REVIEW

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

MAZEN S. BADER, MD, MPH
Staff Physician, Department of Medicine, Hamilton Health Sciences, Juravinski Hospital and Cancer Centre; Department of Medicine, McMaster University, Hamilton, Ontario, Canada

ANNIE BROOKS, BScPhm, PharmD
Clinical Pharmacist, Infectious Diseases & Antimicrobial Stewardship, Hamilton Health Services, Juravinski Hospital; Assistant Clinical Professor (Adjunct), Department of Medicine, McMaster University, Hamilton, Ontario, Canada

DEBORAH V. KELLY, PharmD, FCSHP, AAHIVP
School of Pharmacy, Memorial University of Newfoundland, St. John's, Newfoundland and Labrador, Canada

JOCELYN A. SRIGLEY, MD, MSc
Department of Pathology and Laboratory Medicine, BC Children's & Women's Hospitals; Director, Infection Prevention and Control, Provincial Health Services Authority; Clinical Assistant Professor, University of British Columbia, Vancouver, British Columbia, Canada

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).

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People who have been exposed to an infectious disease should be evaluated promptly and systematically, whether they are healthcare professionals at work,[1] 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.[1,2] 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.[1,2]

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.[1–6]
- 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 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 be given as early as possible to maximize its effects

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 pertussis[7–10]
- 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 prophylaxis[2]
- 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 1

Postexposure management of common blood-borne pathogens

Pathogen and source individual	Exposed individual	Postexposure prophylactic regimen	Initial and follow-up evaluation
Hepatitis B virus (HBV): HBV-infected patient with positive HBsAg	Unvaccinated or nonresponder to the first 3-dose vaccine series[a]	A single dose of HBIG, 0.06 mL/kg IM, followed by HBV vaccine series given at 0, 1–2 months, and 6 months[c] 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[b]	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

[a] Serum level of anti-HBs < 10 mIU/mL.
[b] Serum level of anti-HBs > 10 mIU/mL.
[c] 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 virus1 and 2; ARV = antiretroviral; HBIG = hepatitis B immune globulin; HBsAg = hepatitis B surface antigen; IM = intramuscularly; PI = protease inhibitor

TABLE 2

Postexposure management of sexually transmitted diseases

Disease and source individual	Exposed individual	Postexposure prophylactic regimen	Initial and follow-up evaluation
Chlamydia: Symptomatic or asymptomatic patients with infection confirmed by microbiologic testing (NAAT or culture)	Sexual contact with the index case within 60 days before onset of symptoms or diagnosis[a]	Azithromycin 1 g orally as single dose or doxycycline 100 mg orally twice daily for 7 days or ofloxacin 300 mg orally twice daily for 7 days	Symptom screening and testing of partner for chlamydia by NAAT of genital and extragenital, if indicated, sites or first-catch urine[b] Treat partner for chlamydia[c] Counsel confirmed cases and partner(s) to abstain from sexual intercourse until 7 days after a single-dose regimen or after completion of a multiple-dose regimen, with resolution of symptoms and partner treatment Test of cure for pregnant women
Gonorrhea: Patient with any type of gonococcal infection, including asymptomatic infection, confirmed by microbiologic testing (NAAT or culture)	Sexual contact with the index case within 60 days prior to onset of symptoms or diagnosis[a]	Ceftriaxone 250 mg IM, single dose, plus either single dose azithromycin 1 g orally or doxycycline 100 mg orally twice daily for 7 days or cefixime 400–800 mg orally, single dose, plus either single dose azithromycin 1 g orally or doxycycline 100 mg orally twice daily for 7 days	Symptom screening and testing of partner for gonorrhea by NAAT of genital and extragenital, if indicated, sites or first-catch urine[b] Treat partner for gonorrhea[c] Counsel index case with confirmed infection and partner(s) to abstain from sexual intercourse until 3 days after completion of therapy, with resolution of symptoms and partner treatment Test of cure for pregnant women and those treated with cefixime or azithromycin
Pediculosis pubis: Patient with active infestation	Sexual contact with index case within 30 days before onset of symptoms or diagnosis	Permethrin 1% cream, single application to the affected areas and washed off after 10 minutes (preferred regimen) or pyrethrins with piperonyl butoxide (0.33%), single application to the affected area and washed off after 10 minutes or ivermectin 250 µg/kg orally two doses, 2 weeks apart	Counsel index case with confirmed infestation and partner(s) to abstain from sexual intercourse until completion of treatment, with resolution of symptoms and partner treatment No work or school restriction for either infested or exposed individuals

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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.[16])

Healthcare professionals are commonly

TABLE 2 CONTINUED

Disease and source individual	Exposed individual	Postexposure prophylactic regimen	Initial and follow-up evaluation
Syphilis: Patient with early syphilis (primary, secondary or early latent syphilis)[d]	Sexual contact with the index case within: Primary: preceding 90 days plus duration of symptoms Secondary: preceding 6 months plus duration of symptoms Early latent: preceding 12 months	Benzathine penicillin G 2.4 MU IM single dose (preferred regimen) or doxycycline 100 mg orally twice daily for 14 days	Symptom screening and testing of partner with nontreponemal assays at baseline, 3, and 6 months Treat partner for syphilis[e] Counsel partner and index case with confirmed infection to abstain from sexual intercourse until completion of treatment, documented serologic response and partner treatment
Trichomoniasis: Patient with active trichomoniasis	Sexual contact with the index case within 4 weeks before onset of symptoms or diagnosis	Metronidazole 2 g orally, single dose or metronidazole 500 mg orally twice daily for 7 days (preferred in HIV-infected women) or tinidazole 2 g orally, single dose	Symptom screening of partner Test index case and partner for bacterial vaginosis Treat partner, regardless of symptoms, simultaneously with index case Counsel partner and index case with confirmed infection to abstain from sexual intercourse until 1 week after treatment, with resolution of symptoms and partner treatment

[a]If index case had no sexual contacts within 60 days or if a partner within the 60-day period tests negative, then the index case's last sexual partner should be screened and treated for chlamydia or gonorrhea, even if contact was > 60 days before symptom onset or diagnosis.
[b]Genital mucosal sites include urethra for men and vagina and endocervix for women. Extragenital mucosal sites include oropharynx and rectum. Testing of extragenital sites is indicated when the exposed individual has symptoms or signs suggestive of infection of these sites (eg, pharyngitis, proctitis), has a history of unprotected oral or anal sex, or is a man who has sex with men.
[c]Empiric treatment should be given to the partner while awaiting the results of screening, particularly when the exposure is recent (within 1 week), patient follow-up is in question, or the screening test used is not NAAT.
[d]Early latent syphilis can be diagnosed with seroconversion of nontreponemal antibody testing, a fourfold increase in the nontreponemal antibody titer, documented primary or secondary syphilis, sex partner with documented primary or secondary syphilis, or positive treponemal test and nontreponemal antibody testing and exposure to infectious index case, all within the previous 12 months.
[e]Individuals whose last sexual contact with the index case was within 90 days of diagnosis of early syphilis or more than 90 days if follow-up is uncertain should be treated empirically for syphilis without waiting for, or regardless of, serologic test results.

IM = intramuscular; MU = million units; NAAT = nucleic acid amplification testing

exposed to blood-borne pathogens as a result of needlestick injuries, and these exposures tend to be underreported.[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.[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.[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

infection of concern in the local community. The risk of transmission in most source-unknown exposures is negligible.[3,4,18] 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]

Most healthcare institutions have clear protocols for managing occupational exposure to infectious diseases

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**).[3,18] 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/ept/legal/).[22]

TABLE 3

Postexposure management of infections transmitted by the airborne route

Infection and disease status of source individual	Disease status of exposed individual	Postexposure prophylactic regimen	Initial and follow-up evaluation
Measles: Patient with active infection (4–5 days before onset of rash to 4 days after rash)	Nonimmune immunocompetent contacts[a]	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	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
	Nonimmune pregnant women, infants aged < 12 months, or immunocompromised contacts (regardless of immune status)	A single dose of immune globulin 0.5 mL/kg IM or 400 mg/kg IV within 6 days of exposure	
Tuberculosis (TB): Patient with untreated pulmonary or laryngeal TB[b]	Close contacts with unprotected exposure, regardless of history of TB or vaccination with BCG vaccine	One of the following regimens for LTBI, if TB disease is ruled out: Isoniazid 5 mg/kg orally daily plus vitamin B_6 25–50 mg orally daily for 9 months or isoniazid 900 mg orally once weekly plus vitamin B_6 25–50 mg orally daily plus rifapentine 900 mg orally once weekly for 3 months	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
Varicella and disseminated herpes zoster (HZ): 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	Nonimmune immunocompetent contacts[c]	Two doses of varicella vaccine SC 1 month apart, first dose within 5 days of exposure	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
	Nonimmune pregnant women or immunocompromised contacts	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	

[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]

Hepatitis B is the most infectious of the common blood-borne viruses

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.[7,33]

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]

Postexposure prophylactic options for varicella and herpes zoster include varicella vaccine (not zoster vaccine) and varicella zoster immune globulin (**Table 3**).[12,38–40]

Varicella vaccine is approximately 90% effective if given within 3 days of exposure, and 70% effective if given within 5 days.[12,39]

Antiviral agents should be given if the exposed individual develops manifestations of varicella or herpes zoster.[12,38]

INFECTIONS TRANSMITTED BY THE DROPLET ROUTE

Droplet transmission occurs when respiratory droplets carrying infectious agents travel directly across short distances (3–6 feet) from the respiratory tract of the infected to mucosal surfaces of the susceptible exposed individual. Droplets are generated during coughing, sneezing, talking, and aerosol-generating procedures. Indirect contact with droplets can also transmit infection.[1]

The estimated risk of HIV transmission from a known infected source after percutaneous exposure is 0.3%

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,

TABLE 4

Postexposure management of infections transmitted by the droplet route

Infection and disease status of source individual	Disease status of exposed individual	Postexposure prophylactic regimen	Initial and follow-up evaluation
Group A streptococcus: 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	High-risk household contacts and close contacts	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	No work or school restriction for exposed asymptomatic individuals
Influenza: 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	Close contacts at high risk of complications of influenza or who are in close contact with individuals at high risk of influenza complications	One of the following regimens should be given within 48 hours of last exposure:[a] 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 case[b]	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
Mumps: Patient with laboratory-confirmed mumps infection, from 7 days before onset of parotitis to 9 days after	Nonimmune close contacts	None[a]	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 health care providers, from work for 9 days from onset of parotitis

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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

TABLE 4 CONTINUED

Infection and disease status of source individual	Disease status of exposed individual	Postexposure prophylactic regimen	Initial and follow-up evaluation
Meningitis: Patient with invasive meningococcal infection (meningitis or bacteremia) from 7 days before onset of illness until 24 hours of effective antibiotic therapy[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[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
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:[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 Exclusion of symptomatic individuals from work until 5 days of effective antibiotic therapy or negative microbiologic testing (if not treated)
Rubella: Patient with confirmed rubella, from 1 week before to 7 days after onset of rash	Nonimmune contacts	None[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

[a]Unvaccinated or incompletely vaccinated individuals should be vaccinated according to the adult vaccination schedule.
[b]Zanamavir is not recommended for patients with underlying airway disease because of the risk of bronchospasm and decline in pulmonary function.
[c]Penicillins are ineffective in the eradication of *N meningitidis* from the nasopharynx because of their inability to achieve high levels in nasopharyngeal secretions; therefore, they are not recommended for postexposure prophylaxis.
[d]A single oral dose of azithromycin 500 mg is an option in areas where fluoroquinolone-resistant strains of *N meningiditis* have been identified.
GAS = group A *Streptococcus*; IM = intramuscular; MMR = measles, mumps, and rubella; TMP-SMX = trimethoprim-sulfamethoxazole

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.[13,44,45]

TABLE 5

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

Infection and disease status of source individual	Disease status of exposed individual	Postexposure prophylactic regimen	Initial and follow-up evaluation
Hepatitis A virus (HAV): Confirmed HAV infection from the incubation period (15–50 days) until one week after onset of jaundice	Nonimmune, healthy close contacts between 12 months and 40 years of age	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	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
	Nonimmune close contacts with immunocompromising condition, chronic liver disease, < 12 months old, adults > age 40, or severe allergy to HAV vaccine	IG 0.02 mL/kg IM, single dose, in deltoid or gluteal muscle within 2 weeks of exposure	
	Immune close contacts (previously infected or vaccinated at least 2 weeks prior to exposure)	Not recommended	
Rabies: Bites or contact with suspected rabid animal Contact with patients infected with rabies from 2 weeks before onset of symptoms	Previously unvaccinated	HRIg 20 IU/kg[b] 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)[c]	No work or school restriction for asymptomatic exposed individuals
	Previously vaccinated[a]	Two doses of rabies vaccine IM on days 0 and 3	
Scabies: Patient with untreated infestation[d]	Close and sexual contacts within the preceding month before onset of symptoms or confirmed diagnosis	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	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

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Meningococcal disease

N meningitidis is transmitted from individuals with meningococcal disease or from asymptomatic carriers.[8]

Postexposure prophylaxis is effective in eradicating *N meningiditis* 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

TABLE 5 CONTINUED

Infection and disease status of source individual	Disease status of exposed individual	Postexposure prophylactic regimen	Initial and follow-up evaluation
Tetanus: Not applicable	Individuals with tetanus-prone injuries: Completed primary vaccination series (≥ 3 doses)	Clean, minor wounds: a single booster of age-appropriate tetanus toxoid-containing vaccine IM (DTaP, Tdap, DT, Td, TT) if at least 10 years since last dose of vaccine	No work or school restriction for asymptomatic exposed individuals
		Other wounds: a single booster of age-appropriate tetanus toxoid-containing vaccine IM (DTaP, Tdap, DT, Td, TT) if ≥ 5 years since last dose of vaccine	
	Unknown vaccination history or incomplete primary vaccination series (< 3 doses)	Clean, minor wounds: age-appropriate tetanus toxoid-containing vaccine IM (DTaP, Tdap, DT, Td, TT) and complete vaccine series according to schedule	
		Other wounds: age-appropriate tetanus toxoid-containing vaccine IM (DTaP, Tdap, DT, Td, TT) and complete vaccine series according to schedule	
		plus a single dose of tetanus immune globulin (TIg) 250 U IM, or immune globulin IV if TIg is not available, at a different site with different syringes than the vaccine	

[a] Individuals are considered vaccinated if they received a complete series of a cell-culture vaccine such as human diploid cell vaccine or purified chick-embryo cell vaccine, three 1-mL doses given intramuscularly in the deltoid area on days 0, 7, and 21 or 28.
[b] Full dose of HRIg should be infiltrated in and around the wound if anatomically feasible, with the rest administered into the deltoid muscle, lateral or anterior thigh, or the gluteal region in a separate syringe and site from the vaccine. If HRIg is not administered when active vaccination is begun, it can be administered until day 7.
[c] Day 0 is when the first dose of rabies vaccine was administered. Administer in the deltoid muscle; never administer in the gluteal muscle because of the low titer of neutralizing antibodies.
[d] Affected individuals should be instructed to wash clothing, linens, and towels used within the previous week in hot water and dry at high heat and to vacuum the entire house, furniture, and car interior.

DTaP = diphtheria, tetanus, acellular pertussis vaccine; DT = diphtheria-tetanus toxoids adsorbed; ELISA = enzyme-linked immunosorbent assay; HRIg = human rabies immune globulin; IM = intramuscularly; IV = intravenous; IU = international units; N/A = not applicable; Td = tetanus-diphtheria toxoids adsorbed; Tdap = tetanus toxoid, reduced diphtheria toxoid, acellular pertussis vaccine; TT = tetanus toxoid; U = unit

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

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]

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]

Chlamydia is the most commonly reported communicable disease in the United States

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.[15,48] 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.[15,48]

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.[50]

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.[51]

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, neonates 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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***ADDRESS**: Mazen S. Bader, MD, MPH, Juravinski Hospital and Cancer Centre, Department of Medicine, 711 Concession Street, Hamilton, Ontario L8V1C3 Canada; msbader1@hotmail.com*