separated by 1"–2" to avoid overlap in local reactions.
- For persons at risk for hemorrhage (e.g., persons with hemophilia), the risk of bleeding after intramuscular injection can be minimized by use of a 23-gauge (or smaller) needle, application of direct pressure to the injection site for ≥2 minutes, and administration of vaccine immediately after infusion of coagulation factor. Subcutaneous administration of vaccine can be considered for these persons but might result in lower response and an increased local reaction.
- Hepatitis B vaccine should be stored at 35°–46° F (2°–8° C) and should not be frozen.
- A vaccine information statement (VIS) must be provided to recipients of hepatitis B vaccine. The National Childhood Vaccine Injury Act of 1986 (42 U.S.C. § 300aa-26) requires vaccine providers to give a copy of the most current vaccine-specific VIS to all recipients (children or their guardians) of vaccines that are included on the National Vaccine Injury Compensation Program table maintained by the Health Resources and Services Administration (available at http://www. hrsa.gov). Hepatitis B vaccine is included on this table. The most current VIS for hepatitis B vaccine is available at http://www.cdc.gov/nip/publications/vis. Statements in languages other than English are available from the Immunization Action Coalition at http://www.immunize.org.

Hepatitis B Immune Globulin (HBIG) Dose and Administration

- The standard dose of HBIG is 0.5 mL for postexposure prophylaxis of infants born to hepatitis B surface antigen (HBsAg)–positive women and 0.06 mL/kg for all other applications.
- HBIG may be administered simultaneously with hepatitis B vaccine but in a different injection site.
- HBIG is administered by intramuscular injection. For neonates (aged <1 month) and infants (aged 1-12 months),

HBIG should be administered intramuscularly in the anterolateral thigh using a 22–25-gauge needle. The appropriate needle length is usually 5/8" for neonates and 7/8"–1" for infants. For older children and adolescents, an appropriate muscle mass (i.e., deltoid or gluteal) should be chosen in which to deliver the larger volumes of HBIG required for these age groups by using a needle length appropriate for the person's age and size (*21*).
- Vaccination with certain live-virus vaccines (measles, mumps, rubella, and varicella) should be deferred for at least 3 months after administration of HBIG because HBIG can inhibit the response to these vaccines (*21*).
- HBIG should be stored at 35°–46° F (2°–8° C) and should not be frozen.

Unknown or Uncertain Vaccination Status

- A reliable vaccination history is defined as a written, dated record (personal, school, physician, or immunization registry) of each dose of a complete series.
- In the majority of clinical practice settings and in situations when postexposure prophylaxis is indicated (see Appendix C), providers should accept only written and dated records (e.g., personal, school, physician, or immunization registry) as evidence of vaccination. Although vaccinations should not be postponed if records cannot be located, providers should try to locate missing records by contacting previous health-care providers and searching for personally held records.
- Persons whose records cannot be located should be considered susceptible and started or continued on the age-appropriate vaccine schedule.
- Persons who reside in the United States but were vaccinated in other countries should be considered fully vaccinated if they have written documentation of ≥3 doses of vaccine administered at recommended minimum intervals, including the third dose at age ≥24 weeks. If they were not vaccinated according to recommended minimum intervals, they should be revaccinated (see Minimum Dosing Intervals and Management of Persons Who Were Incorrectly Vaccinated). Persons without written documentation of full vaccination should complete the age-appropriate vaccine series.

Interrupted Vaccine Schedules

- When the hepatitis B vaccine schedule is interrupted, the vaccine series does not need to be restarted.
- If the series is interrupted after the first dose, the second dose should be given as soon as possible, and the second and third doses should be separated by an interval of at least 8 weeks.
- If only the third dose is delayed, it should be administered as soon as possible, after age 24 weeks (164 days).
- It is not necessary to restart the vaccine series for infants switched from one vaccine brand to another, including combination vaccines.

Minimum Dosing Intervals and Management of Persons Who Were Incorrectly Vaccinated

- The third dose of vaccine must be administered at least 8 weeks after the second dose and should follow the first dose by at least 16 weeks; the minimum interval between the first and second doses is 4 weeks. In infants, administration of the final dose is not recommended before age 24 weeks (164 days).
- Inadequate doses of hepatitis B vaccine (see Table 2) or doses received after a shorter-than-recommended dosing interval should be readministered.

Accelerated Vaccine Schedules

- The Food and Drug Administration (FDA) has not approved accelerated schedules in which hepatitis B vaccine is administered more than once in a month. If clinicians choose to use an accelerated schedule (i.e., doses at days 0, 7, and 14 days), the patient should also receive a booster dose at least 6 months after the start of the series to promote long-term immunity.

Hemodialysis Patients and Other Immunocompromised Persons

- Standard hepatitis B vaccine doses (see Table 2) are approved by FDA for vaccination of all persons aged <20 years. For hemodialysis patients and other immunocompromised persons, higher doses might be more immunogenic, but no specific recommendations have been made.
- Serologic testing of hemodialysis patients and other immunocompromised persons is recommended 1–2 months after administration of the final dose of the primary vaccine series to determine the need for revaccination (see Postvaccination Testing for Serologic Response). In addition, booster doses of vaccine might be needed (see Booster Doses).

Prevaccination Serologic Testing for Susceptibility

- Because of the low prevalence of HBV infection among infants, children, and adolescents born in the United States, prevaccination testing for susceptibility usually is not indicated for these age groups.
- Prevaccination testing for susceptibility is recommended for unvaccinated household, sexual, and needle-sharing contacts of HBsAg-positive persons.
- Anti-HBc is the test of choice for prevaccination testing.
- Persons tested for anti-HBc and found to be anti-HBc negative are susceptible and should complete the vaccine series.
- Persons found to be anti-HBc positive should be tested for HBsAg. HBsAg testing may be performed on the same specimen collected for anti-HBc testing. If the HBsAg test result is positive, the person should receive appropriate management (see Appendix A).
- In most situations, the first vaccine dose should be administered immediately after collection of the blood sample for serologic testing.

Postvaccination Testing for Serologic Response

Recommendations for postvaccination testing of infants born to HBsAg-positive women are provided in this report (see Management of Infants Born to Women Who Are HBsAg Positive). This section provides recommendations for postvaccination testing of other persons.

- Serologic testing for immunity is not necessary after routine vaccination of infants, children, or adolescents.
- Testing after vaccination is recommended only for the following persons whose subsequent clinical management depends on knowledge of their immune status:
  - health-care workers;
  - chronic hemodialysis patients, HIV-infected persons, and other immunocompromised persons (e.g., hematopoietic stem-cell transplant recipients or persons receiving chemotherapy), to determine the need for revaccination and the type of follow-up testing; and
  - sex partners of HBsAg-positive persons, to determine the need for revaccination and the need for other methods of protection against HBV infection.
- Testing should be performed 1–2 months after administration of the last dose of the vaccine series by using a method that allows determination of a protective level of anti-HBs (≥10 mIU/mL).
- Persons found to have anti-HBs levels of ≥10 mIU/mL after the primary vaccine series are considered to be immune.
  - Immunocompetent persons have long-term protection and do not need further periodic testing to assess anti-HBs levels.
  - Immunosuppressed persons might need annual testing to assess anti-HBs levels (see Booster Doses).
- Persons found to have anti-HBs levels of <10 mIU/mL after the primary vaccine series should be revaccinated. Administration of three doses on an appropriate schedule (Table 5), followed by anti-HBs testing 1–2 months after the third dose, is usually more practical than serologic testing after one or more doses of vaccine.
- Persons who do not respond to revaccination should be tested for HBsAg.
  - If the HBsAg test result is positive, the persons should receive appropriate management, and any household, sexual, or needle-sharing contacts should be indentified and vaccinated (see Appendix A).
  - Persons who test negative for HBsAg should be considered susceptible to HBV infection and should be counseled about precautions to prevent HBV infection and the need to obtain HBIG postexposure prophylaxis for any known or likely parenteral exposure to HBsAg-positive blood (see Appendix C).

Booster Doses

- Booster doses are not recommended for persons with normal immune status who were vaccinated as infants, children, or adolescents. Serologic testing is not recommended to assess antibody levels in any age group, except in specific circumstances (see Postvaccination Testing for Serologic Response).
- For hemodialysis patients, the need for booster doses should be assessed by annual antibody to hepatitis B survace antigen (anti-HBs) testing. A booster dose should be administered when anti-HBs levels decline to <10 mIU/mL.
- For other immunocompromised persons (e.g., HIV-infected persons, hematopoietic stem cell transplant recipients, and persons receiving chemotherapy), the need for booster doses has not been determined. Annual anti-HBs testing and booster doses when anti-HBs levels decline to <10 mIU/mL should be considered in persons with an ongoing high risk for exposure.

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Appendix C

Postexposure Prophylaxis of Persons with Discrete Identifiable Exposures to Hepatitis B Virus (HBV)

This appendix provides recommendations for management of persons who are exposed to HBV through a discrete, identifiable exposure to blood or body fluids that contain blood. Recommendations for management of infants born to mothers who test positive for hepatitis B surface antigen (HBsAg)-positive mothers are provided in this report (see Prevention of Perinatal HBV Transmission and Management of Pregnant Women).

HBsAg-Positive Source

- Unvaccinated persons (Table C-1) or persons known not to have responded to a complete hepatitis B vaccine series should receive both hepatitis B immune globulin (HBIG) and hepatitis B vaccine as soon as possible after exposure (preferably ≤24 hours). For sexual exposures, HBIG should not be administered more than 14 days after exposure. Hepatitis B vaccine may be administered simultaneously with HBIG in a separate injection site. The hepatitis B vaccine series should be completed using the age-appropriate vaccine dose and schedule (see Tables 2 and 3).
- Persons who are in the process of being vaccinated but who have not completed the vaccine series should receive the appropriate dose of HBIG and should complete the vaccine series.
- Children and adolescents who have written documentation of a complete hepatitis B vaccine series and who were did not receive postvaccination testing should receive a single vaccine booster dose.

Source with Unknown HBsAg Status

- Unvaccinated persons (Table C-1) should receive the hepatitis B vaccine series with the first dose initiated as soon as possible after exposure, preferably ≤24 hours. The vaccine series should be completed using the age-appropriate dose and schedule (see Tables 2, 3, and 5).
- Persons who are not fully vaccinated should complete the vaccine series.
- Children and adolescents with written documentation of a complete hepatitis B vaccine series require no further treatment.

TABLE C-1. Guidelines for postexposure immunoprophylaxis of unvaccinated persons who are exposed to blodo or body fluids that contain blood

Cause	Action
Discrete exposure to an HBsAg*-positive source	
Percutaneous (e.g., bite, needlestick) or mucosal exposure to HBsAg-positive blood or body fluids that contain blood	Administer hepatitis B vaccine and hepatitis B immune globulin (HBIG)†
Sexual or needle-sharing contact of an HBsAg-positive person	Administer hepatitis B vaccine and HBIG†
Victim of sexual assault/abuse by a perpetrator who is HBsAg-positive	Administer hepatitis B vaccine and HBIG†
Discrete exposure to a source with unknown HBsAg status	
Victim of sexual assault/abuse by a perpetrator with unknown HBsAg status	Administer hepatitis B vaccine†
Percutaneous (e.g., bite or needclestick) or mucosal exposure to blood or body fluids that contain blood from a source with unknown HBsAg status	Administer hepatitis B vaccine†

* Hepatitis B surface antigen.
† Immunoprophylaxis should be administered as soon as possible, preferably ≤24 hours. Studies are limited on the maximum interval after exposure during which postexposure prophylaxis is effective, but the interval is unlikely to exceed 7 days for percutaneous exposures and 14 days for sexual exposures. The hepatitis B vaccine series should be completed.

Glossary

Terms and Abbreviations Used in This Report

ACIP	Advisory Committee on Immunization Practices
ALT	alanine aminotransferase
Anti-HBc	antibody to hepatitis B core antigen
Anti-HBe	antibody to hepatitis B e antigen
Anti-HBs	antibody to hepatitis B surface antigen
DTaP	diphtheria and tetanus toxoids and acellular pertussis adsorbed
FDA	Food and Drug Administration
HBcAg	hepatitis B core antigen
HBeAg	hepatitis B e antigen
HBIG	hepatitis B immune globulin
HBsAg	hepatitis B surface antigen
HBV	hepatitis B virus
HCC	hepatocellular carcinoma
HCV	hepatitis C virus
Hib	*Haemophilus influenzae* type b
HIV	human immunodeficiency virus
IgM	immunoglobulin M
IPV	inactivated poliovirus
MS	multiple sclerosis
NHANES	National Health and Nutrition Examination Survey
VAERS	Vaccine Adverse Events Reporting System
VSD	Vaccine Safety Datalink

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Gaps in Hospital Policies and Practices to Prevent Perinatal Transmission of Hepatitis B Virus

The following article, published in *Pediatrics* in April 2010, reports on a survey of perinatal hepatitis B prevention policies in 190 delivery hospitals across the United States. The study examined how well hospitals implemented national ACIP recommendations for perinatal hepatitis B virus (HBV) prevention. Survey results reveal serious gaps in hospital policies and practices regarding perinatal HBV transmission. The study concludes that **"efforts to avoid medical errors through appropriate implementation and monitoring of hospital practices are needed to eliminate perinatal HBV transmission."**

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Bayo C. Willis, Pascale Wortley, Susan A. Wang, Lisa Jacques-Carroll and Fan Zhang

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Gaps in Hospital Policies and Practices to Prevent Perinatal Transmission of Hepatitis B Virus

WHAT'S KNOWN ON THIS SUBJECT: In the United States, an estimated 1.4 million people have chronic HBV infection, causing 2000 to 4000 deaths annually. Newborn HepB administration is a key intervention to prevent perinatal HBV transmission and morbidity and mortality caused by chronic HBV infection.

WHAT THIS STUDY ADDS: This study examined how well national recommendations for perinatal HBV prevention advocated by the CDC and the ACIP are implemented by hospitals. It also reveals considerable gaps in hospital policies and practices that need to be addressed.

abstract

OBJECTIVE: The objective of this study was to examine hospital policies and practices to prevent perinatal transmission of hepatitis B virus (HBV) in the United States and to and identify gaps.

METHODS: In March 2006, a nationally representative sample of 242 delivery hospitals in the 50 states, District of Columbia, and Puerto Rico (with at least 100 annual births) were surveyed about hospital perinatal hepatitis B prevention policies and asked to review paired maternal–infant medical records for 25 consecutive live births. Main outcome measures were hospital policies related to the prevention of perinatal transmission of hepatitis B and the proportion of infants who received recommended care.

RESULTS: A total of 190 of 242 hospitals responded to the survey and completed medical record reviews for 4762 mothers and 4786 infants. The proportion of hospitals that reported each of the 6 policies examined ranged from 63.0% to 80.6%. Among infants who were born to the 18 hepatitis B surface antigen (HBsAg)-positive women with documented prenatal test results, 62.1% received both hepatitis B vaccine and hepatitis B immunoglobulin within 12 hours, but 13.7% were unvaccinated and 19.7% did not receive hepatitis B immunoglobulin before hospital discharge. Among infants who were born to the 320 women with unknown HBsAg status, only 52.4% were vaccinated within 12 hours of birth and 20.1% were unvaccinated before discharge. Among infants who were born to HBsAg-negative mothers, 69.1% received the hepatitis B vaccine before hospital discharge. The strongest predictor of vaccine administration was having a written hospital policy for newborn hepatitis B vaccination.

CONCLUSIONS: These findings indicate that significant gaps persist in hospital policies and practices to prevent perinatal HBV transmission in the United States. Efforts to avoid medical errors through appropriate implementation and monitoring of hospital practices are needed to eliminate perinatal HBV transmission. *Pediatrics* 2010;125:704–711

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KEY WORDS

immunization, perinatal hepatitis B virus, hepatitis B vaccine

ABBREVIATIONS

HBV—hepatitis B virus
CDC—Centers for Disease Control and Prevention
HBsAg—hepatitis B surface antigen
PEP—postexposure prophylaxis
HepB—hepatitis B vaccine
HBIG—hepatitis B immunoglobulin
ACIP—Advisory Committee on Immunization Practices
AHA—American Hospital Association
CI—confidence interval
NIS—National Immunization Survey

All authors are responsible for the reported research. All authors participated in the concept and design, analysis and interpretation of data, and drafting or revising of the manuscript and have approved the manuscript as submitted.

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The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

The assessment protocol was reviewed by the CDC National Center for Immunization and Respiratory Diseases Human Subjects Contact and determined to be a nonresearch assessment of public health practice.

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In the United States, an estimated 1.4 million people have chronic hepatitis B virus (HBV) infection, which is the underlying cause of 2000 to 4000 deaths annually.[1] Two primary modes of HBV transmission occur during infancy: infected mother to newborn during delivery and infected household contact to infant. In contrast to adults with an ~5% risk for chronic HBV infection once infected, infants have an ~90% risk for developing chronic HBV infection and when chronically infected have a 25% risk for dying prematurely of cirrhosis or liver cancer. An estimated 24 000 HBV-infected US women give birth annually (Centers for Disease Control and Prevention [CDC], unpublished data, 2004). Prenatal screening of all pregnant women is recommended to identify hepatitis B surface antigen (HBsAg)-positive women before giving birth to ensure that their newborns can receive postexposure prophylaxis (PEP).[2] PEP includes the administration of hepatitis B vaccine (HepB) and hepatitis B immunoglobulin (HBIG) to newborns within 24 hours of birth and is 85% to 95% effective in preventing HBV transmission; HepB administration alone within the same time frame is 70% to 95% effective.[3,4] Hepatitis B vaccination of newborns also provides preexposure protection to infants born to uninfected women when, if HBV exposure were to occur, the risk for developing chronic HBV infection is greatest. Newborn HepB administration is a key intervention to prevent perinatal HBV transmission and the subsequent morbidity and mortality that are caused by chronic HBV infection.[5]

Despite the availability of PEP, infants continue to become infected. Approximately 40 to 90 perinatal HBV infections are reported to the CDC annually,[6,7] although the true number of annual perinatal HBV infections may be 10 to 20 times higher.[7] Perinatal HBV infections may occur as a result of various health care errors, including prenatal testing and reporting, failure to test all women who are admitted to delivery hospitals without prenatal HBsAg test results, lapses in reporting and documentation of HBsAg test results in maternal and newborn medical records,[8] and failure to administer timely PEP.

The delivery hospital is the critical point for implementing perinatal HBV prevention activities; it is the safety net for ensuring that HBV-infected women are identified at delivery and it is where time-sensitive PEP must be delivered to the newborn. Delivery hospitals also play an important role in reporting HBsAg-positive women to health departments to ensure that infants complete the HepB series, undergo postvaccination serologic testing, and, if infected, are referred for evaluation and care. In December 2005, the Advisory Committee on Immunization Practices (ACIP) published recommendations to address the remaining challenges in prevention of perinatal transmission of HBV.[4] To assess hospital policies and practices pertaining to perinatal HBV prevention, we conducted a nationally representative assessment that included a survey of hospital policies and medical record reviews.

METHODS

Sample Selection

The target population included all delivery hospitals in the 50 states, District of Columbia, and Puerto Rico as identified in the 2003 American Hospital Association (AHA) annual survey. Fifty-two percent of all hospitals (n = 3102) were eligible for selection based on number of births (>100 annually), accounting for 99.5% of births reported by hospitals in the AHA survey. With simple random sampling, a sample size of 200 hospitals was needed to estimate the proportion of hospitals reporting a given policy with a 95% confidence interval (CI) ± 7 percentage points. We allocated the sample size across 51 strata (50 states plus 1 stratum containing Washington, DC, and Puerto Rico) proportional to the number of hospitals in each stratum. When the number of hospitals allocated to a given stratum was <2, the selection of 2 was forced to calculate variance estimation on the basis of the sample design. We sampled 254 hospitals to allow for an ~80% response rate. Hospitals were contacted to verify provision of delivery services and to identify a contact person for survey receipt. Twelve hospitals did not provide delivery services, leaving a final sample of 242.

Hospital Policy Survey

The hospital policy survey was sent in March 2006 to nursing supervisors or clinical nurse managers of the selected hospital nurseries. The survey ascertained whether written policies regarding the following aspects of perinatal HBV prevention existed: review of maternal HBsAg test results during admission to labor and delivery units, testing on admission for women without documented prenatal HBsAg test results, management of infants who were born to women of HBsAg-positive and unknown status, and HepB administration to all newborns before discharge. Additional characteristics such as geographic location (ie, rural or urban [outside or within a metropolitan statistical area]), hospital affiliation type (medical school/residency training programs) and hospital funding type (for profit/not for profit) were obtained from the AHA survey.

Medical Record Review

Each sampled hospital was asked to review paired maternal and infant medical records for 25 consecutive

live births between October 2005 and March 2006. Maternal medical record data collected included demographics (age, race/ethnicity, health insurance type), attending provider type, documentation of results of HBsAg testing during pregnancy and on admission, and admission time/date. Data collected from the infant medical record included time/date of birth, birth weight, administration time/date of infant HepB and HBIG, and documentation of maternal HBsAg test result.

Data Collection

Hospital survey and medical record data were collected by the designated hospital contact, state or local health department staff, or, in the majority of cases, a combination of both. The majority of participating health department staff provided assistance by conducting follow-up telephone calls to ensure survey receipt and completion.

Data Analysis

We conducted the following descriptive analyses: (1) prevalence of policies regarding prevention of perinatal HBV transmission; (2) factors that were associated with prenatal testing; (3) prevalence of maternal HBV infection; (4) HepB and HBIG receipt within 12 hours of delivery for infants who were born to women with HBsAg-positive or unknown status, according to ACIP recommendations[4]; and (5) maternal and facility characteristics associated with HepB receipt at birth. We also compared maternal HBsAg test results that were documented in the maternal medical record from prenatal and on-admission testing, as well as maternal results that were documented in the infant's medical record.

Among mother–infant pairs with any mention of a positive maternal HBsAg test result, we defined 2 subsets. First, for estimation of the national prevalence of HBV infection, pregnant women were considered infected when they had documentation of a positive HBsAg test result prenatally or on admission and when there were no contradictory results in any records (eg, women who were HBsAg-positive prenatally but HBsAg-negative according to infant medical record were excluded). Second, for assessment of management of infants of HBsAg-positive mothers who were identified prenatally, data on all infants whose mothers had a documented HBsAg-positive prenatal test result were included.

Hospital survey data were weighted according to inverse probability of hospital selection and adjusted for nonresponse. For data analysis of mother–infant pairs, hospitals were identified as primary sampling units and results were weighted according to the number of annual live births in the respective hospitals. Analyses were conducted by using SUDAAN 903 to account for the stratified survey design. Weighted proportions and raw numbers are reported throughout.

RESULTS

Response Rate

Of 242 sampled hospitals, 190 (78.5%) completed the policy survey and medical record review. Hospital response rates by state ranged from 0% to 100% (100% of sampled hospitals in 32 states, 75%–99% in 8 states, 50%–74% in 8 states, 28% in 1 state, and 0% [among 12 hospitals] in 3 states). The median number of responding hospitals by state was 3 (range: 1–10). There were no statistically significant differences between responding and nonresponding hospitals regarding annual number of live births, hospital funding type (profit/not for profit) and urban/rural location. Medical record reviews were completed for 4762 mothers and 4786 infants (24 twins) who were born January 2005 through December 2006.

Policies for Perinatal Hepatitis B Prevention

The proportion of hospitals reporting each of the 6 policies examined ranged from 63.0% to 80.6% (Table 1). Most hospitals reported having policies for administration of HBIG (77.2% [95% CI: 70.7–82.6]) and HepB to infants who were born to HBV-infected women (80.6% [95% CI: 74.1–85.7]). Policies for testing on admission of women who were admitted with unknown HBsAg test results (63.0% [95% CI: 56.0–69.4]) and policies for universal HepB administration to newborns before hospital discharge (67% [95% CI: 59.1–73.5]) were reported least frequently.

Maternal Characteristics and HBsAg Screening

The majority of the 4762 women were white, privately insured, and 18 to 25 years of age (Table 2). Prenatal HBsAg test results were documented in 92.6% (95% CI: 90.4–94.3) of maternal medical records and varied little by demographic characteristic. HBsAg test results were documented by copy of the laboratory report in 12.8% (95% CI: 9.6–16.9) of maternal medical records reviewed; documentation in the re-

TABLE 1 Prevalence of Hospital Policies That Pertain to Prevention of Perinatal Hepatitis B Transmission ($n = 190$)

Policy	*n*	Wt% (95% CI)
Review prenatal HBsAg test on admission	133	72.9 (66.3–78.6)
Test pregnant women on admission if no documented HBsAg test result	118	63.0 (56.0–69.4)
Give HBIG to exposed infants within 12 h	145	77.2 (70.7–82.6)
Give hepatitis B vaccine to exposed infants within 12 h	152	80.6 (74.1–85.7)
Give HepB to infants of mothers of unknown status within 12 h	133	70.3 (63.3–76.5)
Universal hepatitis B vaccination of newborns before hospital discharge	127	67.0 (59.1–73.5)

TABLE 2 Demographic Characteristics of Mothers Sampled and Proportion Screened During Pregnancy by Demographic Characteristic

Maternal Characteristic	Sample		Documented Prenatal HBsAg Test Result	
	n	Wt % (95% CI)	*n*	Wt% (95% CI)
Race/ethnicity				
White	2893	47.5 (41.2–53.9)	2742	95.1 (93.1–96.5)
Black	600	15.2 (12.1–19.0)	527	88.9 (84.1–92.4)
Asian	129	4.1 (2.8–6.0)	126	95.6 (86.8–98.6)
Hispanic	657	24.5 (17.8–32.6)	592	88.9 (84.9–92.0)
Other/unknown	483	8.7 (6.1–12.2)	457	94.7 (90.7–97.0)
Insurance status				
Private	2304	52.4 (46.5–58.3)	2195	95.9 (94.4–97.0)
Medicaid	2055	37.2 (32.4–42.3)	1892	89.0 (85.0–92.1)
Other/unknown	403	10.3 (7.0–15.0)	357	89.0 (81.8–93.6)
Maternal age at time of infant birth, y				
<18	179	3.7 (2.8–4.8)	160	90.3 (81.3–95.2)
18–25	2101	37.2 (34.3–40.5)	1948	90.1 (86.6–92.7)
26–30	1243	27.2 (24.9–30.0)	1163	92.8 (90.0–95.0)
>30	1219	29.1 (28.2–35.3)	1157	95.8 (93.1–97.4)
Hospital location				
Rural	1816	10.4 (7.6–14.1)	1718	95.3 (93.3–96.7)
Urban	2946	89.6 (85.9–92.4)	2726	92.3 (90.0–94.2)

maining 79.8% of maternal records was through clinical notes. Of 318 women without a documented prenatal test result, 57.3% (95% CI: 46.9–67.1) were tested on admission; overall, 96.8% of women had documented HBsAg test results. Among women without prenatal test documentation, the proportion tested on admission varied widely across states, ranging from 0% to 100%, with a median of 25%.

Prevalence of Maternal HBV Infection

Twenty-one women had documentation of a positive HBsAg prenatal test ($n = 18$) or tested positive on admission ($n = 3$) for an overall weighted prevalence of 0.9% (95% CI: 0.5–1.8). This prevalence estimate is based on test results for 96.8% of the sample; 174 women had neither documentation of a prenatal HBsAg test result nor a test on admission.

Management of Infants Who Were Born to Women With HBsAg-Positive and HBsAg-Unknown Status

Of the 18 infants who were born to HBsAg-positive women with a documented positive HBsAg prenatal test, 13 (67.1% [95% CI: 35.3–88.4]) received HepB within 12 hours of birth and 11 (62.1% [95% CI: 31.8–85.2]) received both HBIG and HepB within 12 hours. Two infants (13.7% [95% CI: 2.4–51.1]) did not receive HepB, and 5 infants (19.7% [95% CI: 5.3–51.8]) did not receive HBIG before discharge.

Among 320 infants who were born to women without documented prenatal HBsAg test results, 150 (52.4% [95% CI: 39.5–64.9]) were vaccinated within 12 hours of birth and 67 (20.1% [95% CI: 11.0–33.8]) were not vaccinated before discharge. Only 4 (1.9% [95% CI: 0.4–8.5]) of 41 infants who weighed <2000 g and were born to women of unknown HBsAg status received HBIG (Table 3).

Documentation of Maternal HBsAg Status and Discrepant Test Results

Table 4 provides data for 27 women with a documented HBsAg positive test result from any source. In 15 cases, the maternal test results in the infant medical record were discrepant or missing.

Universal Newborn HepB Vaccination

Overall, 68.7% (95% CI: 59.4–76.6) of infants received HepB at birth. Most strongly associated with vaccine administration was having a written hospital policy for HepB administration at birth and hospital location in a state with a universal birth dose policy.[9] Other significant factors included maternal insurance carrier (Medicaid), hospital affiliated with a medical residency program, and rural location (Table 5).

TABLE 3 Management of Infants Who Were Born to HBsAg-Positive Mothers and Mothers With Unknown HBsAg Status

Parameter	*n*	No Administration		≤12 h		>12 h		Administration, Unknown Time	
		n (Wt %)	95% CI	*n* (Wt %)	95% CI	*n* (Wt %)	95% CI	*n* (Wt %)	95% CI
HepB administration									
Born to HBsAg positive mothers[a]	18	2 (13.7)	2.4–51.1	13 (67.1)	35.3–88.4	1 (10.8)	1.5–49.3	2 (8.4)	1.4–37.6
Mother unknown status[b]	320	67 (20.1)	11.0–33.8	150 (52.4)	39.5–64.9	67 (15.3)	10.1–22.4	36 (12.3)	6.2–23.0
HBIG administration									
Born to HBsAg positive mothers[a]	18	5 (19.7)	5.3–51.8	11 (62.1)	31.8–85.2	1 (10.8)	1.5–49.3	1 (7.5)	1.0–39.2
<2000 g mother unknown status[b]	41	37 (98.1)	91.5–99.6	3 (1.3)	0.3–5.8	0 (0.0)	0	1 (0.6)	0.1–4.5

[a] Infants whose mothers had a documented positive prenatal test, regardless of subsequent notations in the medical record (see Table 4).
[b] Infants who were born to mothers with no documentation of prenatal HBsAg test result.

TABLE 4 Documentation of Maternal HBsAg Status: Comparison of Prenatal Test Results, Results of Tests Performed on Admission to Labor and Delivery Unit, and Test Results as Documented in Infant's Medical Record for 27 Mother–Infant Pairs With Any Mention of Positive Maternal HBsAg Test Results

Prenatal HBsAg Test Result (Maternal Record)	HBsAg Test Result on Admission (Maternal Record)	Maternal HBsAg Status (Infant Record)	*n*	No. of Infants Who Received HepB		No. of Infants Who Received HBIG
				At ≤12 h	At >12 h	
Positive[a,b]	Not documented	Positive	12	10	2[c]	1
Positive[a,b]	Not documented	Not documented	3	1	0	1
Negative[a]	Positive	Not documented	3	2	0	0
Negative	Not documented	Positive	3	2	1	0
Not documented	Negative	Positive	2	1	1	0
Positive[b]	Not documented	Negative	2	2	0	0
Positive[b]	Negative	Negative	1	0	0	0
Not documented	Not documented	Positive	1	0	0	0

[a] Cases included in estimate of percentage of mothers infected.
[b] Cases included in Table 3, infants who were born to HBsAg-positive mothers.
[c] Includes 1 infant who received birth dose but for whom time of receipt was not documented.

DISCUSSION

We conducted a national survey of hospitals to determine policies for prevention of perinatal HBV transmission and conducted medical record reviews for almost 5000 mother–infant pairs. Our findings document gaps in prevention of perinatal HBV transmission that illustrate the importance of fully implementing the 2005 ACIP recommendations to prevent perinatal HBV transmission. Although prenatal HBsAg screening rates are high and consistent with past studies conducted in selected areas,[10–12] they could be improved among selected groups, including, black and Hispanic individuals and those who have Medicaid. Furthermore, substantial gaps exist for hospital policies aimed at preventing perinatal HBV transmission. In addition, gaps exist in hospital practices for testing women who are admitted with unknown status and managing infants who are born to mothers with an HBsAg-positive or unknown test result.

Policies that are specific to various aspects of prevention of perinatal HBV transmission were absent in up to one third of hospitals. Previous national data on policies examined in this survey are available only for screening of women who present with unknown status. Two studies conducted in 1993 estimated that 51% and 56% of hospitals had policies to perform HBsAg testing of women with unknown status, as compared with the 63% of hospitals in this survey.[13,14] Data from the medical record review showed that the presence of policies was not uniformly associated with the outcome targeted by the policy. Specifically, although administration of HepB to all newborns was significantly associated with having a hospital policy for newborn vaccination, no association was observed for administration of HepB to infants who were born to women of unknown HBsAg status, and a nonsignificant association was observed for testing pregnant women on admission without documentation of prenatal HBsAg test results. This lack of consistency reflects gaps in implemented policies and highlights the importance of monitoring clinical practices and assessing performance indicators through hospital-based quality assurance reviews.

With respect to screening practices, although screening prenatally has become the norm, this is not true for screening women who are admitted without documented prenatal HBsAg results. A small proportion of women are admitted without test results and are not tested on admission. Hospitals in 3 states had high testing rates for such women, including those in Texas, where testing of all women who present for delivery is mandated. Reasons for the high testing rates in the 2 other states are unclear.

Management of HBV-exposed infants and infants born to women with unknown HBsAg status was suboptimal in this study. For HBV-exposed infants, comparisons with past studies are difficult because the number of HBV-exposed infants in this study and others is small. In the study by Yusuf et al,[13] 9 of 12 exposed infants were vaccinated and 8 of 12 received HBIG (timing unspecified). In the study by Pierce et al,[10] 7 of 9 were vaccinated within 24 hours (HBIG administration not reported). Administration of HepB to infants who were born to women with unknown HBsAg status was higher in this study than in that reported by Yusuf et al (22%). Administration of HBIG to infants who weighed <2000 g and were born to women with unknown status was very low in this study. Whereas the American Academy of Pediatrics has recommended that these infants receive HBIG since 1997,[15] the ACIP adopted the recommendation only in 2005.[4]

Errors in the transcription of maternal HBsAg status have been well documented[8]; as a result, the revised 2005 ACIP statement recommends that a copy of the original laboratory report indicating HBsAg status be included in both the maternal and infant medical records. Of the 27 mother–infant pairs in our sample with any documentation of a positive maternal HBsAg test result (Table 4), maternal results in the infant medical records were discrepant or missing for 15, demonstrating a medical documentation error rate of >50%. This is alarming, particularly when one considers that these errors were identified only among mother–infant pairs with any documentation of

TABLE 5 Factors Associated With Newborn Hepatitis B Vaccination

Characteristic	Newborns Who Received Vaccine		*P*
	n/*N*[a]	Wt% (95% CI)	
Mother's race/ethnicity			.5000
White non-Hispanic	1917/2710	65.7 (57.6–72.9)	
Black non-Hispanic	457/541	75.8 (61.0–86.2)	
Asian	96/128	63.2 (38.7–82.3)	
Hispanic	449/626	72.6 (54.2–85.6)	
Other/unknown	329/450	63.4 (42.5–80.2)	
Insurance status			.0300
Private	1510/2163	63.2 (52.1–73.1)	
Medicaid	1468/1916	75.3 (66.5–82.4)	
Other/unknown	270/376	71.1 (50.6–85.5)	
Maternal age at time of infant birth, y			.4000
<18	123/157	70.8 (55.0–82.8)	
18–25	1479/1959	71.7 (62.5–79.4)	
26–30	845/1179	65.7 (54.2–75.6)	
≥31	788/1141	67.5 (57.1–76.4)	
Hospital has written policy for universal dose of birth HepB			<.0001
Yes	2549/2910	87.2 (76.0–93.6)	
No	682/1520	38.4 (27.2–51.0)	
No. of births per year			.5000
<350	831/1106	74.5 (61.7–84.1)	
≥350 and <700	869/1178	76.5 (67.0–83.9)	
≥700 and <2000	838/1053	73.9 (59.6–84.4)	
≥2000	710/1118	65.6 (51.9–77.1)	
Highest level of neonatal care			.7000
Basic care	1564/2119	64.1 (43.9–80.3)	
Specialty care	995/1379	65.1 (50.7–77.2)	
Subspecialty care (neonatal intensive care)	664/932	72.5 (57.2–83.9)	
Attending provider			.7000
Obstetrician	2406/3265	69.2 (58.7–78.0)	
Family physician	517/704	68.9 (54.8–80.2)	
Other/unknown	325/486	64.9 (54.3–74.2)	
Hospital contains medical residency program			.0100
Yes	708/945	80.4 (69.8–87.9)	
No	2540/3510	61.8 (50.0–72.4)	
Hospital geographic location			.0300
Rural	1313/1684	81.6 (73.1–87.8)	
Urban	1935/2771	67.2 (56.9–76.0)	
Hospital funding type			.5900
For profit	400/546	63.0 (37.0–83.2)	
Not for profit	2848/3909	70.0 (60.3–78.2)	
State with universal birth dose supply policy[b]			.0001
Yes	1718/2155	83.9 (77.6–88.6)	
No	1461/2225	57.9 (44.6–70.2)	
Total	3248/4455[c]	68.7 (59.4–76.6)	

[a] Totals may vary; missing and "don't know" responses were excluded.
[b] Policy to provide the newborn HepB dose at no cost to all infants, regardless of insurance status.
[c] Infants who weighed <2000 g at birth and were born to HBsAg-negative mothers were excluded.

a positive maternal HBsAg test result and thus may represent only more readily identified errors. It is possible that additional HBsAg documentation errors could be discovered among mother–infant pairs without any documentation of a positive HBsAg test result where positive test results were consistently documented as negative or omitted altogether; however, uncovering these types of errors are more labor-intensive. As expected, a minority (16%) of hospitals documented maternal HBsAg status by placing a copy of the original laboratory report in the medical record. Infants who were born to women with inconsistencies in documented HBsAg status were less likely to receive prophylaxis, which has been reported previously.[10]

The strongest predictor of newborn HepB receipt was having a written hospital policy for HepB administration at birth, highlighting the importance of such policies. Newborn HepB coverage was higher in this study (69%) than that reported in the 2007 National Immunization Survey (NIS) where 53.2% of newborns were vaccinated by the third day of life.[16] Infants who were included in the 2007 NIS were born January 2004 through June 2006, and infants who were included in this study were born January 2005 through December 2006. A potential reason for the difference between these 2 estimates is that this study included data that were collected directly from infant hospital medical records, whereas in the NIS, vaccination coverage was obtained from outpatient pediatric provider medical records. The latter might not always have records of hospital-administered HepB. Random error and systematic biases in either survey may also contribute to the differences.

The estimated HBsAg-positive prevalence among pregnant women in this assessment was 0.9% (95% CI: 0.5–1.8) compared with 0.4% (95% CI: 0.2–0.8) in the 1993 study[13]; however, this difference is not statistically significant. Given differences in the proportion of mothers with known HBsAg status between the 2 assessments and discrepancies in HBsAg test result documentation discussed, ascertainment of true infection rate from a medical record review is challenging.

There is a growing need for implementation of perinatal HBV prevention practices by delivery hospitals given that the number of births to foreign-born women is increasing. In 2004, 24% of all US births were to foreign-born women compared with 18% in 1993.[17] In addition, immigra-

tion from countries with high endemicity has increased.[1,18]

There are certain limitations to these findings. First, personnel who conducted data collection varied, with the majority of medical record abstractions conducted by health department staff and the remainder by hospital personnel. Second, although the overall response rate was high, 2 large states, California and Texas, had low hospital participation rates, which could affect the representativeness of the data. Third, this study was not designed to follow infants who were born to HBsAg-positive mothers to determine perinatal HBV infection rate.

CONCLUSIONS

Given the existence of highly effective PEP, perinatal HBV transmission can be almost entirely prevented, but gaps in the delivery hospital prevention policies and practices persist. Universal newborn HepB vaccination, together with timely administration of appropriate prophylaxis to infants who are born to HBsAg-positive women and women of unknown HBsAg status, are essential hospital clinical practices for preventing perinatal HBV infections. In October 2008, the National Quality Forum endorsed 2 perinatal care performance measures specific to HepB,[19] 1 to monitor hospital newborn HepB coverage and a second to monitor the proportion of infants who are born to HBsAg-positive women and receive timely and appropriate prophylaxis in delivery hospitals. Although use of National Quality Forum performance measures is a promising step toward closing the persistent hospital gaps for perinatal HBV prevention in the United States, considerable work remains.

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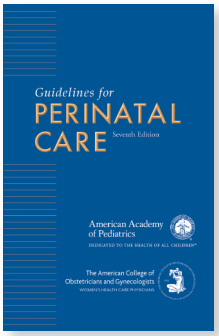

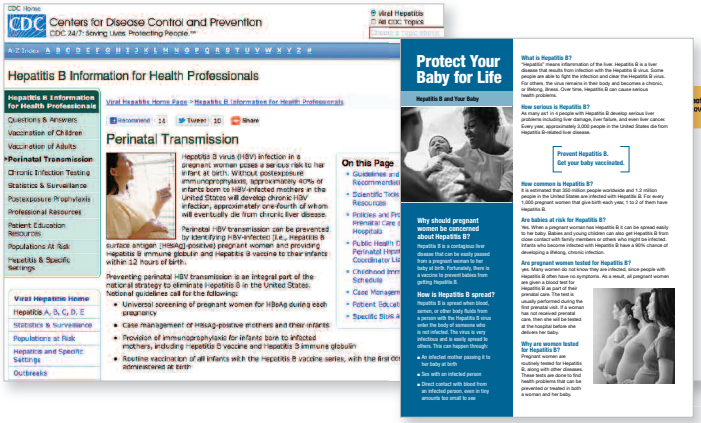

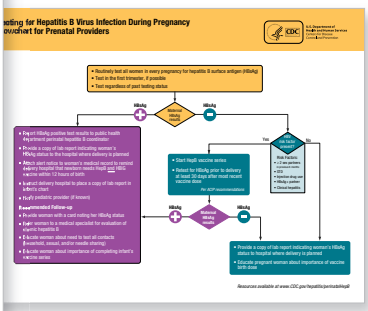

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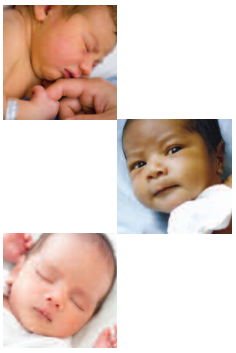

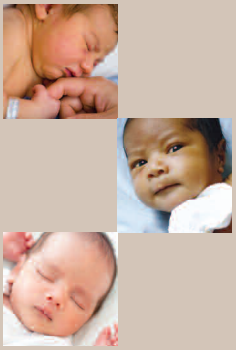

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