Recommendations for Immunization of Healthcare Personnel (HCP)\textsuperscript{1}

\textsuperscript{1}Immunization of Health-Care Personnel: Recommendations of the Advisory Committee on Immunization Practices (ACIP). November 25, 2011/60(RR07);1-45.
<table>
<thead>
<tr>
<th>Disease</th>
<th>Primary schedule and booster</th>
<th>Indication(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis B</td>
<td>3 doses: First two doses 4 weeks apart, 3rd dose 5 months after second</td>
<td>HCP at risk for blood or body fluid exposure</td>
</tr>
<tr>
<td>Influenza</td>
<td>Annual</td>
<td>All HCP</td>
</tr>
<tr>
<td>Measles</td>
<td>2 doses: ≥28 days apart</td>
<td>All HCP who lack presumptive evidence of immunity; consider for those born before 1957</td>
</tr>
<tr>
<td>Mumps</td>
<td>2 doses: ≥28 days apart</td>
<td>All HCP who lack presumptive evidence of immunity; consider for those born before 1957</td>
</tr>
<tr>
<td>Rubella</td>
<td>1 dose (most HCP receive 2 doses of MMR)</td>
<td>All HCP who lack presumptive evidence of immunity (birth before 1957 NOT acceptable evidence of immunity for women who could become pregnant)</td>
</tr>
<tr>
<td>Pertussis</td>
<td>1 dose (with Tdap; Td every 10 years)</td>
<td>All HCP</td>
</tr>
<tr>
<td>Varicella</td>
<td>2 doses administered 4-8 weeks apart if ≥13 years old</td>
<td>HCP who lack evidence of immunity</td>
</tr>
</tbody>
</table>
# Vaccines Recommended for HCP in Certain Circumstances

<table>
<thead>
<tr>
<th>Disease</th>
<th>Primary schedule and booster</th>
<th>Indication(s)</th>
</tr>
</thead>
</table>
| Meningococcal   | Quadrivalent conjugate vaccine for HCP ages 19-54 years; quadrivalent polysaccharide vaccine for HCP ages ≥55 years  
                 | 1 dose; booster dose in 5 years if HCP remains at increased risk                                                 | Microbiologists who might routinely be exposed to *N. meningitidis*                                                      |
| Typhoid fever   | IM vaccine: 1 dose, booster every 2 years  
                 | Oral vaccine: 4 doses on alternate days; manufacturer recommends revaccination with the entire 4-dose series every 5 years  | Workers in microbiology labs who frequently work with *Salmonella Typhi*                                                  |
| Polio (IPV)     | 2 doses 4-8 weeks apart, 3rd dose 6-12 months after second dose                                      | HCP who have close contact with patients who might be excreting polioviruses                                           |
# Proof of Immunity for HCP

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Birth before 1957</th>
<th>MD Dx</th>
<th>+ Serology</th>
<th>Self Report</th>
<th>Documented Vaccination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis B</td>
<td>No</td>
<td></td>
<td>≥10 mIU/mL</td>
<td>No</td>
<td>✓</td>
</tr>
<tr>
<td>Influenza</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>✓</td>
</tr>
<tr>
<td>Measles</td>
<td>✓¹</td>
<td>Yes³</td>
<td>✓</td>
<td>No</td>
<td>✓</td>
</tr>
<tr>
<td>Mumps</td>
<td>✓¹</td>
<td>Yes³</td>
<td>✓</td>
<td>No</td>
<td>✓</td>
</tr>
<tr>
<td>Rubella</td>
<td>✓¹,²</td>
<td>No</td>
<td>✓</td>
<td>No</td>
<td>✓</td>
</tr>
<tr>
<td>Pertussis</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>✓</td>
</tr>
<tr>
<td>Varicella</td>
<td>No</td>
<td>Yes</td>
<td>✓</td>
<td>No</td>
<td>✓</td>
</tr>
</tbody>
</table>

¹Consider immunization of HCP born before 1957, recommend during an outbreak
²All HCP of childbearing potential should be immunized
³Requires lab confirmation
⁴Obtain 1-2 months post last vaccine dose

Weber DJ, Schaffner W. ICHE 2011
HepB Vaccination

- ≥3-dose series for all HCP with risk for blood and body fluid exposure (since 1982)
  - Generally administered at 0, 1, and 6 months

<table>
<thead>
<tr>
<th>Single-antigen vaccines¹</th>
<th>Combination vaccine¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recombivax HB®</strong></td>
<td><strong>Engerix-B®</strong></td>
</tr>
<tr>
<td>Dose</td>
<td>Volume</td>
</tr>
<tr>
<td>10 µg</td>
<td>1 mL</td>
</tr>
</tbody>
</table>

Post-vaccination serologic testing (antibody to hepatitis B surface antigen [anti-HBs]) 1-2 months after last dose recommended for all HCP at high risk for blood and body fluid exposure (since ~1997)

- HCP with anti-HBs $\geq 10$ mIU/mL:
  - No post-exposure prophylaxis for hepatitis B necessary, regardless of source patient’s hepatitis B surface antigen (HBsAg) status

- HCP with anti-HBs <10 mIU/mL:
  - Revaccinate (1-3 doses), followed by PVS 1-2 months after last dose
Vaccine Non-Responders (anti-HBs <10 mIU/mL)

- >6 total doses HepB vaccine not recommended
- Vaccine non-responders (after 6 doses) should be tested to determine infection status
  - Hepatitis B surface antigen (HBsAg)
  - Antibody to hepatitis B core antigen (anti-HBc)
- Infected HCP (HBsAg-positive) who perform exposure-prone procedures should seek counsel from a review panel regarding the procedures they can safely perform; they should not be excluded from work

1Updated CDC Recommendations for the Management of Hepatitis B Virus-Infected Health-Care Providers and Students. July 6, 2012/61(RR03);1-12.
# Post-Exposure Prophylaxis

<table>
<thead>
<tr>
<th>HCP vaccination and response status</th>
<th>Source patient HBsAg status¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unvaccinated</strong></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>HBIG x1, initiate vaccination</td>
</tr>
<tr>
<td>Negative</td>
<td></td>
</tr>
<tr>
<td><strong>Previously vaccinated</strong></td>
<td></td>
</tr>
<tr>
<td>Known responder</td>
<td>No treatment</td>
</tr>
<tr>
<td>Known non-responder</td>
<td></td>
</tr>
<tr>
<td>After 3 doses</td>
<td>HBIG x1, initiate revaccination</td>
</tr>
<tr>
<td>After 6 doses</td>
<td>HBIG x2 (separated by 1 month)</td>
</tr>
</tbody>
</table>

¹If source patient has unknown HBsAg status but high-risk, HCP managed as if source patient HBsAg-positive
Occupational Safety and Health Administration (OSHA) Bloodborne Pathogens Standard

- States what employers must do to protect workers who are occupationally exposed to blood or other potentially infectious materials
  - Offer HepB vaccine
  - Post-exposure evaluation/prophylaxis (immediately available)
- Unpaid trainees and volunteers not covered
- Effective since 1992

Decline in Hepatitis B Infections among HCP

- Hepatitis B infections among HCP:
  - 1983: 17,000 cases estimated\(^1\)
  - 2010: 263 cases estimated\(^2\)

- Decline attributed to:
  - HepB vaccination
  - Improvements in infection control

\(^1\) Beltrami 2000
\(^2\) Surveillance data, considering that occupational history was assessed for 43.6% of cases and using a correction factor of 10.5 to account for underreporting and asymptomatic infection
Proportion of HCP who Received HepB Vaccine by Patient Contact Status — NHIS, 2010

NHIS=National Health Interview Survey, provided by K. Byrd
## Risk and Reporting of Occupational Blood and Body Fluid Exposures

<table>
<thead>
<tr>
<th>Risk (annual)</th>
<th>Non-Trainee</th>
<th>Trainee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percutaneous injury¹</td>
<td>10%</td>
<td>18%</td>
</tr>
<tr>
<td>Mucosal exposure²</td>
<td>13%</td>
<td>22%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proportion of exposures reported to occupational health</th>
<th>Non-Trainee</th>
<th>Trainee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percutaneous injury¹</td>
<td>54%</td>
<td>54%</td>
</tr>
<tr>
<td>Mucosal exposure²</td>
<td>17%</td>
<td>17%</td>
</tr>
</tbody>
</table>

¹Needlesticks, cuts, or bites
²Blood or body fluid contact with mucus membranes or non-intact skin
Acute Hepatitis B Surveillance — NNDSS, 2005-2010

- 203 cases among HCP\(^1\) reported to CDC
- HepB vaccination determined through routine surveillance question: “Has this patient ever received the three dose series of Hepatitis B vaccine?”
  - Yes: 39 (19.2%)
  - Unknown: 49 (24.1%)
  - No: 115 (56.7%)

Additional information 67/88 (76%)

NNDSS=National Notifiable Diseases Surveillance System
\(^1\)Occupational history assessed for a subset of cases (e.g., 46.0% and 43.6% of cases for 2009 and 2010, respectively).
203 Cases of Acute Hepatitis B among HCP Reported to CDC, 2005-2010

- Mean age: 41.7 years, range: 18-69 years (n=203)
- Male: 40.4% (82/203)
- Accidental stick with needle/sharp object: 16.7% (28/168)\(^1\)
- Other hepatitis B risk factor: 59.6% (121/203)\(^2\)

\(^1\) During 6 weeks – 6 months prior to illness; information on post-exposure prophylaxis not available
\(^2\) Other risk factors consist of: contact with hepatitis case, receipt of dialysis, blood transfusion, men who have sex with men, injection drug use, multiple sexual partners, surgery, acupuncture, or tattoo
203 Cases of Acute Hepatitis B among HCP Reported to CDC, 2005-2010, cont.

- Hospitalized: 40.8% (75/184)
- Developed chronic infection: 37.5% (6/16)
- Died: 0% (0/151)
- Vaccinated: 19.2% (35/182)\(^1\)

\(^1\)Follow-up not attempted for 115 cases initially reported to have not received HepB vaccination series
Vaccination and PVS Testing Status among HCP with Acute Hepatitis B

203 HCP with acute Hepatitis B

35 had $\geq 3$ doses HepB vaccine$^{1,2}$

1 responder
1 indeterminate response
4 non-responders
1 response unknown
28 lacked PVS

$^1$7 with complete documentation of dates of vaccination; minimum dosing intervals heeded for 7 with complete documentation
$^2$4 of 8 with information developed chronic infection
Previously Vaccinated HCP

- Increasing proportion of HCP have received HepB vaccine series in remote past
  - 1991: Routine infant HepB vaccination (2011: ≥91% coverage for children aged 19-35 months\(^1\))
  - 1999: Catch-up vaccination 0-18 yrs (2010-11: 90% coverage for adolescents aged 17 years\(^2\))

- PVS testing not recommended after routine infant or child HepB vaccination
  - Approximately 95% of infants have serologic evidence of protection after vaccination

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\(^1\)National Immunization Survey, ≥3 dose
\(^2\)National Immunization Survey – Teen, ≥3 dose
Age of HCP at Time of HepB Vaccination

- Over time, more HCP will have been vaccinated at <1 year of age, instead of ≥1 year of age
  - Years after vaccination, persons vaccinated at <1 year of age more often have anti-HBs <10 mIU/mL (compared to persons vaccinated at ≥1 year of age)
Projected HepB Vaccination Coverage (≥3 doses) by Age at First Dose and Age Group in General U.S. Population

Testing for Anti-HBs and Protection

- **Anti-HBs after HepB vaccine series wanes over time**
  - Even when anti-HBs decreases to <10 mIU/mL, breakthrough HBV infection uncommon in immunocompetent vaccine responders

- **Anti-HBs <10 mIU/mL at a time distant from vaccine completion does not distinguish:**
  - Initial responders
  - Non-responders (susceptible to infection after 6 doses of vaccine)

\(^1\)Leuridan, CID 2011
ACIP Hepatitis Work Group Considered Approaches for Ensuring Protection for HCP Vaccinated in the Distant Past

- No pre-exposure management (post-exposure evaluation for all recognized and reported exposures)
- Pre-exposure anti-HBs, followed by revaccination if necessary\(^1\)
- Pre-exposure challenge dose of vaccine, followed by anti-HBs and revaccination if necessary\(^1\)

\(^1\)Up to 3 additional doses (6 doses total) of vaccine administered pre-exposure; anti-HBs measured after last dose
## Incremental Cost-Effectiveness Ratios (ICERs), US$ (Assumes 95% Protection)

<table>
<thead>
<tr>
<th></th>
<th>No pre-exposure management</th>
<th>Pre-exposure anti-HBs</th>
<th>Pre-exposure challenge dose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st year</td>
<td>10 years</td>
<td>1st year</td>
</tr>
<tr>
<td>Non-trainees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,610,998</td>
<td>1,114,364</td>
<td>3,149,183</td>
</tr>
<tr>
<td>Trainees</td>
<td>2,270,801</td>
<td>917,859</td>
<td>4,542,467</td>
</tr>
<tr>
<td>HBV infections</td>
<td>1.7</td>
<td>--</td>
<td>0.4</td>
</tr>
<tr>
<td>(per 100,000)</td>
<td>3.0</td>
<td>--</td>
<td>0.7</td>
</tr>
</tbody>
</table>

- ICERs <$50,000 generally considered cost-effective
Proportion of Healthcare Institutions Using Various Approaches for Managing Vaccinated HCP Lacking PVS Testing

153 responding institutions (response rate 39.3%); institutions predominantly acute care hospitals
Information Considered for Identifying Preferred Approach

- Changing epidemiology of hepatitis B
- HCP risk of blood and body fluid exposure
- HCP rates of reporting blood and body fluid exposures
- Probability of HBsAg-positive source patient
- Efficacy of hepatitis B immune globulin (HBIG) for post-exposure prophylaxis
- HCP HepB vaccine coverage
- Evidence of serologic and clinical protection after vaccination with HepB primary series
- Evidence of serologic protection after “challenge” dose of HepB vaccine
- Long-term HepB vaccine protection
- Acute hepatitis B among HCP
- Current practices survey
Work Group’s Preferred Approaches for Ensuring Protection for HCP Vaccinated in the Distant Past

- No pre-exposure management (post-exposure evaluation for all recognized and reported exposures)
- Pre-exposure anti-HBs, followed by revaccination if necessary¹

¹Up to 3 additional doses (6 doses total) of vaccine administered pre-exposure; anti-HBs measured after last dose
Comparison of Approaches

No pre-exposure management

- No protection for unrecognized and unreported exposures
- More infections
- Less work now, more work on exposure
- Lower initial incremental cost-effectiveness ratios

Pre-exposure anti-HBs

- Protection for unrecognized and unreported exposures
- Fewer infections
- More work now, less work on exposure
- Lower 10-year incremental cost-effectiveness ratios
Institutional Characteristics that May Favor An Approach

No pre-exposure management
- High staff turnover (e.g., long-term care facilities)

Pre-exposure anti-HBs
- Frequent blood and body fluid exposures among HCP
- High prevalence of HBsAg-positive source patients
- Post-exposure prophylaxis not readily available (e.g., home healthcare staff)
Discussion or Questions?
ACIP Hepatitis Work Group

- Mark Sawyer, ACIP, Chair
- Douglas Campos-Outcalt, ACIP
- Jonathan Temte, ACIP
- Alexis Elward, HICPAC Liaison
- Stephen Feinstone, FDA
- Kathleen Harriman, CDPH
- Samuel Katz, Former ACIP Chair
- Harry Keyserling, SHEA Liaison
- Thomas Koinis, AAFP
- Myron Levin, Former ACIP Chair
- Marian Major, FDA
- Brian McMahon, ANTHC
- Amy Middleman, SAHM Liaison
- David Nace, AMDA
- Georges Peter, Brown U
- Brenna Simons, ANTHC
- James Turner, ACHA Liaison
- David Weber, SHEA
- Geoff Beckett, CDC/DVH
- Kathy Byrd, CDC/DVH
- Scott Holmberg, CDC/DVH
- Erin Kennedy, CDC/ISD
- David Kuhar, CDC/DHQ
- Trudy Murphy, CDC/DVH
- Marie de Perio, NIOSH
- Sarah Schillie, CDC/DVH
- Philip Spradling, CDC/DVH
- Eyasu Teshale, CDC/DVH
- Cindy Weinbaum, CDC/DHQ
- Fujie Xu, CDC/DVH
Acknowledgements

ACIP Hepatitis Work Group

Division of Viral Hepatitis, NCHHSTP
  Trudy V. Murphy
  John Ward
  Meredith Reilly
  Kathleen Ly
  Henry Roberts
  Emily Smith
  Ruth Jiles
  Rachel Wilson
  Kathy Byrd
  Elizabeth Hughes
  Steve Veselsky

International Healthcare Worker Safety Center
  Ginger Parker

Division of Healthcare Quality Promotion, NCEZID
  Ronda Sinkowitz-Cochran
  Tara MacCannell

Division of Surveillance, Hazard Evaluations, and Field Studies, NIOSH
  Winnie Boal

Office of Surveillance, Laboratory, and Epidemiology Services
  Lina Balluz
  William Garvin

Immunization Services Division, NCIRD
  James Singleton
  Qian Li
  Gary Urquhart
  Raymond Strikas

Occupational Safety and Health Administration
  Dionne Williams

University of Pittsburgh Medical Center
  Mark Tanis
  Jay Harper

Research Triangle Institute, Int.
  Tom Hoerger
  Christina Ludlow-Bradley
Additional Slides
Annual Proportion of BBF Exposures to HCP (Non-trainees) by Exposure Type, 2002-present

Median PI: 10% (Range: 4-16%)
Median ME: 13% (Range: 3-16%)

RN=registered nurses (non-hospital based, home healthcare)
PCA=patient care assistants
Risk Ratio for BBF Exposure: Trainees vs. Non-trainees

RN=registered nurses, OR=operating room, Inpt=inpatient, ICU=intensive care unit

Percutaneous injuries only

Overall Risk Ratio: 1.75
Needlestick Safety and Prevention Act

- Directed OSHA to revise Occupational Exposure to Bloodborne Pathogens Standard
- Established in greater detail requirements that employers identify and use effective and safer medical devices¹
  - Effective since 2001

¹http://www.osha.gov/SLTC/bloodbornepathogens/standards.html
Rates of Percutaneous Injuries (PI)\(^1\) and Mucosal Exposures (ME)\(^2\) — EPINet, 1997-2009\(^3\)

EPINet=Exposure Prevention Information Network
\(^1\)PI=Needlestick, cut, or bite
\(^2\)ME (termed “blood and body fluid exposures” by EPINet)=Contact with mucous membranes or non-intact skin
\(^3\)http://www.healthsystem.virginia.edu/pub/epinet/rates.html
### Prevalence of Chronic Hepatitis B among Selected Populations

<table>
<thead>
<tr>
<th>Population</th>
<th>Prevalence</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>US population (overall)</td>
<td>0.3%</td>
<td>Wasley 2010</td>
</tr>
<tr>
<td>Alaska Natives</td>
<td>1% - 2%</td>
<td>Personal communication¹</td>
</tr>
<tr>
<td>Inmates</td>
<td>1% - 4%</td>
<td>MMWR 2003/52 (RR01)</td>
</tr>
<tr>
<td>Injection drug users</td>
<td>3%</td>
<td>MMWR 2006/55 (RR16)</td>
</tr>
<tr>
<td>US immigrants</td>
<td>4% - 11%</td>
<td>Mitchell 2011</td>
</tr>
<tr>
<td>HIV-positive persons</td>
<td>6% - 14%</td>
<td>MMWR 2006/55 (RR16)</td>
</tr>
<tr>
<td>API in NYC</td>
<td>12% - 24%</td>
<td>Wang 2011</td>
</tr>
</tbody>
</table>

- 0.9%² of source patients HBsAg-positive

---

API = Asian Pacific Islanders  
¹Brian McMahon and Brenna Simons, Alaska Native Tribal Health Consortium  
²Representing 7,170 exposures from three healthcare institutions
Number of Reported Acute Hepatitis B Cases (U.S.) — NNDSS, 1991–2010

NNDSS=National Notifiable Diseases Surveillance System

Estimated 35,000 cases
Weighted Prevalence of Chronic Hepatitis B\textsuperscript{1} (U.S.) — NHANES, 1976–2010

- Estimated 800,000 to 1.4 million persons with chronic Hepatitis B in U.S.

NHANES=National Health and Nutrition Examination Survey
\textsuperscript{1}Chronic Hepatitis B defined as the presence of both hepatitis B surface antigen (HBsAg) and antibody to hepatitis B core antigen (anti-HBc), prepared by H. Roberts
Other Hepatitis B Risk Factors

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Reported to CDC (N=203)</th>
<th>History of ≥3 doses HepB vaccine (N=35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact with Hepatitis case</td>
<td>36/155 (23.2%)</td>
<td>4/25 (16.0%)</td>
</tr>
<tr>
<td>Dialysis patient</td>
<td>1/171 (0.6%)</td>
<td>1/24 (4.2%)</td>
</tr>
<tr>
<td>Blood transfusion</td>
<td>9/191 (4.7%)</td>
<td>2/35 (5.7%)</td>
</tr>
<tr>
<td>MSM</td>
<td>10/39 (25.6%)</td>
<td>1/2 (50%)</td>
</tr>
<tr>
<td>Injection drug use</td>
<td>11/192 (5.7%)</td>
<td>1/34 (2.9%)</td>
</tr>
<tr>
<td>Multiple sex partners</td>
<td>52/141 (36.9%)</td>
<td>9/22 (40.9%)</td>
</tr>
<tr>
<td>Surgery</td>
<td>46/192 (24.0%)</td>
<td>7/35 (20.0%)</td>
</tr>
<tr>
<td>Acupuncture</td>
<td>7/144 (4.9%)</td>
<td>1/25 (4.0%)</td>
</tr>
<tr>
<td>Tattoo</td>
<td>38/189 (20.1%)</td>
<td>8/35 (22.9%)</td>
</tr>
<tr>
<td>Any of above</td>
<td>121/203 (59.6%)</td>
<td>18/35 (51.4%)</td>
</tr>
</tbody>
</table>

¹During 6 weeks – 6 months prior to illness except blood transfusion
²Excludes 4 misclassified cases
Current Practices Survey

- Administered electronically to 580 listserv subscribers in California
  - Predominantly infection control and employee health staff
- One survey to be completed per institution
- Assessed current practices for ensuring healthcare personnel (HCP) protection against Hepatitis B Virus (HBV)
- 153 responses
  - 39.3% response rate\(^1\)

\(^1\)Based on denominator of 389 acute care hospitals
Institution Classification

- Nongovernment Not-for-Profit Community Hospital
- Investor-Owned (For-Profit) Community Hospital
- State and Local Government Community Hospital
- Federal Government Hospital
- Nonfederal Long Term Care Hospital
- Hospital Unit of Institution
- Other
Institution Characteristics

- **Number of licensed beds**: 8-1801 (median=202)
  - 151 (98.7%) have adult beds
  - 78 (51.0%) have pediatric beds
- **Proportion teaching hospital**: 24.2%
- **Number of HCP with reasonably anticipated risk for blood or body fluid exposure**: 35-15,421 (median=1000)