Emerging Health Threats

Avian Influenza

New Research on Prevention and Treatment

Over the last several years, the highly pathogenic avian influenza A (H5N1) virus has spread to birds in Asia, Africa, Europe, and the Near East—and some of those birds have passed the virus on to humans. Of the few avian flu viruses that have crossed the species barrier to infect humans, H5N1 has caused the largest number of detected cases of severe disease and death. From late 2003 through December 2007, the virus caused nearly 350 laboratory-confirmed human infections; more than 60 percent of those infected died. Most people were infected after coming into close contact with infected birds, but health experts worry that these viruses could develop the ability to spread easily among humans, creating the potential for a pandemic.

In response to this threat, NCIRD researchers recently collaborated on testing an experimental drug as an alternative approach to preventing and treating avian flu in humans. The study results were promising. The novel sialidase fusion protein protected 100% of test mice from fatal disease, effectively blocked infection in 70% of them, and prevented the virus from spreading to their brains. The study also showed that with early treatment, mice that were infected had a better chance for survival.

Investigating Flu Outbreaks in Poultry

In May 2007, NCIRD investigators went to Ghana to help investigate avian influenza outbreaks on poultry farms; these outbreaks marked the first known appearances of the H5N1 virus in the country. CDC staff joined national health officials on a mission to the neighboring Brong-Ahafo and Ashanti regions to conduct a needs assessment and assist with outbreak response.

The seven-person response team provided technical assistance and training for both local veterinary staff and human healthcare providers, and developed a set of recommendations based on their visit. One recommendation made after observing the response was the importance of having good communication and interactions between the human and veterinary health services so that both remain knowledgeable about the situation and are able to respond appropriately.

Communities in Vietnam join the effort

Vietnam has reported more human cases of avian influenza than almost any other country in the world. Thanks to a collaborative effort between CDC and the international relief and development organization CARE, residents of one region of Vietnam are making sustainable progress toward preventing and controlling outbreaks.

Every week, village health volunteers in Hai Phong, a province on the northeast coast of Vietnam, travel door-to-door talking to local farmers about bird flu. Using a questionnaire, they collect information from the farmers on local bird sickness and death. Since the project began in September 2006, the volunteers have been able to help identify several outbreaks of bird flu in the province. CARE has been responsible for project implementation, while CDC is providing the necessary technical expertise.

The results of the surveillance are helping CDC, CARE, and their local partners educate families in Hai Phong about the disease and how they can help prevent it. These efforts can reduce local outbreaks among poultry flocks and help prevent illness in humans—now and in the future. In addition, the project is helping link these efforts with the development of national and provincial early-warning systems. CDC and CARE are also planning to use this model to develop similar programs in other provinces in Vietnam, as well as in Laos, Cambodia, and other countries.

Preparing CDC and the World for Pandemic Influenza

Training CDC staff

To increase its capacity to respond quickly and effectively to an influenza pandemic—both at home and globally—NCIRD provided Epidemic Intelligence Service (EIS) officers as well as CDC staff scientists and program officers with a comprehensive, three-day training course. This training covered a broad range of influenza-related topics, including surveillance, case investigation, case management, pandemic containment, infection control, and risk communications. As a result, CDC now has more than 500 staff members trained in the operational and scientific aspects of pandemic response.

Creating domestic rapid response teams

Working with the Council of State and Territorial Epidemiologists, NCIRD is helping every state in America create teams of public health responders to help combat potential outbreaks of avian influenza. Adapting its international rapid-response curricula for domestic use, NCIRD has created a three-day online training course, released May 15, 2007, that gives state and local responders the skills and knowledge they need to identify and control avian influenza—and potentially other emerging diseases. A novel aspect of the training is that it brings together human- and animal-health professionals in a multidisciplinary response to an avian influenza threat.

Improving laboratory surge capacity

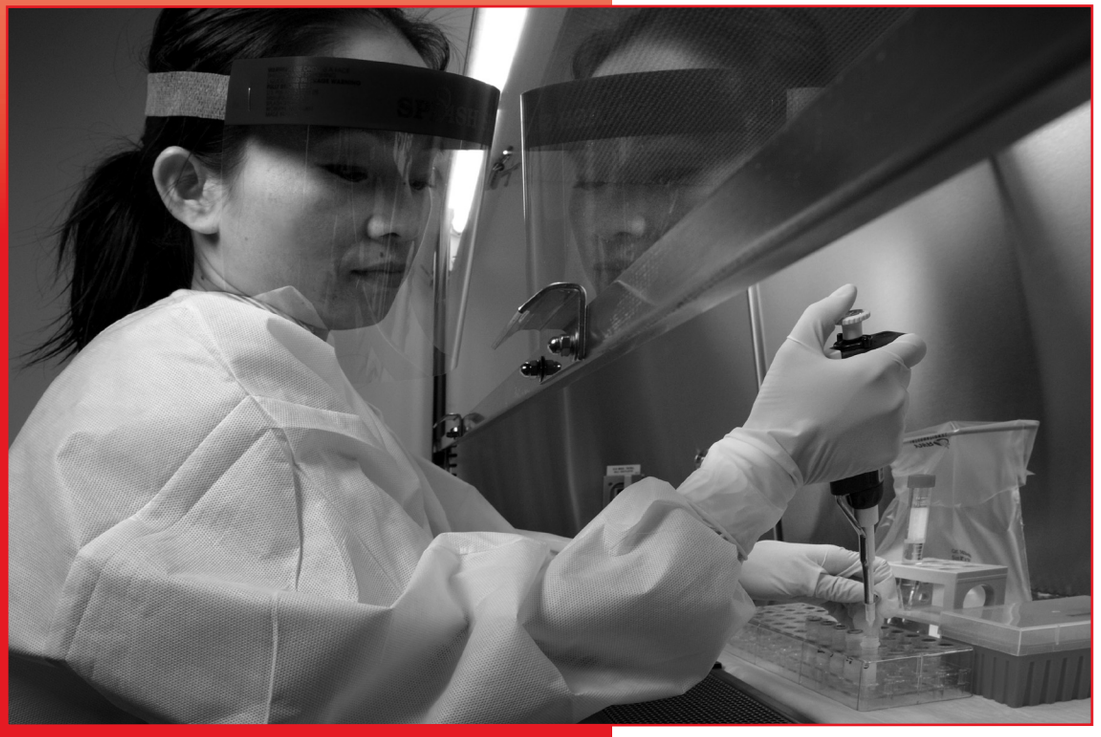
As one of four WHO Collaborating Centers for the Surveillance, Epidemiology and Control of Influenza, NCIRD will be at the nexus of the next global pandemic response. In 2007, NCIRD commissioned a series of computer simulations of its laboratory surveillance processes to examine how well it is prepared to handle a future pandemic. The computer simulations indicated that the demand for diagnostic testing during a pandemic could be more than 20 times that of a normal flu season. The analysis further found that testing the expected sample load would require more than a 200% increase in staff, assigned across multiple shifts, as well as more laboratory space and equipment. The analysis also identified process bottlenecks and determined the resources required to handle multiple response scenarios. These findings will help us continue to refine our pandemic preparedness plans.

Training the global health community

NCIRD has collaborated with WHO and other international health partners to develop training curricula to guide the development and implementation of national pandemic plans. In addition, NCIRD is helping countries threatened by avian influenza to develop rapid response teams, enhance their flu sureillance systems, and implement advanced laboratory diagnostic techniques.

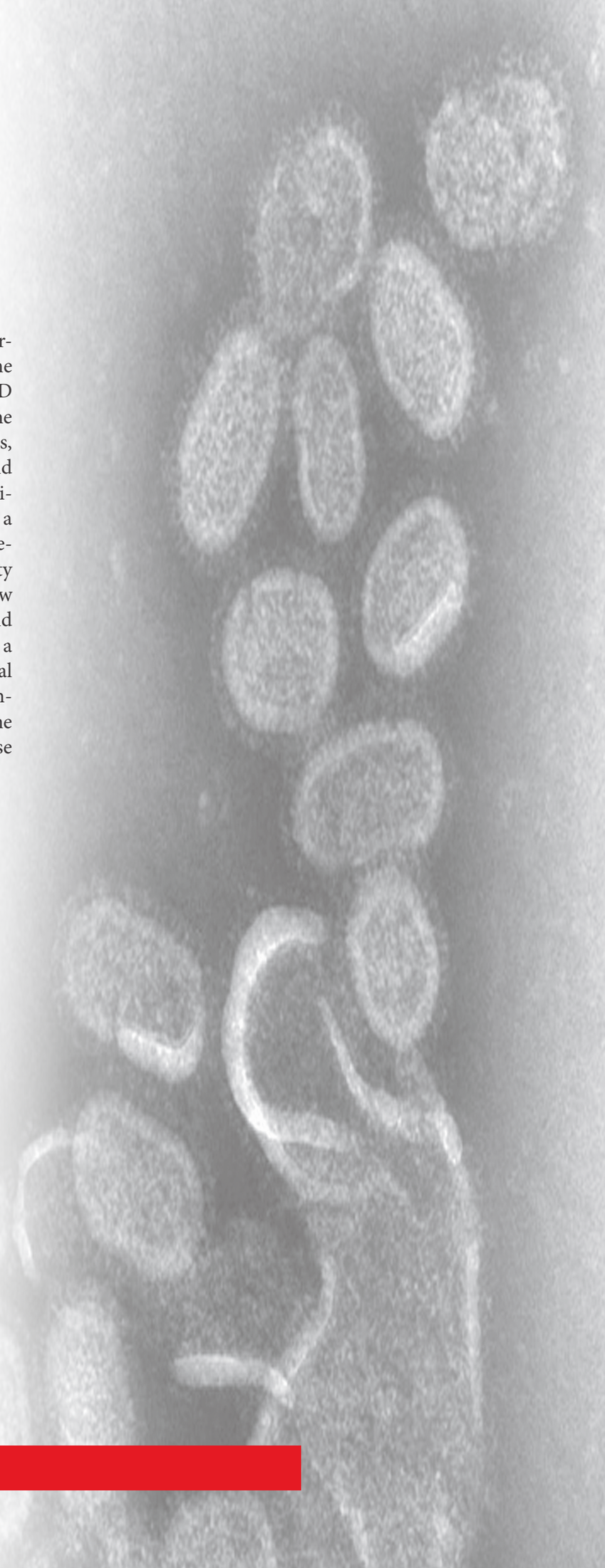
Developing early-warning networks

To react quickly to a flu pandemic, the global health community must have in place effective and wide-reaching surveillance systems. CDC has been working to prepare its partners in Central Europe, Central and Southeast Asia, South America, and Africa through training on surveillance and other relevant topics. CDC also provided on-site technical assistance at workshops for staff in Mongolia and Russia, and partnered with the World Health Organization to develop a generic influenza surveillance protocol for countries in Southeast Asia working to expand their flu and severe respiratory disease surveillance.



Vaccine Research and Development

Developing new vaccines is a critical aspect of preparing for new pandemic threats. In collaboration with the National Center for Environmental Health, NCIRD has been working to improve its method for testing the potency of pandemic and seasonal influenza vaccines, with the aim of greater speed, sensitivity, precision, and accuracy in the quantification of influenza hemagglutinin, the component critical for immune response to a vaccine. Other NCIRD research is exploring how to create vaccines that offer broader cross-reactive immunity and protection, especially for the elderly, as well as how to develop techniques to speed vaccination and extend vaccine supply. For example, preliminary results from a study led by CDC and the Walter Reed Army Medical Center indicate that during a vaccine shortage, healthcare providers might be able to stretch limited vaccine supply by immunizing healthy adults with a half-dose of seasonal influenza vaccine.



Global Disease Detection Innovative Project

Disease surveillance systems depend on timely, accurate diagnoses in order to provide data for outbreak detection and response, as well as to correctly inform policy decisions. *Now in its second year, NCIRD's Global Disease Detection (GDD) Innovative Project is adapting existing polio and measles surveillance networks to build sustainable surveillance and laboratory capacity for emerging infectious diseases.* The project focuses on surveillance for acute encephalitis and meningitis in Bangladesh, China, and India, with a combined population of more than 2.5 billion people. In addition, these systems will enable programs to distinguish between the many causes of these syndromes — for example, Japanese encephalitis, *Neisseria meningitidis*, *Streptococcus pneumoniae* and *Haemophilus influenzae*. This initiative will help ensure appropriate responses to outbreaks as well as necessary adjustments to vaccination strategies. In 2007, GDD project accomplishments included:

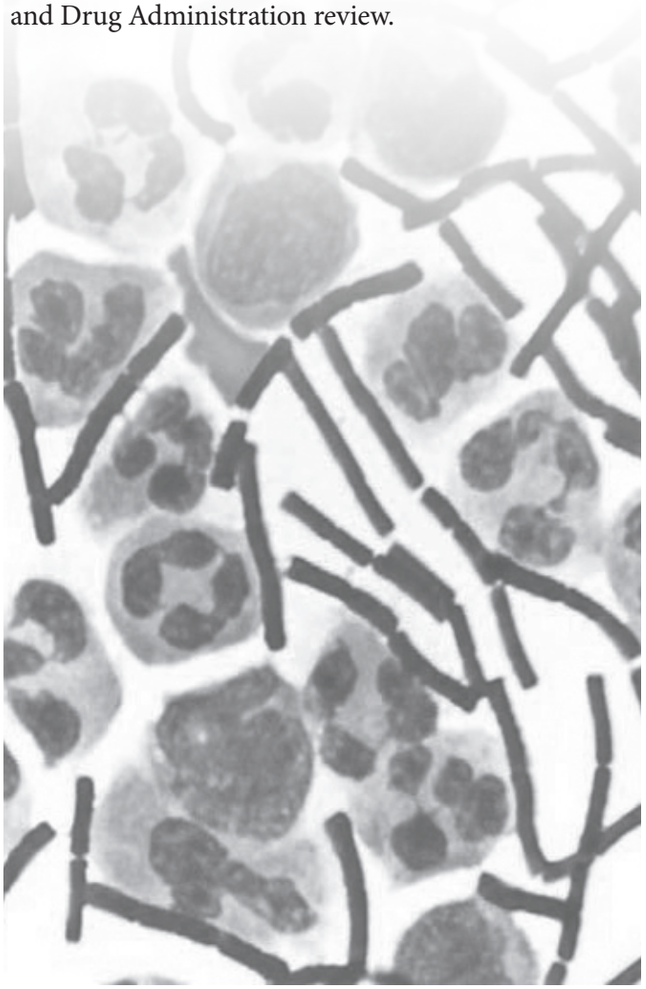
- In-country assessments of surveillance/laboratory needs;
- Development of technical protocols for surveillance of acute meningitis and encephalitis syndrome;
- Training in surveillance, laboratory testing, bacteriology, and RT PCR; and
- Initiation of surveillance activities in two sentinel sites in India, three sentinel sites in Bangladesh, and four provinces in China.

All the sentinel sites in these three countries are reporting acute encephalitis and meningitis cases. Specimens are being tested at the national laboratories with enhanced capacity developed through the GDD Innovative Project.

Studying Anthrax Vaccine

Anthrax can cause serious illness or death in both humans and animals. Though it no longer captures headlines like it did in 2001—when 22 people were infected following distribution of mail contaminated with the anthrax-causing bacteria *Bacillus anthracis*—the disease is still considered a bioterrorist threat, and military personnel are routinely vaccinated against it.

There is currently only one anthrax vaccine licensed in the United States: Anthrax Vaccine Adsorbed (AVA), also known as Biothrax®. NCIRD is conducting ongoing research to ensure it is safe and easy to use. One of these studies—a large-scale, multi-center, Phase IV human clinical trial with more than 1,500 participants—is evaluating whether the vaccine can be administered more easily, using fewer vaccinations, and with fewer side effects. Though the study will not conclude until 2009, interim results have been submitted for U.S. Food and Drug Administration review.



Studying Past Pandemics Gives Hope for Identifying New Ones

Between 1918 and 1919, a flu pandemic (commonly referred to as the Spanish Flu) killed as many as 50 million people worldwide. Now NCIRD researchers and their colleagues have found molecular-level clues to how the virus that caused the pandemic was able to spread. In an article in the February 5, 2007, issue of *Science* entitled "A Two-Amino Acid Change in the Hemagglutinin of the 1918 Influenza Virus Abolishes Transmission," the researchers reported that by altering two amino acids in one of the surface proteins of the virus, they could create a version of the virus that is unable to spread between test animals, yet still retains its ability to cause severe illness. This discovery provides insight into changes in the 1918 virus that led to person-to-person transmission.

Detecting and Investigating Swine Influenza

On rare occasions, swine influenza virus can infect humans and cause serious illness, especially in young children or people with underlying health problems. In the past, CDC typically received one influenza virus isolate from humans each year that tested positive for swine influenza. However, more of these infections were detected in 2006 and 2007, likely as a result of increased diagnostic capabilities. In 2007, NCIRD helped identify and investigate five human cases of swine influenza in Illinois, Iowa, Michigan, and Ohio. These were detected as cases of novel influenza A virus infection, which became a nationally notifiable condition fairly recently. Because person-to-person transmission of novel influenza A viruses could signal the beginning of an influenza pandemic, it was critical that CDC investigate the cases immediately. Working with state and local health departments as well as state animal health authorities, CDC staff helped assess the scope of swine-to-human infections, the sources of the infections, and any possible human-to-human transmission of the virus. These and future swine influenza investigations will help further national pandemic preparedness and response.

As part of earning their Try-It career badge, members of Brownie Troop #3531 visit CDC's TV studio, where they get to experience "the hot seat."

Appendix

Calendar of

National Vaccine Advisory Committee Meeting (NVAC)
February 5–6, 2008
Washington, DC
202-690-5566
www.hhs.gov/nvpo/nvac

FDA's Vaccines and Related Biologicals Advisory Committee (VRBAC)
February 20–21, 2008
Hilton Hotel DC/Gaithersburg
Gaithersburg, MD
www.fda.gov/Cber

American College of Preventive Medicine (ACPM)—Preventive Medicine
February 20–23, 2008
Austin, TX
www.preventivemedicine2008.org/

Advisory Committee on Immunization Practices
February 27–28, 2008
Atlanta, GA
www.cdc.gov/vaccines/recs/acip/

58th National Medical Association (NMA) Convention—Health Care Justice: Pursuing the Dream of a Healthy Society
March 12–16, 2008
Hyatt Regency Houston
Houston, TX
www.amsa.org/conv/

25th Annual Behavioral Risk Factor Surveillance System Conference—"BRFSS: Meeting Challenges and Staying Ahead"
March 15-19, 2008
Florida Hotel and Conference Center
Orlando, FL
www.cdc.gov/brfss/conference/

International Conference on Emerging Infectious Diseases (ICEID)
March 16-19, 2008
Hyatt Regency Atlanta
Atlanta, GA
http://www.iceid.org/

42nd National Immunization Conference
March 17-20, 2008
Hilton Atlanta
Atlanta, GA
www.cdc.gov/vaccines/events/nic/default.htm

7th Annual Forum for Improving Children's Health Care
March 19–21, 2008
InterContinental Miami
Miami, FL
www.nichq.org/nichq

57th Annual Epidemic Intelligence Service (EIS)
Conference
April 14–18, 2008
www.cdc.gov/eis/conference/conference.htm

National Infant Immunization Week (NIIW)
Vaccination Week in the Americas (VWA)
April 19–26, 2008
www.cdc.gov/vaccines/events/niiw/

World Vaccine Congress Washington
April 21-24, 2008
Hyatt Regency Crystal City
Arlington, VA
www.terrapinn.com/2008/

11th Annual Conference on Vaccine Research
May 5-8, 2008
Baltimore Marriott Waterfront Hotel,
Baltimore, MD
www.nfid.org/conferences/vaccine08/

National Rural Health Association (NRHA)
May 7–10, 2008
New Orleans, LA
www.nrharural.org/conferences/

National Influenza Vaccine Summit Meeting
May 12–13, 2007
Atlanta, GA
www.preventinfluenza.com/

53rd Annual Meeting and Exposition
American College of Nurse-Midwives (ACNM)
May 23–29, 2008
Boston, MA
www.midwife.org

35th Annual Global Health Council's International Conference
May 27-31, 2008
Omni Shoreham Hotel
Washington, DC
www.globalhealth.org/conference/

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Events 2008

National Vaccine Advisory Committee Meeting (NVAC)
June 3-4, 2008
202-690-5566
www.hhs.gov/nvpo/nvac

6th International Symposium on Pneumococci & Pneumococcal Diseases
June 8-12, 2008
Reykjavik, Iceland
www.congress.is/ISPPD-6/

Advisory Committee on Immunization Practices
June 25-26, 2008
Atlanta, GA
http://www.cdc.gov/vaccines/recs/acip/

40th Annual National Association of School Nurses Conference (NASN)
June 28 – July 1, 2008
Albuquerque, NM
www.nasn.org/

2008 Joint Statistical Meeting
August 3–7, 2008
Denver Convention Center
Denver, CO
www.amstat.org/meetings/

36th Annual National Black Nurses Association (NBNA) Institute and Conference
August 4-8, 2008
The Mandalay Bay Resort & Casino
Las Vegas, NV
http://www.nbna.org/calendar.htm

2nd Annual National Conference on Health Communication, Marketing, and Media
August 12-14, 2008
Atlanta, GA
www.cdc.gov/healthmarketing/conference2008.htm

Association of State and Territorial Health Officials (ASTHO) & National Association of County and City Health Officials (NACCHO) Joint Conference
September 9-12, 2008
Sacramento Convention Center
Hyatt Regency Sacramento, Sheraton Grand Sacramento
Sacramento, CA
www.naccho.org/
www.astho.org

National Vaccine Advisory Committee Meeting (NVAC)
September 16-17, 2008
202-690-5566
www.hhs.gov/nvpo/nvac

National Adult Immunization Awareness Week
September 21-27, 2008
Nationwide
www.cdc.gov/vaccines/events/naiaw/

National Public Health Information Coalition (NPHIC)
October 5-8, 2008
San Antonio, TX
http://www.nphic.org/

Advisory Committee on Immunization Practices (ACIP)
October 22-23, 2008
Atlanta, GA
http://www.cdc.gov/vaccines/recs/acip/

48th Annual Interscience Conference on Antimicrobial Agents and Chemotherapy (ICAAC) /46th Annual Infectious Disease Society of America (IDSA) Meeting
October 25-28, 2008
Washington, DC
www.idsociety.org/

136th Annual American Public Health Association Meeting—Public Health Without Borders
October 25-29, 2008
San Diego, CA
www.apha.org/meetings/

82nd Annual ASHA School Health Conference—Finding Human Ground in Human Sexuality & Other Adolescent Health Issues
November 12-15, 2008
Hyatt Regency Downtown Tampa
Tampa, FL
www.ashaweb.org/annual_conferences.html

National Influenza Vaccination Week (NIVW)
December 7–13, 2008
www.cdc.gov/flu

AUGUST

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Who's who in *NCIRD*




Greg Armstrong
Chief,
Epidemiology
Branch,
DVD

April Allman
Program
Management
Officer,
DVD

Larry Anderson
Director,
DVD

Beth Bell
Associate Director
for Epidemiologic
Science,
NCIRD




William Bellini
Chief,
MMR and
Herpes Branch,
DVD

Joe Bresee
Chief,
Epidemiology and
Prevention Branch,
ID

Carolyn Bridges
Associate Director
for Science,
ID

Brent Burkholder
Director,
GID




Steve Cochi*
Chief,
Disease
Elimination
and Eradication
Branch,
GID

Nancy Cox
Director,
ID

Michael Detmer
Associate Director
for Management
and Operations,
NCIRD

Vance Dietz
Chief,
Strengthening
Immunization
Systems Branch
(proposed),
GID




Ruben Donis
Chief,
Molecular
Virology and
Vaccines Branch,
ID

Nancy Fasano
Chief,
Program
Operations
Branch,
ISD

Barry Fields*
Associate Director
for Laboratory
Science,
DBD

Kim Fears
Program
Management
Officer,
GID




John Fitzsimmons
Deputy Director,
GID

Jon Gentsch
Chief,
Gastroenteritis and
Respiratory Viruses
Branch,
DVD

Sue Goldstein
Associate Director
for Science,
DVD

Rana Hajjeh
Director,
DBD



Marie Hicks*
Program
Management
Officer,
ID

Dan Jernigan
Deputy
Director,
ID

Jacqueline Katz
Chief,
Immunology
and Pathogenesis
Branch,
ID

DBD	Division of Bacterial Diseases
DVD	Division of Viral Diseases
GID	Global Immunization Division
ID	Influenza Division
ISD	Immunization Services Division
NCIRD	National Center for Immunization and Respiratory Diseases

Acting *

Center Leadership

Vanda Kelley
Associate Director for Policy,
ISD

Olen Kew
Associate Director for Global Laboratory Science,
NCIRD

Alexander Klimov
Chief,
Virus Surveillance and Diagnosis Branch,
ID

Wendi Kuhnert
Associate Director for Laboratory Science,
DVD




Derrick Lake
Program Management Officer,
DBD

Eric Mast
Associate Director for Science,
GID

Alison Mawle
Associate Director for Laboratory Science,
NCIRD

Nancy Messonnier
Chief,
Meningitis and Vaccine Preventable Diseases Branch,
DBD




Ann Moen
Associate Director for Extramural Programs,
ID

Gina Mootrey
Associate Director for Adult Immunization,
ISD

Trudy Murphy*
Associate Director for Science,
DBD

Mark Pallansch
Chief,
Polio and Picorna-viruses Laboratory Branch,
DVD

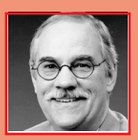



Larry Pickering
Senior Advisor,
NCIRD ;
Executive Secretariat,
ACIP

Kristin Pope
Associate Director for Health Policy,
NCIRD

Lance Rodewald
Director,
ISD

Jeanne Santoli
Deputy Director,
ISD




Anne Schuchat
Director,
NCIRD

Jane Seward*
Deputy Director,
DVD

Michael Shaw
Associate Director for Laboratory Science,
ID

Kristine Sheedy
Associate Director for Communica-tion Science,
NCIRD




Abigail Shefer
Associate Director for Science,
ISD

Jim Singleton
Chief,
Assessment Branch,
ISD

Julie Smith
Program Management Officer,
ISD

Kathy Towers-Solis
Chief,
Education, Information and Partnership Branch,
ISD




Gary Urquhart*
Chief,
Immunization Information Systems Support Branch,
ISD

Greg Wallace
Chief
Vaccine Supply and Assurance Branch,
ISD

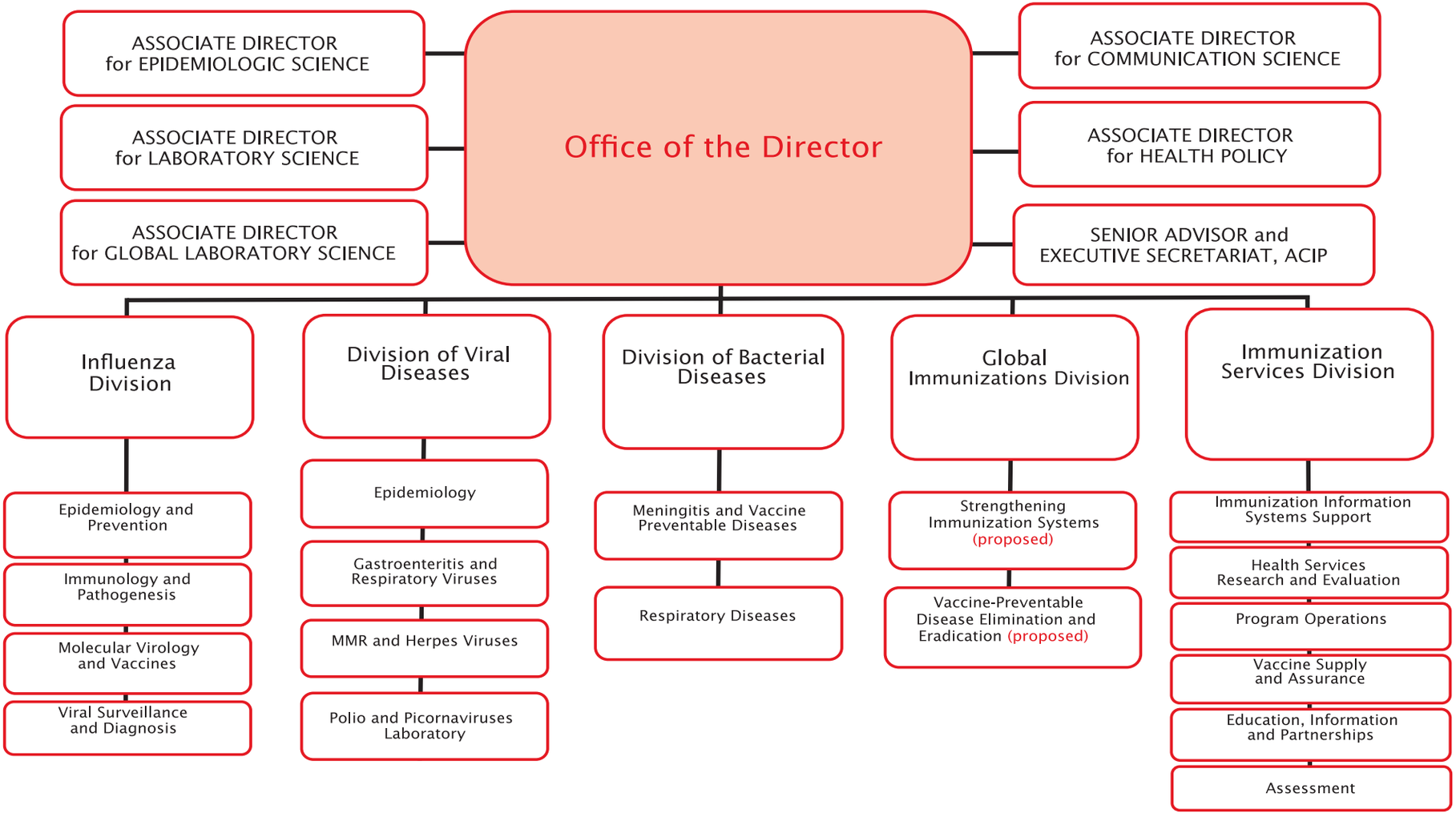
Melinda Wharton
Deputy Director,
NCIRD

Cynthia Whitney
Chief,
Respiratory Diseases Branch,
DBD

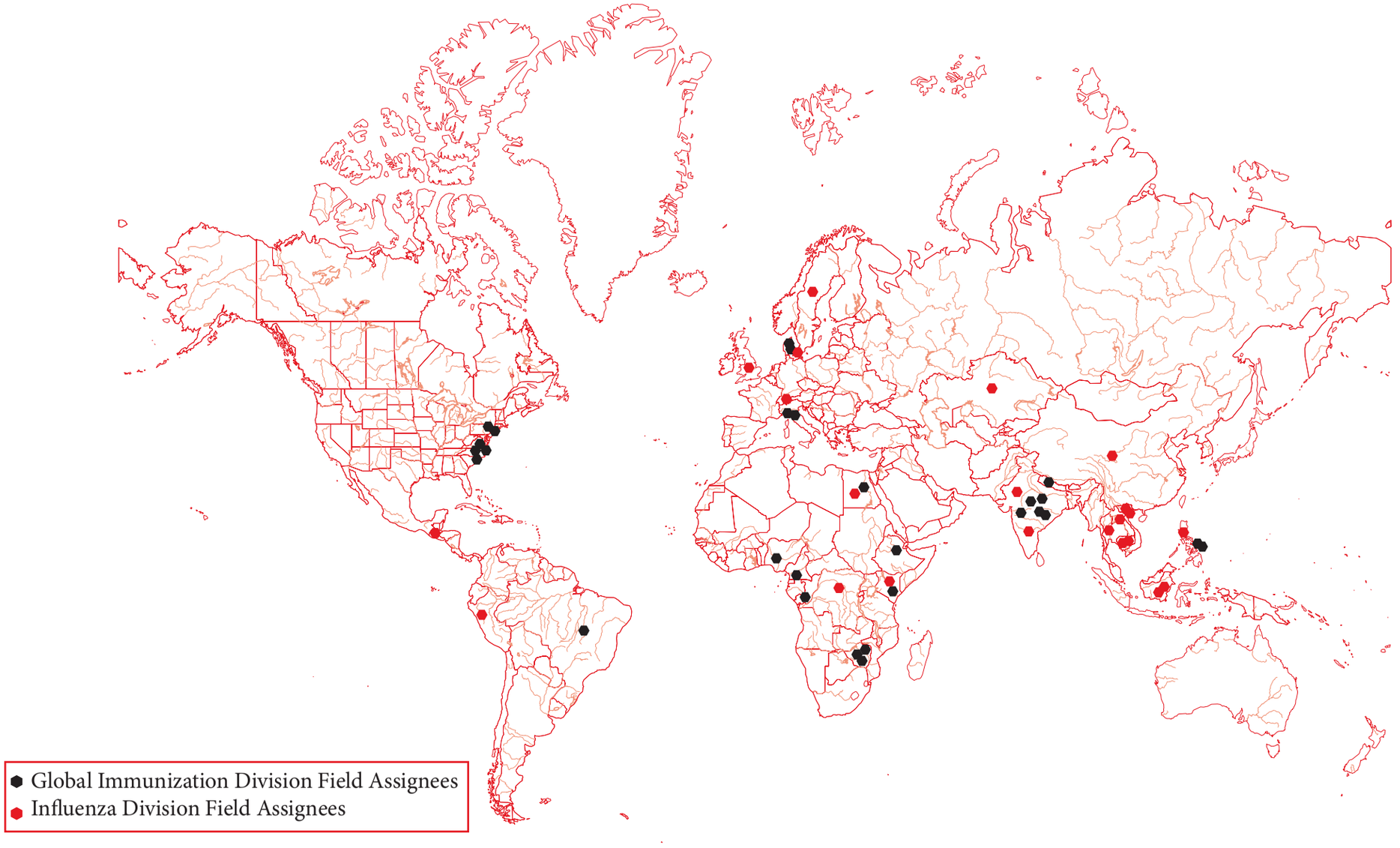



Pascale Wortley
Chief,
Health Services Research and Evaluation Branch,
ISD

NCIRD Organization



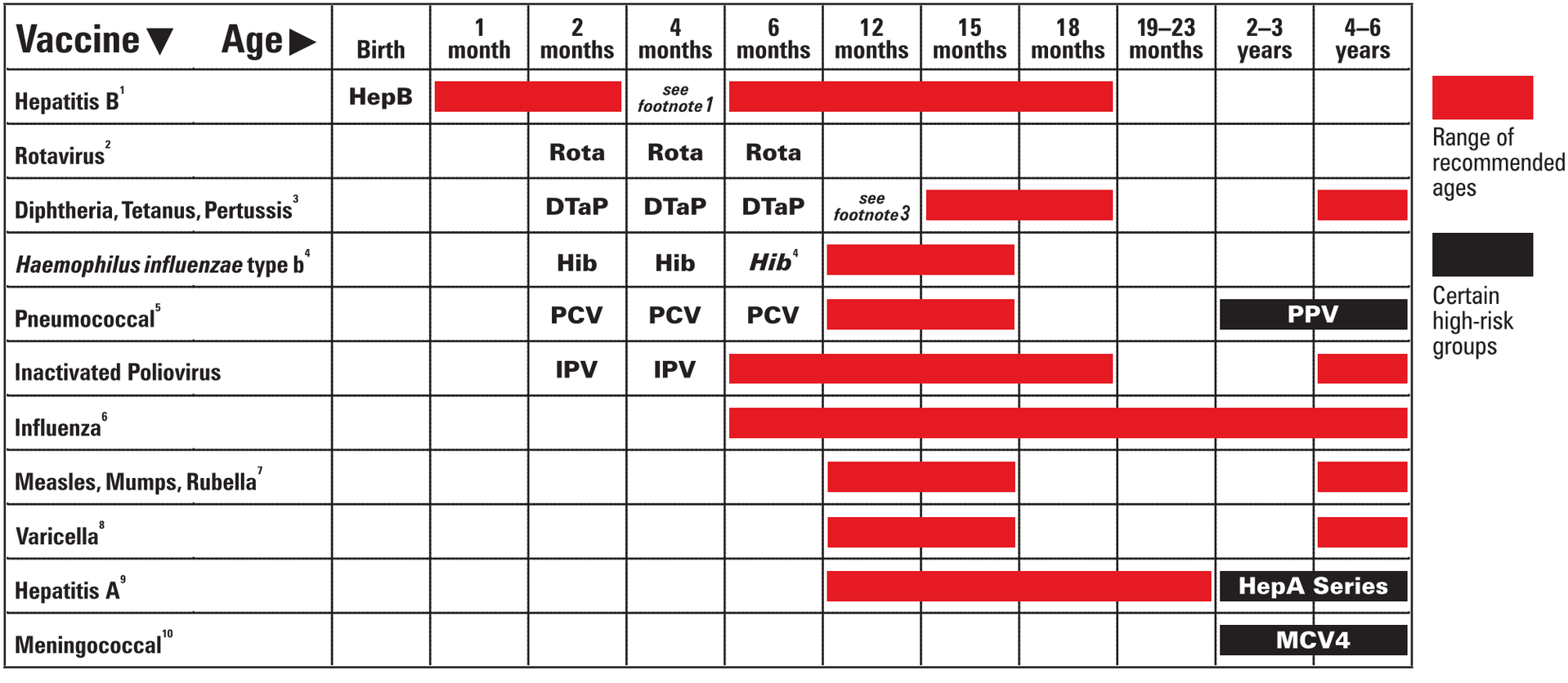
NCIRD international field staff 2007



These schedules indicate the recommended ages for routine administration of currently licensed childhood vaccines, as of December 1, 2007, for persons aged 0 through 18 years. Additional information is available at www.cdc.gov/vaccines/recs/schedules. Any dose not administered at the recommended age should be administered at any subsequent visit, when indicated and feasible. Additional vaccines may be licensed and recommended during the year. Licensed combination vaccines may be used whenever any components of the combination are indicated and other components of the vaccine are not contraindicated and if approved by the Food and Drug Administration for that dose of the series. Providers should consult the respective Advisory Committee on Immunization Practices statement for detailed recommendations, including for high risk conditions: http://www.cdc.gov/vaccines/pubs/ACIP-list.htm. Clinically significant adverse events that follow immunization should be reported to the Vaccine Adverse Event Reporting System (VAERS). Guidance about how to obtain and complete VAERS form is available at www.vaers.hhs.gov or by telephone, 800-822-7967.

Recommended Immunization Schedule for Persons Aged 0–6 Years—UNITED STATES • 2008

For those who fall behind or start late, see the catch-up schedule



Recommended Immunization Schedule for Persons Aged 7–18 Years—UNITED STATES • 2008

For those who fall behind or start late, see the green bars and the catch-up schedule

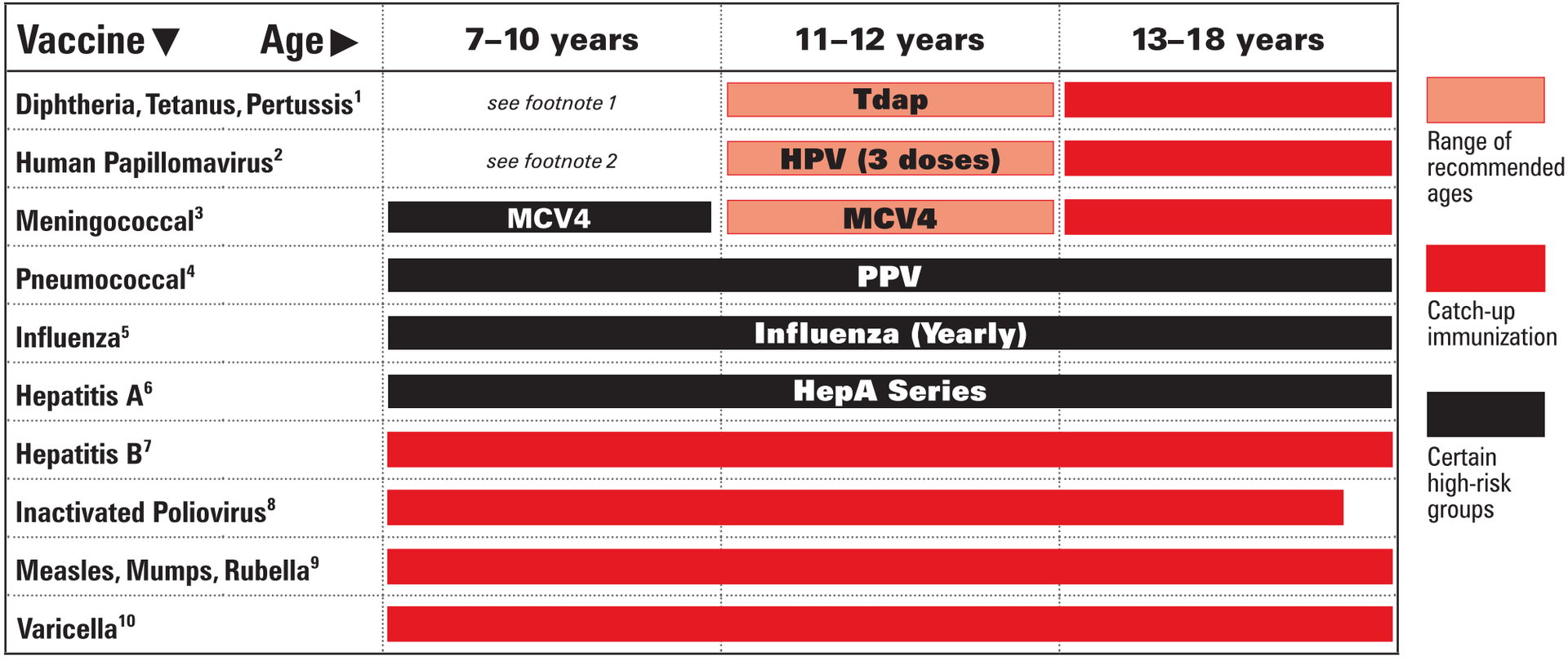
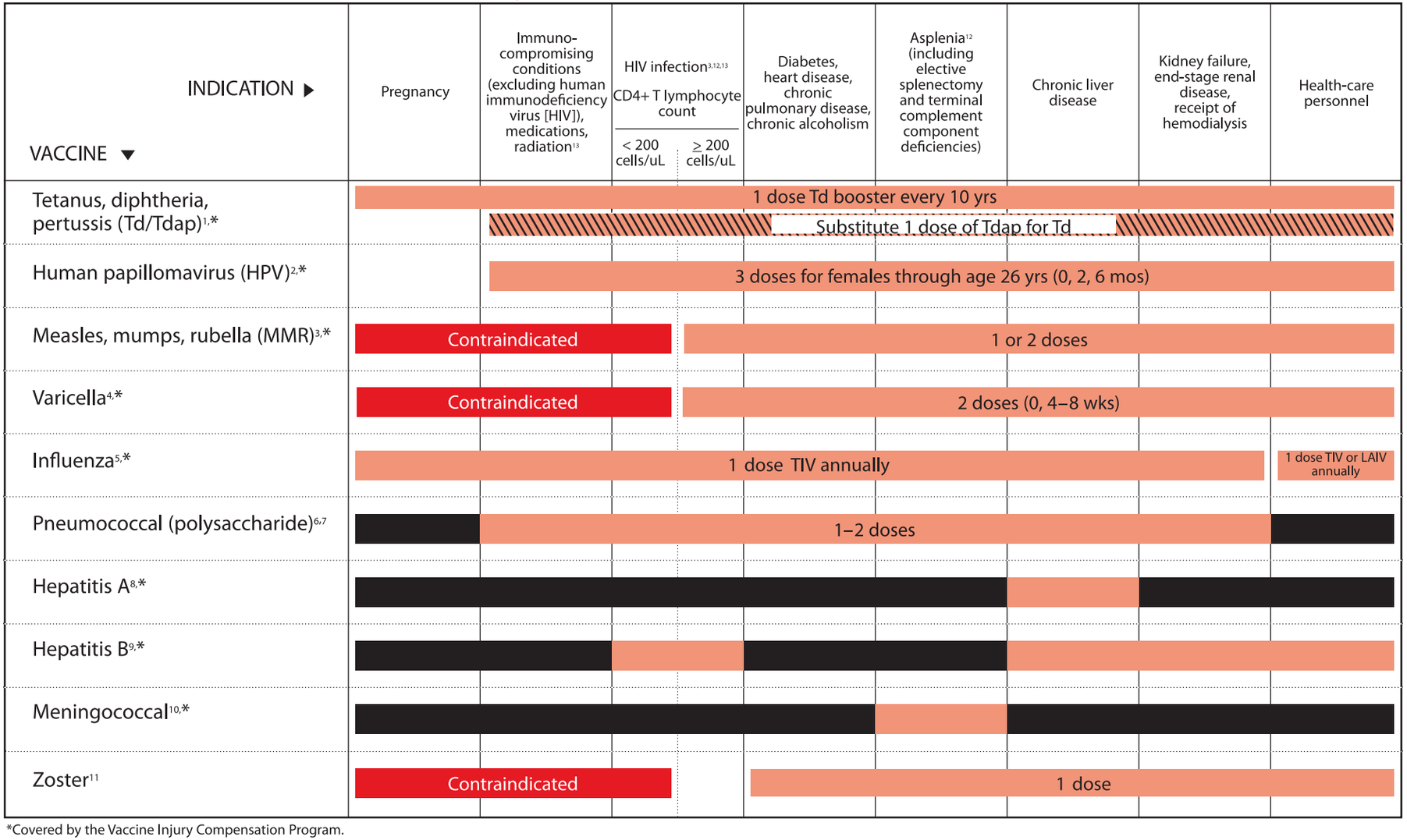


Figure 2. Vaccines that might be indicated for adults based on medical and other indications United States, October 2007 – September 2008



*Covered by the Vaccine Injury Compensation Program.

For all persons in this category who meet the age requirements and who lack evidence of immunity (e.g., lack documentation of vaccination or have no evidence of prior

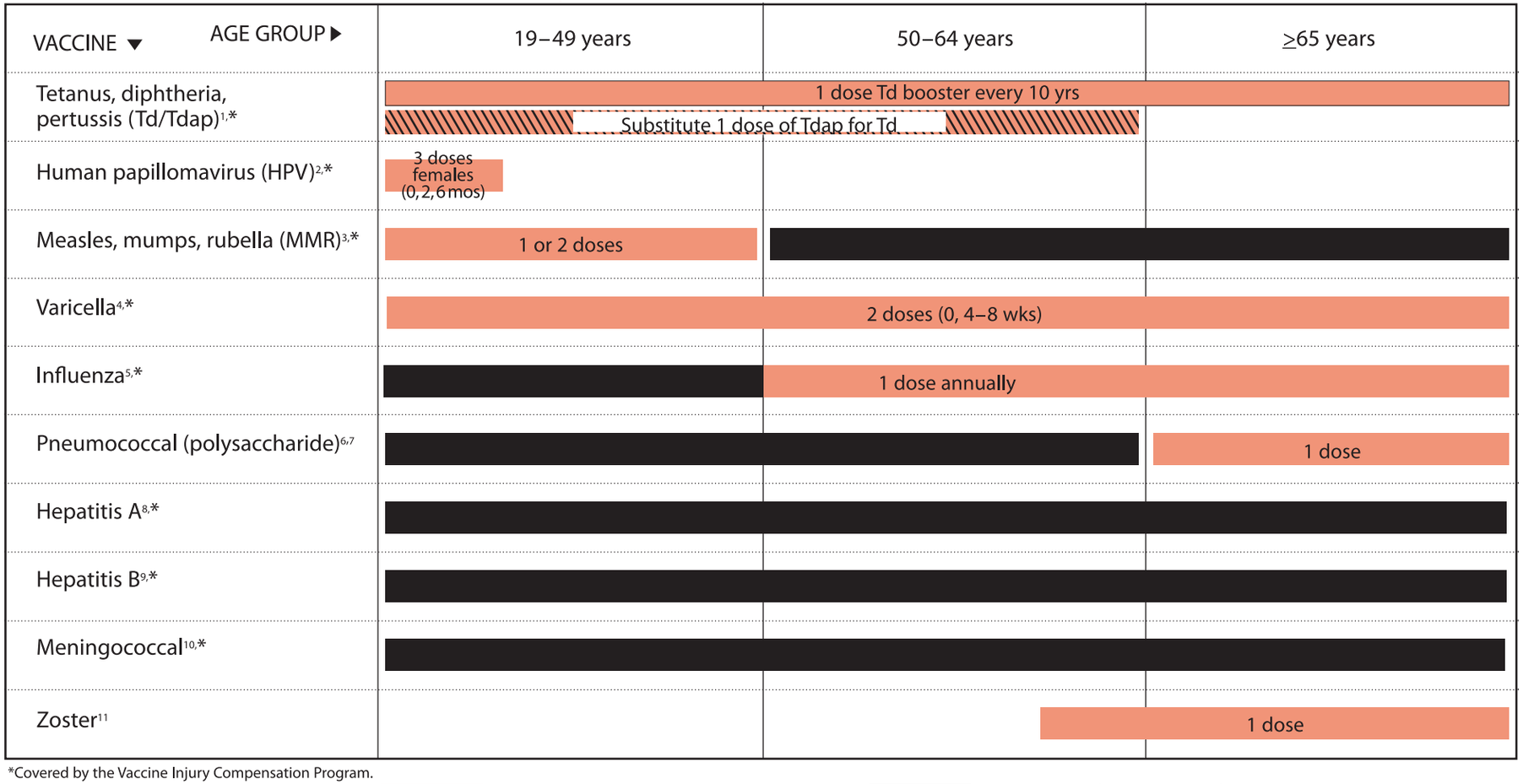
Recommended if some other risk factor is present (e.g., on the basis of medical, occupational, lifestyle, or other indications)

These schedules indicate the recommended age groups and medical indications for which administration of currently licensed vaccines are commonly indicated for adults ages 19 years and older, as of October 1, 2007. Licensed combination vaccines may be used whenever any components of the combination are indicated and when the vaccine's other components are not contraindicated. For detailed recommendations on all vaccines, including those used primarily for travelers or that are issued during the year, consult the manufacturers' package inserts and the complete statements from the Advisory Committee on Immunization Practices

Recommended Adult Immunization Schedule

Note: These recommendations must be read with the footnotes that follow.

Figure 1. Recommended adult immunization schedule, by vaccine and age group United States, October 2007 – September 2008



*Covered by the Vaccine Injury Compensation Program.

For all persons in this category who meet the age requirements and who lack evidence of immunity (e.g., lack documentation of vaccination or have no evidence of prior

Recommended if some other risk factor is present (e.g., on the basis of medical, occupational, lifestyle, or other indications)

Report all clinically significant postvaccination reactions to the Vaccine Adverse Event Reporting System (VAERS). Reporting forms and instructions on filing a VAERS report are available at www.vaers.hhs.gov or by telephone, 800-822-7967.

Information on how to file a Vaccine Injury Compensation Program claim is available at www.hrsa.gov/vaccinecompensation or by telephone, 800-338-2382. To file a claim for vaccine injury, contact the U.S. Court of Federal Claims, 717 Madison Place, N.W., Washington, D.C. 20005; telephone, 202-357-6400.

Additional information about the vaccines in this schedule, extent of available data, and contraindications for vaccination is also available at www.cdc.gov/vaccines or from the CDC-INFO Contact Center at 800-CDC-INFO (800-232-4636) in English and Spanish, 24 hours a day, 7 days a week.

Use of trade names and commercial sources is for identification only and does not imply endorsement by the U.S. Department of Health and Human Services.

Catch-up Immunization Schedule

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for Persons Aged 4 Months–18 Years Who Start Late or Who Are More Than 1 Month Behind

The table below provides catch-up schedules and minimum intervals between doses for children whose vaccinations have been delayed. A vaccine series does not need to be restarted, regardless of the time that has elapsed between doses. Use the section appropriate for the child's age.

CATCH-UP SCHEDULE FOR PERSONS AGED 4 MONTHS–6 YEARS					
Hepatitis B[1]	**Birth**	**4 weeks**	**8 weeks** (and 16 weeks after first dose)		
Rotavirus[2]	**6 wks**	**4 weeks**	**4 weeks**		
Diphtheria, Tetanus, Pertussis[3]	**6 wks**	**4 weeks**	**4 weeks**	**6 months**	**6 months**[3]
***Haemophilus influenzae* type b**[4]	**6 wks**	**4 weeks** if first dose administered at younger than 12 months of age **8 weeks (as final dose)** if first dose administered at age 12-14 months **No further doses needed** if first dose administered at 15 months of age or older	**4 weeks**[4] if current age is younger than 12 months **8 weeks (as final dose)**[4] if current age is 12 months or older and second dose administered at younger than 15 months of age **No further doses needed** if previous dose administered at age 15 months or older	**8 weeks (as final dose)** This dose only necessary for children aged 12 months–5 years who received 3 doses before age 12 months	
Pneumococcal[5]	**6 wks**	**4 weeks** if first dose administered at younger than 12 months of age **8 weeks (as final dose)** if first dose administered at age 12 months or older or current age 24–59 months **No further doses needed** for healthy children if first dose administered at age 24 months or older	**4 weeks** if current age is younger than 12 months **8 weeks (as final dose)** if current age is 12 months or older **No further doses needed** for healthy children if previous dose administered at age 24 months or older	**8 weeks (as final dose)** This dose only necessary for children aged 12 months–5 years who received 3 doses before age 12 months	
Inactivated Poliovirus[6]	**6 wks**	**4 weeks**	**4 weeks**	**4 weeks**[6]	
Measles, Mumps, Rubella[7]	**12 mos**	**4 weeks**			
Varicella[8]	**12 mos**	**3 months**			
Hepatitis A[9]	**12 mos**	**6 months**			
CATCH-UP SCHEDULE FOR PERSONS AGED 7–18 YEARS					
Tetanus, Diphtheria/ Tetanus, Diphtheria, Pertussis[10]	**7 yrs**[10]	**4 weeks**	**4 weeks** if first dose administered at younger than 12 months of age **6 months** if first dose administered at age 12 months or older	**6 months** if first dose administered at younger than 12 months of age	
Human Papillomavirus[11]	**9 yrs**	**4 weeks**	**12 weeks**		
Hepatitis A[9]	**12 mos**	**6 months**			
Hepatitis B[1]	**Birth**	**4 weeks**	**8 weeks** (and 16 weeks after first dose)		
Inactivated Poliovirus[6]	**6 wks**	**4 weeks**	**4 weeks**	**4 weeks**[6]	
Measles, Mumps, Rubella[7]	**12 mos**	**4 weeks**			
Varicella[8]	**12 mos**	**4 weeks** if first dose administered at age 13 years or older **3 months** if first dose administered at younger than 13 years of age			

Footnotes *to immunization schedules*

Childhood Schedule Footnotes

1. Hepatitis B vaccine (HepB). (Minimum age: birth)

At birth:

- Administer monovalent HepB to all newborns prior to hospital discharge.
- If mother is hepatitis B surface antigen (HBsAg) positive, administer HepB and 0.5 mL of hepatitis B immune globulin (HBIG) within 12 hours of birth.
- If mother's HBsAg status is unknown, administer HepB within 12 hours of birth. Determine the HBsAg status as soon as possible and if HBsAg positive, administer HBIG (no later than age 1 week).
- If mother is HBsAg negative, the birth dose can be delayed, in rare cases, with a provider's order and a copy of the mother's negative HBsAg laboratory report in the infant's medical record.

After the birth dose:

- The HepB series should be completed with either monovalent HepB or a combination vaccine containing HepB. The second dose should be administered at age 1–2 months. The final dose should be administered no earlier than age 24 weeks. Infants born to HBsAg positive mothers should be tested for HBsAg and antibody to HBsAg after completion of at least 3 doses of a licensed HepB series, at age 9–18 months (generally at the next well-child visit).

4-month dose:

- It is permissible to administer 4 doses of HepB when combination vaccines are administered after the birth dose. If monovalent HepB is used for doses after the birth dose, a dose at age 4 months is not needed.

2. Rotavirus vaccine (Rota). (Minimum age: 6 weeks)

- Administer the first dose at age 6–12 weeks.
- Do not start the series later than age 12 weeks.
- Administer the final dose in the series by age 32 weeks. Do not administer any dose later than age 32 weeks.
- Data on safety and efficacy outside of these age ranges are insufficient.

3. Diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP). (Minimum age: 6 weeks)

- The fourth dose of DTaP may be administered as early as age 12 months, provided 6 months have elapsed since the third dose.
- Administer the final dose in the series at age 4–6 years.

4. Haemophilus influenzae type b conjugate vaccine (Hib). (Minimum age: 6 weeks)

- If PRP-OMP (PedvaxHIB® or ComVax® [Merck]) is administered at ages 2 and 4 months, a dose at age 6 months is not required.
- TriHIBit® (DTaP/Hib) combination products should not be used for primary immunization but can be used as boosters following any Hib vaccine in children age 12 months or older.

5. Pneumococcal vaccine. (Minimum age: 6 weeks for pneumococcal conjugate vaccine [PCV]; 2 years for pneumococcal polysaccharide vaccine [PPV])

- Administer one dose of PCV to all healthy children aged 24–59 months having any incomplete schedule.
- Administer PPV to children aged 2 years and older with underlying medical conditions.

6. Influenza vaccine. (Minimum age: 6 months for trivalent inactivated influenza vaccine [TIV]; 2 years for live, attenuated influenza vaccine [LAIV])

- Administer annually to children aged 6–59 months and to all eligible close contacts of children aged 0–59 months.
- Administer annually to children 5 years of age and older with certain risk factors, to other persons (including household members) in close contact with persons in groups at higher risk, and to any child whose parents request vaccination.
- For healthy persons (those who do not have underlying medical conditions that predispose them to influenza complications) ages 2–49 years, either LAIV or TIV may be used.
- Children receiving TIV should receive 0.25 mL if age 6–35 months or 0.5 mL if age 3 years or older.
- Administer 2 doses (separated by 4 weeks or longer) to children younger than 9 years who are receiving influenza vaccine for the first time or who were vaccinated for the first time last season but only received one dose.

7. Measles, mumps, and rubella vaccine (MMR). (Minimum age: 12 months)

- Administer the second dose of MMR at age 4–6 years. MMR may be administered before age 4–6 years, provided 4 weeks or more have elapsed since the first dose.

8. Varicella vaccine. (Minimum age: 12 months)

- Administer second dose at age 4–6 years; may be administered 3 months or more after first dose.
- Do not repeat second dose if administered 28 days or more after first dose.

9. Hepatitis A vaccine (HepA). (Minimum age: 12 months)

- Administer to all children aged 1 year (i.e., aged 12–23 months). Administer the 2 doses in the series at least 6 months apart.
- Children not fully vaccinated by age 2 years can be vaccinated at subsequent visits.
- HepA is recommended for certain other groups of children, including in areas where vaccination programs target older children.

10. Meningococcal vaccine. (Minimum age: 2 years for meningococcal conjugate vaccine (MCV4) and for meningococcal polysaccharide vaccine (MPSV4))

- Administer MCV4 to children aged 2–10 years with terminal complement deficiencies or anatomic or functional asplenia and certain other high-risk groups. MPSV4 is also acceptable.
- Administer MCV4 to persons who received MPSV4 3 or more years previously and remain at increased risk for meningococcal disease.

Adolescent Schedule Footnotes

1. Tetanus and diphtheria toxoids and acellular pertussis vaccine (Tdap). (Minimum age: 10 years for BOOSTRIX® and 11 years for ADACEL™)
- Administer at age 11–12 years for those who have completed the recommended childhood DTP/DTaP vaccination series and have not received a tetanus and diphtheria toxoids (Td) booster dose.
- 13–18-year-olds who missed the 11–12 year Tdap or received Td only are encouraged to receive one dose of Tdap 5 years after the last Td/DTaP dose.

2. Human papillomavirus vaccine (HPV). (Minimum age: 9 years)
- Administer the first dose of the HPV vaccine series to females at age 11–12 years.
- Administer the second dose 2 months after the first dose and the third dose 6 months after the first dose.
- Administer the HPV vaccine series to females at age 13–18 years if not previously vaccinated.

3. Meningococcal vaccine.
- Administer MCV4 at age 11–12 years and at age 13–18 years if not previously vaccinated. MPSV4 is an acceptable alternative.
- Administer MCV4 to previously unvaccinated college freshmen living in dormitories.
- MCV4 is recommended for children aged 2–10 years with terminal complement deficiencies or anatomic or functional asplenia and certain other high-risk groups.
- Persons who received MPSV4 3 or more years previously and remain at increased risk for meningococcal disease should be vaccinated with MCV4.

4. Pneumococcal polysaccharide vaccine (PPV).
- Administer PPV to certain high-risk groups.

5. Influenza vaccine.
- Administer annually to all close contacts of children aged 0–59 months.
- Administer annually to persons with certain risk factors, health-care workers, and other persons (including household members) in close contact with persons in groups at higher risk.
- Administer 2 doses (separated by 4 weeks or longer) to children younger than 9 years who are receiving influenza vaccine for the first time or who were vaccinated for the first time last season but only received one dose.
- For healthy nonpregnant persons (those who do not have underlying medical conditions that predispose them to influenza complications) ages 2–49 years, either LAIV or TIV may be used.

6. Hepatitis A vaccine (HepA).
- Administer 2 doses in the series at least 6 months apart.
- HepA is recommended for certain other groups of children, including in areas where vaccination programs target older children.

7. Hepatitis B vaccine (HepB).
- Administer the 3-dose series to those who were not previously vaccinated.
- A 2-dose series of Recombivax HB® is licensed for children aged 11–15 years.

8. Inactivated poliovirus vaccine (IPV).
- For children who received an all-IPV or all-oral poliovirus (OPV) series, a fourth dose is not necessary if the third dose was administered at age 4 years or older.
- If both OPV and IPV were administered as part of a series, a total of 4 doses should be administered, regardless of the child's current age.

9. Measles, mumps, and rubella vaccine (MMR).
- If not previously vaccinated, administer 2 doses of MMR during any visit, with 4 or more weeks between the doses.

10. Varicella vaccine.
- Administer 2 doses of varicella vaccine to persons younger than 13 years of age at least 3 months apart. Do not repeat the second dose if administered 28 or more days following the first dose.
- Administer 2 doses of varicella vaccine to persons aged 13 years or older at least 4 weeks apart.

Catchup Schedule Footnotes

1. Hepatitis B vaccine (HepB).
- Administer the 3-dose series to those who were not previously vaccinated.
- A 2-dose series of Recombivax HB® is licensed for children aged 11–15 years.

2. Rotavirus vaccine (Rota).
- Do not start the series later than age 12 weeks.
- Administer the final dose in the series by age 32 weeks.
- Do not administer a dose later than age 32 weeks.
- Data on safety and efficacy outside of these age ranges are insufficient.

3. Diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP).
- The fifth dose is not necessary if the fourth dose was administered at age 4 years or older.
- DTaP is not indicated for persons aged 7 years or older.

4. Haemophilus influenzae type b conjugate vaccine (Hib).
- Vaccine is not generally recommended for children aged 5 years or older.
- If current age is younger than 12 months and the first 2 doses were PRP-OMP (PedvaxHIB® or ComVax® [Merck]), the third (and final) dose should be administered at age 12–15 months and at least 8 weeks after the second dose.
- If first dose was administered at age 7–11 months, administer 2 doses separated by 4 weeks plus a booster at age 12–15 months.

5. Pneumococcal conjugate vaccine (PCV).
- Administer one dose of PCV to all healthy children aged 24–59 months having any incomplete schedule.
- For children with underlying medical conditions, administer 2 doses of PCV at least 8 weeks apart if previously received less than 3 doses, or 1 dose of PCV if previously received 3 doses.

6. Inactivated poliovirus vaccine (IPV).
- For children who received an all-IPV or all-oral poliovirus (OPV) series, a fourth dose is not necessary if third dose was administered at age 4 years or older.
- If both OPV and IPV were administered as part of a series, a total of 4 doses should be administered, regardless of the child's current age.
- IPV is not routinely recommended for persons aged 18 years and older.

7. Measles, mumps, and rubella vaccine (MMR).
- The second dose of MMR is recommended routinely at age 4–6 years but may be administered earlier if desired.
- If not previously vaccinated, administer 2 doses of MMR during any visit with≥4 or more weeks between the doses.

8. Varicella vaccine.
- The second dose of varicella vaccine is recommended routinely at age 4–6 years but may be administered earlier if desired.
- Do not repeat the second dose in persons younger than 13 years of age if administered 28 or more days after the first dose.

9. Hepatitis A vaccine (HepA).
- HepA is recommended for certain groups of children, including in areas where vaccination programs target older children. See MMWR 2006;55(No. RR-7):1–23.

10. Tetanus and diphtheria toxoids vaccine (Td) and tetanus and diphtheria toxoids and acellular pertussis vaccine (Tdap).
- Tdap should be substituted for a single dose of Td in the primary catch-up series or as a booster if age appropriate; use Td for other doses.
- A 5-year interval from the last Td dose is encouraged when Tdap is used as a booster dose. A booster (fourth) dose is needed if any of the previous doses were administered at younger than 12 months of age. Refer to ACIP recommendations for further information. See MMWR 2006;55(No. RR-3).

11. Human papillomavirus vaccine (HPV).
- Administer the HPV vaccine series to females at age 13–18 years if not previously vaccinated.

Adult

1. Tetanus, diphtheria, and acellular pertussis (Td/Tdap) vaccination

Tdap should replace a single dose of Td for adults aged <65 years who have not previously received a dose of Tdap. Only one of two Tdap products (Adacel®[sanofi pasteur]) is licensed for use in adults. Adults with uncertain histories of a complete primary vaccination series with tetanus and diphtheria toxoid–containing vaccines should begin or complete a primary vaccination series. A primary series for adults is 3 doses of tetanus and diphtheria toxoid–containing vaccines; administer the first 2 doses at least 4 weeks apart and the third dose 6–12 months after the second. However, Tdap can substitute for any one of the doses of Td in the 3-dose primary series. The booster dose of tetanus and diphtheria toxoid–containing vaccine should be administered to adults who have completed a primary series and if the last vaccination was received ≥10 years previously. Tdap or Td vaccine may be used, as indicated. If the person is pregnant and received the last Td vaccination ≥10 years previously, administer Td during the second or third trimester; if the person received the last Td vaccination in <10 years, administer Tdap during the immediate postpartum period. A one-time administration of 1 dose of Tdap with an interval as short as 2 years from a previous Td vaccination is recommended for postpartum women, close contacts of infants aged <12 months, and all health-care workers with direct patient contact. In certain situations, Td can be deferred during pregnancy and Tdap substituted in the immediate postpartum period, or Tdap can be administered instead of Td to a pregnant woman after an informed discussion with the woman. Consult the ACIP statement for recommendations for administering Td as prophylaxis in wound management.

2. Human papillomavirus (HPV) vaccination

HPV vaccination is recommended for all females aged ≤26 years who have not completed the vaccine series. History of genital warts, abnormal Papanicolaou test, or positive HPV DNA test is not evidence of prior infection with all vaccine HPV types; HPV vaccination is still recommended for these persons. Ideally, vaccine should be administered before potential exposure to HPV through sexual activity; however, females who are sexually active should still be vaccinated. Sexually active females who have not been infected with any of the HPV vaccine types receive the full benefit of the vaccination. Vaccination is less beneficial for females who have already been infected with one or more of the HPV vaccine types. A complete series consists of 3 doses. The second dose should be administered 2 months after the first dose; the third dose should be administered 6 months after the first dose. Although HPV vaccination is not specifically recommended for females with the medical indications described in Figure 2, "Vaccines that might be indicated for adults based on medical and other indications," it is not a live-virus vaccine and can be administered. However, immune response and vaccine efficacy might be less than in persons who do not have the medical indications described or who are immunocompetent.

3. Measles, mumps, rubella (MMR) vaccination

Measles component: Adults born before 1957 can be considered immune to measles. Adults born during or after 1957 should receive ≥1 dose of MMR unless they have a medical contraindication, documentation of ≥1 dose, history of measles based on health-care provider diagnosis, or laboratory evidence of immunity. A second dose of MMR is recommended for adults who 1) have been recently exposed to measles or are in an outbreak setting; 2) have been previously vaccinated with killed measles vaccine; 3) have been vaccinated with an unknown type of measles vaccine during 1963–1967; 4) are students in postsecondary educational institutions; 5) work in a health-care facility; or 6) plan to travel internationally. Mumps component: Adults born before 1957 can generally be considered immune to mumps. Adults born during or after 1957 should receive 1 dose of MMR unless they have a medical contraindication, history of mumps based on health-care provider diagnosis, or laboratory evidence of immunity. A second dose of MMR is recommended for adults who 1) are in an age group that is affected during a mumps outbreak; 2) are students in postsecondary educational institutions; 3) work in a health-care facility; or 4) plan to travel internationally. For unvaccinated health-care workers born before 1957 who do not have other evidence of mumps immunity, consider administering 1 dose on a routine basis and strongly consider administering a second dose during an outbreak. Rubella component: Administer 1 dose of MMR vaccine to women whose rubella vaccination history is unreliable or who lack laboratory evidence of immunity. For women of childbearing age, regardless of birth year, routinely determine rubella immunity and counsel women regarding congenital rubella syndrome. Women who do not have evidence of immunity should receive MMR vaccine upon completion or termination of pregnancy and before discharge from the health-care facility.

4. Varicella vaccination

All adults without evidence of immunity to varicella should receive 2 doses of single-antigen varicella vaccine unless they have a medical contraindication. Special consideration should be given to those who 1) have close contact with persons at high risk for severe disease (e.g., health-care personnel and family contacts of immunocompromised persons) or 2) are at high risk for exposure or transmission (e.g., teachers; child care employees; residents and staff members of institutional settings, including correctional institutions; college students; military personnel; adolescents and adults living in households with children; nonpregnant women of childbearing age; and international travelers). Evidence of immunity to varicella in adults includes any of the following: 1) documentation of 2 doses of varicella vaccine at least 4 weeks apart; 2) U.S.-born before 1980 (although for health-care personnel and pregnant women birth before 1980 should not be considered evidence of immunity); 3) history of varicella based on diagnosis or verification of varicella by a health-care provider (for a patient reporting a history of or presenting with an atypical case, a mild case, or both, health-care providers should seek either an epidemiologic link with a typical varicella case or to a laboratory-confirmed case or evidence of laboratory confirmation, if it was performed at the time of acute disease); 4) history of herpes zoster based on health-care provider diagnosis; or 5) laboratory evidence of immunity or laboratory confirmation of disease. Assess pregnant women for evidence of varicella immunity. Women who do not have evidence of immunity should receive the first dose of varicella vaccine upon completion or termination of pregnancy and before discharge from the health-care facility. The second dose should be administered 4–8 weeks after the first dose.

5. Influenza vaccination

Medical indications: Chronic disorders of the cardiovascular or pulmonary systems, including asthma; chronic metabolic diseases, including diabetes mellitus, renal or hepatic dysfunction, hemoglobinopathies, or immunosuppression (including immunosuppression caused by medications or human immunodeficiency virus [HIV]); any condition that compromises respiratory function or the handling of respiratory secretions or that can increase the risk of aspiration (e.g., cognitive dysfunction, spinal cord injury, or seizure disorder or other neuromuscular disorder); and pregnancy during the influenza season. No data exist on the risk for severe or complicated influenza disease among persons with asplenia; however, influenza is a risk factor for secondary bacterial infections that can cause severe disease among persons with asplenia. Occupational indications: Health-care personnel and employees of long-term care and assisted-living facilities. Other indications: Residents of nursing homes and other long-term care and assisted-living facilities; persons likely to transmit influenza to persons at high risk (e.g., in-home household contacts and

caregivers of children aged 0–59 months, or persons of all ages with high-risk conditions); and anyone who would like to be vaccinated. Healthy, nonpregnant adults aged ≤49 years without high-risk medical conditions who are not contacts of severely immunocompromised persons in special care units can receive either intranasally administered live, attenuated influenza vaccine (FluMist®) or inactivated vaccine. Other persons should receive the inactivated vaccine.

6. Pneumococcal polysaccharide vaccination

Medical indications: Chronic pulmonary disease (excluding asthma); chronic cardiovascular diseases; diabetes mellitus; chronic liver diseases, including liver disease as a result of alcohol abuse (e.g., cirrhosis); chronic alcoholism, chronic renal failure or nephrotic syndrome; functional or anatomic asplenia (e.g., sickle cell disease or splenectomy [if elective splenectomy is planned, vaccinate at least 2 weeks before surgery]); immunosuppressive conditions; and cochlear implants and cerebrospinal fluid leaks. Vaccinate as close to HIV diagnosis as possible. Other indications: Alaska Natives and certain American Indian populations and residents of nursing homes or other long-term care facilities.

7. Revaccination with pneumococcal polysaccharide vaccine

One-time revaccination after 5 years for persons with chronic renal failure or nephrotic syndrome; functional or anatomic asplenia (e.g., sickle cell disease or splenectomy); or immunosuppressive conditions. For persons aged ≥65 years, one-time revaccination if they were vaccinated ≥5 years previously and were aged <65 years at the time of primary vaccination.

8. Hepatitis A vaccination

Medical indications: Persons with chronic liver disease and persons who receive clotting factor concentrates. Behavioral indications: Men who have sex with men and persons who use illegal drugs. Occupational indications: Persons working with hepatitis A virus (HAV)–infected primates or with HAV in a research laboratory setting. Other indications: Persons traveling to or working in countries that have high or intermediate endemicity of hepatitis A (a list of countries is available at wwwn.cdc.gov/travel/contentdiseases.aspx) and any person seeking protection from HAV infection. Single-antigen vaccine formulations should be administered in a 2-dose schedule at either 0 and 6–12 months (Havrix®), or 0 and 6–18 months (Vaqta®). If the combined hepatitis A and hepatitis B vaccine (Twinrix®) is used, administer 3 doses at 0, 1, and 6 months.

9. Hepatitis B vaccination

Medical indications: Persons with end-stage renal disease, including patients receiving hemodialysis; persons seeking evaluation or treatment for a sexually transmitted disease (STD); persons with HIV infection; and persons with chronic liver disease. Occupational indications: Health-care personnel and public-safety workers who are exposed to blood or other potentially infectious body fluids. Behavioral indications: Sexually active persons who are not in a long-term, mutually monogamous relationship (e.g., persons with more than 1 sex partner during the previous 6 months); current or recent injection-drug users; and men who have sex with men. Other indications: Household contacts and sex partners of persons with chronic hepatitis B virus (HBV) infection; clients and staff members of institutions for persons with developmental disabilities; international travelers to countries with high or intermediate prevalence of chronic HBV infection (a list of countries is available at wwwn.cdc.gov/travel/contentdiseases.aspx); and any adult seeking protection from HBV infection. Settings where hepatitis B vaccination is recommended for all adults: STD treatment facilities; HIV testing and treatment facilities; facilities providing drug-abuse treatment and prevention services; health-care settings targeting services to injection-drug users or men who have sex with men; correctional facilities; end-stage renal disease programs and facilities for chronic hemodialysis patients; and institutions and nonresidential daycare facilities for persons with developmental disabilities. Special formulation indications: For adult patients receiving hemodialysis and other immunocompromised adults, 1 dose of 40 µg/mL (Recombivax HB®), or 2 doses of 20 µg/mL (Engerix-B®) administered simultaneously.

10. Meningococcal vaccination

Medical indications: Adults with anatomic or functional asplenia, or terminal complement component deficiencies. Other indications: First-year college students living in dormitories; microbiologists who are routinely exposed to isolates of Neisseria meningitidis; military recruits; and persons who travel to or live in countries in which meningococcal disease is hyperendemic or epidemic (e.g., the "meningitis belt" of sub-Saharan Africa during the dry season [December–June]), particularly if their contact with local populations will be prolonged. Vaccination is required by the government of Saudi Arabia for all travelers to Mecca during the annual Hajj. Meningococcal conjugate vaccine is preferred for adults with any of the preceding indications who are aged ≤55 years, although meningococcal polysaccharide vaccine (MPSV4) is an acceptable alternative. Revaccination after 3–5 years might be indicated for adults previously vaccinated with MPSV4 who remain at increased risk for infection (e.g., persons residing in areas in which disease is epidemic).

11. Herpes zoster vaccination

A single dose of zoster vaccine is recommended for adults aged ≥60 years regardless of whether they report a prior episode of herpes zoster. Persons with chronic medical conditions may be vaccinated unless a contraindication or precaution exists for their condition.

12. Selected conditions for which *Haemophilus influenzae* type b (Hib) vaccine may be used

Hib conjugate vaccines are licensed for children aged 6 weeks–71 months. No efficacy data are available on which to base a recommendation concerning use of Hib vaccine for older children and adults with the chronic conditions associated with an increased risk for Hib disease. However, studies suggest good immunogenicity in patients who have sickle cell disease, leukemia, or HIV infection or who have had splenectomies; administering vaccine to these patients is not contraindicated.

13. Immunocompromising conditions

Inactivated vaccines are generally acceptable (e.g., pneumococcal, meningococcal, and influenza [trivalent inactivated influenza vaccine]), and live vaccines generally are avoided in persons with immune deficiencies or immune suppressive conditions. Information on specific conditions is available at www.cdc.gov/vaccines/pubs/acip-list.htm.

2007 NCIRD Publications

Peer-reviewed Scientific Journals

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Notes