RESEARCH

Postexposure Interventions to Prevent Infection With HBV, HCV, or HIV, and Tetanus in People Wounded During Bombings and Other Mass Casualty Events—United States, 2008

Recommendations of the Centers for Disease Control and Prevention and Disaster Medicine and Public Health Preparedness

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ABSTRACT

People wounded during bombings or other events resulting in mass casualties or in conjunction with the resulting emergency response may be exposed to blood, body fluids, or tissue from other injured people and thus be at risk for bloodborne infections such as hepatitis B virus, hepatitis C virus, human immunodeficiency virus, or tetanus. This report adapts existing general recommendations on the use of immunization and postexposure prophylaxis for tetanus and for occupational and nonoccupational exposures to bloodborne pathogens to the specific situation of a mass casualty event. Decisions regarding the implementation of prophylaxis are complex, and drawing parallels from existing guidelines is difficult. For any prophylactic intervention to be implemented effectively, guidance must be simple, straightforward, and logistically undemanding. Critical review during development of this guidance was provided by representatives of the National Association of County and City Health Officials, the Council of State and Territorial Epidemiologists, and representatives of the acute injury care, trauma, and emergency response medical communities participating in the Centers for Disease Control and Prevention's Terrorism Injuries: Information, Dissemination and Exchange project. The recommendations contained in this report represent the consensus of US federal public health officials and reflect the experience and input of public health officials at all levels of government and the acute injury response community. (*Disaster Med Public Health Preparedness.* 2008;2:150–165)

Editors' Note: The staff of *Disaster Medicine and Public Health Preparedness* is proud to copublish the article by Chapman and colleagues in conjunction with the Centers for Disease Control and Prevention's (CDC) *Morbidity and Mortality Weekly Report (MMWR)*. This article provides valuable information regarding procedures for postexposure prophylaxes to prevent bloodborne viral infections among victims of bombings and other mass casualty events. Our collaboration with the CDC to provide readers with timely access to this information represents a significant milestone for our journal. We are proud to work in conjunction with the CDC and *MMWR* and look forward to ongoing collaborations that will allow us to serve a valuable informational resource to the disaster medicine and public health preparedness community. Moreover, *DMPHP* remains committed to making timely information immediately available and will continue to publish articles ahead of print when doing so is in the best interest of our readership.

Public health authorities must consider how to provide care to injured people in the event of acts such as bombings that result in mass casualties. Of 318 acts of terrorism in the United States or its territories that were investigated by the Federal Bureau of Investigation from 1980 to 2005, 208 (65%) involved attempted bombings; of these 208 attempts, 183 (88%) succeeded. The majority of

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these acts were committed by domestic extremist groups that intentionally targeted property and did not cause deaths or injuries; however, 19 bombings (10% of those that were successful) resulted in 181 deaths and 1967 injured survivors. These figures do not include mass casualty incidents that occurred outside the United States and its territories or those that occurred on US soil that were classified as crimes, accidents, unintended negligence, or terrorist incidents other than bombings (eg, the 2972 individuals killed in the terrorist attacks of September 11, 2001). A total of 1967 (91%) people injured during terrorist bombings in the United States and approximately 12,000 (80%) people injured during the terrorist attacks of September 11, 2001, survived.[1]

Military health care providers frequently must respond to mass casualty events. Of 35,630 casualties incurred by US Department of Defense forces involved in Operation Enduring Freedom in Afghanistan and Operation Iraqi Freedom in Iraq from Oc-tober 7, 2001 to March 1, 2008, 27,441 (77%) resulted from mass casualty events. Explosive devices accounted for 23,277 (65%) of these casualties. Of 27,441 individuals wounded during Operation Enduring Freedom– and Operation Iraqi Freedom–related mass casualty events, 24,433 (89%) survived (US Department of Defense, unpublished data, 2008).

In August 2001 the Israeli health ministry announced that tissue from 2 suicide bombers had tested positive for evidence of hepatitis B virus (HBV).[2] A 2002 case report from Israel described evidence of HBV in a bone fragment that was traumatically implanted into a bombing survivor.[3] Traumatically implanted bone fragments removed from 5 survivors of the 2005 London bombings were taken directly to forensic custody without being tested for bloodborne pathogens.[4] These observations support the potential for explosions to result in transmission of infections among people injured during the event and indicate that emergency responders and health care providers in the United States need uniform guidance on prophylactic interventions that are appropriate for individuals injured in bombings and other events resulting in mass casualties. Wounds resulting from mass casualty events require the same considerations for management as similar injuries resulting from trauma cases not involving mass casualties, including the risk for tetanus. In addition, exposure of wounds, abraded skin, or mucous membranes to blood, body fluids, or tissue from other injured people (including suicide bombers and bombing casualties) may carry a risk for infection with a bloodborne virus. Injured survivors of mass casualty events are at risk for infection with HBV, hepatitis C virus (HCV), human immunodeficiency virus (HIV), and tetanus.

Decisions regarding the administration of prophylaxis after a mass casualty event are complex, and drawing direct parallels from existing guidelines regarding prophylaxis against bloodborne pathogens in occupational or nonoccupational settings is difficult. Assessment of risk factors that are commonly used to estimate the need for prophylactic intervention may not be possible in the setting of response to a mass casualty event because responses to such events may overwhelm local emergency response facilities, and medical response staff will be focused primarily on rendering lifesaving trauma treatments. Because no uniform guidance existed for postexposure interventions to prevent bloodborne infections and tetanus among US civilians or military personnel wounded during mass casualty events, the Centers for Disease Control and Prevention (CDC) convened a working group comprising experts in injury response, immunizations, bloodborne infections, tetanus, and federal-, state-, and local-level public health response to develop such guidance.

The recommendations herein pertain only to bombings and other mass casualty events and are not meant to supplant existing recommendations for other settings. In a situation involving a substantial number of casualties, the ability to assess medical and vaccination histories or the risks associated with the source of exposures may be limited, as may the supply of biologics. Thus, in certain instances, the recommendations provided differ from standard published recommendations for vaccination and prophylaxis in other settings. In addition, the recommendations provided in this report are limited to issues regarding initial postexposure management for bloodborne pathogens and tetanus prophylaxis. Other prophylactic measures that may be appropriate (eg, use of antibiotics for the prevention of bacterial infection) are not discussed.

Individual states set forth their own legal requirements as to what constitutes the nature of informed consent that may be required before certain medical interventions are rendered. In general, these statutes also provide for exemptions in emergency circumstances. It is these state-specific laws that should guide response when informed consent would be applicable, but the circumstances of response to a mass casualty event may preclude adherence to standard informed consent processes. Emergency responders and health care providers should consult their legal counsel for guidance regarding the relevant laws of their jurisdictions in advance of any mass casualty event.

METHODS

This report was developed through consultation among people with expertise in immunization and other prophylactic interventions against bloodborne and other infections, physicians who specialize in acute injury care medicine (trauma and emergency medicine), and local, state, and federal public health epidemiologists. Thus, the recommendations in this report represent the best consensus judgment of expert opinion. The report adapts existing recommendations on the use of immunization and postexposure prophylaxis (PEP) in response to occupational and nonoccupational exposures to bloodborne pathogens in the United States to the specific mass casualty event setting, while acknowledging the difficulty of drawing direct parallels. This adaptation also draws

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on guidance and practices developed previously and in use in the United Kingdom and Israel.[2,5–7]

These recommendations were adopted through a process of expert consultation and consensus development. First, CDC drafted proposed preliminary recommendations on the basis of relevant existing US guidance and practices of Israel and the United Kingdom.[2,5–7] These proposed recommendations were discussed by representatives of the US and international trauma response communities at a May 2006 meeting in Atlanta, Georgia; following this discussion, the initial draft was revised. A working group then was convened comprising CDC staff members with expertise in injury response, tetanus, viral hepatitis, HIV infection, immunization and PEP, and occupational safety and health, and representatives of the National Association of County and City Health Officials and the Council of State and Territorial Epidemiologists with experience in local- and state-level public health response. This group worked through the draft section by section to revise, update, and refine the recommendations; this revised document was shared again with representatives of the US and international trauma response communities for additional comment during a meeting in Atlanta in August 2007. Because this guidance met the requirements established by the Office of Management and Budget for a Highly Influential Scientific Assessment (*http://www.whitehouse.gov/omb/memoranda/fy2005/m05-03.html*), the recommendations underwent a final process of external review in addition to undergoing internal CDC review for scientific content. As part of the Office of Management and Budget Highly Influential Scientific Assessment peer review, the document was posted on the CDC Web site for public comment. An external expert panel subsequently reviewed and critiqued the document, the public comments, and CDC's response to those comments, and the document was revised a final time in response to the external review process.

BLOODBORNE PATHOGENS OF IMMEDIATE CONCERN

Although transfusions and injuries from sharp objects (eg, needlestick) have been associated with the transmission of multiple different pathogens,[8,9] 3 bloodborne pathogens merit specific consideration in mass casualty situations: HBV, HCV, and HIV. All 3 viruses are endemic at low levels in the United States and can be transmitted by exposure of infectious blood to an open wound or, more rarely, to skin abrasions or through exposure to intact mucous membranes. These viruses also can be transmitted by similar exposures to other body fluids or tissues from infected individuals. Infection risks and options for PEP vary, depending on the virus and the type of injury and exposure. Because hepatitis A virus is transmitted via the fecal–oral route and is not considered a bloodborne pathogen,[10] hepatitis A prophylaxis is not recommended during a mass casualty event.

The information typically used in occupational settings to guide prophylactic intervention decisions (including the circumstances of the injury, background prevalence of disease, or risk for infection of the source of exposure) may not be as clearly interpretable or as readily available in a mass casualty setting. For example, both the extent of exposed disrupted skin and the volume of blood contributing to the exposure may greatly exceed that of usual occupational exposures. In addition, injured people may be exposed to blood from multiple other people or to biological material from the body of a bomber or another injured person. The HBV, HCV, and HIV status of the source(s) usually will be unknown, and timely ascertainment may not be practical. If the circumstance in which each victim was injured can be characterized, then this information can be used to assess the likelihood that an injured person was exposed to another person's blood. However, when such information is not readily available for people injured during blast-related mass casualty events, such blood exposure should be assumed.

Hepatitis B Virus

The prevalence of chronic HBV infection in the United States is approximately 0.4%. Prevalence varies by race, ethnicity, age group, geographic location, and individual history of risk behaviors.[11] Newly acquired HBV infection often is asymptomatic; only 30% to 50% of children older than 5 years and adults have initial clinical signs or symptoms.[11] The fatality rate among people with reported cases of acute symptomatic HBV is 0.5% to 1.0%.[11] No specific treatment exists for acute HBV. Acute HBV infection fails to resolve and instead progresses to chronic HBV infection in approximately 90% of those infected as infants, 30% of children infected at age <5 years, and $<5\%$ of people infected at ≥ 5 years.[11] Overall, approximately 25% of people who become chronically infected during childhood and 15% of those who become chronically infected after childhood die prematurely from cirrhosis or liver cancer.[11] Therapeutic agents approved by the US Food and Drug Administration (FDA) for treating chronic HBV can achieve sustained suppression of HBV replication and remission of liver disease for certain individuals.[11]

HBV is transmitted by percutaneous or mucosal exposure to infectious blood or body fluids. Although HBV surface antigen (HBsAg) has been detected in multiple body fluids, only serum, semen, and saliva have been demonstrated to be infectious.[11] Serum has the highest concentration of HBV, with lower concentrations in semen and saliva. HBV remains viable for 7 days or longer on environmental surfaces at room temperature.[11] Among susceptible health care personnel, the risk for HBV infection after a needlestick injury involving an HBV-positive source is 23% to 62%.[12] Prompt and appropriate PEP intervention reduces this risk. Many infections that occurred before the widespread vaccination of health care personnel probably resulted from unapparent exposures (eg, inoculation into cutaneous scratches, lesions, or mucosal surfaces).[12]

Both passive-active PEP with hepatitis B immunoglobulin (HBIG) combined with hepatitis B vaccine and active PEP with

hepatitis B vaccine alone have been demonstrated to be highly effective in preventing transmission after exposure to HBV.[12] HBIG alone has been demonstrated to be effective in preventing HBV transmission. Since the hepatitis B vaccine became available, however, HBIG is used typically (and preferentially) as an adjunct to vaccination.[11] The major determinant of the effectiveness of PEP is early administration of the initial dose of vaccine (or HBIG). The effectiveness of PEP diminishes the longer after exposure that it is initiated.[12] Studies on the maximum interval after exposure during which PEP is effective are limited, but the interval is unlikely to exceed 7 days for perinatal and needlestick exposures.[12] No data are available on the efficacy of HBsAg-containing combination vaccines when used to complete the vaccine series for PEP, but the efficacy of combination vaccines is expected to be similar to that of single-antigen vaccines because the HBsAg component induces a comparable antibody response.[12] Antiviral PEP is not available for HBV.

A policy of liberal use of hepatitis B vaccine for PEP after bombings or in other mass casualty situations is recommended because of the high concentration of HBV in the blood of infected people, the durability of HBV in the environment, and the efficacy and relative ease of administration of vaccine.[11] Such use is consistent with existing recommendations for administering the hepatitis B vaccine series as PEP for people (eg, health care personnel, sexual assault victims) exposed to a source with unknown HBV infection status.[11,12] In general, PEP for HBV will be warranted for people previously unvaccinated if wounds, nonintact skin, or intact mucous membranes may have been exposed to blood or body fluids from another person or people. In a mass casualty setting, failure to provide hepatitis B vaccination when needed could result in preventable illness, whereas unnecessary vaccination is unlikely to cause harm.[11] Completion of primary vaccination at the time of discharge or during follow-up visits should be ensured for all individuals who receive an initial hepatitis B vaccine dose as part of the acute response to a mass casualty event.

If hepatitis B vaccine is in short supply, assessing how likely a person is to have been vaccinated previously may be necessary. In general, hepatitis B vaccination rates are highest among children younger than 17 years (80%–90%) and health care personnel (approximately 80%; Table 1; see Pathogen-specific Management Recommendations).[13–15]

Federal law requires the use of a Vaccine Information Statement (VIS) before the administration of vaccines against HBV. (VIS forms are available at *http://www.cdc.gov/vaccines/pubs/vis/default.htm.*) Whenever feasible, a VIS form should be provided to patients or guardians before vaccination.

Hepatitis C Virus

The prevalence of chronic HCV infection in the United States is approximately 1.3%.[16] Prevalence varies by race/ethnicity, age group, geographic location, and individual history of risk behaviors.[16,17]

TABLE 1

Estimated Percentage of People in US Vaccinated Against HBV Infection, by Age Group and Selected Characteristics, 2001–2006

Group	No. Doses	% Vaccinated (95% CI)
Infants 19–35 mo[13]	3	93.4 (92.8%–94%)
Adolescents 13–17 y[14]	3	81.3 (79.4%–83.1%)
Adults 18–49 y[15]	≥1	34.6 (33.5%–35.6%)
Health care personnel	≥1	80.5 (77.3%–83.4%)
Police/firefighters	≥1	63.3 (56.6%–70.1%)
Adults at high risk*	≥1	45.4 (41.7%–49.2%)

CI, confidence interval.

*Includes people who reported having a sexually transmitted disease other than human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome during the previous 5 years, people who consider themselves at high risk for HIV infection, and people who reported any 1 of the following risk factors: hemophilia with receipt of clotting factor concentrates, men who have sex with men, injection-drug use, trading sex for money or drugs, testing positive for HIV, or having sex with someone with any of these risk factors.

People with acute HCV infection typically either are asymptomatic or have a mild clinical illness. Antibody to HCV (anti-HCV) can be detected in 80% of patients within 15 weeks after exposure and in 97% of patients by 6 months after exposure. Chronic HCV infection develops in 75% to 85% of infected individuals. The majority remain asymptomatic until onset of cirrhosis or end-stage liver disease, which develops within 20 to 30 years in approximately 10% to 20% of infected individuals.[17]

HCV is transmitted primarily through exposure to large amounts of blood or repeated direct percutaneous exposures to blood (ie, transfusion or injection-drug use). HCV is not transmitted efficiently through occupational exposures to blood; the average incidence of anti-HCV seroconversion after accidental percutaneous exposure from an HCV-positive source is 1.8% (range 0%–7%), with 1 study indicating that transmission occurred only from hollow-bore needles.[17] Transmission rarely occurs through mucous membrane exposures to blood, and in only 1 instance was transmission in a health care provider attributed to exposure of nonintact skin to blood.[18] The risk for transmission from exposure to fluids or tissues other than HCV-infected blood has not been quantified, but it is expected to be low. The exact duration of HCV viability in the environment is unknown but is at least 16 to 23 hours.[19,20]

Immunoglobulin and antiviral agents are not recommended for PEP after exposure to HCV-positive blood. No vaccine against HCV exists. In the absence of PEP for HCV, recommendations for postexposure management are intended to achieve early identification of infection and, if present, referral for evaluation of treatment options. No guidelines exist

for administration of therapy during the acute phase of HCV infection. However, limited data indicate that antiviral therapy may be beneficial when started early in the course of HCV infection. When HCV seroconversion is identified early, the person should be referred for medical management to a knowledgeable specialist.[12,17]

Testing is not routinely recommended in the absence of a risk factor for infection or a known exposure to an HCV-positive source.[17] However, current public health practice often does include advising testing for potential exposures to unknown sources (eg, playground incidents involving needlestick, health care exposures involving possible needle or syringe reuse, inadequately disinfected equipment). In the setting of a bombing or other mass casualty event, both the extent of exposed disrupted skin and the volume of blood contributing to the exposure may greatly exceed that of typical occupational exposures. Thus, baseline and follow-up HCV testing should be considered for people injured during bombings or other mass casualty events whose penetrating injuries or nonintact skin are suspected to have come into contact with another person's blood or body fluids (see Pathogen-specific Management Recommendations).

Human Immunodeficiency Virus

The overall prevalence of HIV infection in the United States was estimated to be 311.5/100,000 population (0.31%) in 2005, with wide geographic variability (range 26.4/100,000 population [0.03%, North Dakota]–2060/100,000 population [2.06%, Washington, DC]).[21] Prevalence may vary greatly among subpopulations within the same communities (eg, residents of a nursing facility compared with residents of transitional housing associated with a drug treatment program). The principal means of transmission in the United States is through sexual contact or through sharing injection-drug use equipment with an infected person.[21] Exposures also occur in occupational settings (principally among health care personnel) and infrequently can result in transmission. Guidelines for the use of antiretroviral PEP in both occupational and nonoccupational settings have been published,[22–24] but these documents do not specifically address situations involving mass casualties.

Potentially infectious materials include blood and visibly bloody body fluids, semen, and vaginal secretions. Cerebrospinal, synovial, pleural, peritoneal, pericardial, and amniotic fluids also are considered infectious, but the transmission risk associated with them is less well defined. Feces, nasal secretions, saliva, sputum, sweat, tears, urine, and vomitus are not considered infectious unless visibly bloody. Exposures that pose a risk for transmission include percutaneous injuries and contact of mucous membranes or of nonintact skin with potentially infected fluids.[22–24]

In studies of health care personnel, the average risk for HIV transmission has been estimated to be approximately 0.3% (95% confidence interval [CI] 0.2%–0.5%) after a percutaneous exposure to HIV-infected blood and approximately 0.09% (95% CI 0.01%–0.5%) after a mucous membrane exposure. Transmission risk from nonintact skin exposure has not been quantified but is estimated to be less than that for mucous membrane exposure. Risk following percutaneous exposure is correlated positively with exposure to a larger quantity of blood, direct penetration of a vein or artery, a deep tissue injury, or exposure to blood from a source person with terminal illness,[25] presumably related to high viral load.

Use of PEP with antiretroviral medications, initiated as soon as possible after exposure and continuing for 28 days, has been associated with a decreased risk for infection following percutaneous exposure in health care settings.[22] PEP also is recommended following nonoccupational sexual and injection-drug use–related exposures.[24] Because of the potential toxicities of antiretroviral drugs, PEP is recommended unequivocally only for exposures to sources known to be infected with HIV. The decision to use PEP following unknown-source exposures is to be made on a case-by-case basis, considering the information available about the type of exposure, known risk characteristics of the source, and prevalence in the setting concerned.

In the majority of instances involving bombings or other mass casualty events, the working group concluded that the risk for exposure to HIV-infected materials probably is low and that therefore PEP is not indicated. On this basis, PEP is not routinely recommended for treating people injured in mass casualty settings in the United Kingdom.[7] For the same reason, HIV PEP should not be administered universally in mass casualty settings in the United States unless recommended by the local public health authority. Such instances may occur for mass casualty events in certain specific settings judged by public health authorities to be associated with higher risk for HIV exposure (eg, a research facility that contained a large archive of HIV-infected blood specimens). In the rare situation in which PEP is recommended, it should be initiated as soon as possible after exposure, and specimens from the exposed person should be collected for baseline HIV testing; however, PEP should not be delayed for the results of testing. If PEP is used, then certain other laboratory studies also are indicated. Consultation by health care professionals knowledgeable about HIV infection is ideal and is particularly important for pediatric patients and pregnant women. All people for whom HIV PEP has been initiated should be referred to a clinician experienced in HIV care for follow-up.

TETANUS

Clostridium tetani, the causative agent of tetanus, is ubiquitous in the environment and distributed worldwide. The organism is found in soil and in the intestines of animals and humans. When spores of *C. tetani* are introduced into the anaerobic or hypoaerobic conditions found in wounds or devitalized tissue, they germinate to vegetative bacilli that elaborate toxin and cause disease. This now infrequent but often fatal disease has been associated with injuries to oth-

erwise healthy people, particularly during military conflicts. From 1998 to 2000, the case-fatality ratio for reported tetanus in the United States was 18%.[26] Although tetanus is not transmitted from person to person, contamination of wounds with debris may increase the risk for tetanus among individuals injured in mass casualty settings. Proper wound care and debridement play a critical role in tetanus prevention.

Serological tests indicate that immunity to tetanus toxin is not acquired naturally. However, protection against tetanus is achievable almost universally by use of highly immunogenic and safe tetanus toxoid–containing vaccines. The disease now occurs almost exclusively among people who were not vaccinated adequately or whose vaccination histories are unknown or uncertain.[27,28] Universal primary vaccination, with subsequent maintenance of adequate antitoxin levels by means of appropriately timed boosters, protects people in all age groups.

The age distribution of recent cases and the results of serosurveys indicate that many adults in the United States are not protected against tetanus.[29] The proportions of people lacking protective levels of circulating antitoxins against tetanus increase with age; at least 40% of people 60 years and older may lack protection. In the United States, tetanus is primarily a disease of older adults.[27,28] Children are much more likely to have received age-appropriate vaccination; rates for receipt of 3 doses among children 19 to 35 months old exceed 96%.[28] Only 15 cases of tetanus were reported in the United States among children younger than 15 years old from 1992 to 2000. Parental philosophical or religious objection to vaccination accounted for the absence of immune protection for 12 (80%) affected children.[30] Foreign-born immigrants, especially those from regions other than North America or Europe, also may be relatively undervaccinated.[29,31]

Available evidence indicates that complete primary vaccination with tetanus toxoid provides long-lasting protection. After routine childhood tetanus vaccination, the Advisory Committee on Immunization Practices (ACIP) recommends routine booster vaccination with tetanus toxoid–containing vaccines every 10 years. For clean and minor wounds, a booster dose is recommended if the patient has not received a dose within the past 10 years. For all other wounds, a booster is appropriate if the patient has not received tetanus toxoid during the preceding 5 years.

In the setting of acute response to a mass casualty event, failure to provide a tetanus vaccination when needed could result in preventable illness, whereas unnecessary vaccination is unlikely to cause harm.[26–29,32,33] A substantial proportion of patients in this setting may be unable to provide a history of vaccination or history of contraindications to tetanus toxoid–containing vaccines, and the majority of wounds sustained will be considered tetanus prone because they are likely to be exposed to dirt or feces. Thus, a wounded adult patient who cannot confirm receipt of a tetanus booster during the preceding 5 years should be vaccinated with tetanus and diphtheria toxoids vaccine (Td) or tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine (Tdap); adults 65 years and older should receive Td.[26] Similarly, a child with an uncertain vaccination history should receive a tetanus booster as age indicated by the standard childhood immunization table (pediatric diphtheria and tetanus toxoid and acellular pertussis vaccine [DTaP] if younger than 7 years, Td if 7 to 10 years old, and Tdap if 11 years and older).[32,34]

ACIP recommends that patients without a complete primary tetanus series who sustain a tetanus-prone wound routinely receive passive immunization with tetanus immunoglobulin (TIG) and tetanus toxoid.[33] In the setting of acute response to a mass casualty event, many wounded patients probably will be unable to confirm previous vaccination histories, and thus TIG normally would be indicated. However, this may not be feasible in a mass casualty setting if supplies of TIG are limited. All decisions to administer TIG depend on the number of casualties and the readily available supply of TIG. If the supply of TIG is adequate, then consideration may be given to providing both tetanus toxoid and passive immunization with TIG at the time of management of tetanus-prone wounds. TIG is indicated if completion of a primary vaccination series is uncertain for an adult or if prior receipt of age-appropriate vaccinations is uncertain for a child. If TIG is in short supply, then it should be reserved for patients who are the least likely to have received adequate primary vaccination. In general, this group includes people 60 years and older and immigrants from regions other than North America or Europe who may be less likely to have adequate antitetanus antibodies and who thus would derive the most benefit from TIG.[32]

The TIG prophylactic dose that is recommended currently for wounds is 250 U administered intramuscularly (IM) for adult and pediatric patients. When tetanus toxoid and TIG are administered concurrently, separate syringes and separate sites should be used.[35] In circumstances in which passive protection is clearly indicated but TIG is unavailable, intravenous immunoglobulin may be substituted for TIG. Postexposure chemoprophylaxis with antimicrobials against tetanus is not recommended.

ACIP recommends that adults and adolescents with a history of uncertain or incomplete primary vaccination complete a 3-dose primary series for tetanus, diphtheria, and pertussis.[26,30–34] In the setting of acute response to a mass casualty event, completion of the primary vaccination series of any vaccine provided initially during acute response during follow-up visits should be ensured at the time of discharge for inadequately vaccinated patients of all ages. Special precautions regarding management of pregnant women in the setting of emergency delivery have been identified (see Special Situations).

Federal law requires the use of a VIS before the administration of vaccines against tetanus. (VIS forms are available

at *http://www.cdc.gov/vaccines/pubs/vis/default.htm.*) Whenever feasible, a VIS form should be provided to patients or guardians before vaccination.

RECOMMENDATIONS

Risk Assessment

To determine appropriate actions in response to the evaluation of casualties of bombings or other mass casualty events, health care providers should do the following:

- Assess individual exposure risk by categorizing the patient into 1 of 3 exposure risk categories (Table 2) that are numbered sequentially from the highest (category 1) to the lowest (category 3) level of exposure risk and assign each person to the highest level risk category for which he or she qualifies.
- Identify the appropriate risk category-specific and pathogen-specific management recommendation(s) (Table 2).
- Determine the appropriate action to take (see Pathogen-specific Management Recommendations) in response to management recommendations.

When evaluating management choices for casualties of bombings or other mass casualty events, health care providers should assume that exposure to blood from other injured individuals is likely unless the information available on the circumstances of injury suggests otherwise. Blast injuries result occasionally in traumatic implantation of bone or other biological material that is alien to the wounded person. Testing of such matter is not recommended as a useful adjunct for clinical management of wounded people. Public health authorities can provide assistance in assessing exposure risk for affected groups of injured people. Tetanus risk is not dependent upon blood exposure.

Pathogen-specific Management Recommendations

Hepatitis B Virus

Unless an injured person who is unable to communicate an accurate medical history or for whom medical records are not readily available is accompanied by a person able to function as a health care proxy, responders should assume the absence of a reliable hepatitis B vaccination history and no contraindication to vaccination with hepatitis B vaccine (see Contraindications and Precautions). If administration of hepatitis B vaccine to a large number of people after a mass casualty event is anticipated to result in shortages of hepatitis B vaccine products, or if such shortages already exist, then assistance with vaccine supply is available (see Vaccine and Antitoxin Supply).

Recommendation: Intervene

- Individuals for whom neither a reliable history of completed vaccination against HBV nor a known contraindication to vaccination against HBV exist should receive the first dose of the HBV vaccine series as soon as possible (preferably within 24 hours) and not later than 7 days after the event.
- Individuals who receive or are identified as candidates for a dose of hepatitis B vaccine while undergoing evaluation or treatment in immediate response to a mass casualty event should be discharged with referrals for follow-up and written information on predischarge treatment to facilitate the ability of primary health care providers to evaluate and, if appropriate, initiate or complete age-appropriate vaccinations or vaccination series (Appendix).

Recommendation: No Action

- No action is necessary to prevent HBV infection.

Hepatitis C Virus

Recommendation: Consider Testing

Testing should be considered when an HCV-infected source is known or thought to be likely on the basis of the setting in which the injury occurred or exposure to blood or biological material from a bomber or multiple other injured people is suspected.

Public health authorities can provide assistance in assessing exposures and therefore treatment for affected groups of

TABLE 2

Recommended Postexposure Management by Risk Category and Specific Pathogen

Risk Category	HBV	HCV	HIV	Tetanus
1: Penetrating injuries or nonintact skin exposures*	Intervene	Consider testing	Generally no action	Intervene
2: Mucous membrane exposures†	Intervene	Generally no action	Generally no action	No action
3: Superficial exposure of intact skin‡	No action	No action	No action	No action

HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus.

*Penetration of skin by a sharp object that was in contact with blood, tissue, or other potentially infectious body fluid (ie, semen, vaginal fluid, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, or any other visibly bloody body fluid or tissue) before penetration. Nonintact skin exposure is defined as contact of nonintact skin with any of these potentially infectious tissues or fluids.

†Contact of mucous membranes (ie, eyes, nose, mouth, or inner surfaces of the gut or genital areas) with blood, tissue, or other potentially infectious body fluid (ie, semen, vaginal fluid, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, or any other visibly bloody body fluid or tissue).

‡Superficial exposure of intact skin (but not of mucous membranes) with blood, tissue, or other potentially infectious body fluid (ie, semen, vaginal fluid, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, or any other visibly bloody body fluid or tissue).

injured people. A decision to perform testing of specific individuals may be made on the basis of the judgment of the treating physician and the preferences of the individual patient; testing during a follow-up referral may be a more feasible logistical option in the setting of response to a mass casualty event.

If a decision is made to perform testing, then:

Baseline testing for anti-HCV and alanine aminotransferase (ALT) should be performed within 7 to 14 days of the exposure.

Follow-up testing for anti-HCV and ALT should be performed 4 to 6 months after exposure to assess seroconversion, preferably arranged as part of discharge planning.

HCV RNA testing should be performed at 4 to 6 weeks if an earlier diagnosis of HCV infection is desired.

Positive anti-HCV with low signal-to-cutoff value should be confirmed using a more specific supplemental assay before communicating the results to the patient.

People who are tested or are identified as candidates for testing regarding exposure to HCV while undergoing evaluation or treatment in immediate response to a mass casualty event should be discharged with a referral for follow-up and written information on predischarge treatment (Appendix).

Recommendation: Generally No Action

- Exposure of mucous membranes to blood from a source with unknown HCV status generally poses a minor risk for infection and does not require further action.
- In settings in which exposure to an HCV-infected source is known or thought to be highly likely, testing for early identification of HCV infection following mucous membrane exposure may be considered. The decision to perform testing should be made on the basis of the judgment of the treating physician and the preference of the individual patient.

Recommendation: No Action

- No action is necessary to prevent HCV infection.

Human Immunodeficiency Virus

Recommendation: Generally No Action

- In general, HIV PEP is not warranted. HIV PEP may be considered only in settings in which exposure to an HIV-infected source is known or thought to be highly likely (eg, a blast injury incident that occurred in a research facility that contained a large archive of HIV-infected blood specimens).
- HIV PEP should not be administered universally in response to mass casualty events unless recommended by the local public health authority.
- In the rare event that HIV PEP is considered, it should be initiated as soon as possible after exposure. The patient should be counseled about the availability of PEP and informed of the potential benefits and risks and the need for prompt initiation to maximize potential effectiveness. If PEP is thought to be indicated on the basis of exposure risk, then administration should not be delayed for HIV test results. Specific guidance on how to administer HIV PEP in unusual circumstances when it is warranted is available (see Special Situations).
- People who receive or are identified as candidates for HIV PEP while undergoing evaluation or treatment in immediate response to a mass casualty event should be discharged with referrals for urgent follow-up. Written information on predischarge treatment should be provided to facilitate a primary health care provider's ability to evaluate and, if appropriate, complete age-appropriate vaccinations or vaccination series (Appendix).
- In all health care settings, opt-out screening for HIV (performing HIV screening after notifying the patient that the test will be performed, with assent inferred unless the patient declines or defers testing) is recommended for all patients 13 to 64 years old. In the setting of response to a mass casualty event, testing during a follow-up referral may be a more feasible logistic option unless a decision to administer PEP has been made.[35]

Recommendation: No Action

- No action is necessary to prevent HIV infection.

Tetanus

All individuals who sustain tetanus-prone injuries in mass casualty settings should be evaluated for the need for tetanus prophylaxis. Tetanus-prone injuries include but are not limited to puncture and other penetrating wounds with the potential to result in an anaerobic environment (wounds resulting from projectiles or by crushing) and wounds, avulsions, burns, or other nonintact skin that may be contaminated with feces, soil, or saliva.

All individuals who are not accompanied by either medical records or a health care proxy and whose ability to communicate an accurate medical history is uncertain for any reason should be deemed to lack a reliable tetanus toxoid vaccination history and to have no contraindication to vaccination with tetanus toxoid (see Contraindications and Precautions). If compliance with recommendations is anticipated to result in a shortage of tetanus toxoid products or TIG, then assistance with product supplies is available (see Vaccine and Antitoxin Supply).

Recommendation: Intervene

- Appropriate wound care and debridement are critical to tetanus prevention.
- Age-appropriate vaccines should be used if possible. However, in a mass casualty setting, this may not be possible, and any tetanus vaccine formulation may be

used because the tetanus toxoid content is adequate for tetanus prophylaxis in any age group. In this setting, the benefit of supplying tetanus prophylaxis outweighs the potential for adverse reactions from formulations from a different age indication.

- Adult patients who cannot readily confirm receipt of a tetanus booster during the preceding 5 years and who do not have known contraindication to tetanus vaccination should be vaccinated with Tdap (or with Td if Tdap is unavailable) or with Td if 65 years or older.
- Pediatric patients with uncertain vaccination history and with no known contraindication to tetanus vaccination should receive a tetanus booster according to the following schedule:

  —DTaP if younger than 7 years old
  —Td if 7 to 10 years old
  —Tdap (or Td if Tdap is unavailable) if 11 years or older

- In a mass casualty situation, unusually high demand may result in shortages of age-specific vaccine formulations, and logistic considerations may make differentiating patients by age category prohibitive. If supplies of DTaP are inadequate, health care providers may consider substituting Tdap or Td for DTaP because the amount of tetanus toxoid in all formulations is adequate to induce an immune response in a child. Similarly, if supplies of Td are inadequate, health care providers may consider substituting Tdap for Td for people 65 years or older. Pediatric DTaP generally is not indicated in individuals 7 years old or older; the increased diphtheria toxoid content is associated with higher rates of local adverse reactions in older people[26,32]; however, in a mass casualty setting, other options may not exist.
- TIG may be indicated if completion of a primary vaccination series is uncertain for an adult, or prior receipt of age-appropriate vaccinations is uncertain for a child.

  —If TIG is in short supply, use of TIG should be reserved first for people 60 years old or older and for immigrants from regions other than North America or Europe. All decisions to administer TIG depend on the number of casualties and the readily available supply of TIG.
  —The recommended prophylactic dose of TIG is 250 U IM for adult and pediatric patients. When tetanus toxoid and TIG are administered concurrently, separate syringes and separate sites should be used.[34]

- People who receive or are identified as candidates for tetanus toxoid–containing products or TIG while undergoing evaluation or treatment in immediate response to a mass casualty event should be discharged with referrals for follow-up if possible. Written information on predischarge treatment should be provided to facilitate the ability of primary health care providers to evaluate and, if appropriate, complete age-appropriate vaccinations or vaccination series (Appendix).

Recommendation: No Action

- No action is necessary to prevent tetanus. Exposure to blood or other body fluids generally is not considered a risk factor for tetanus.
- Responders or people engaged in debris clean-up and construction are candidates for prophylaxis even if they do not sustain any wounds. When feasible, as a routine public health measure, tetanus toxoid vaccination with Tdap or Td should be offered to all individuals whose last tetanus toxoid–containing vaccine was received 10 or more years previously and who either are responders or are engaged in either debris clean-up or construction and who thus may be expected to encounter further risk for exposure.[36–39]

VACCINE AND ANTITOXIN SUPPLY

Adherence to the above recommendations may increase the acute demand for tetanus toxoid–containing vaccine, TIG, and hepatitis B vaccine beyond the available local supply. Thus, local authorities may be forced to rely on local and state health departments, mutual aid agreements, or commercial vendors to supplement the supply of needed biological or pharmaceutical products. If a local authority's capacity to respond to an emergency is exceeded and other local or regional resources are inadequate, then local and state public health jurisdictions can, through their established communication channels for health emergencies, work with CDC and others as appropriate to assist with product shortages.

CDC's Strategic National Stockpile (SNS) maintains bulk quantities of pharmaceutical and nonpharmaceutical medical supplies for use in a national emergency. Tetanus toxoid, tetanus immunoglobulin, and hepatitis B vaccine are not included in the stockpile formulary. However, SNS has purchasing agreements for acquiring medical materials in large quantities, subject to commercial availability. CDC maintains stockpiles of pediatric vaccine products purchased by the Vaccines for Children Program that may be used to assist state, territorial, and tribal health departments in meeting emergent local demands for vaccines. CDC also can work with manufacturers and with state and local health authorities to assist with supply of vaccines that are not available in either the SNS or other CDC vaccine stockpiles.

COUNSELING

Hepatitis B and C Viruses

People undergoing postexposure treatment for possible exposure to HBV- or HCV-infected blood do not need to take any special precautions to prevent secondary transmission during the follow-up period.[12,17] The exposed person does not need to modify sexual practices or refrain from becoming pregnant. An exposed nursing mother may continue to breastfeed. However, people who have been exposed should refrain from

donating blood, plasma, organs, tissue, or semen until follow-up testing by a health care provider has excluded seroconversion.[12,17]

Human Immunodeficiency Virus

People known to be exposed to HIV should refrain from blood, plasma, organ, tissue, or semen donation until follow-up testing by a health care provider has excluded seroconversion. In addition, measures to prevent sexual transmission (eg, abstinence, use of condoms) should be taken, and breastfeeding should be avoided until HIV infection has been ruled out.[22]

SPECIAL SITUATIONS

When HIV PEP Is Initiated

HIV PEP should be considered only under exceptional circumstances. In the rare event that HIV PEP is considered, it should be initiated as soon as possible after exposure. The patient should be counseled about the availability of PEP and informed about the potential benefits and risks and the need for prompt initiation to maximize potential effectiveness. If PEP is thought to be indicated on the basis of exposure risk, then administration should not be delayed for HIV test results.

In the rare event that HIV PEP is administered, specimens should be collected for baseline HIV testing on all patients provided with PEP using a blood or oral fluid rapid test if available; otherwise, conventional testing should be used. Testing should be discussed with the patient if the patient's medical condition permits. Procedures for testing should be in accordance with applicable state and local laws. PEP can be initiated and test results reviewed at follow-up. If the HIV test result is positive, then PEP can be discontinued and the patient referred for treatment to a clinician experienced with HIV care.

If PEP is administered, then a health care provider also should obtain baseline complete blood count, renal function, hepatic function tests, and, in women, a pregnancy test. Because efavirenz may be teratogenic, it should not be administered until pregnancy test results are available.[12,22] Otherwise, test results need not be available before PEP initiation but should be reviewed in follow-up.

Selection of antiretroviral regimens should aim for simplicity and tolerability. Because of the complexity of selection of HIV PEP regimens, consultation with individuals having expertise in antiretroviral therapy and HIV transmission is strongly recommended. Resources for consultation are available from the following sources:

- Local infectious diseases, hospital epidemiology, or occupational health consultants.
- Local, state, or federal public health authorities.
- PEPline (*http://www.nccc.ucsf.edu/Hotlines/PEPline.html*; telephone 888-448-4911).
- HIV/AIDS Treatment Information Service (*http://aidsinfo.nih.gov*.)
- Previously published guidance (see Information Sources).

Nevirapine should not be included in HIV PEP regimens because of potential severe hepatic and cutaneous toxicity. Efavirenz should not be used if pregnancy is known or suspected because of potential teratogenicity.[12,22]

PEP should be started as soon after exposure as possible and continue for 4 weeks. For ambulatory patients, a starter pack of 5 to 7 days of medication should be provided, if possible. Alternatively, for hospitalized patients, the first dose should be taken in the emergency department, and follow-up orders should be written for completion of the course in the hospital.

Patients receiving PEP should be reassessed for adherence, toxicity, and for follow-up of HIV testing (if rapid testing was not available at baseline) within 72 hours by an infectious disease consultant. Patients continuing to receive PEP should have follow-up laboratory evaluation as recommended previously,[22–24] including a complete blood count and renal and hepatic function tests at baseline and at 2 weeks postexposure, and HIV testing at baseline, 6 weeks, 3 months, and 6 months postexposure.

Individuals who will receive HIV PEP should be discharged with written instructions and a referral to ensure follow-up care with a clinician experienced with HIV care and information on the age-appropriate dose and schedule (Appendix).

Simultaneous Administration

When tetanus toxoid and TIG are administered concurrently, separate syringes and separate anatomic sites should be used.[40] Hepatitis B vaccine and tetanus toxoid–containing vaccines may be administered at the same time using separate syringes and separate sites.[36]

Treatment with an antimicrobial agent generally is not a contraindication to vaccination.[40] Antimicrobial agents have no effect on the responses to vaccines against tetanus or HBV.

Administration of Blood Products

The administration of hepatitis B vaccine or tetanus toxoid–containing products does not need to be deferred in people who have received a blood transfusion or other blood products.

Pregnancy

Pregnancy is not a contraindication to vaccination against HBV. Limited data suggest that a developing fetus is not at risk for adverse events when hepatitis B vaccine is administered to a pregnant woman. Available vaccines contain noninfectious HBsAg and should cause no risk for infection to the fetus.[11]

Pregnancy is not a contraindication for HIV PEP; however, use of efavirenz should be avoided when pregnancy is known or suspected.[11,22]

Pregnant adolescents and adults who received the most recent tetanus toxoid–containing vaccine 5 years old and older

TABLE 3

Summary of Recommendations for Immediate Prophylactic Intervention

Type of Injury or Blood Exposure	HBV	HCV	HIV	Tetanus
Category 1: Penetrating injury/nonintact skin*	For people for whom no reliable history of hepatitis B vaccination exists and for whom no contraindication to vaccine is known, initiate hepatitis B vaccine series, preferably within 24 h and not later than 7 d	No prophylaxis recommended. Consider testing (immediately or during a follow-up referral) if exposure is to a known or likely HCV-infected source or multiple sources. If testing is performed, obtain baseline (within 7–14 d) and follow-up (4–6 mo) anti-HCV and ALT	Generally, no PEP† is warranted; consider only if exposure is to a known or highly likely HIV-infected source	Clean and debride wound as appropriate. Give age-appropriate tetanus toxoid vaccine if date of receipt of last dose is unknown and no known history of vaccine contraindication exists. May consider administering TIG (in addition to tetanus toxoid) if no reliable history of tetanus primary series exists (always use separate syringes and separate administration sites). If TIG is in short supply, people 60 y old and older and immigrants from regions other than Europe or North America are most likely to derive benefit
Category 2: Mucous membranes‡	For people for whom no reliable history of hepatitis B vaccination exists and for whom no contraindication to vaccine is known, initiate hepatitis B vaccine series, preferably within 24 h and not later than 7 d	Generally, no action is warranted. Testing for early identification of HCV infection following mucous membrane exposure should be considered only in settings in which exposure to an HCV-infected source is known or thought to be highly likely	Generally, no PEP† is warranted. Consider only if exposure is to a known or highly likely HIV-infected source	No action
Category 3: Superficial exposure of intact skin§	No action	No action	No action	No action

HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus; ALT, alanine transaminase; TIG, tetanus immunoglobulin; PEP, postexposure prophylaxis.

*Penetration of skin by a sharp object that was in contact with blood, tissue, or other potentially infectious body fluid (ie, semen, vaginal fluid, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, or any other visibly bloody body fluid or tissue) before penetration. Nonintact skin exposure is defined as contact of nonintact skin with any of these potentially infectious tissues or fluids.

†HIV PEP rarely is indicated. If PEP is indicated, then the following 8 procedures should be undertaken: (1) PEP should be started as soon as possible after exposure, without waiting for HIV test results; (2) PEP should be continued for 4 weeks; (3) specimens should be collected for baseline testing, including HIV, complete blood count, liver function, creatinine, and pregnancy tests; (4) testing should be conducted in accordance with applicable state and local laws; (5) expert consultation should be obtained: sources of expert consultation include local people with infectious disease, hospital epidemiology, or occupational health expertise; local, state, or federal public health authorities; PEPline (available 24 hours/day at 888-448-4911 [preferred] or *http://www.nccc.ucsf.edu/Hotlines/PEPline.html* ; or the HIV/AIDS Rx information service [*http://aidsinfo.nih.gov*]); (6) PEP should be continued for 4 weeks; (7) the patient should be discharged with written information, a 5- to 7-day supply of medication, and a follow-up appointment; and (8) an HIV specialist should reassess the patient's condition within 72 hours.

‡Contact of mucous membranes (ie, eyes, nose, mouth, or inner surfaces of the gut or genital areas) with blood, tissue, or other potentially infectious body fluids (ie, semen, vaginal fluid, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, or any other visibly bloody body fluid or tissue).

§Superficial exposure of intact skin (but not of mucous membranes) to blood, tissue, or other potentially infectious body fluids (ie, semen, vaginal fluid, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, or any other visibly bloody body fluid or tissue).

TABLE 4

Summary of Recommendations for Issues in Special Situations Potentially Associated With Immediate Prophylactic Intervention

Issue/Situation	HBV	HCV	HIV	Tetanus
Vaccine supply shortage	Local public health departments, mutual aid agreements, or commercial vendors should be relied on. If local capacity is exceeded, local public health authorities should work through established communication channels with CDC and others	NA	NA	Age-appropriate vaccines are preferred. If age-appropriate vaccine supply is expended, any tetanus vaccine formulation may be used because the tetanus toxoid content is adequate for tetanus prophylaxis in any age group. In this setting, the benefit of supplying tetanus prophylaxis outweighs the potential for adverse reactions from formulations from a different age indication. Local public health departments, mutual aid agreements, or commercial vendors should be relied on. If local capacity is exceeded, local public health authorities should work through established communication channels with CDC and others
Counseling	People who have been exposed should refrain from donating blood, plasma, organs, tissue, or semen	People who have been exposed should refrain from donating blood, plasma, organs, tissue, or semen	People who have been exposed should refrain from donating blood, plasma, organs, tissue, or semen. In addition, people known to be exposed to HIV should avoid breastfeeding and organ/tissue donation and take precautions to avoid sexual transmission until HIV infection has been ruled out	NA
HIV PEP is initiated*	NA	NA	HIV PEP rarely is indicated. If it is, recommended procedures should be followed*	
Simultaneous administration	HBV vaccine and tetanus toxoid can be administered concurrently; use separate syringes and anatomic sites	NA	NA	Separate syringes and anatomic sites should be used for concurrent administration of TIG and tetanus toxoid
Administration of blood products	Receipt of blood products does not require deferral of vaccination	NA	NA	Receipt of blood products does not require deferral of vaccination
Pregnancy	Pregnancy is not a contraindication to HBV vaccination	NA	Pregnancy is not a contraindication to HIV PEP. Efavirenz should be avoided if pregnancy is suspected	Td is preferred to Tdap for pregnant adolescents and adults who received their most recent tetanus toxoid product >5 y previously
Responders and other personnel	Workers should be treated according to existing guidelines for management of occupational exposures	Workers should be treated according to existing guidelines for management of occupational exposures	Workers should be treated according to existing guidelines for management of occupational exposures	Tetanus toxoid vaccination should be offered proactively if no reliable history exists of a booster within the past 10 years; nonwounded workers remain at risk for wounds throughout response
Contraindications and precautions	Vaccine is contraindicated if history of anaphylactic allergy to yeast or to any vaccine component or of serious adverse event after prior receipt of HBV vaccine	NA	Nevirapine should not be used for HIV PEP because of liver toxicity. Efavirenz should not be used if pregnancy is known or suspected. People with HIV PEP expertise should be consulted, if possible	Contraindicated if history of neurological or severe allergic reaction to a previous dose. If wound is at risk and vaccine is contraindicated, TIG should be used
Reporting adverse events	VAERS, telephone 800-822-7967, or *http://vaers.hhs.gov*	NA	MEDWATCH, telephone 800-332-1088, or *http://www.fda.gov/medwatch*	VAERS, telephone 800-822-7967, or *http://vaers.hhs.gov*. Workers should be treated according to existing guidelines for management of occupational exposures
NVICP	HRSA, telephone 800-338-2382, or http://www.hrsa.gov/vaccinecompensation	NA	NA	HRSA, telephone 800-338-2382, or *http://www.hrsa.gov/vaccinecompensation*

HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus; NA, not applicable; CDC, Centers for Disease Control and Prevention; PEP, postexposure prophylaxis; TIG, tetanus immunoglobulin; NVICP, National Vaccine Injury Compensation Program; VAERS, Vaccine Adverse Events Reporting System; HRSA, Health Resources and Services Administration.

*If PEP is indicated, the following 8 procedures should be undertaken: (1) PEP should be started as soon as possible after exposure, without waiting for HIV test results; (2) PEP should be continued for 4 weeks; (3) specimens should be collected for baseline testing, including HIV, complete blood count, liver function, creatinine, and pregnancy tests; (4) testing should be conducted in accordance with applicable state and local laws; (5) expert consultation should be obtained: sources of expert consultation include local persons with infectious disease, hospital epidemiology, or occupational health expertise; local, state, or federal public health authorities; PEPline (available 24 hours/day at 888-448-4911 [preferred] or *http://www.nccc.ucsf.edu/Hotlines/PEPline.html* ; or the HIV/AIDS Rx information service [*http://aidsinfo.nih.gov*]); (6) PEP should be continued for 4 weeks; (7) the patient should be discharged with written information, a 5- to 7-day supply of medication, and a follow-up appointment; and (8) an HIV specialist should reassess the patient's condition within 72 hours.

previously generally should receive Td in preference to Tdap when possible.[41]

RESPONDERS AND OTHER PERSONNEL

Responders and personnel engaged in debris removal or construction often are at risk for incurring wounds throughout the duration of response and clean-up work. As a routine public health measure, health care providers should offer tetanus toxoid vaccination to all response workers who do not have a reliable history of receipt of a tetanus toxoid–containing vaccine during the preceding 10 years, regardless of whether the health care visit was for a wound.[38,39] Such individuals may encounter potential exposure situations throughout the duration of their work in response to a mass casualty situation.

Health care personnel, emergency response, public safety, and other workers (eg, construction workers, equipment operators) who are injured and exposed to blood while providing assistance after a mass casualty event should be treated according to existing guidelines and standards for the management of occupational exposures.[10,22,42] Health care personnel and first responders whose activities involve contact with blood or other body fluids should have been previously vaccinated against HBV and tetanus.[12,22]

CONTRAINDICATIONS AND PRECAUTIONS

Hepatitis B Vaccine

Hepatitis B vaccination is contraindicated for people with a history of anaphylactic allergy to yeast or any vaccine component.[11] On the basis of CDC's Vaccine Study Datalink data, the estimated incidence of anaphylaxis among children and adolescents who received hepatitis B vaccine is 1 case per 1.1 million vaccine doses distributed (95% CI 0.1%–3.9%).[11] People with a history of serious adverse events (eg, anaphylaxis) after receipt of hepatitis B vaccine should not receive additional doses. Vaccination is not contraindicated in people with a history of multiple sclerosis, Guillain-Barré syndrome, autoimmune disease (eg, systemic lupus erythematosis, rheumatoid arthritis), or other chronic diseases.[11]

Antiretroviral Therapy

Nevirapine should not be included in HIV PEP regimens because of potential severe hepatic and cutaneous toxicity. Efavirenz should not be used if pregnancy is known or suspected because of potential teratogenicity.[12,22]

Preparations Containing Tetanus Toxoid

The only contraindication to preparations containing tetanus toxoid (TT, Td, or Tdap) is a history of a neurological or severe allergic reaction following a previous dose. Local side effects alone do not preclude continued use.[26,30,31] If a person has a wound that is neither clean nor minor and for which tetanus prophylaxis is indicated but also a contraindication to receipt of tetanus toxoid–containing preparations, then only passive immunization using human TIG should be administered.

VACCINE ADVERSE EVENTS REPORTING SYSTEM

Any clinically significant adverse events that occur after administration of any vaccine should be reported to the Vaccine Adverse Events Reporting System (VAERS), even if causal relation to vaccination is uncertain. The National Childhood Vaccine Injury Act requires health care providers to report to VAERS any event listed by the vaccine manufacturers as a contraindication to subsequent doses of the vaccine or any event listed in the Reportable Events Table (*http://vaers.hhs.gov/reportable.htm*) that occurs within the specified period after vaccination. VAERS reporting forms and information can be requested 24 hours per day by calling 800-822-7967 or by accessing VAERS (*http://vaers.hhs.gov*). Web-based reporting also is available, and providers are encouraged to report adverse events electronically at *http://secure.vaers.org/VaersDataEntryintro.htm*.

Reporting Adverse Events Associated With Antiretroviral Drugs and TIG

Unusual or severe toxicities believed to be associated with use of antiretroviral agents or TIG should be reported to FDA's MEDWATCH program (*http://www.fda.gov/medwatch*) at MEDWATCH, HF-2, Food and Drug Administration, 5600 Fishers Lane, Rockville, MD 20857, telephone 800-332-1088.

National Vaccine Injury Compensation Program

The National Vaccine Injury Compensation Program (NVICP) was established by the National Childhood Vaccine Injury Act and became operational on October 1, 1988. Intended as an alternative to civil litigation under the traditional tort system (in that negligence need not be proven), NVICP is a no-fault system in which people thought to have suffered an injury or death as a result of administration of a covered vaccine may seek compensation. Claims may be filed on behalf of infants, children, and adolescents, or by adults receiving VICP-covered vaccines. Other legal requirements (eg, the statute of limitations for filing an injury or death claim) must be satisfied to pursue compensation. Claims arising from covered vaccines must be adjudicated through the program before civil litigation can be pursued. The program relies on a Reportable Events Table listing the vaccines covered by the program and the injuries, disabilities, illnesses, and conditions (including death) for which compensation may be awarded. Additional information about NVICP is available at *http://www.hrsa.gov/vaccinecompensation* or from the National Vaccine Injury Compensation Program, Health Resources and Services Administration, Parklawn Building, Room 11C-26, 5600 Fishers Lane, Rockville, MD 20857, telephone 800-338-2382.

INFORMATION SOURCES

Recommendations for immediate prophylactic interventions have been summarized in Table 3. Recommendations for issues that may arise in association with immediate prophylactic intervention also have been summarized in Table 4.

Appendix

Sample Information to Be Provided to Patients at Discharge, With a Copy Retained on the Patient Chart

Discharge instructions for the health-care provider of: _____
Patient Name

This patient was discharged from ____ Outpatient Clinic of _____
____ Emergency Department Institution
____ Hospital

On Date: _____/_____/_____
Month / Day / Year

This patient received pre-discharge administration of:

_____ Tetanus toxoid–containing vaccine
____ DTaP Manufacturer_____ Lot # _____
____ Tdap Manufacturer_____ Lot # _____
____ Td Manufacturer_____ Lot # _____
____ TT Manufacturer_____ Lot # _____

_____ Tetanus Immune Globulin (TIG)
____ Dose Manufacturer_____ Lot # _____

_____ Hepatitis B vaccine
Manufacturer_____ Lot # _____
Product: _____ Dose: _____

This patient will need further evaluation regarding whether administration of a vaccine or completion of an immunization series is needed.

Evaluate need for immunization series completion:

_____Tetanus
_____Hepatitis B
_____Other:_____

Assess need for evaluation of seroconversion to:

_____Hepatitis C infection

- Baseline testing for anti-HCV and alanine aminotransferase (ALT) within 7–14 days of the exposure
- Follow-up testing for anti-HCV and ALT 4–6 months after exposure to assess seroconversion
- HCV RNA test at 4–6 weeks if earlier diagnosis of HCV infection is desired
- Confirm positive anti-HCV with low signal-to-cutoff results using a more specific supplemental assay before communicating results to patient

_____HIV infection

Follow up on the following tests collected during the acute care visit:

_____AST/ALT
_____Hepatitis C virus serology
_____HIV serology

Antibiotic or other antimicrobial given:

Specific discharge instructions that need further medical evaluation:

Wound care instructions:

Other:

In addition to the guidance provided in these recommendations, information on specific vaccines or other prophylactic interventions also is available. ACIP recommendations regarding vaccine use are published in *Morbidity and Mortality Weekly Report*.

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Information included in these recommendations may not represent FDA approval or approved labeling for the particular product or indications in question. Specifically, the terms "safe" and "effective" may not be synonymous with the FDA-defined legal standard for product approval.

This article does not include any discussion of the unlabeled use of a product or products under investigational use, with the exception of the discussions of the following:

1. Use of antiretroviral medications for HIV PEP.
2. Off-label use of tetanus toxoid, reduced diphtheria toxoid, and Tdap in the following situations:
   a. The interval between tetanus and Td and Tdap may be shorter than the 5 years indicated in the package insert.
   b. The interval between doses of Td may be shorter than the 5 years indicated in the package insert.
   c. A dose of Tdap may be administered to a person who has already received Tdap.
   d. A dose of Tdap may be administered to a person younger than 7 years or older than 64 years.
   e. Tdap may be used as part of the primary series for tetanus and diphtheria.

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REFERENCES

1. Federal Bureau of Investigation. Terrorism 2002–2005. 2006. *http://www.fbi.gov/publications.htm*.
2. Siegel-Itzkovich J. Israeli minister orders hepatitis B vaccine for survivors of suicide bomb attacks. *BMJ*. 2001;323:417.
3. Braverman I, Wexler D, Oren M. A novel mode of infection with hepatitis B: penetrating bone fragments due to the explosion of a suicide bomber. *Isr Med Assoc J*. 2002;4:528–529.
4. Wong JM, Marsh D, Abu-Sitta G, et al. Biological foreign body implantation in victims of the London July 7th suicide bombings. *J Trauma*. 2006;60:402–404.
5. *Hepatitis B Vaccination Protocol in Survivors of Mass Casualty Bombings*. Israel Ministry of Health Medical Guidelines 2001 (35)/1/13 (Communique 57/2001). Tel Aviv: Israel Ministry of Health; 2001.
6. Hepatitis B Vaccination Protocol in Survivors of Mass Casualty Bombings–revision. Israel Ministry of Health Medical Guidelines 2001 (35)/2/13 (Communique 72/2001). Tel Aviv: Israel Ministry of Health; 2001.
7. *Post-exposure Prophylaxis Against Hepatitis B for Bomb Victims and Immediate Care Providers. Consideration of Other Blood borne Viruses (Hepatitis C and HIV)*. London: Health Protection Agency; 2005.
8. Jagger J, De Carli G, Perry J, Puro V, Ippolito G. Occupational exposure to bloodborne pathogens: epidemiology and prevention. In: Wenzel R, ed. *Prevention and Control of Nosocomial Infections*. 4th ed. Baltimore: Lippincott Williams & Wilkins; 2003.
9. Alter HJ, Stramer SL, Dodd RY. Emerging infectious diseases that threaten the blood supply: I. *Semin Hematol*. 2007;44:32–41.
10. Prevention of hepatitis A through active or passive immunization: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR*. 2006;55 (No. RR-7).
11. A comprehensive immunization strategy to eliminate transmission of hepatitis B virus infection in the United States: recommendations of the Advisory Committee on Immunization Practices (ACIP): II. Immunization of adults. *MMWR*. 2006;55 (No. RR-16).
12. Updated U.S. Public Health Service guidelines for the management of occupational exposures to HBV, HCV, and HIV and recommendations for postexposure prophylaxis. *MMWR*. 2001;50 (No. RR-11).
13. National, state, and local area vaccination coverage among children aged 19–35 months—United States, 2006. *MMWR*. 2007;56:880–885.
14. National vaccination coverage among adolescents aged 13–17 years—United States, 2006. *MMWR*. 2007;56:885–888.
15. Hepatitis B vaccination among adults—United States, 2004. *MMWR*. 2006;55:509–511.
16. Armstrong GL, Wasley A, Simard EP, McQuillan GM, Kuhnert WL, Alter MJ. The prevalence of hepatitis C virus infection in the United States, 1999 through 2002. *Ann Intern Med*. 2006;144:705–714.

17. Recommendations for prevention and control of hepatitis C virus (HCV) infection and HCV-related chronic disease. *MMWR*. 1998;47 (No. RR-19).
18. Beltrami EM, Kozak A, Williams IT, et al. Transmission of HIV and hepatitis C virus from a nursing home patient to a health care worker. *Am J Infect Control*. 2003;31:168–175.
19. Kamili S, Krawczynski K, McCaustland K, Li X, Alter MJ. Infectivity of hepatitis C virus in plasma after drying and storing at room temperature. *Infect Control Hosp Epidemiol*. 2007;28:519–524.
20. Patel PR, Larson AK, Castel AD, et al. Hepatitis C virus infections from a contaminated radiopharmaceutical used in myocardial perfusion studies. *JAMA*. 2006;296:2005–2011.
21. *HIV/AIDS Surveillance Report, Cases of HIV Infection and AIDS in the United States and Dependent Areas, 2005. Vol 17. Revised June 2007*. Atlanta: US Department of Health and Human Services, Public Health Service, CDC; 2007.
22. Updated U.S. Public Health Service guidelines for the management of occupational exposures to HIV and recommendations for postexposure prophylaxis. *MMWR*. 2005;54 (No. RR-9).
23. Notice to readers: updated information regarding antiretroviral agents used as HIV postexposure prophylaxis for occupational HIV exposures. *MMWR*. 2007;56:1291–1292.
24. Antiretroviral postexposure prophylaxis after sexual, injection-drug use, or other nonoccupational exposure to HIV in the United States. *MMWR*. 2005;54 (No. RR-2).
25. Bell DM. Occupational risk of human immunodeficiency virus infection in health-care workers: an overview. *Am J Med*. 1997;102:9–15.
26. Preventing tetanus, diphtheria and pertussis among adults: use of tetanus toxoid, reduced diphtheria toxoid and acellular pertussis vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP) and Recommendation of ACIP, supported by the Healthcare Infection Control Practices Advisory Committee (HICPAC), for use of Tdap among health-care personnel. *MMWR*. 2006;55 (No. RR-17).
27. Pascual FB, McGinley E, Zanardi L, et al. Tetanus surveillance—United States, 1998–2000. CDC Surveillance Summaries, June 20, 2003. *MMWR*. 2003;52 (No. SS-3).
28. Srivastava P, Brown K, Chen J, Kretsinger K, Roper M. Trends in tetanus epidemiology in the United States, 1972–2001. Paper presented at 39th National Immunization Conference, Washington, DC; March 21–24, 2005. *http://cdc.confex.com/cdc/nic2005/techprogram/paper_7813.htm*. Accessed August 8, 2008.
29. McQuillan GM, Kruszon-Moran D, Deforest A, et al. Serologic immunity to diphtheria and tetanus in the United States. *Ann Intern Med*. 2002;136:660–666.
30. Fair E, Murphy T, Golaz A, Wharton M. Philosophic objection to vaccination as a risk factor for tetanus among children younger than 15 years. *Pediatrics*. 2002;109:E2.
31. Talan DA, Abrahamian FM, Moran GJ, et al. Tetanus immunity and physician compliance with tetanus prophylaxis practices among emergency department patients presenting with wounds. *Ann Emerg Med*. 2004;43:305–311.
32. Preventing tetanus, diphtheria, and pertussis among adolescents: use of tetanus toxoid, reduced diphtheria toxoid and acellular pertussis vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR*. 2006;55 (No. RR-3).
33. Diphtheria, tetanus, and pertussis: recommendations for vaccine use and other preventive measures: recommendations of the Immunization Practices Advisory Committee (ACIP). *MMWR*. 1991;40 (No. RR-10).
34. Childhood, adolescent and adult immunization schedules. US Department of Health and Human Services, CDC Web site. 2007. *http://www.cdc.gov/vaccines/recs/schedules/default.htm*. Accessed August 8, 2008.
35. Revised recommendations for HIV testing of adults, adolescents, and pregnant women in health-care settings. *MMWR*. 2006;55 (No. RR-14).
36. Interim immunization recommendations for disaster responders. US Department of Health and Human Services, CDC Web site. 2005. *http://www.bt.cdc.gov/disasters/disease/responderimmun.asp*. Accessed August 8, 2008.
37. Emergency wound care after a natural disaster. US Department of Health and Human Services, CDC Web site. 2005. *http://www.bt.cdc.gov/disasters/woundcare.asp*. Accessed August 8, 2008.
38. Update: NIOSH warns of hazards of flood cleanup work. NIOSH publication no. 94-123. US Department of Health and Human Services, CDC Web site. 1997. *http://www.cdc.gov/niosh/flood.html*. Accessed August 8, 2008.
39. Fact sheets on natural disaster recovery: flood cleanup. US Department of Labor, Occupational Safety and Health Administration Web site. 2008. *http://www.osha.gov/OshDoc/floodCleanup.html*. Accessed August 8, 2008.
40. General recommendations on immunization: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR*. 2006;55 (No. RR-15).
41. Prevention of pertussis, tetanus, and diphtheria among pregnant and postpartum women and their infants: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR*. 2008;57 (No. RR-4).
42. Bloodborne Pathogens Standard, 29 C.F.R. Sect. 1910.1030 [56 FR 64004, Dec. 06, 1991, as amended at 57 FR 12717, April 13, 1992; 57 FR 29206, July 1, 1992; 61 FR 5507, Feb. 13, 1996; 66 FR 5325 Jan., 18, 2001; 71 FR 16672 and 16673, April 3, 2006].