# A Report on Vaccine Availability and Administration Protocols as of August 2002

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**The development of vaccines has contributed to the great increase in human survival and longevity over the past 200 years. While some developments have been restricted due to interactions, side effects, or eradication, the 17 commonly recommended vaccines form a safe an effective arsenal held against infectious agents. Primary vaccination is a key component of the fight against infectious disease, as well as vaccination of immigrants and travelers. High-risk groups have some special considerations. While vaccine supply and production problems have, and in some cases continue to pose difficulties, following the recommended guidelines will help to ensure the safety and health of the population.**

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Human survival and longevity has increased significantly over the past 200 years, and, as a tool to mobilize individuals' immune systems and prevent clinically significant infections, vaccination has played a vital role in this increase. The last 50 years has witnessed the development of many new vaccines with notable successes against infectious agents, including smallpox, polio, and ***Haemophilus influenzae*** type b. The proliferation of vaccines has presented an ongoing need to inform people about the choices, usefulness, and availability of the different vaccines.

Vaccines and vaccine administration can be defined in terms of the intended recipients. Groups are generally divided into children and adults, and schedules and vaccine choices of the central 17 vaccines (Table 1) are adjusted for each group. Not included in Table 1 are vaccines against smallpox, anthrax, rotavirus, Lyme disease, and the Bacillus Calmette-Guerin (BCG) vaccine, which each involve some special circumstances.

## RESTRICTED VACCINES

The anthrax vaccine was created for the military population and is currently available only to the military and certain laboratory research personnel working directly with anthrax. BCG is an attenuated tuberculosis vaccine that is generally not given in the US due to reservations about its effectiveness; it is used as an adjuvant immunomodulatory agent in treatment of some

**Table 1.** The 17 commonly administered vaccinations.

| | |
|---|---|
| Diphtheria | Pertussis |
| *Haemophilus influenzae* b | Pneumococcal |
| Hepatitis A | Poliovirus |
| Hepatitis B | Rubella |
| Influenza | Tetanus |
| Japanese encephalitis | Typhoid |
| Measles | Varicella (chickenpox) |
| Meningococcal | Yellow fever |
| Mumps | |

**Table 2.** Primary vaccination scheduling recommendations. Data from (2-6).

**Hepatitis B**
Series of three injections
1. Within 2 months of birth
2. 1 month after #1
3. 6 months after #1

**DTaP**
(diphtheria, tetanus, acellular pertussis)
Series of five injections
1. 2 months
2. 4 months
3. 6 months
4. 18 months
5. 4 years

***Haemophilus influenzae* type b** (Hib)
Series of 4 injections
1. 2 months
2. 4 months
3. 6 months
4. 12 months

**Inactivated polio vaccine** (IPV)
Series of 4 injections
1. 2 months
2. 4 months
3. 12 months
4. 4 years

**Measles, mumps and rubella** (MMR)
Series of 2 injections
1. 12 months
2. 4 years

Note: Measles vaccination may be associated with a number of febrile seizures (13 of 137,457 recipients) (3). A syndrome of fever, rash and pneumonitis is sometimes associated with postvaccination hypersensitivity, possibly for years after vaccination.

**Pneumococcal conjugate vaccine** (PCV)
Series of 4 injections
1. 2 months old
2. 4 months old
3. 6 months old
4. 12 months old

Note: There are two types of pneumococcal vaccines: the conjugate vaccine for patients under 2 years old and the polysaccharide vaccine for adults and children over 2 years old. In patients younger than 2 years old, the conjugate vaccine is used to increase immune response. There are no studies of its use in adults.

**Pneumococcal polysaccharide vaccine** (PPV)
Series of 2 injections
1. 2 years old
2. 7 years old

**Varicella**
- If given by 12 years of age, one injection
- If given after 12 years, two injections separated by 1 month

Note: Failure of varicella vaccine has been reported in patients younger than 14 months (4). Decreased incidence of shingles among varicella vaccine recipients has been reported but not confirmed.

**Influenza**
- If older than 6 months but younger than 9 years, two injections separated by a month followed by annual boosters
- If older than 9 years, one injection followed by annual boosters

**Hepatitis A**
Series of two injections
1. 24 months
2. 30 months

Note: Although not yet explicitly included on the recommended vaccine list of the Advisory Committee on Immunization Practices, hepatitis A vaccine is a frequent addition.

malignancies. Lyme and rotavirus vaccines were both available within the last 4 years but have been withdrawn by the manufacturers: Lyme vaccine due to concerns about autoimmune arteritis in recipients, and rotavirus vaccine because of increased incidents of intussusception among the children who received it.

Smallpox has been eliminated as an ongoing intrinsic human pathogen, and vaccination against smallpox ceased in the early 1970s. However, the terrorist events of the Fall of 2001 have reawakened concerns about the need to protect populations against this possible bioweapon. The concerns are complicated by estimates that 1 in 500,000 to 1,000,000 persons face major adverse reactions including death as a result of the vaccination, and by uncertainty about the efficacy of the current vaccine against a militarily altered strain such as that which may have caused an outbreak of the disease in the Arial Sea region in 1971 (1). The recently released Centers for Disease Control and Prevention (CDC) recommendation is not to vaccinate the general population, but, in the event of an outbreak of any origin, to use containment vaccination of the exposed population. This is an epidemiologically effective tactic, used, for example, to contain the 1948 New York City outbreak.

## PRIMARY VACCINATION

Primary vaccination is generally given to infants and children. Immunization schedules are organized to influence both the production of antibodies and to optimize immunogenic memory. The currently recommended primary vaccines are hepatitis A and B, DTaP (diphtheria, tetanus, acellular pertussis), ***H. influenzae*** type b (Hib), inactivated poliovirus, pneumococcal conjugate vaccine (PCV), MMR (measles, mumps, and rubella) varicella, pneumococcal vaccine, and influenza.

A summary of suggested schedules for primary immunizations is given in Table 2. The recommendations in Table 2 do not include children with immune deficiencies or autoimmune diseases. Patients with autoimmune issues and immunodeficiencies require special

prevaccination evaluation by health care providers. Respiratory syncytial virus may be treated with a monoclonal antibody, which does not affect any vaccination.

The scheduling of injections for the recommended vaccines can range from complicated to onerous. Some general principles can be used to minimize the scheduling burden. Acute minor illnesses such as upper respiratory illnesses, diarrhea, or ear infections do not preclude vaccination even with the presence of fever or the use oral antibiotics. To minimize the number of vaccination visits, up to seven intravenous vaccinations may be given simultaneously, but different vaccine products may not be combined in the same syringe. The exceptions are the multiple product vaccines such as MMR and DTaP that are manufactured as combination vaccines. (MMR and DTaP are not to be combined in a syringe with one another.) An example of seven vaccines given simultaneously is MMR, varicella, Hib, PCV, DTaP, inactive polio, and hepatitis B (2). For the inactive vaccines, there are no time limits or specific sequence between the different vaccines. Live vaccines such as MMR and varicella should either be given simultaneously or separated by 30 days. The only contraindication to a vaccination is allergy to the vaccine or a constituent of the vaccine such as chicken eggs or gelatin. Penicillin is not a component of any vaccines marketed in the US. Breast feeding does not preclude vaccination for mother or child.

## INFLUENZA

For the 2002-2003 flu season, a trivalent vaccine composed of the influenzae A (H1,N1), influenzae A (H3,N2), and influenzae B (Hong Kong) strains is being made available. This formulation is recommended whether the manufacture's production process produces the more immunogenic but more side effect reactive whole virus vaccine or the less immunogenic, less reactive, chemically fractured subvirion split-virus vaccine. Planned supplies are 95 million doses and, using estimates based on cost saving per vaccinee, the potential societal savings for 95 million vaccinees is $1.3 billion.

Vaccination is to begin in October with initial focus on high-risk individuals (Table 3). These include persons over 65 years of age, residents of any age in nursing homes or chronic care establishments, and persons with pulmonary (i.e. asthma), cardiovascular, or renal disease. Because of the potential for Reye's syndrome after influenzae infection, children on chronic aspirin therapy should be immunized. All health care workers should receive the influenzae vaccine, especially those whose setting includes dialysis centers, long term or intensive care (adult or pediatric), or care of HIV patients or transplant recipients. Women who will be 3 to 9 months pregnant during November to April are also encouraged to receive flu vaccination.

**Table 3.** High-risk groups with particular potential benefit from influenzae vaccination.

1. Patients over 65 years of age
2. Patients with high-risk conditions: diabetes mellitus; heart, pulmonary, and renal disease; hemoglobinopathies; HIV; transplant recipients
3. Children on chronic aspirin therapy
4. Health care workers (especially those in HIV, dialysis, long-term, and intensive care units)
5. Women 3 to 9 months pregnant

## US IMMIGRANTS

Foreign adopted children and older immigrant children should be integrated into the US vaccination schedule as soon as possible. Questions about the vaccination status of adults, both US citizens and immigrants, are most appropriately addressed through official vaccination documentation records. When documentation is unavailable, serological testing is possible to confirm immunity to hepatitis A and B, tetanus, diphtheria, varicella, rubella, measles, mumps, and polio. Individuals who need primary vaccination should follow vaccination schedules with the same number and monthly intervals between injections as recommended for children. Typically, adults have more specific needs. Individuals who are over 65 years old should receive polysaccharide pneumococcal vaccine, and individuals over age 50 should receive annual flu vaccinations.

## TRAVEL VACCINATIONS

US residents who travel abroad have specific needs regarding typhoid, meningococcal, yellow fever, Japanese encephalitis, and rabies vaccinations. The need for each vaccine depends on the country, setting (rural or urban), and length of stay. Usually the longer the stay and the more rural the setting the greater the need for more extended vaccine protection. Yellow fever is a single injection repeated every 10 years. Japanese encephalitis vaccine is a three-injection sequence given on days 0, 7, and 30 and boosted every 3 years. Typhoid vaccine is a single injection followed by a booster every 2 years while in endemic areas (only the inactivated injectable form is available in the US). Rabies is a three-injection series given on days 0, 7, and 24. No clear criteria for boosting rabies vaccination have been established. Meningococcal vaccine is a single injection that requires boosting at 5-year intervals. The current recommendation is to provide it to travelers to areas with high meningococcal disease rates and to young adults in crowded living accommodation (e.g. college dormitories). The current meningococcal vaccine protects against four of the five common meningococcal serogroups (A, C, Y, W135). It does not protect against serogroup B.

## PREGNANCY

Pregnancy presents especially emotive issues on vaccination. No evidence indicates risk to fetus or mother from the inactivated vaccines. For the live vaccines (MMR and varicella), the current practice is to not vaccinate from 4 weeks prior to pregnancy until completion of pregnancy. A specific history about pregnancy or intended pregnancy is appropriate before giving a live viral vaccine to women between menarche and menopause.

## WEST NILE VIRUS

Another currently emotional issue (especially in Louisiana) is West Nile virus. In the Fall of 2001, an equine vaccine was licensed by the United States Department of Agriculture. This vaccine has been released years before any anticipated human vaccine. The current research most likely to lead to a human vaccine involves mouse monoclonal antibodies to West Nile Virus and to Venezuelan equine virus and brucella.

## VACCINE SUPPLY

For the last 2 years there have been significant problems with vaccine supplies. MMR, DTaP, PCV, and varicella vaccines have all been affected by production problems. As of July 2002, there are adequate supplies of MMR and DTaP, and normal vaccination schedules should resume. Supplies of PCV and varicella vaccine remain constrained. The current recommendation is to forego the fourth dose of PCV and delay giving varicella vaccine until the age of 2 years. The CDC anticipates the return of adequate supplies of both PCV and varicella vaccine by the end of 2002 .

## CONCLUSION

Vaccines make a considerable contribution to the modern quality of life. The benefits of vaccination accrue from individuals receiving both the primary sequence of doses and the booster doses at suggested intervals. Most residents of the United States received an adequate cycle of primary vaccination in childhood. For those who may not have had adequate primary vaccination, such as individual who grew up in nonindustrialized countries or who received primary vaccination before the development of all the current vaccines, we have presented the primary vaccination regimens of the currently suggested vaccines. Immunization effectiveness also depends on adequate vaccines supplies. For the past 2-3 years there have been recurrent difficulties with supplies. These supply shortfalls are now resolved and normal vaccination procedures can resume. Updated information on current vaccine administration guidelines and supply issues is available from the CDC at www.cdc.gov.

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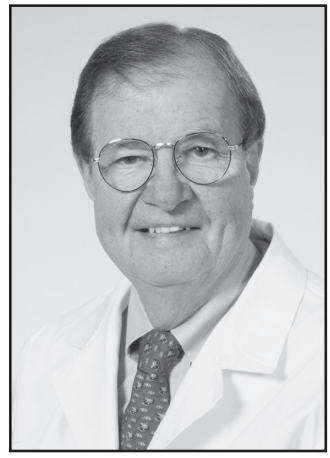

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