

# *Haemophilus influenzae* type b (Invasive)

**Also known as:** Hib disease, *H. flu*, spinal meningitis, *Haemophilus*

---

## Responsibilities:

**Hospital:** Report immediately by phone, follow up required

**Infection Preventionist:** Report immediately by phone, follow up required

**Lab Report / Isolate submission requirements:** Isolates from invasive sites, should be submitted to State Hygienic Laboratory (SHL), for serotyping.

**Lab:** Report positive isolates immediately by phone

**Physician:** Report immediately by phone

**Local Public Health Agency (LPHA):** Report immediately by phone, follow up required

## Iowa Department of Public Health

**Disease Reporting Hotline: (800) 362-2736**

**Secure Fax: (515) 281-5698**

## 1) THE DISEASE AND ITS EPIDEMIOLOGY

### A. Agent

*Haemophilus influenzae* disease is caused by small gram-negative coccobacilli that may be either encapsulated (types a–f) or unencapsulated (nontypeable). Type b (Hib) is the only kind for which there is a vaccine and for which control measures are considered necessary. It is the only type that is reportable.

### B. Clinical Description

**Symptoms:** Invasive disease may produce various clinical syndromes, including meningitis, bacteremia or sepsis, epiglottitis, pneumonia, septic arthritis, osteomyelitis, pericarditis, empyema, and abscesses. In contrast, mucosal infections such as bronchitis, sinusitis, and otitis, which can be caused by Hib, are considered noninvasive disease

**Onset:** Onset will depend on the site of infection. With meningitis, sudden onset of high fever, vomiting, lethargy, and meningeal irritation consisting of bulging fontanelle in infants or stiff neck in older children can occur.

### C. Reservoir

Humans are the only known host.

### D. Modes of Transmission

*Haemophilus influenzae* type b is transmitted person-to-person by droplet or direct contact with nasopharyngeal secretions of an infected person. The most common portal of entry is the nasopharynx. Newborns can become infected by inhaling amniotic fluid or genital tract secretions containing the organism.

### E. Incubation Period

The incubation period is unknown but probably short, 2 – 4 days.

### F. Period of Communicability or Infectious Period

- **If not on antibiotic therapy**—as long as organisms are present in the upper respiratory tract, which may be for a prolonged period even without symptoms.
- **If on antibiotic therapy**—noncommunicable within 24–48 hours after starting effective antibiotic therapy.

The contagious potential of invasive Hib disease is considered to be limited. However, certain circumstances, particularly close contact with a case (*e.g.*, in a household, child care center, or institutional setting), can lead to outbreaks of Hib or direct secondary transmission of the disease. Asymptomatic carriage is known to occur.

### G. Epidemiology

Hib occurs worldwide. Invasive Hib is most prevalent among children 2 months to 3 years old and is unusual in healthy individuals over the age of 5 years (though can occur in adults with chronic conditions such as chronic obstructive pulmonary disease). In the United States, peak incidence is in children 6 – 12 months of age. Secondary cases may occur in households, child care centers, and other institutional settings.

Before the widespread use of Hib conjugate vaccines, *Haemophilus influenzae* type b (Hib) was a leading cause of bacterial meningitis in the United States among children less than 5 years old and a major cause of other life-threatening invasive bacterial diseases in this age group. Meningitis occurred in approximately two-thirds of children with invasive Hib disease, resulting in hearing impairment or severe permanent neurologic sequelae (mental retardation, seizure disorder, cognitive and developmental delays,) and paralysis in 15–30% of survivors. Approximately 5% of all cases were fatal. Invasive Hib disease now occurs in unvaccinated or under vaccinated children and adults. Type f is the most common other serotype causing invasive infections in the U.S. Iowa had approximately 64 cases of Hib per year prior to the vaccine. In the last 10 years Iowa has averaged 0.7 cases per year in persons less than 5 years of age.

Invasive disease has been more frequent in boys, African Americans, Alaskan Eskimos, Apache and Navajo Indians, child-care center attendees, children living in overcrowded conditions, and children who were not breastfed. Unimmunized children, particularly those younger than 4 years old, in prolonged close contact (such as in a household setting) with a child with invasive Hib disease, are at increased risk for invasive Hib disease. Other factors predisposing to invasive disease include sickle cell disease, asplenia, HIV infection, certain immunodeficiency syndromes, and malignant neoplasms.

### H. Bioterrorism Potential

None.

## 2) DISEASE REPORTING AND CASE INVESTIGATION

### A. Purpose of Surveillance and Reporting

- To ensure that all cases of invasive *Haemophilus influenzae* are typed and to identify all cases of Hib.
- To identify household and child care contacts of Hib cases that need antimicrobial prophylaxis and/or immunization and to prevent further spread of the disease for Hib cases.
- To distinguish between failure to vaccinate and vaccine failure.

## B. Laboratory and Healthcare Provider Reporting Requirements

Iowa Administrative Code 641-1.3(139) stipulates that the laboratory and the healthcare provider immediately report any suspected or confirmed case. The reporting number for IDPH Center for Acute Disease Epidemiology (CADE) is (800) 362-2736, if calling after business hours, call the Iowa State Patrol Office at (515) 323-4360 and they will page a member of the on-call CADE staff.

*Note:* Due to the potential severity and spread of invasive *Haemophilus influenzae*, IDPH requests that information about any case be **immediately reported** to the local public health agency where diagnosed. If this is not possible, call IDPH Center for Acute Disease Epidemiology (CADE) at (800) 362-2736.

### What to Report to the Iowa Department of Public Health (IDPH)

- A case clinically compatible with invasive Hib (*e.g.*, with meningitis, bacteremia, epiglottitis, or pneumonia), as diagnosed by a healthcare professional, or
- Isolation (culture) of Hib from a normally sterile body site (blood, cerebrospinal fluid (CSF), or less commonly joint, pleural, or pericardial fluid), or
- Detection of Hib antigen in CSF.

### Laboratory Testing Services Available

Confirmation and serotyping of *Haemophilus influenzae* isolates are available at the University of Iowa State Hygienic Laboratory (SHL). All strains of *Haemophilus influenzae* isolated from normally sterile sites must be serotyped in order to identify the strain and to differentiate between serotype B and other serotypes, for which no control measures are necessary. Subcultures should be sent with a requisition form to SHL. Call (319) 335-4500 for shipping directions.

*Note:* Positive antigen results from urine and/or serum samples are not reliable for diagnosis of Hib disease and should not be used as a substitute for culture results, but can help in determining immediate control measures while awaiting laboratory results.

## C. Local Public Health Agency Follow-Up Responsibilities

If a case of Hib is identified, IDPH Center for Acute Disease Epidemiology (CADE) will become involved in the investigation and disease control recommendations, in collaboration with the local public health agencies. The infection preventionist and the local public health agency should fax the lab report and/or other information to the CADE. The confidential fax number is (515) 281-5698.

## 2. Case Investigation

- a. Ensure that typing of the *Haemophilus influenzae* isolate has been or is being done, preferably at the SHL.
- b. The local public health agency in conjunction the hospital infection preventionist will collect pertinent information (demographic, clinical, exposure setting, transmission setting, detailed immunization history, and other pertinent history on the case) and record in the Iowa Disease Surveillance System (IDSS). To assess and prepare for the possibility of a type b case, it is important to pay special attention to the case's Hib vaccination history, whether the case had contact with another case of invasive Hib, whether a child care setting is involved, and the ages and Hib vaccination histories of children exposed to the case in the household and child care center.
- c. If type b is identified, notify CADE (800) 362-2736. After completing the investigation and gathering the information to complete the investigation form, enter information into IDSS, or FAX the report form with supporting laboratory documentation to (515) 281-5698
- d. If type b is not identified, no additional control measures are necessary and a case investigation form does not need to be completed.

### 3) CONTROLLING FURTHER SPREAD

Control measures are for *Haemophilus influenzae* type b (Hib) *only*. There are no control measures for other types.

#### A. Isolation and Quarantine Requirements

Current recommendations are as follows:

##### **Period of Isolation of Patient**

Isolate the case until 24 hours after initiating appropriate antimicrobial treatment to eliminate carriage. Cefotaxime and ceftriaxone or chloramphenicol is recommended for treatment concurrently or singly until antibiotic sensitivities are known. Rifampin should be given to eliminate nasal carriage of the organism.

##### **Protection of Contacts**

Prophylaxis is indicated to protect children less than 12 months old or a child of 1-3 years who is inadequately immunized. If this circumstance is found, everyone around them, including household contacts of any age, should receive prophylaxis.

When 2 or more cases of invasive disease have occurred within 60 days and unimmunized or incompletely immunized children attend the child-care facility, administration of rifampin to all attendees and supervisory personnel is indicated. For a single case of Hib disease in a child who attends childcare, the decision to offer chemoprophylaxis to the childcare contacts should be made based on a case by case basis.

#### B. Protection of Contacts of a Case

1. **Isolate the case** until 24 hours after initiating appropriate antimicrobial treatment. Currently, only the treatment drugs cefotaxime and ceftriaxone are known to eradicate Hib from the nasopharynx. Patient's who are younger than 2 years of age or have susceptible household contacts, treated with ampicillin or chloramphenicol, must also receive rifampin prophylaxis to eliminate nasal carriage. Also, note that Hib disease does not necessarily confer immunity to subsequent disease. Immunize as follows:
  - **Children with invasive Hib disease at less than 24 months old**—immunize according to the age-appropriate schedule for unvaccinated children and as if they had received no prior doses. Begin 1 month after onset of disease or as soon as possible thereafter. For additional information, please refer to the table in Section 4) B. 3.
  - **Children with invasive Hib disease at older than 24 months old**—no immunization is necessary, regardless of previous immunization status, because the disease probably induced a protective immune response and second episodes at this age are rare.
2. **Antimicrobial prophylaxis for close contacts.** Although several antibiotics are useful for *treatment* of invasive Hib disease and elimination of carriage in the case, rifampin is the appropriate drug to use for antibiotic *prophylaxis* of contacts. Several studies have shown that rifampin eradicated Hib carriage in greater than or equal to 95% of contacts of primary Hib cases, including children in child cares.

Prophylaxis is needed for all household contacts (including adults) in households with any children less than 12 months old who have not received a primary vaccine series, or a child of 1-3 years who is inadequately immunized, or a household with an immunocompromised child regardless of that child's Hib immunization status.

If the criteria in the above paragraph are met, prophylaxis should be initiated as soon as possible. Most secondary cases in households occur in the first week after hospitalization of the index case. Prophylaxis of household contacts that begins more than or equal to 1 week after hospitalization of the case may still be of benefit, although initiation of prophylaxis beyond 4 weeks after that date is probably of limited utility. It is important for all children and employees

having at least four hours of contact with the ill child in the week before onset or hospitalization to take rifampin, unless immunization criteria are met. Prophylaxis is not recommended for pregnant women who are contacts because the effect of rifampin on the fetus has not been established.

<b>Rifampin Prophylaxis against Hib</b>	
<b>Age Group</b>	<b>Dosage/Schedule</b>
Infants < 1 month of age	10 mg/kg PO QD x 4 days
Children	20 mg/kg PO QD x 4 days (maximum: 600 mg/dose)
Adults	600 mg PO QD x 4 days

The risk of secondary disease in children attending child-care centers appears to be lower than that observed for age-susceptible household contacts, and secondary disease in child-care contacts is rare when all contacts are older than 2 years. Also, the efficacy of rifampin in preventing disease in child care groups is not established. Nevertheless, rifampin prophylaxis is recommended in certain situations, as indicated in the table below.

**Indications and Guidelines for Rifampin Chemoprophylaxis for Contacts of Index Cases of Invasive *Haemophilus influenzae* Type b (Hib) Disease**

**Chemoprophylaxis recommended**

- In certain index cases:
  - Index case, if treated with regimens other than cefotaxime or ceftriaxone. Chemoprophylaxis (rifampin) usually is provided just before discharge.
- In certain household situations:
  - All household contacts (except pregnant women),<sup>1</sup> irrespective of age, in households where at least 1 contact is < 48 months of age *and* is unimmunized or incompletely immunized<sup>1</sup>
  - All household contacts (except pregnant women),<sup>1</sup> irrespective of age, in households where a child is < 12 months of age, even if the primary series has been given
  - All household contacts (except pregnant women),<sup>1</sup> irrespective of age, in households with an immunocompromised child, irrespective of the child's Hib immunization status
- In certain child care situations:
  - Nursery and child care centers contacts where  $\geq 2$  cases occurred within 60 days, with  $\geq 1$  unimmunized or incompletely immunized child < 48 months of age<sup>2,3</sup> For a single case of Hib disease in a child who attends childcare, the decision to offer chemoprophylaxis to the childcare contacts should be made based on a case by case basis.

**Chemoprophylaxis *not* recommended**

- In certain individuals:
  - Pregnant women
- In certain household situations:
  - Occupants of households with no children < 48 months of age other than the index patient
  - Occupants of households when all household contacts < 48 months of age have completed their Hib immunization series<sup>4</sup>
- In certain child care situations:
  - Nursery and child care contacts of 1 index case, when all children < 48 months of age have completed their Hib immunization series<sup>4</sup>
  - Nursery and child care center contacts where  $\geq 2$  cases occurred within 60 days, when all children < 48 months of age have completed their Hib immunization series<sup>4</sup>

<sup>1</sup> Defined as persons residing with the index patient or nonresidents who spent  $\geq 4$  hours with the index case for  $\geq 5$  of the 7 days preceding the day of hospital admission of the index case.

<sup>2</sup> Only children who are age-appropriately immunized and on rifampin should be permitted to enter the child care group during the time prophylaxis is given. Children enrolling in the child care center or other setting during the time prophylaxis is given should also receive rifampin, as should supervisory personnel.

<sup>3</sup> When a single case has occurred, the advisability of rifampin prophylaxis in exposed child care groups with unimmunized or incompletely immunized children is controversial, but many experts recommend no prophylaxis.

<sup>4</sup> Complete immunization is defined as having had  $\geq 1$  dose of conjugate vaccine at  $\geq 15$  months of age; 2 doses between 12 and 14 months of age; or a 2- or 3-dose primary series (number of doses required depends on vaccine type and age at initiation) when  $< 12$  months with a booster dose at  $\geq 12$  months of age. Note that all infants ( $< 12$  months of age) are by definition incompletely immunized.

3. **Ensure appropriate immunization of contacts.** The number of doses required is determined by the current age of the child and the number, timing, and type of Hib vaccine doses previously received. Unvaccinated and incompletely vaccinated children less than 5 years old should be scheduled for completion of the recommended age-specific immunization schedule (see definition of "complete immunization" in Footnote 4 of the table above). Infants should be placed on an accelerated schedule using minimum intervals between doses. Unvaccinated high-risk individuals older than 5 years should receive one dose.

The accelerated schedule for situations in which an incompletely vaccinated child has been exposed follows:

<b>Accelerated schedule for Hib vaccination</b> —to be used for unvaccinated and incompletely vaccinated children (including all infants) after exposure to invasive Hib disease.				
<b>Type of Hib vaccine</b>	<b>Minimum age for first dose</b>	<b>Minimum interval from dose 1 to 2</b>	<b>Minimum interval from dose 2 to 3</b>	<b>Minimum interval from dose 3 to 4</b>
<b>HbOC (HIB-TITER®)</b>	6 weeks	1 month	1 month	This booster at $\geq 12$ mo. of age and $\geq 2$ mo. after previous dose
<b>PRP-T (ActHIB®, OmniHIB®)</b>	6 weeks	1 month	1 month	
<b>PRP-OMP (PedVax-HIB®)</b>	6 weeks	1 month	This booster at $\geq 12$ mo. of age and $\geq 2$ mo. after previous dose	Not required

4. **Conduct surveillance.** Careful observation of exposed contacts, especially children younger than 4 years, is essential. Those in whom a febrile illness develops should receive prompt medical attention, regardless of Hib vaccination status.

#### D. Preventive Measures

Routine childhood vaccination is the best preventive measure against Hib disease. Good personal hygiene (which consists of proper handwashing, disposal of used tissues, not sharing eating utensils, etc.) is also important.

Please consult the chapter on *Haemophilus influenzae* in the Red Book of the American Academy of Pediatrics for a full discussion of vaccines, immunization schedules, and special circumstances. For example, children, including those older than 5 years, with underlying conditions predisposing them to Hib disease may need additional doses.

## 4) ADDITIONAL INFORMATION

The Council of State and Territorial Epidemiologists (CSTE) surveillance case definitions for *Haemophilus influenzae* type b can be found at:

[www.cdc.gov/osels/ph\\_surveillance/nndss/phs/infdis.htm#top](http://www.cdc.gov/osels/ph_surveillance/nndss/phs/infdis.htm#top)

CSTE case definitions should not affect the investigation or reporting of a case that fulfills the criteria in this chapter. (CSTE case definitions are used by the state health department and the CDC to maintain uniform standards for national reporting.)

### Comment

Positive antigen test results from urine or serum samples are unreliable for diagnosis of *H. influenzae* disease, but may help determine need for control measures while waiting for definitive laboratory results.

## References

American Academy of Pediatrics. *Red Book 2009: Report of the Committee on Infectious Disease, 28<sup>th</sup> Edition*. Illinois, American Academy of Pediatrics, 2009.

CDC. Progress toward elimination of *Haemophilus influenzae* type b disease among infants and children—United States, 1987–1995. *MMWR*. 1996; 45:901–906.

CDC. *Haemophilus* website available at: [www.cdc.gov/hi-disease/index.html](http://www.cdc.gov/hi-disease/index.html)

CDC. Updated Recommendations for Use of *Haemophilus influenzae* Type b (Hib) Vaccine: Reinstatement of the Booster Dose at Ages 12--15 Months. *MMWR*. 2009; 58(24):673-674

CDC. *Manual for the Surveillance of Vaccine-Preventable Disease*, Available at:

[www.cdc.gov/vaccines/pubs/surv-manual/index.html](http://www.cdc.gov/vaccines/pubs/surv-manual/index.html)

Heymann, D.L., ed. *Control of Communicable Diseases Manual, 20<sup>th</sup> Edition*. Washington, DC, American Public Health Association, 2015.

## Resources

[www.cdc.gov/vaccines/vpd-vac/hib/default.htm](http://www.cdc.gov/vaccines/vpd-vac/hib/default.htm)

State Hygienic Laboratory [www.shl.uiowa.edu/](http://www.shl.uiowa.edu/)