

UNIT NO. 4

ADULT VACCINATION UPDATE 2014

Dr Wong Sin Yew

ABSTRACT

Adult vaccination should no longer be considered a luxury for developed countries. Instead, we must view how lifelong immunisation can have an important public health role in reducing vaccine preventable diseases and their sequelae. In Singapore, we do not have an “official” adult immunisation schedule and many of the references and recommendations that I will discuss come from the United States where such recommendations have been in existence for many years. Travel vaccinations are being considered in a separate article in this series. The “routine” adult vaccinations are against: Influenza, pneumococcal infection, tetanus, diphtheria, pertussis, varicella zoster, human papilloma virus, measles, mumps, and rubella.

Keywords:

Influenza, pneumococcal infection, tetanus, diphtheria, pertussis, varicella zoster, human papilloma virus, measles, mumps, rubella

SFP2014; 40(1): 27-32

INTRODUCTION

National immunisation programmes in Singapore and many other developed countries have traditionally been aimed at infants and children. These programmes have been successful in increasing vaccine coverage and conferring herd immunity, dramatically reducing the incidence of many diseases such as tetanus, measles, mumps, rubella, tuberculosis, Hepatitis B etc. Introduction of newer vaccines including conjugated Haemophilus influenza B, conjugated pneumococcal and more recently, Human Papilloma Virus vaccines have further reduced the burden of infectious diseases in the community. Most will agree that adult immunisation has been underutilised as a public health measure and that vaccinations should now be recommended throughout life to prevent vaccine preventable diseases and their sequelae.

Vaccines are recommended for adults on the following basis:

- Age.
- Prior vaccination status/history.
- Health condition.
- Lifestyle.
- Occupation.
- Travel destination.

WONG SIN YEW, Director and Infectious Disease Physician, Infectious Disease Specialists®

In this article, we will focus on the “routine” adult vaccines that family practitioners can incorporate in their practice. In Singapore, we do not have an “official” adult immunisation schedule and many of the references and recommendations that I will discuss come from the United States where such recommendations have been in existence for many years. Please refer to the Recommended Adult Immunization Schedule for United States 2014 at the website of the Centres for Disease Control and Prevention (CDC) for details. This has also been reproduced in the Annex to this paper. Travel vaccinations are being considered in a separate article in this series. Whilst there are many reasons why vaccine coverage in adults is low, the recommendation by family physicians and other health care providers is a strong motivator for patients to receive their recommended vaccines. We encourage assessing gaps in vaccine needs for adults as an important opportunity for family physicians to enhance their doctor-patient relationship.

INFLUENZA

Recommendations: All adults annually

Routine annual influenza vaccinations have been advocated for many years. The indications have been broadened so extensively that any person above the age of 6 months should possibly receive the influenza vaccine on an annual basis! For the 2012-2013 influenza season in the United States and taking into consideration the current vaccine coverage, it has been estimated by the Centres for Disease Control and Prevention that influenza vaccination resulted in 79,000 less hospitalisations, 6.6 million less influenza illnesses and 3.2 million less medically related attendances. These figures are obviously significant! In Singapore, there were 773,139 attendances for acute respiratory infections (ARI) seen at the polyclinics in 2012. Approximately 45.8% to 65.5% of these ARI were due to influenza. If you extrapolate the US results to Singapore, we could certainly reduce our outpatient attendances and hospitalisations for respiratory infections with influenza vaccination.

In the past 2 years, there have been interesting new formulations that may allow us to improve our fight against influenza. Recombinant influenza vaccines (RIV) have been registered in numerous countries and we expect this to be available in Singapore in the near future. The main advantage of RIV is that it does not contain egg protein and it can be safely administered in those who have egg allergy. Quadrivalent Influenza vaccines (QIV) have also become available and the additional B strain in the QIV will ensure that the almost 90% of the circulating influenza B strains are covered. It is important

to highlight that in Singapore, influenza B strains predominated and were more common than influenza A strains in the first half of 2012. Several vaccine companies have registered QIV in the US and we expect them to enter the local market soon.

PNEUMOCOCCAL INFECTION

Recommendations: 1 or 2 doses in adulthood. Recommended for adults aged >65 years, younger if they have underlying medical conditions that put them at risk for pneumococcal disease.

Adult pneumococcal disease has been a persistent health problem that should lend itself to vaccine intervention. There are 2 formulations of pneumococcal vaccine licensed in Singapore for use in adults ie conjugate pneumococcal 13 valent vaccine (PCV 13) and pneumococcal polysaccharide 23 valent vaccine (PPV 23). The indications for use are for all adults above aged 65 years and younger for those with underlying diseases including cardiovascular and respiratory diseases. In the US, approximately 60% of adults >65 years have received pneumococcal vaccination, whereas only 20% of adults between the ages 19 years to 64 years who were at high risk for pneumococcal disease received the vaccine. Prevention of pneumococcal disease got a huge boost in Singapore as deduction through Medisave is now allowed for adults taking pneumococcal vaccines. We await official announcement of the latest trial on PCV13 in the prevention of community acquired pneumonia.

TETANUS DIPHTHERIA AND ACCELLULAR PERTUSSIS (TD or TDap)

Recommendations: TD once every 10 years and substitute TDap once for Td booster

After the primary series of 5 doses in childhood, these vaccines should be administered once every 10 years. In the past, the focus was administration of tetanus and/or diphtheria (DT). However, pertussis has become a re-emerging infection recently because of waning immunity in adults. The current recommendation is that adults should have 1 dose of TDap (tetanus, diphtheria and acellular pertussis) in place of the DT booster. Thereafter, only DT needs to be given every 10 years.

VARICELLA ZOSTER

Recommendations: For varicella, 2 doses for all in adulthood if not done in childhood. For persons >60 years, one dose of zoster vaccine

Before varicella infection was taken off mandatory infectious disease notification in Singapore, approximately 20,000 cases of varicella were reported cases annually. We expect the number

of cases to have reduced markedly from increased awareness and introduction of the varicella vaccine. In 2012, there were 4766 polyclinic attendances for treatment of chickenpox. Approximately 1/3 of them were in persons aged 20 years and older. It is likely that we continue to have more than a thousand cases of varicella in adults annually in Singapore. For those who did not receive childhood vaccination with varicella, they should do so in adulthood with 2 doses at least 2 months apart.

In light of our aging population, we expect to see more cases of zoster infection. Zoster vaccine has been registered in Singapore since 2013. Increasing awareness of the morbidity of zoster has prompted more of the elderly population to come forward for the vaccine. In the US, approximately 20% of adults > 60 years of age had received zoster vaccination in 2012.

HUMAN PAPILLOMA VIRUS

Recommendations: 3 dose schedule for all females from ages 9-10 years up to 26 years

There are 2 vaccines against HPV licensed for use in females, the bivalent (HPV2) and the quadrivalent (HPV4). For females, a 3 dose series is recommended from ages 9-10 years until 25-26 years. The costs of HPV vaccines are claimable through Medisave. The HP4 is registered for use in males aged 9 years to 26 years. Australia has recently reported their experience with the roll out of HPV vaccine. Since 2007, 3 dose HPV vaccine coverage was >77% in the 12-13 age group and there was significant reduction (>77%) in HPV vaccine related infections in vaccine eligible females, >90% reduction in genital warts and reduction in high grade cervical lesions in this age group. These results are indeed remarkable and will hopefully be replicated in other countries including Singapore.

HEPATITIS VACCINES

Recommendations: Hepatitis B: all adults with 3 dose schedule if not done in childhood. Hepatitis A: 2 dose vaccine for all adults. Hepatitis A and B co-formulation (Twinrix) requires a 3 dose schedule for adults.

Routine childhood hepatitis B vaccine was incorporated into our national childhood immunisation programme since 1987. Seroprevalence data in 2010 has shown reduction in anti-HBc and HBsAg compared to other surveys in 2004 and 1996. In addition, there has been reduction in age specific incidence of hepatocellular carcinoma in Singapore. There continue to be a small group of adults who have yet to be vaccinated. In Singapore, 58 cases of acute hepatitis B were notified in 2012 (compared with 73 cases in 2011).

Hepatitis A vaccination is strongly advised in view of the high endemicity of Hepatitis A in the region. In 2012, there were 108 cases of acute hepatitis A notified compared with 66 cases in 2011. We also continue to have cases of acute hepatitis

A acquired “locally”. It is estimated that 59% of acute hepatitis A were acquired overseas whilst the rest were “local”. In the US, only 12% of the adult population between the ages of 19 years to 49 years have received vaccination against Hepatitis A.

MEASLES, MUMPS, RUBELLA VACCINE

Some of the older adults were only vaccinated with one dose of MMR vaccine in childhood. In Singapore 2 doses of MMR vaccine have been made compulsory since 1998. In the past 10 years, industrialised countries continue to report episodic outbreaks of measles and mumps. In the United States, for the first 8 months of 2013, there were 159 cases of measles reported and 92% of these cases had not received prior vaccination. 79% of those who were unvaccinated cited philosophical reasons for declining measles immunisation. In 2012, there were 38 cases of measles, 64 cases of rubella and 521 cases of mumps reported in Singapore.

CONCLUSION

Adult vaccination should no longer be considered a luxury for developed countries. Instead, we must view how lifelong immunisation can have an important public health role in reducing vaccine preventable diseases and their sequelae.

Despite having well established recommendations for adult immunisation in the US, vaccine coverage varies considerably and in some instances may be as low as 12%! Clearly, we can do much better by assessing and engaging our patients to help narrow their immunisation gaps.

ACKNOWLEDGEMENTS

The reproduction of the Recommended Adult Immunisation Schedule – United States 2014 in the Annex to this paper is acknowledged with thanks to the US Department of Health and Human Services.

REFERENCES

1. Johnson DR, Nichol KL, Lipczynski. Barriers to adult immunization. *Am J Med* 2008;121:S28-35. doi:10.1016/j.amjmed.2008.05.005.
2. Tan TQ, Bhattacharya L, Gerbie MV. Awareness, perceptions and knowledge of recommended adult vaccines among a nationwide sample of adult primary care providers. *J Reprod Med* 2011;56:301-7.
3. Bridges CB, Coyne-Beasley T. Advisory Committee on Immunization Practices Recommended Immunization Schedule for Adults Aged 19 years or older: United States 2014. *Ann Int Med* 2014;160:190-8. doi:10.7326/M13-2826.
4. Communicable Diseases Surveillance Report 2012. Ministry of Health.
5. Williams WW, Lu PJ, O'Halloran A et al. Non-influenza vaccination coverage among adults – US 2012. *MMWR Morb Mortal Wkly Report* 2014 Feb 7;63(5):95-102.
6. Garland SM. The Australian experience with HPV Vaccine. *Clin Ther* 2014;36:17-23.

LEARNING POINTS

- **Adult vaccination should no longer be considered a luxury but viewed as lifelong immunisation that play an important public health role in reducing vaccine preventable diseases and their sequelae.**
- **In Singapore, we do not have an “official” adult immunisation schedule and many of the references and recommendations come from the United States where such recommendations have been in existence for many years.**
- **Travel vaccinations are being considered in a separate article in this series.**
- **The “routine” vaccinations of recommended to Singapore adults are vaccinations against:**
 - **Influenza - annually**
 - **Pneumococcal infection - 1 or 2 doses in adulthood. Recommended for adults aged >65 years, younger if they have underlying medical conditions that put them at risk for pneumococcal disease.**
 - **Tetanus Diphtheria and Pertussis (TD or Tdap) - TD once every 10 years and substitute Tdap once for Td booster**
 - **Varicella Zoster - 2 doses for all in adulthood if not done in childhood. For persons >60 years, one dose of zoster vaccine**
 - **Human Papilloma Virus - 3 dose schedule for all females from ages 9-10 years up to 26 years**
 - **Measles Mumps and Rubella (MMR) - 2 doses (at least 1 month apart) for adults if not done in childhood**
 - **Hepatitis Vaccines - 3 dose schedule if not done in childhood. Hepatitis A: 2 dose vaccine for all adults. Hepatitis A and B co-formulation (Twinrix) requires a 3 dose schedule for adults.**

ANNEX 1: RECOMMENDED ADULT IMMUNIZATION SCHEDULE FOR UNITED STATES 2014

Recommended Adult Immunization Schedule—United States - 2014

Note: These recommendations must be read with the footnotes that follow containing number of doses, intervals between doses, and other important information.

Figure 1. Recommended adult immunization schedule, by vaccine and age group¹

VACCINE ▼	AGE GROUP ►	19-21 years	22-26 years	27-49 years	50-59 years	60-64 years	≥ 65 years
Influenza ^{2,*}		1 dose annually					
Tetanus, diphtheria, pertussis (Td/Tdap) ^{4,*}		Substitute 1-time dose of Tdap for Td booster; then boost with Td every 10 yrs					
Varicella ^{4,*}		2 doses					
Human papillomavirus (HPV) Female ^{1,*}		3 doses					
Human papillomavirus (HPV) Male ^{5,*}		3 doses					
Zoster ⁵						1 dose	
Measles, mumps, rubella (MMR) ^{7,*}		1 or 2 doses					
Pneumococcal 13-valent conjugate (PCV13) ^{8,*}		1 dose					
Pneumococcal polysaccharide (PPSV23) ^{8,10}		1 or 2 doses					1 dose
Meningococcal ^{11,*}		1 or more doses					
Hepatitis A ^{12,*}		2 doses					
Hepatitis B ^{13,*}		3 doses					
Haemophilus influenzae type b (Hib) ^{14,*}		1 or 3 doses					

¹Covered by the Vaccine Injury Compensation Program

-  For all persons in this category who meet the age requirements and who lack documentation of vaccination or have no evidence of previous infection; zoster vaccine recommended regardless of prior episode of zoster
-  Recommended if some other risk factor is present (e.g., on the basis of medical, occupational, lifestyle, or other indication)
-  No recommendation

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, 8:00 a.m. - 8:00 p.m. Eastern Time, Monday - Friday, excluding holidays.

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.

The recommendations in this schedule were approved by the Centers for Disease Control and Prevention's (CDC) Advisory Committee on Immunization Practices (ACIP), the American Academy of Family Physicians (AAFP), the American College of Physicians (ACP), American College of Obstetricians and Gynecologists (ACOG) and American College of Nurse-Midwives (ACNM).

Figure 2. Vaccines that might be indicated for adults based on medical and other indications¹

VACCINE ▼	INDICATION ►	Pregnancy	Immuno-compromising conditions (excluding human immunodeficiency virus (HIV)) ^{1,6,7,8,15}	HIV infection CD4+ T lymphocyte count ^{4,6,7,8,15}	Men who have sex with men (MSM)	Kidney failure, end-stage renal disease, receipt of hemodialysis	Heart disease, chronic lung disease, chronic alcoholism	Asplenia (including elective splenectomy and persistent complement component deficiencies) ^{8,14}	Chronic liver disease	Diabetes	Healthcare personnel
Influenza ^{2,3}			1 dose IIV annually	< 200 cells/μL	≥ 200 cells/μL	1 dose IIV or LAIV annually	1 dose IIV annually				1 dose IIV or LAIV annually
Tetanus, diphtheria, pertussis (Td/Tdap) ^{4,5}		1 dose Tdap each pregnancy	Substitute 1-time dose of Tdap for Td booster; then boost with Td every 10 yrs								
Varicella ^{6,7}		Contraindicated					2 doses				
Human papillomavirus (HPV) Female ^{8,9}			3 doses through age 26 yrs				3 doses through age 26 yrs				
Human papillomavirus (HPV) Male ^{8,9}			3 doses through age 26 yrs				3 doses through age 21 yrs				
Zoster ⁶		Contraindicated					1 dose				
Measles, mumps, rubella (MMR) ^{7,10}		Contraindicated					1 or 2 doses				
Pneumococcal 13-valent conjugate (PCV13) ^{8,11}							1 dose				
Pneumococcal polysaccharide (PPSV23) ^{9,10}							1 or 2 doses				
Meningococcal ^{11,12}							1 or more doses				
Hepatitis A ^{12,13}							2 doses				
Hepatitis B ^{13,14}							3 doses				
Haemophilus influenzae type b (Hib) ^{14,15}			post-RSCT recipients only				1 or 3 doses				

¹Covered by the Vaccine Injury Compensation Program

 For all persons in this category who meet the age requirements and who lack documentation of vaccination or have no evidence of previous infection; zoster vaccine recommended regardless of prior episode of zoster

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

 No recommendation



U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

These schedules indicate the recommended age groups and medical indications for which administration of currently licensed vaccines is commonly indicated for adults ages 19 years and older, as of February 1, 2014. For all vaccines being recommended on the Adult Immunization Schedule, a vaccine series does not need to be restarted, regardless of the time that has elapsed between doses. 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 (www.cdc.gov/vaccines/hcp/acip-recs/index.html). 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.

Footnotes

Recommended Immunization Schedule for Adults Aged 19 Years or Older: United States, 2014

1. Additional information

- Additional guidance for the use of the vaccines described in this supplement is available at www.cdc.gov/vaccines/hcp/acip-recs/index.html.
- Information on vaccination recommendations when vaccination status is unknown and other general immunization information can be found in the General Recommendations on Immunization at www.cdc.gov/mmwr/preview/mmwrhtml/r6002a1.htm.
- Information on travel vaccine requirements and recommendations (e.g., for hepatitis A and B, meningococcal, and other vaccines) is available at <http://wwwnc.cdc.gov/travel/destinations/list>.
- Additional information and resources regarding vaccination of pregnant women can be found at <http://www.cdc.gov/vaccines/adults/rec-vac/pregnant.html>.

2. Influenza vaccination

- Annual vaccination against influenza is recommended for all persons aged 6 months or older.
- Persons aged 6 months or older, including pregnant women and persons with hives-only allergy to eggs, can receive the inactivated influenza vaccine (IIV). An age-appropriate IIV formulation should be used.
- Adults aged 18 to 49 years can receive the recombinant influenza vaccine (RIV) (FluBlok). RIV does not contain any egg protein.
- Healthy, nonpregnant persons aged 2 to 49 years without high-risk medical conditions can receive either intranasally administered live, attenuated influenza vaccine (LAIV) (FluMist), or IIV. Health care personnel who care for severely immunocompromised persons (i.e., those who require care in a protected environment) should receive IIV or RIV rather than LAIV.
- The intramuscularly or intradermally administered IIV are options for adults aged 18 to 64 years.
- Adults aged 65 years or older can receive the standard-dose IIV or the high-dose IIV (Fluzone High-Dose).

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

- Administer 1 dose of Tdap vaccine to pregnant women during each pregnancy (preferred during 27 to 36 weeks' gestation) regardless of interval since prior Td or Tdap vaccination.
- Persons aged 11 years or older who have not received Tdap vaccine or for whom vaccine status is unknown should receive a dose of Tdap followed by tetanus and diphtheria toxoids (Td) booster doses every 10 years thereafter. Tdap can be administered regardless of interval since the most recent tetanus or diphtheria-toxoid containing vaccine.
- Adults with an unknown or incomplete history of completing a 3-dose primary vaccination series with Td-containing vaccines should begin or complete a primary vaccination series including a Tdap dose.
- For unvaccinated adults, administer the first 2 doses at least 4 weeks apart and the third dose 6 to 12 months after the second.
- For incompletely vaccinated (i.e., less than 3 doses) adults, administer remaining doses.
- Refer to the ACIP statement for recommendations for administering Td/Tdap as prophylaxis in wound management (see footnote 1).

4. Varicella vaccination

- All adults without evidence of immunity to varicella (as defined below) should receive 2 doses of single-antigen varicella vaccine or a second dose if they have received only 1 dose.
- Vaccination should be emphasized for those who have close contact with persons at high risk for severe disease (e.g., health care personnel and family contacts of persons with immunocompromising conditions) or 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).
- Pregnant women should be assessed 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 to 8 weeks after the first dose.
- Evidence of immunity to varicella in adults includes any of the following:
 - documentation of 2 doses of varicella vaccine at least 4 weeks apart;
 - U.S.-born before 1980, except health care personnel and pregnant women;
 - history of varicella based on diagnosis or verification of varicella disease by a health care provider;
 - history of herpes zoster based on diagnosis or verification of herpes zoster disease by a health care provider; or
 - laboratory evidence of immunity or laboratory confirmation of disease.

5. Human papillomavirus (HPV) vaccination

- Two vaccines are licensed for use in females, bivalent HPV vaccine (HPV2) and quadrivalent HPV vaccine (HPV4), and one HPV vaccine for use in males (HPV4).
- For females, either HPV4 or HPV2 is recommended in a 3-dose series for routine vaccination at age 11 or 12 years and for those aged 13 through 26 years, if not previously vaccinated.
- For males, HPV4 is recommended in a 3-dose series for routine vaccination at age 11 or 12 years and for those aged 13 through 21 years, if not previously vaccinated. Males aged 22 through 26 years may be vaccinated.

5. Human papillomavirus (HPV) vaccination (cont'd)

- HPV4 is recommended for men who have sex with men through age 26 years for those who did not get any or all doses when they were younger.
- Vaccination is recommended for immunocompromised persons (including those with HIV infection) through age 26 years for those who did not get any or all doses when they were younger.
- A complete series for either HPV4 or HPV2 consists of 3 doses. The second dose should be administered 4 to 8 weeks (minimum interval of 4 weeks) after the first dose; the third dose should be administered 24 weeks after the first dose and 16 weeks after the second dose (minimum interval of at least 12 weeks).
- HPV vaccines are not recommended for use in pregnant women. However, pregnancy testing is not needed before vaccination. If a woman is found to be pregnant after initiating the vaccination series, no intervention is needed; the remainder of the 3-dose series should be delayed until completion of pregnancy.

6. Zoster vaccination

- A single dose of zoster vaccine is recommended for adults aged 60 years or older regardless of whether they report a prior episode of herpes zoster. Although the vaccine is licensed by the U.S. Food and Drug Administration for use among and can be administered to persons aged 50 years or older, ACIP recommends that vaccination begin at age 60 years.
- Persons aged 60 years or older with chronic medical conditions may be vaccinated unless their condition constitutes a contraindication, such as pregnancy or severe immunodeficiency.

7. Measles, mumps, rubella (MMR) vaccination

- Adults born before 1957 are generally considered immune to measles and mumps. All adults born in 1957 or later should have documentation of 1 or more doses of MMR vaccine unless they have a medical contraindication to the vaccine or laboratory evidence of immunity to each of the three diseases. Documentation of provider-diagnosed disease is not considered acceptable evidence of immunity for measles, mumps, or rubella.

Measles component:

- A routine second dose of MMR vaccine, administered a minimum of 28 days after the first dose, is recommended for adults who:
 - are students in postsecondary educational institutions;
 - work in a health care facility; or
 - plan to travel internationally.
- Persons who received inactivated (killed) measles vaccine or measles vaccine of unknown type during 1963–1967 should be revaccinated with 2 doses of MMR vaccine.

Mumps component:

- A routine second dose of MMR vaccine, administered a minimum of 28 days after the first dose, is recommended for adults who:
 - are students in a postsecondary educational institution;
 - work in a health care facility; or
 - plan to travel internationally.
- Persons vaccinated before 1979 with either killed mumps vaccine or mumps vaccine of unknown type who are at high risk for mumps infection (e.g., persons who are working in a health care facility) should be considered for revaccination with 2 doses of MMR vaccine.

Rubella component:

- For women of childbearing age, regardless of birth year, rubella immunity should be determined. If there is no evidence of immunity, women who are not pregnant should be vaccinated. Pregnant 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.
- *Health care personnel born before 1957:*
 - For unvaccinated health care personnel born before 1957 who lack laboratory evidence of measles, mumps, and/or rubella immunity or laboratory confirmation of disease, health care facilities should consider vaccinating personnel with 2 doses of MMR vaccine at the appropriate interval for measles and mumps or 1 dose of MMR vaccine for rubella.

8. Pneumococcal conjugate (PCV13) vaccination

- Adults aged 19 years or older with immunocompromising conditions (including chronic renal failure and nephrotic syndrome), functional or anatomic asplenia, cerebrospinal fluid leaks, or cochlear implants who have not previously received PCV13 or PPSV23 should receive a single dose of PCV13 followed by a dose of PPSV23 at least 8 weeks later.
- Adults aged 19 years or older with the aforementioned conditions who have previously received 1 or more doses of PPSV23 should receive a dose of PCV13 one or more years after the last PPSV23 dose was received. For adults who require additional doses of PPSV23, the first such dose should be given no sooner than 8 weeks after PCV13 and at least 5 years after the most recent dose of PPSV23.
- When indicated, PCV13 should be administered to patients who are uncertain of their vaccination status history and have no record of previous vaccination.
- Although PCV13 is licensed by the U.S. Food and Drug Administration for use among and can be administered to persons aged 50 years or older, ACIP recommends PCV13 for adults aged 19 years or older with the specific medical conditions noted above.

9. Pneumococcal polysaccharide (PPSV23) vaccination

- When PCV13 is also indicated, PCV13 should be given first (see footnote 8).
- Vaccinate all persons with the following indications:
 - all adults aged 65 years or older;
 - adults younger than 65 years with chronic lung disease (including chronic obstructive pulmonary disease, emphysema, and asthma), chronic cardiovascular diseases, diabetes mellitus, chronic renal failure, nephrotic syndrome, chronic liver disease (including cirrhosis), alcoholism, cochlear implants, cerebrospinal fluid leaks, immunocompromising conditions, and functional or anatomic asplenia (e.g., sickle cell disease and other hemoglobinopathies, congenital or acquired asplenia, splenic dysfunction, or splenectomy [if elective splenectomy is planned, vaccinate at least 2 weeks before surgery]);
 - residents of nursing homes or long-term care facilities; and
 - adults who smoke cigarettes.
- Persons with immunocompromising conditions and other selected conditions are recommended to receive PCV13 and PPSV23 vaccines. See footnote 8 for information on timing of PCV13 and PPSV23 vaccinations.
- Persons with asymptomatic or symptomatic HIV infection should be vaccinated as soon as possible after their diagnosis.
- When cancer chemotherapy or other immunosuppressive therapy is being considered, the interval between vaccination and initiation of immunosuppressive therapy should be at least 2 weeks. Vaccination during chemotherapy or radiation therapy should be avoided.
- Routine use of PPSV23 vaccine is not recommended for American Indians/Alaska Natives or other persons younger than 65 years unless they have underlying medical conditions that are PPSV23 indications. However, public health authorities may consider recommending PPSV23 for American Indians/Alaska Natives who are living in areas where the risk for invasive pneumococcal disease is increased.
- When indicated, PPSV23 vaccine should be administered to patients who are uncertain of their vaccination status and have no record of vaccination.

10. Revaccination with PPSV23

- One-time revaccination 5 years after the first dose of PPSV23 is recommended for persons aged 19 through 64 years with chronic renal failure or nephrotic syndrome, functional or anatomic asplenia (e.g., sickle cell disease or splenectomy), or immunocompromising conditions.
- Persons who received 1 or 2 doses of PPSV23 before age 65 years for any indication should receive another dose of the vaccine at age 65 years or later if at least 5 years have passed since their previous dose.
- No further doses of PPSV23 are needed for persons vaccinated with PPSV23 at or after age 65 years.

11. Meningococcal vaccination

- Administer 2 doses of quadrivalent meningococcal conjugate vaccine (MenACWY [Menactra, Menveo]) at least 2 months apart to adults of all ages with functional asplenia or persistent complement component deficiencies. HIV infection is not an indication for routine vaccination with MenACWY. If an HIV-infected person of any age is vaccinated, 2 doses of MenACWY should be administered at least 2 months apart.
- Administer a single dose of meningococcal vaccine to microbiologists routinely exposed to isolates of *Neisseria meningitidis*, military recruits, persons at risk during an outbreak attributable to a vaccine serogroup, and persons who travel to or live in countries in which meningococcal disease is hyperendemic or epidemic.
- First-year college students up through age 21 years who are living in residence halls should be vaccinated if they have not received a dose on or after their 16th birthday.
- MenACWY is preferred for adults with any of the preceding indications who are aged 55 years or younger as well as for adults aged 56 years or older who a) were vaccinated previously with MenACWY and are recommended for revaccination, or b) for whom multiple doses are anticipated. Meningococcal polysaccharide vaccine (MPSV4 [Menomune]) is preferred for adults aged 56 years or older who have not received MenACWY previously and who require a single dose only (e.g., travelers).
- Revaccination with MenACWY every 5 years is recommended for adults previously vaccinated with MenACWY or MPSV4 who remain at increased risk for infection (e.g., adults with anatomic or functional asplenia, persistent complement component deficiencies, or microbiologists).

12. Hepatitis A vaccination

- Vaccinate any person seeking protection from hepatitis A virus (HAV) infection and persons with any of the following indications:
 - men who have sex with men and persons who use injection or non-injection illicit drugs;
 - persons working with HAV-infected primates or with HAV in a research laboratory setting;
 - persons with chronic liver disease and persons who receive clotting factor concentrates;
 - persons traveling to or working in countries that have high or intermediate endemicity of hepatitis A; and

12. Hepatitis A vaccination (cont'd)

- unvaccinated persons who anticipate close personal contact (e.g., household or regular babysitting) with an international adoptee during the first 60 days after arrival in the United States from a country with high or intermediate endemicity. (See footnote 1 for more information on travel recommendations.) The first dose of the 2-dose hepatitis A vaccine series should be administered as soon as adoption is planned, ideally 2 or more weeks before the arrival of the adoptee.
- Single-antigen vaccine formulations should be administered in a 2-dose schedule at either 0 and 6 to 12 months (Havrix), or 0 and 6 to 18 months (Vaqta). If the combined hepatitis A and hepatitis B vaccine (Twinrix) is used, administer 3 doses at 0, 1, and 6 months; alternatively, a 4-dose schedule may be used, administered on days 0, 7, and 21 to 30 followed by a booster dose at month 12.

13. Hepatitis B vaccination

- Vaccinate persons with any of the following indications and any person seeking protection from hepatitis B virus (HBV) infection:
 - 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); persons seeking evaluation or treatment for a sexually transmitted disease (STD); current or recent injection drug users; and men who have sex with men;
 - health care personnel and public safety workers who are potentially exposed to blood or other infectious body fluids;
 - persons with diabetes who are younger than age 60 years as soon as feasible after diagnosis; persons with diabetes who are age 60 years or older at the discretion of the treating clinician based on the likelihood of acquiring HBV infection, including the risk posed by an increased need for assisted blood glucose monitoring in long-term care facilities, the likelihood of experiencing chronic sequelae if infected with HBV, and the likelihood of immune response to vaccination;
 - persons with end-stage renal disease, including patients receiving hemodialysis, persons with HIV infection, and persons with chronic liver disease;
 - household contacts and sex partners of hepatitis B surface antigen-positive persons, clients and staff members of institutions for persons with developmental disabilities, and international travelers to countries with high or intermediate prevalence of chronic HBV infection; and
 - all adults in the following settings: 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 day care facilities for persons with developmental disabilities.
- Administer missing doses to complete a 3-dose series of hepatitis B vaccine to those persons not vaccinated or not completely vaccinated. The second dose should be administered 1 month after the first dose; the third dose should be given at least 2 months after the second dose (and at least 4 months after the first dose). If the combined hepatitis A and hepatitis B vaccine (Twinrix) is used, give 3 doses at 0, 1, and 6 months; alternatively, a 4-dose Twinrix schedule, administered on days 0, 7, and 21 to 30 followed by a booster dose at month 12 may be used.
- Adult patients receiving hemodialysis or with other immunocompromising conditions should receive 1 dose of 40 mcg/mL (Recombivax HB) administered on a 3-dose schedule at 0, 1, and 6 months or 2 doses of 20 mcg/mL (Engerix-B) administered simultaneously on a 4-dose schedule at 0, 1, 2, and 6 months.

14. *Haemophilus influenzae* type b (Hib) vaccination

- One dose of Hib vaccine should be administered to persons who have functional or anatomic asplenia or sickle cell disease or are undergoing elective splenectomy if they have not previously received Hib vaccine. Hib vaccination 14 or more days before splenectomy is suggested.
- Recipients of a hematopoietic stem cell transplant should be vaccinated with a 3-dose regimen 6 to 12 months after a successful transplant, regardless of vaccination history; at least 4 weeks should separate doses.
- Hib vaccine is not recommended for adults with HIV infection since their risk for Hib infection is low.

15. Immunocompromising conditions

- Inactivated vaccines generally are acceptable (e.g., pneumococcal, meningococcal, and inactivated influenza vaccine) and live vaccines generally are avoided in persons with immune deficiencies or immunocompromising conditions. Information on specific conditions is available at <http://www.cdc.gov/vaccines/hcp/acip-recs/index.html>.