Haemophilus influenzae type b (Hib) is a bacterium capable of causing serious infection, primarily in children. These bacteria exist in two forms: non-encapsulated and encapsulated.

- Non-encapsulated forms of the bacteria are commonly carried in the upper respiratory passages and can cause ear infections, acute exacerbations of chronic obstructive pulmonary disease (COPD), and a number of other infections that are generally not life-threatening.

- Encapsulated Haemophilus influenzae comes in six types designated by letters “a” through “f”. Type b (Hib) causes 95% of serious invasive infections, including blood infections, meningitis, epiglottitis, cellulitis, pneumonia, arthritis, osteomyelitis (infection of the bone), and pericarditis (infection of membrane surrounding the heart). Children from the ages of 2-4 months to 2-3 years are most susceptible to these infections. Native American and Alaskan children have a 10-fold increase of invasive Hib disease.

**Hib Infection in Children**

**Meningitis**

Approximately two-thirds of all cases of invasive Hib disease present as meningitis, an infection of the membrane surrounding the brain and spinal cord. Initial symptoms of meningitis may be similar to a common upper respiratory infection and can progress to include fever, a stiff neck, headache, nausea, vomiting, and a change in mental status such as confusion or disorientation. Infants may have a bulging fontanel or “soft spot”. Occasionally these symptoms can progress very rapidly, leading to death in only a few hours. For this reason anyone suspected of having meningitis must be promptly evaluated by a medical professional. People suspected of having meningitis will undergo lumbar puncture (spinal tap) for inspection and culture of cerebrospinal fluid so the exact bacterial cause can be identified. Meningitis causes death in 2-5% of all cases, even with treatment. Permanent neurological damage occurs in 15-30% of all children with meningitis, including hearing loss, mental retardation, vision loss, seizure disorders, and speech and motor delays.

**Epiglottitis**

Epiglottitis is an infection of the upper airway that causes swelling of the tissue that covers and protects the larynx when swallowing. This infection is seen most often in children between the ages of 2-5 years. Symptoms of fever and sore throat develop quickly, followed within hours by difficulty with speech, swallowing, and breathing. Airway obstruction can cause children to make harsh, high-pitched breathing sounds known as stridor. A child with epiglottitis appears quite ill and often leans forward with mouth opened and jaw thrust forward in an effort to open the blocked airway.
**Cellulitis**

Cellulitis or infection of the skin due to Hib is seen most often in children less than two years of age. Infection occurs most often on the face and especially on the cheeks or around the eye.

**Other Infections**

Other less common infections caused by Hib include: pneumonia; septic arthritis, or joint infection; osteomyelitis, or bone infection; and pericarditis, or infection of the membrane surrounding the heart.

**Hib in Adults**

Hib vaccines were not developed until the 1980s. Most adults are immune to infection with Hib, probably because they formed protective antibodies to the bacterium after childhood exposure.

Adults considered at increased risk of serious infection for Hib include:

- individuals who have had their spleens removed;
- persons with compromised immune systems due to HIV or AIDS, cancer, organ transplant, etc.;
- those with diabetes and chronic respiratory disease;
- the elderly;
- persons institutionalized or living in crowded situations, such as shelters or dormitories.

**Transmission**

Hib is thought to spread via respiratory droplets (coughing) and nasal secretions (sneezing). Some people, known as carriers, have no symptoms and never become sick, but are still capable of spreading Hib. Sharing drinking glasses, cigarettes, infant toys, bottles, and other objects that have been in contact with the mouth and saliva may spread Hib.

Bacteria enter the body through the nose and throat and can spread to the skin, lungs, ears, joints, blood, and brain. 2-5% of unimmunized children are carriers of Hib. The highest rates of Hib are found in children aged three to five years, people in crowded conditions (shelters, daycare, etc.), and persons in direct contact with an Hib case. Hib is not considered to be highly contagious since only a small percentage of people exposed to the disease actually become ill. However, household contacts are 500-600 times more likely to develop infection from exposure to an infected household member. Newborns are somewhat protected from Hib because of maternal antibodies but this wanes after two months.

**Diagnosis**

The first step in the diagnosis of Hib infection is the recognition of the common signs and symptoms of this infection. A careful history is very important, including when, where and how the symptoms started. Clinicians should inquire about close contacts of the patient who are sick. If Hib is suspected, testing should be done which includes blood cultures as well as Gram stain and cultures of the infected body fluid (e.g. CSF, middle ear, pleural, joint).

**Treatment**

Delaying the start of antibiotic therapy can lead to poor outcomes. Therefore anyone suspected of having invasive Hib disease needs prompt evaluation by a doctor or health care professional and treatment in the hospital. Patients with suspected or known invasive Hib disease are placed under precautions for 24 hours in an attempt to prevent the spread of disease. Hib is treated using a third-generation cephalosporin. Rifampin (RifadinTM) is then used to remove any remaining organisms that may have colonized the upper respiratory tract. Persons with Hib meningitis may also receive treatment with an IV steroid to prevent hearing loss.

The issue of antibiotic resistance is important to consider because strains of Hib resistant to ampicillin, the drug once considered first-line therapy, are now common in the United States. Rates of resistance vary by region.

**Prevention and Control**

**Vaccination**

Vaccination is the best way to prevent and control Hib and is responsible for a 99% decrease in the disease from 1989 to 1997 among children under five years of age. Before the vaccine was developed, about 20,000 persons in the USA developed invasive Hib disease annually (meningitis, bacteremia, epiglottitis, pneumonia, cellulitis, arthritis, osteomyelitis, pericarditis). One in 200 children experienced invasive disease before age five. Meningitis was the most common manifestation of infection, occurring in about 60% of young children who experienced invasive disease and resulting in about 600 deaths per year. Hib was the most important cause of invasive bacterial disease in
young children before the introduction of an effective Hib vaccine in 1990.

The first vaccination for Hib, designed to be given to children 18 months of age and older, was introduced in 1985 but was not very effective. In the same year a more effective vaccine for children ages 15 months and older was introduced. In 1990 a vaccine for infants was approved.

In 1991 the American Academy of Pediatrics Committee on Infectious Diseases and the Advisory Committee on Immunization Practices recommended that all children should be immunized with the vaccine beginning at two months of age. A four-dose schedule for most Hib vaccines is recommended (at 2, 4, 6, and 12-15 months). The dose at six months is not needed if PRP-OMP vaccine is used. Children over the age of seven months who have not been immunized can start with an abbreviated schedule because of their age. Vaccination is generally not recommended for healthy children age 5 and over, as the majority of these children have developed immunity through previous asymptomatic infection. Immunocompromised children and adults who have not been immunized in the past can follow an abbreviated schedule based on their particular medical conditions.

Two combination vaccines are available in the USA. TriHIBit combines DTaP (diphtheria, tetanus, and acellular pertussis) and Hib, but is only recommended as a booster shot. COMVAX combines hepatitis B and Hib, but must not be used in infants whose mothers are hepatitis B surface antigen positive.

Although all of the vaccines have an excellent safety record and do not interfere with other vaccines given at the same time, adverse reactions have occurred. These reactions are uncommon, short lived, and include fever, irritability, swelling, redness, and pain at the injection site. Vaccination should be delayed in individuals with moderate or severe acute illness, and no Hib vaccines should be given to children less than six weeks old.

Although the incidence of Hib is low, illness and death still occur among infants who have not completed the primary series of Hib vaccination. Certain situations have been documented that hinder people from completing the vaccination schedule: families with younger mothers (under 30 years of age); families with large numbers of children; and having multiple vaccination providers. Families in shelters experience frequent changes in address, health care providers, daycare centers, and schools, making it difficult to coordinate and follow a tight immunization schedule. At every early childhood health care visit, providers should conduct a thorough assessment of vaccination status in order to help with vaccination compliance.

Post-Exposure Prophylaxis

Another method of controlling Hib is to treat individuals who have been exposed to Hib infection. Prophylaxis for household contacts is no longer indicated if all contacts under age four are fully vaccinated against Hib disease. A child is considered fully immunized under the following conditions:

- at least one dose of conjugate vaccine at 15-59 months of age; or
- one dose of conjugate vaccine at 12-14 months of age, followed by booster at 15 months; or
- two or more doses of conjugate vaccine before 12 months of age, followed by a booster at age 12-15 months.

Following a case of Hib infection in a family member, household contacts should receive rifampin (Rifadin™) if there is at least one inadequately vaccinated child less than four years old. Prophylaxis is also indicated if there are any immunocompromised children in the household. Prophylaxis of contacts in daycare/preschool/shelter settings is controversial, but is generally indicated if there have been at least 25 hours of exposure by incompletely immunized children under age two years. Prophylaxis is also indicated after two or more cases have occurred within a 60-day period in any facility with incompletely immunized children. In these cases all children and staff should be treated. If all children under four years of age are fully vaccinated, then no treatment is indicated.

Treatment includes the antibiotic rifampin (Rifadin™), administered once daily for four days in a dose of 20 mg/kg (maximum daily dose is 600 mg) or 10 mg/kg in infants younger than one month. Treatment should be implemented quickly since efficacy declines after 14 days.

Summary

*Haemophilus influenzae* type b infection can be very serious and cause severe, long-term complications. Thanks to the development of a vaccine, the incidence of disease has declined dramatically since the first edition of this manual in 1991. From 1989 to 1997, disease attributable to Hib among children
under five years of age declined 99%. Invasive Hib infections are now reportable to state health departments, which in turn help local public health professionals understand and track current disease prevalence and patterns.

Bacterial resistance to antibiotic therapy in the treatment of Hib infection is on the rise and rapidly becoming a major concern. Moreover, homeless individuals have an increased risk of developing Hib because of the crowded living conditions of shelters. Homeless families who move and change medical providers frequently are less likely to finish the immunization schedule. Thus the importance of taking a vaccination history from every child can not be underestimated. One of the objectives of Healthy People 2010 is the elimination of all invasive diseases among children under the age of five by the year 2010. The availability of vaccines, the tracking of disease patterns by state and federal health departments, and prophylactic post exposure treatment should help attain this goal.

The authors of this chapter gratefully acknowledge the invaluable contribution of George Alliegro, MD, who authored this chapter in the original Manual.

### References


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### Haemophilus Influenzae (Hib) Medication List

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<th>Generic</th>
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<th>Cost</th>
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<td>rifampin</td>
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