EDUCATIONAL OBJECTIVE: Readers will evaluate and treat patients who have been exposed to infectious diseases to prevent acquisition and transmission of the infection.

Postexposure management of infectious diseases

ABSTRACT

Anyone exposed to an infectious disease—whether a healthcare provider, patient, or contact of a patient—should be evaluated promptly and the source of the infection identified. A systematic response entails postexposure prophylactic therapy if available and indicated, infection control measures to prevent further transmission, counseling and educating those involved, and assessing those who may require work restriction or modification.

KEY POINTS

Whether to give prophylactic therapy depends on the transmissibility of the infection, the susceptibility of the exposed individual, and the risk of infection-related complications.

Postexposure prophylactic therapy should begin as soon as possible, while awaiting results of further diagnostic tests, to maximize the chances of preventing or ameliorating the infection.

Keeping up-to-date with current institutional policies and national guidelines is essential. Sources include US Public Health Service guidelines and reports from the US Centers for Disease Control and Prevention, as well as consultation with an expert healthcare provider (eg, infectious diseases physician, infection control provider, public health officer).

P E O P L E W H O H A V E B E E N E X P O S E D T O A N infectious disease should be evaluated promptly and systematically, whether they are healthcare professionals at work, patients, or contacts of patients. The primary goals are to prevent acquisition and transmission of the infection, allay the exposed person’s anxiety, and avoid unnecessary interventions and loss of work days. Some may need postexposure prophylaxis.

ESSENTIAL ELEMENTS OF POSTEXPOSURE MANAGEMENT

Because postexposure management can be challenging, an experienced clinician or expert consultant (eg, infectious disease specialist, infection control provider, or public health officer) should be involved. Institution-specific policies and procedures for postexposure prophylaxis and testing should be followed.

Postexposure management should include the following elements:

- Immediate care of the wound or other site of exposure in cases of blood-borne exposures and tetanus- and rabies-prone injuries. This includes thoroughly washing with soap and water or cleansing with an antiseptic agent, flushing affected mucous membranes with water, and debridement of devitalized tissue.
- Deciding whether postexposure prophylaxis is indicated and, if so, the type, dose, route, and duration.
- Initiating prophylaxis as soon as possible.
- Determining an appropriate baseline assessment and follow-up plan for the exposed individual.
- Counseling exposed women who are pregnant or breast-feeding about the risks and benefits of prophylaxis.

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benefits of postexposure prophylaxis to mother, fetus, and infant.
• Identifying required infection control precautions, including work and school restriction, for exposed and source individuals.
• Counseling and psychological support for exposed individuals, who need to know about the risks of acquiring the infection and transmitting it to others, infection control precautions, benefits, and adverse effects of postexposure prophylaxis, the importance of adhering to the regimen, and the follow-up plan. They must understand that this treatment may not completely prevent the infection, and they should seek medical attention if they develop fever or any symptoms or signs of the infection of concern.1,2

IS POSTEXPOSURE PROPHYLAXIS INDICATED?
Postexposure management begins with an assessment to determine whether the exposure is likely to result in infection; whether the exposed individual is susceptible to the infection of concern or is at greater risk of complications from it than the general population; and whether postexposure prophylaxis is needed. This involves a complete focused history, physical examination, and laboratory testing of the potentially exposed individual and of the source, if possible.1,2

Postexposure prophylaxis should begin as soon as possible to maximize its effects while awaiting the results of further diagnostic tests. However, if the exposed individual seeks care after the recommended period, prophylactic therapy can still be effective for certain infections that have a long incubation period, such as tetanus and rabies.5,6 The choice of regimen should be guided by efficacy, safety, cost, toxicity, ease of adherence, drug interactions, and antimicrobial resistance.1,2

HOW GREAT IS THE RISK OF INFECTION?
Exposed individuals are not all at the same risk of acquiring a given infection. The risk depends on:
• Type and extent of exposure (see below)
• Characteristics of the infectious agent (eg, virulence, infectious dose)
• Status of the infectious source (eg, whether the disease is in its infectious period or is being treated); effective treatment can shorten the duration of microbial shedding and subsequently reduce risk of transmission of certain infections such as tuberculosis, meningococcal infection, invasive group A streptococcal infection, and pertussis5-10
• Immune status of the exposed individual (eg, prior infection or vaccination), since people who are immune to the infection of concern usually do not need postexposure prophylaxis2
• Adherence to infection prevention and control principles; postexposure prophylaxis may not be required if the potentially exposed individual was wearing appropriate personal protective equipment such as a surgical mask, gown, and gloves and was following standard precautions.1

WHO SHOULD BE RESTRICTED FROM WORK OR SCHOOL?
Most people without symptoms who were exposed to most types of infections do not need to stay home from work or school. However, susceptible people, particularly healthcare providers exposed to measles, mumps, rubella, and varicella, should be excluded from work while they are capable of transmitting these diseases, even if they have no symptoms.11,12 Moreover, people with symptoms with infections primarily transmitted via the airborne, droplet, or contact route should be restricted from work until no longer infectious.1,2,7,9-15

Most healthcare institutions have clear protocols for managing occupational exposures to infectious diseases, in particular for blood-borne pathogens such as human immunodeficiency virus (HIV). The protocol should include appropriate evaluation and laboratory testing of the source patient and exposed healthcare provider, as well as procedures for counseling the exposed provider, identifying and procuring an initial prophylactic regimen for timely administration, a mechanism for formal expert consultation (eg, with an in-house infectious diseases consultant), and a plan for outpatient follow-up.
<table>
<thead>
<tr>
<th>Pathogen and source individual</th>
<th>Exposed individual</th>
<th>Postexposure prophylactic regimen</th>
<th>Initial and follow-up evaluation</th>
</tr>
</thead>
</table>
| **Hepatitis B virus (HBV):** HBV-infected patient with positive HBsAg | Unvaccinated or nonresponder to the first 3-dose vaccine series<sup>a</sup> | A single dose of HBIG, 0.06 mL/kg IM, followed by HBV vaccine series given at 0, 1–2 months, and 6 months<sup>c</sup> injected at different site than HBIG; give HBIG within 24 hours but no later than 7 days after exposure | Source individual: HbsAg if status is unknown  
Exposed individual: Baseline HbsAg, anti-HBs, anti-HBc HbsAg and anti-HBc at 6 months  
No work or school restriction for exposed individuals, including healthcare providers |
|                                | Currently receiving first 3-dose vaccine series | A single dose of HBIG 0.06 mL/kg IM, followed by completion of 3-dose vaccine series | |
|                                | Previous HBV infection or vaccinated with adequate response<sup>b</sup> | Not required | |
| **Hepatitis C virus (HCV):** HCV-infected patient with positive anti-HCV and HCV RNA | Hepatitis C seronegative | None is available | Source individual: Anti-HCV, HCV RNA if status is unknown  
Exposed individual: Anti-HCV, HCV RNA, and ALT at baseline HCV RNA and ALT at 4 weeks  
Anti-HCV, HCV RNA, and ALT at 12 weeks  
Anti-HCV and ALT at 24 weeks  
No work or school restriction for exposed individuals, including healthcare providers |
| **Human immunodeficiency virus (HIV):** HIV-infected patient | HIV seronegative | Tenofovir-emtricitabine 300/200 mg once daily plus raltegravir 400 mg orally twice daily | Source individual: Anti-HIV1/HIV2 if status is unknown  
Exposed individual: Anti-HIV1/HIV2 at baseline, 6 weeks, and 16 weeks postexposure  
Complete blood count, urea, creatinine, liver function tests, serum glucose (if on PIs), and creatine phosphokinase (if on raltegravir) at baseline, 2 weeks, and 4 weeks after initiating ARV drugs  
No work or school restriction for exposed individuals, including healthcare providers |

<sup>a</sup>Serum level of anti-HBs < 10 mIU/mL.  
<sup>b</sup>Serum level of anti-HBs > 10 mIU/mL.  
<sup>c</sup>Day 0 is the day when the first dose of vaccine was given.  
ALT = alanine aminotransferase; anti-HBc = antibody against hepatitis B core antigen; anti-HBs = antibody against hepatitis B surface antigen; anti-HCV = antibody against hepatitis C virus; anti-HIV1/HIV2 = antibodies against human immunodeficiency virus 1 and 2; ARV = antiretroviral; HBIG = hepatitis B immune globulin; HbsAg = hepatitis B surface antigen; IM = intramuscularly; PI = protease inhibitor
The next section reviews postexposure management of common infections categorized by mode of transmission, including the risk of transmission, initial and follow-up evaluation, and considerations for postexposure prophylaxis.

### BLOOD-BORNE INFECTIONS

Blood-borne pathogens can be transmitted by accidental needlesticks or cuts or by exposure of the eyes, mucous membranes, or nonintact skin to blood, tissue, or other potentially infectious body fluids—cerebrospinal, pericardial, pleural, peritoneal, synovial, and amniotic fluid, semen, and vaginal secretions. (Feces, nasal secretions, saliva, sputum, sweat, tears, urine, and vomitus are considered noninfectious for blood-borne pathogens unless they contain blood.15)

Healthcare professionals are commonly
exposed to blood-borne pathogens as a result of needlestick injuries, and these exposures tend to be underreported.\textsuperscript{17}

When someone has been exposed to blood or other infectious body fluids, the source individual and the exposed individual should be assessed for risk factors for hepatitis B virus, hepatitis C virus, HIV, and other blood-borne pathogens.\textsuperscript{3,4,16,18} If the disease status for these viruses is unknown, the source and exposed individual should be tested in accordance with institutional policies regarding consent to testing. Testing of needles or sharp instruments implicated in an exposure is not recommended.\textsuperscript{3,4,16,18}

Determining the need for prophylaxis after exposure to an unknown source such as a disposed needle can be challenging. Assessment should be made on a case-by-case basis, depending on the known prevalence of the
Most healthcare institutions have clear protocols for managing occupational exposure to infectious diseases.

infection of concern in the local community. The risk of transmission in most source-unknown exposures is negligible. However, hepatitis B vaccine and hepatitis B immunoglobulin should be used liberally as postexposure prophylaxis for previously unvaccinated healthcare providers exposed to an unknown source.3,4,16,18

**Hepatitis B**

Hepatitis B virus (Table 1) is the most infectious of the common blood-borne viruses. The risk of transmission after percutaneous exposure to hepatitis B-infected blood ranges from 1% to 30% based on hepatitis Be antigen status and viral load (based on hepatitis B viral DNA).1,2,4,16

Hepatitis B vaccine or immunoglobulin, or both, are recommended for postexposure prophylaxis in pregnant women, based on evidence that perinatal transmission was reduced by 70% to 90% when these were given within 12 to 24 hours of exposure.4,16,19

**Hepatitis C**

The risk of infection after percutaneous exposure to hepatitis C virus-infected blood is estimated to be 1.8% per exposure.16 The risk is lower with exposure of a mucous membrane or nonintact skin to blood, fluids, or tissues from hepatitis C-infected patients.16,18

Since there is no effective postexposure prophylactic regimen, the goal of postexposure assessment of hepatitis C is early identification of infection (by monitoring the patient to see if he or she seroconverts) and, if infection is present, referral to an experienced clinician for further evaluation (Table 1). However, data supporting the utility of direct-acting anti-hepatitis C antiviral drugs as postexposure prophylaxis after occupational exposure to hepatitis C are lacking.

**Human immunodeficiency virus**

The estimated risk of HIV transmission from a known infected source after percutaneous exposure is 0.3%, and after mucosal exposures it is 0.09%.20

If postexposure prophylaxis is indicated, it should be a three-drug regimen (Table 1).1,18 The recommended antiretroviral therapies have been proven effective in clinical trials of HIV treatment, not for postexposure prophylaxis per se, but they are recommended because they are effective, safe, tolerable, and associated with high adherence rates.3,16,18,21 If the source individual is known to have HIV infection, information about his or her stage of infection, CD4+ T-cell count, results of viral load testing, current and previous antiretroviral therapy, and results of any genotypic viral resistance testing will guide the choice of postexposure prophylactic regimen.3,18

The clinician should give the exposed patient a starter pack of 5 to 7 days of medication, give the first dose then and there, and arrange follow-up with an experienced clinician within a few days of the exposure to determine whether a complete 30-day course is needed.3,16,18

**SEXUALLY TRANSMITTED INFECTIONS**

In the case of sexually transmitted infections, “exposure” means unprotected sexual contact with someone who has a sexually transmitted infection.22 People with sexually transmitted infections often have no symptoms but can still transmit the infection. Thus, people at risk should be identified and screened for all suspected sexually transmitted infections.23–25

Patients with sexually transmitted infections should be instructed to refer their sex partners for evaluation and treatment to prevent further transmission and reinfection. Assessment of exposed partners includes a medical history, physical examination, microbiologic testing for all potential sexually transmitted infections, and eligibility for hepatitis A virus, hepatitis B virus, and human papillomavirus vaccines.22 Ideally, exposed partners should be reassessed within 1 to 2 weeks to follow up testing results and to monitor for side effects of and adherence to postexposure prophylaxis, if applicable.

Public health departments should be notified of sexually transmitted infections such as gonorrhea, chlamydia, chancroid, and syphilis.22

Expedited partner therapy, in which index patients deliver the medication or a prescription for it directly to their partners, is an alternative for partner management where legally allowed by state and local health departments (see www.cdc.gov/std/epi/legal/).22
TABLE 3

Postexposure management of infections transmitted by the airborne route

<table>
<thead>
<tr>
<th>Infection and disease status of source individual</th>
<th>Disease status of exposed individual</th>
<th>Postexposure prophylactic regimen</th>
<th>Initial and follow-up evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measles:</strong> Patient with active infection (4–5 days before onset of rash to 4 days after rash)</td>
<td>Nonimmune immunocompetent contacts *a</td>
<td>Live measles virus-containing vaccine (2 doses MMR, or MMRV if indicated [eg, patient not immune to varicella], at least 28 days or 3 months apart, respectively) SC within 3 days of exposure</td>
<td>Exclusion of exposed nonimmune individuals from work from day 5 to 21 after exposure, unless vaccine was given within 3 days of exposure. Exclusion of symptomatic individuals immediately from work until ≥ 4 days after onset of rash.</td>
</tr>
<tr>
<td>Nonimmune pregnant women, infants aged &lt; 12 months, or immunocompromised contacts (regardless of immune status)</td>
<td>A single dose of immune globulin 0.5 mL/kg IM or 400 mg/kg IV within 6 days of exposure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tuberculosis (TB):</strong> Patient with untreated pulmonary or laryngeal TB *b</td>
<td>Close contacts with unprotected exposure, regardless of history of TB or vaccination with BCG vaccine</td>
<td>One of the following regimens for LTBI, if TB disease is ruled out: Isoniazid 5 mg/kg orally daily plus vitamin B6 25–50 mg orally daily for 9 months or isoniazid 900 mg orally once weekly plus vitamin B6 25–50 mg orally daily plus rifapentine 900 mg orally once weekly for 3 months</td>
<td>TB symptom screen and TST or IGRA at presentation and 8–12 weeks postexposure if initially negative for TB infection. Chest radiography if TST or IGRA is positive at presentation or follow-up. Baseline and monthly liver function tests while on treatment for LTBI. No work or school restriction for exposed asymptomatic individuals with or without LTBI.</td>
</tr>
<tr>
<td><strong>Varicella and disseminated herpes zoster (HZ):</strong> Patient with active infection from 1–2 days before onset of rash for varicella or from onset of rash for HZ, until all lesions have crusted</td>
<td>Nonimmune immunocompetent contacts *c</td>
<td>Two doses of varicella vaccine SC 1 month apart, first dose within 5 days of exposure A single dose of VarizIG 125 units/10 kg IM/IV within 96 hours (up to 10 days postexposure) or immune globulin 400 mg/kg IV if VarizIG is not available</td>
<td>Exclusion of nonimmune exposed individuals from work from day 8 to 21 after last exposure (from day 8 to 28 if they received VarizIG) Exclusion of symptomatic individuals with varicella or disseminated HZ from work until all lesions are dry and crusted.</td>
</tr>
<tr>
<td>Nonimmune pregnant women or immunocompromised contacts</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a An individual is considered immune if any of the following applies: documentation of vaccination with 2 doses of live measles virus-containing vaccine, with the first dose of the vaccine being administered ≥ 12 months of age and the second dose at least 28 days after the first one; laboratory evidence of immunity; laboratory confirmation of disease; or birth before 1957 (except healthcare providers, who require one of the other indicators for immunity).

*b For patients with pulmonary TB that tests positive on acid-fast bacilli smear, the contagious period starts 3 months before the collection date of the first smear-positive sputum or onset of symptoms, whichever is earlier, and ends when the patient is in airborne isolation or the date of collection for the first consistently negative smear results. For patients with pulmonary TB that tests negative on acid-fast bacilli smear, the contagious period starts 1 month before onset of symptoms and ends when the patient is in airborne isolation.

*c An individual is considered immune to varicella or HZ if any of the following applies: documentation of vaccination with 2 doses of varicella vaccine; diagnosis or verification of history of varicella disease or HZ by a healthcare provider; serologic evidence of either immunity or disease; or birth in the United States before 1980 (except in healthcare providers, immunocompromised individuals, and pregnant women, who require one of the other indicators for immunity).

BCG = bacillus Calmette-Guérin; IGRA = interferon-gamma release assay; IM = intramuscularly; IV = intravenously; LTBI = latent tuberculosis infection; MMR = measles, mumps, rubella; MMRV = measles, mumps, rubella, varicella; SC = subcutaneously; TST = tuberculin skin test; VarizIG = varicella zoster immunoglobulin.
Recommended postexposure prophylactic regimens for sexually transmitted infections (Table 2) are based on their efficacy in the treatment of these infections.22,26–28 The regimen for HIV prophylaxis is the same as in Table 1.3,18,26

Chlamydia
Chlamydia is the most commonly reported communicable disease in the United States. The risk of transmission after sexual intercourse with a person who has an active infection is approximately 65% and increases with the number of exposures.22,29

Gonorrhea
Infection with *Neisseria gonorrhoeae* is the second most commonly reported communicable disease in the United States. The transmission rate of gonorrhea after sex with someone who has it ranges from 50% to 93%.22 When prescribing postexposure prophylaxis for gonorrhea, it is essential to consider the risk of antimicrobial resistance and local susceptibility data.22

Human immunodeficiency virus
Risk of HIV transmission through sexual contact varies depending on the nature of the exposure, ranging from 0.05% to 0.5%.30

Syphilis
The risk of transmission of syphilis in its early stages (primary and secondary) after sexual exposure is approximately 30%. Transmission requires open lesions such as chancres in primary syphilis and mucocutaneous lesions (mucous patches, condyloma lata) in secondary syphilis.22

After sexual assault
In cases of sexual assault, the risk of sexually transmitted infections may be increased due to trauma and bleeding. Testing for all sexually transmitted infections, including HIV, should be considered on a case-by-case basis.22 Survivors of sexual assault have been shown to be poorly compliant with follow-up visits, and thus provision of postexposure prophylaxis at the time of initial assessment is preferable to deferred treatment.22 The recommended regimen should cover chlamydia, gonorrhea, and trichomoniasis (a single dose of intramuscular ceftriaxone 250 mg, oral azithromycin 1 g, and either oral metronidazole 2 g or tinidazole 2 g), in addition to HIV if the victim presents within 72 hours of exposure (Table 2).22,26

Hepatitis B virus vaccine, not immunoglobulin, should be given if the hepatitis status of the assailant is unknown and the survivor has not been previously vaccinated. Both hepatitis B vaccine and immunoglobulin should be given to unvaccinated survivors if the assailant is known to be hepatitis B surface antigen-positive.22

Human papillomavirus vaccination is recommended for female survivors ages 9 to 26 and male survivors ages 9 to 21.

Emergency contraception should be given if there is a risk of pregnancy.22,26

In many jurisdictions, sexual assault centers provide trained examiners through Sexual Assault Nurse Examiners to perform evidence collection and to provide initial contact with the aftercare resources of the center.

Advice on medical management of sexual assault can be obtained by calling National PEPline (888–448–4911).

### INFECTIONS TRANSMITTED BY THE AIRBORNE ROUTE

Airborne transmission of infections occurs by inhalation of droplet nuclei (diameter ≤ 5 μm) generated by coughing and sneezing. Certain procedures (eg, administration of nebulized medication, sputum induction, bronchoscopy) also generate droplets and aerosols, which can transmit organisms.1

Measles
Measles (Table 3) is highly contagious; up to 90% of susceptible individuals develop measles after exposure. The virus is transmitted by direct contact with infectious droplets and by the airborne route. It remains infectious in the air and on surfaces for up to 2 hours; therefore, any type of exposure, even transient, is an indication for postexposure prophylaxis in susceptible individuals.11

Both the measles, mumps, rubella (MMR) vaccine and immune globulin may prevent or modify disease severity in susceptible exposed individuals if given within 3 days of exposure (for the vaccine) or within 6 days of exposure (for immune globulin).31,32
**Tuberculosis**

*Mycobacterium tuberculosis* is transmitted from patients with pulmonary or laryngeal tuberculosis, particularly if patients cough and are sputum-positive for acid-fast bacilli. Patients with extrapulmonary tuberculosis or latent tuberculosis infection are not infectious.1,7

Postexposure management of tuberculosis occurs through contact investigation of a newly diagnosed index case of tuberculosis disease. Contacts are categorized as household contacts, close nonhousehold contacts (those having regular, extensive contact with the index case), casual contacts, and transient community contacts. The highest priority for contact investigations should be household contacts, close nonhousehold or casual contacts at high risk of progressing to tuberculosis disease (eg, those with HIV, those on dialysis, or transplant recipients), and unprotected healthcare providers exposed during aerosol-generating procedures. Postexposure management includes screening exposed individuals for tuberculosis symptoms and performing tuberculin skin testing or interferon-gamma release assay (blood testing) for those who had previously negative results (Table 3). Chest radiography is recommended for exposed immunocompromised individuals, due to high risk of tuberculosis disease and low sensitivity of skin or blood testing, and for those with a documented history of tuberculosis or previous positive skin or blood test.7,33,34

A positive tuberculin skin test for persons with recent contact with tuberculosis is defined as a wheal 5 mm or larger on baseline or follow-up screening. Prior bacillus Calmette-Guérin vaccination status should not be used in the interpretation of tuberculin skin testing in the setting of contact investigation.7,33

All exposed asymptomatic people with a positive result on testing should be treated for latent tuberculosis infection, since treatment reduces the risk of progression to tuberculosis disease by 60% to 90%.7,33,35–37

**Varicella and disseminated herpes zoster**

Varicella zoster virus is transmitted by direct contact with vesicular fluid of skin lesions and inhalation of aerosols from vesicular fluid or respiratory tract secretions. Varicella (chickenpox) is highly contagious, with a secondary attack rate in susceptible household contacts of 85%.12 Herpes zoster is less contagious than varicella.38

Postexposure prophylaxis against varicella is recommended for susceptible individuals who had household exposure, had face-to-face contact with an infectious patient while indoors, or shared the same hospital room with the patient.12

**Group A streptococcal infection**

Although group A streptococcal infection (Table 4) may spread to close contacts of the index case and in closed populations (eg, military recruit camps, schools, institutions), secondary cases of invasive group A streptococcal infection rarely occur in family and institutional contacts.9,41,42

Postexposure prophylaxis for contacts of people with invasive group A streptococcal infection is debated, because it is unknown if antibiotic therapy will decrease the risk of acquiring the infection. It is generally agreed that it should not be routinely given to all contacts. The decision should be based on the clinician’s assessment of each individual’s risk and guidance from the local institution. If indicated, postexposure prophylaxis should be given to household and close contacts,

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**The estimated risk of HIV transmission from a known infected source after percutaneous exposure is 0.3%**
particularly in high-risk groups (eg, Native Americans and those with risk factors such as old age, HIV infection, diabetes mellitus, heart disease, chickenpox, cancer, systemic corticosteroid therapy, other immunosuppressive medications, intravenous drug use, recent surgery or childbirth). 9,41,42  

**Influenza**

Influenza (Table 4) causes a significant burden in healthcare settings, given its prevalence and potential to cause outbreaks of severe respiratory illness in hospitalized patients and residents of long-term-care facilities. 13,43 Neuraminidase inhibitors are effective

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**TABLE 4**  
Postexposure management of infections transmitted by the droplet route

<table>
<thead>
<tr>
<th>Infection and disease status of source individual</th>
<th>Disease status of exposed individual</th>
<th>Postexposure prophylactic regimen</th>
<th>Initial and follow-up evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group A streptococcus:</strong> Patient with invasive GAS infection (eg, streptococcal toxic shock syndrome, necrotizing fasciitis, meningitis, or pneumonia), from 7 days before symptom onset until 24 hours of effective antibiotic therapy</td>
<td>High-risk household contacts and close contacts</td>
<td>One of the following regimens should be considered within 24 hours, and up to 7 days, after the last exposure: Cephalexin 250–500 mg orally 2 to 4 times daily for 10 days or amoxicillin 500 mg orally 3 times daily for 10 days or clindamycin 300 mg orally 3 times daily for 10 days or azithromycin 500 mg orally daily for 3–5 days</td>
<td>No work or school restriction for exposed asymptomatic individuals</td>
</tr>
<tr>
<td><strong>Influenza:</strong> Symptomatic patient with laboratory-confirmed seasonal influenza A, B, or H1N1 infection, from 1 day before onset of symptoms until 24 hours after resolution of fever</td>
<td>Close contacts at high risk of complications of influenza or who are in close contact with individuals at high risk of influenza complications</td>
<td>One of the following regimens should be given within 48 hours of last exposure:³ Oseltamivir 75 mg orally once daily for 10 days, or during outbreaks for a minimum of 2 weeks and up to 1 week after identification of the last case or zanamavir 10 mg (2 inhalations) once daily for 10 days, or during outbreaks for at least 2 weeks and up to 1 week after identification of the last case⁵</td>
<td>No work or school restriction for asymptomatic exposed individuals Exclusion of symptomatic healthcare provider with confirmed influenza from patient care until afebrile ≥ 24 hours without the use of antipyretics</td>
</tr>
<tr>
<td><strong>Mumps:</strong> Patient with laboratory-confirmed mumps infection, from 7 days before onset of parotitis to 9 days after</td>
<td>Nonimmune close contacts</td>
<td>None³</td>
<td>No work or school restriction for asymptomatic exposed individuals, including healthcare providers, who are either fully vaccinated or received one dose of the MMR vaccine Exclusion of susceptible exposed individuals from work from day 12 after first unprotected exposure through day 25 after last exposure Exclusion of symptomatic individuals with mumps, including healthcare providers, from work for 9 days from onset of parotitis</td>
</tr>
</tbody>
</table>

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as prophylaxis after unprotected exposure to influenza, particularly in outbreak situations. However, their use is not widely recommended, since overuse could lead to antiviral resistance. In selected cases, postexposure prophylaxis may be indicated for close contacts who are at high risk of complications of influenza (eg, age 65 or older, in third trimester of pregnancy or 2 weeks postpartum, morbid obesity, chronic comorbid conditions such as a cardiopulmonary and renal disorder, immunocompromising condition) or who are in close contact with persons at high risk of influenza-related complications.\textsuperscript{13,44,45}

\begin{table}[h]
\centering
\begin{tabular}{|l|l|l|l|}
\hline
\textbf{Infection and disease status of source individual} & \textbf{Disease status of exposed individual} & \textbf{Postexposure prophylactic regimen} & \textbf{Initial and follow-up evaluation} \\
\hline
\textbf{Meningitis:} Patient with invasive meningococcal infection (meningitis or bacteremia) from 7 days before onset of illness until 24 hours of effective antibiotic therapy\textsuperscript{c} & Household and close contacts, regardless of vaccination status & One of the following regimens should be given as soon as possible, and up to 14 days after exposure: A single dose of ciprofloxacin 500 mg orally\textsuperscript{d} or a single dose of ceftriaxone 250 mg IM or rifampin 600 mg orally twice daily for 2 days & No work or school restriction for asymptomatic exposed individuals, including healthcare providers \\
\hline
\textbf{Pertussis:} Symptomatic patient in the first 3 weeks of illness confirmed with culture, polymerase chain reaction testing, or serology based on patient’s age & Household and close contacts, regardless of vaccination status & One of the following regimens should be given as early as possible but no later than 3 weeks after onset of cough in the index case:\textsuperscript{a} Azithromycin 500 mg orally on day 1 followed by 250 mg daily on days 2 through 5 or TMP-SMX 1 double-strength tablet (TMP 160 mg, SMX 800 mg) orally twice daily for 14 days & No work or school restriction for asymptomatic individuals, including healthcare providers \\
\hline
\textbf{Rubella:} Patient with confirmed rubella, from 1 week before to 7 days after onset of rash & Nonimmune contacts & None\textsuperscript{a} & Acute and convalescent serology in susceptible pregnant women who had unprotected exposure; if seroconversion occurs, counseling about risk of congenital rubella syndrome \\
& & & Exclusion of susceptible exposed individuals from work from day 5 after first exposure to day 23 after last exposure \\
& & & Exclusion of symptomatic individuals with rubella, including healthcare providers, from work immediately until 7 days after rash onset \\
\hline
\end{tabular}
\caption{Continued}
\end{table}

\textsuperscript{a}Unvaccinated or incompletely vaccinated individuals should be vaccinated according to the adult vaccination schedule.

\textsuperscript{b}Zanamavir is not recommended for patients with underlying airway disease because of the risk of bronchospasm and decline in pulmonary function.

\textsuperscript{c}Penicillins are ineffective in the eradication of \textit{N meningitidis} from the nasopharynx because of their inability to achieve high levels in nasopharyngeal secretions; therefore, they are not recommended for postexposure prophylaxis.

\textsuperscript{d}A single oral dose of azithromycin 500 mg is an option in areas where fluoroquinolone-resistant strains of \textit{N meningitidis} have been identified.

GAS = group A \textit{Streptococcus}; IM = intramuscular; MMR = measles, mumps, and rubella; TMP-SMX = trimethoprim-sulfamethoxazole
Meningococcal disease

*N meningitidis* is transmitted from individuals with meningococcal disease or from asymptomatic carriers.8 Postexposure prophylaxis is effective in eradicating *N meningitidis* and is recommended for all close contacts of patients with invasive meningococcal disease (Table 4).46 Close contacts include household contacts, childcare and preschool contacts, contacts exposed in dormitories or military training centers, those who had direct contact with the index case’s respiratory secretions (eg, intimate kissing, mouth-to-mouth resuscitation, unprotected contact during endotracheal intubation or endotracheal tube management), and passengers seated directly next to an index case on airplane flights of longer than 8 hours.

Postexposure prophylaxis is not indicated for those who had brief contact, those who

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**TABLE 5**

Postexposure management of infections via contact, injury, and bite routes

<table>
<thead>
<tr>
<th>Infection and disease status of source individual</th>
<th>Disease status of exposed individual</th>
<th>Postexposure prophylactic regimen</th>
<th>Initial and follow-up evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hepatitis A virus (HAV):</strong> Confirmed HAV infection from the incubation period (15–50 days) until one week after onset of jaundice</td>
<td>Nonimmune, healthy close contacts between 12 months and 40 years of age</td>
<td>Two doses of inactivated HAV vaccine (1,440 ELISA units per 1 mL for Havrix or 1 mL (50 U) for Vaqta IM in the deltoid muscle 6–18 months apart or immune globulin (IG) 0.02 mL/kg IM, single dose, in the deltoid or gluteal muscle IG 0.02 mL/kg IM, single dose, in deltoid or gluteal muscle within 2 weeks of exposure</td>
<td>Source patient: anti-HAV IgM if status is unknown Exclusion of individuals with HAV infection from patient care, patient environment, food handling, or daycare until 7 days after onset of jaundice No work or school restriction for asymptomatic exposed individuals</td>
</tr>
<tr>
<td></td>
<td>Nonimmune close contacts with immunocompromising condition, chronic liver disease, &lt; 12 months old, adults &gt; age 40, or severe allergy to HAV vaccine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Immune close contacts (previously infected or vaccinated at least 2 weeks prior to exposure)</td>
<td>Not recommended</td>
<td></td>
</tr>
<tr>
<td><strong>Rabies:</strong> Bites or contact with suspected rabid animal Contact with patients infected with rabies from 2 weeks before onset of symptoms</td>
<td>Previously unvaccinated</td>
<td>HRlg 20 IU/kg§ single dose and four doses of rabies vaccine (1 mL) IM on days 0, 3, 7, and 14 (5th dose on day 28 for immunocompromised only)7</td>
<td>No work or school restriction for asymptomatic exposed individuals</td>
</tr>
<tr>
<td></td>
<td>Previously vaccinated§</td>
<td>Two doses of rabies vaccine IM on days 0 and 3</td>
<td></td>
</tr>
<tr>
<td><strong>Scabies:</strong> Patient with untreated infestation6</td>
<td>Close and sexual contacts within the preceding month before onset of symptoms or confirmed diagnosis</td>
<td>Permethrin 5% cream (preferred regimen), apply from neck to toe and wash off after 8–14 hours; repeat in 1–2 weeks or crotamiton 10% cream, lotion, after a bath, apply from chin to toes; repeat in 24 hours or two doses of ivermectin 200 μg/kg orally 2 weeks apart</td>
<td>Exclusion of infested individuals until the end of treatment or, for infested individuals with crusted scabies, until skin scrapings are negative No work or school restriction for asymptomatic exposed individuals</td>
</tr>
</tbody>
</table>

CONTINUED
had contact that did not involve exposure to oral or respiratory secretions, or for close contacts of patients with \textit{N meningitidis} isolated in nonsterile sites only (eg, oropharynx, trachea, conjunctiva).8,46

\textbf{Pertussis}

Pertussis is highly contagious, with a secondary attack rate of approximately 80\% in susceptible individuals. Approximately one-third of susceptible household contacts develop pertussis after exposure.10

Postexposure prophylaxis for pertussis should be given to all household and close contacts (Table 4).10,47

\textbf{Rubella}

Transmission occurs through droplets or direct contact with nasopharyngeal secretions of an infectious case. Neither MMR vaccine nor...
immunoglobulin has been shown to prevent rubella in exposed contacts, and they are not recommended.11

■ INFECTIONS TRANSMITTED BY DIRECT CONTACT

Direct contact transmission includes infectious agents transmitted from an infected or colonized individual to another, whereas indirect contact transmission involves a contaminated intermediate object or person (eg, hands of healthcare providers, electronic thermometers, surgical instruments).1

There are no available postexposure prophylactic regimens for the organisms most commonly transmitted by this route (eg, methicillin-resistant Staphylococcus aureus, Clostridium difficile), but transmission can be prevented with adherence to standard precautions, including hand hygiene.1

Hepatitis A

Person-to-person transmission of hepatitis A virus occurs via the fecal-oral route. Common-source outbreaks and sporadic cases can occur from exposure to food or water contaminated with feces.1,15

Postexposure prophylaxis is indicated only for nonimmune close contacts (eg, household and sexual contacts) (Table 5). Without this treatment, secondary attack rates of 15% to 30% have been reported among households.1,48 Both hepatitis A vaccine and immune globulin are effective in preventing and ameliorating symptomatic hepatitis A infection. Advantages of vaccination include induction of longer-lasting immunity (at least 2 years), greater ease of administration, and lower cost than immune globulin.1,15,46

Scabies

Scabies is an infestation of the skin by the mite Sarcoptes scabiei var hominis. Person-to-person transmission typically occurs through direct, prolonged skin-to-skin contact with an infested person (eg, household and sexual contacts). However, crusted scabies can be transmitted after brief skin-to-skin contact or by exposure to bedding, clothing, or furniture used by the infested person.

All potentially infested persons should be treated concomitantly (Table 5).14,49

■ INFECTIONS TRANSMITTED BY MAMMAL BITES AND INJURIES

Bites and injury wounds account for approximately 1% of all visits to emergency departments.50 Human bites are associated with a risk of infection by blood-borne pathogens, herpes simplex infection, and bacterial infections (eg, skin and soft-tissue infections, bacteremia). Animal bites are associated with a risk of bacterial infections, rabies, tetanus, hepatitis B virus, and monkeypox.30

Rabies

Human rabies (Table 5) is almost always fatal. Essential factors in determining the need for postexposure prophylaxis include knowledge of the epidemiology of animal rabies in the area where the contact occurred and the species of animal involved, availability of the animal for observation or rabies testing, health status of the biting animal, and vaccination history of both the animal and exposed individual.6 Clinicians should seek assistance from public health officials for evaluating exposures and determining the need for postexposure prophylaxis in situations that are not routine.31

High-risk wild animals associated with rabies in North America include bats, raccoons, skunks, foxes, coyotes, bobcats, and woodchucks. Bats are the most common source of human rabies infections in the United States, and transmission can occur from minor, sometimes unnoticed, bites. The types of exposures that require postexposure prophylaxis include bites, abrasions, scratches, and contamination of mucous membranes or open wound with saliva or neural tissue of a suspected rabid animal.

Human-to-human transmission of rabies can rarely occur through exposure of mucous membrane or nonintact skin to an infectious material (saliva, tears, neural tissue), in addition to organ transplantation.6

Animal capture and testing is a strategy for excluding rabies risk and reducing the need for postexposure prophylaxis. A dog, cat, or ferret that bites a person should be confined and observed for 10 days without administering postexposure prophylaxis for rabies, unless the bite or exposure is on the face or neck, in which case this treatment should be given im-
mediately.6 If the observed biting animal lives and remains healthy, postexposure prophylaxis is not recommended. However, if signs suggestive of rabies develop, postexposure prophylaxis should be given and the animal should be euthanized, with testing of brain tissue for rabies virus. Postexposure prophylaxis should be discontinued if rabies testing is negative.

The combination of rabies vaccine and human rabies immunoglobulin is nearly 100% effective in preventing rabies if administered in a timely and accurate fashion after exposure (Table 5).6

### Tetanus

Tetanus transmission can occur through injuries ranging from small cuts to severe trauma and through contact with contaminated objects (eg, bites, nails, needles, splinters, neoplasms whose umbilical cord is cut with contaminated surgical instruments, and during circumcision or piercing with contaminated instruments).5

Tetanus is almost completely preventable with vaccination, and timely administration of postexposure prophylaxis (tetanus toxoid-containing vaccine, tetanus immune globulin) decreases disease severity (Table 5).2,5,52

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**REFERENCES**


