Introduction
The morbidity and mortality of vaccine-preventable diseases among adults are high, particularly among populations at high risk because of underlying medical conditions.

Many adults may not be aware of the importance for continued vigilance with regard to vaccination and, as a result, are at risk of contracting serious infectious diseases. An accident at work, at home or on the road can mean the possibility of tetanus and hepatitis B. People in certain professions, such as healthcare workers, police officers and athletes who play contact sports are especially at risk. Sexually active people who engage in unprotected sex and users of recreational drugs also have a higher risk of contracting and spreading life-threatening diseases, such as AIDS and hepatitis A and hepatitis B, through contact with body fluids, fecal material and contaminated needles and other drug paraphernalia. If not properly vaccinated, parents and other adults may also transmit some of these diseases to newborn babies.

International travel also carries a risk of infection. Not only are patients at risk of contracting infections such as typhoid disease and malaria (— diseases that are almost unheard of in the US —) but they are also at risk for infection with hepatitis A and hepatitis B, particularly in countries that are plagued by outbreaks. Any physician who is responsible for the regular care of patients over an extended period of time, including Family Physicians, Internists, Physicians in all internal medicine specialties and Ob-Gyns, should be acutely aware of the need for vaccinations when their patients are traveling abroad.

The Importance of Adult Immunizations
Aren’t Shots Just for Kids — Why do I need to be Immunized?¹
- About 12,000 American adults die each year from influenza (“flu”) - related illnesses.²
- Pneumococcal disease, such as pneumonia, kills about 40,000 Americans each year.¹
- Hepatitis B infects 150,000 people (mostly young adults) and kills 5,000 adults each year.¹

What do these statistics have in common? All these deaths could have been prevented by simple immunization. Like children, adults need immunization to avoid illness and stay healthy. For every child that dies each year from a disease that could have been prevented, well over 100 adults die. As
many as 80,000 adults die each year from the vaccine-preventable diseases mentioned above as well as:

- Hepatitis A
- Hepatitis B
- Tetanus, diphtheria
- Measles, mumps, and rubella
- Meningitis
- Varicella

The Toll of Vaccine Neglect
Diseases that could be prevented by adult vaccines rival or outstrip many higher-profile causes of death in the U.S. (Fig. 1)³

Why is the rate of vaccination remain so low? The National Vaccine Advisory Committee cited the following major reasons for undervaccination of adults.⁴

- Limited appreciation of the importance of vaccine-preventable diseases in adults
- Doubts about the safety and efficacy of adult vaccines
- Different target groups for different vaccines, necessitating a selective rather than a universal approach
- Too few programs, either public or private, to deliver adult vaccines
- Issues regarding payment for adult vaccination

In uenza

Impact
In uenza is one of the unconquered scourges of mankind as it causes frequent epidemics and periodic pandemics and hence is a major public health problem. It is estimated that annually around 0.5 –1million people die and 600 – 1200 million become sick due to in uenza epidemics worldwide.⁵ India experienced in uenza pandemics in 1781, 1889, and 1918. During 1976 to 2000, several outbreaks of in uenza were investigated by the National In uenza center located at the National Institute of Virology. Between the period of 1990 and 2000 in Pune H3N2 strains were predominant. Predominant circulation of H3N2 strain have been reported from all over the world during the past 10 years.⁶ An outbreak of in uenza occurred in Delhi during 1993 wherein isolates of the H3N2 virus were recovered.
Vaccine

Inactivated Vaccine
Inactivated in uenza viral vaccine comprise the current strains of type A and B viruses for parenteral use in humans. They have to be regularly updated because of antigenic variation. Annual vaccination (FLUARIX®, VAXIGRIP®) is recommended for persons belonging to the high risk group (the elderly, debilitated persons and those suffering from chronic disease), children, and persons who might transmit in uenza to high groups (medical personnel, employees in chronic care facilities and household members).

Live Attenuated Vaccine
A live attenuated, cold adapted, trivalent in uenza virus vaccine (nasal spray) has been shown to be effective in children.

In uncontrolled studies of in uenza vaccination, the incidence of clinical illness in vaccinated persons has been 70% to 90% less than expected in healthy adults <65 years of age. Among the elderly in nursing homes, vaccinated persons experienced a 30% to 40% reduction in the incidence of illness, a 50% to 60% reduction in hospitalization and pneumonia, and a 70% to 100% reduction in mortality.

Pneumococcal Disease

Impact
Pneumococcal disease causes an estimated 3000 cases of meningitis, 50,000 cases of bacteremia, and 500,000 cases of pneumonia annually in the United States. Most (60% to 87%) cases of pneumococcal bacteremia in adults are associated with pneumonia, and the rate of bacteremia is highest in persons aged 65 and older. Streptococcus pneumoniae causes 25% to 35% of the cases of community-acquired pneumonia that require hospitalization. Despite appropriate therapy, the overall case-fatality rate for pneumococcal bacteremia is 15% to 20% among adults; this climbs to approximately 30% to 40% for elderly patients.

Vaccine
In a meta-analysis of randomized controlled trials of older pneumococcal polysaccharide vaccines, the efficacy was 66% effective against definitive pneumococcal pneumonia and 83% against definitive pneumococcal pneumonia for vaccine types. For the 23-valent vaccine (PNEUMO 23®, PNU-IMUNE 23®) in current use, the efficacy in case-control studies generally ranged from 56% to 81%. Pneumococcal polysaccharide vaccine is recommended for all persons 65 years and older. The ACIP recommends that persons aged 65 years and older who were initially vaccinated before age 65 should receive 1 revaccination, provided that at least 5 years have elapsed since the initial vaccination.

Hepatitis A and Hepatitis B

Impact
The epidemiology of hepatitis A is highly in uenced by personal and public hygiene. In areas of the world where there is inadequate or non-existent provision for sewage disposal, infection occurs early in life and is almost always subclinical. In developing countries, exposure, infection and subsequent immunity are virtually universal in childhood. In areas where the hepatitis A virus is not in wide circulation, the population is not immune and is therefore more vulnerable to infection occurring later in life. One of the most important factors for disease severity is the age of the patient. Childhood infections can be asymptomatic, while almost all adults suffer from the overt disease with symptoms ranging from mild u-like symptoms to severe gastrointestinal symptoms, fever, prolonged jaundice
and severe weight loss. Nearly two-thirds of adult patients with clinically apparent disease experience complete clinical recovery within two months. Fulminant hepatitis A can occur, although rarely, and is frequently fatal particularly in the older patient. Chronic hepatitis A does not occur but a relapsing form of the disease has been described. Relapse occurs 2-18 weeks after the primary infection and affects 3-20% of patients with acute hepatitis A infection - after a clinical phase and subsequent recovery, including normalization of liver enzymes, a second clinical phase with an elevation of liver enzymes occurs, persisting for up to 40 weeks.

Blood has long been recognized as a major vehicle for the transmission of hepatitis B virus (HBV). Four major modes of transmission are recognized: vertical (also known as perinatal), horizontal, parenteral/percutaneous and sexual. The age of infection is the primary correlate for route of infection. In areas of intermediate and high endemicity of the disease, infection occurs early in life through mother-child transmission and through close personal contact among children. In areas of low HBV endemicity, infection occurs primarily in adolescent/adult life and by the sexual route and intravenous drug abuse. Individual response to the infection varies greatly. The age at which infection is acquired affects whether the infection is self-limiting or results in the chronic carrier state. Although the acute infection is more severe in adults, infections in infants and pre-school age children carry much greater risks of chronic carriage thereby increasing the risk of primary hepatocellular carcinoma and cirrhosis later in life.

Vaccine
The overall effectiveness of the vaccine (ENGERIX B®, GENEVAC -B®, ENIVAC HB®, HEPPACINE - B®, etc) in preventing infection is 80% to 90%; it is 70% in persons 50 –59 years of age and 50% in those >60 years of age. The duration of protection is uncertain, but is at 7 years among healthy adults.

Hepatitis A vaccine (HAVRIX® AVAXIM®) is highly immunogenic, provides lasting protection in healthy individuals and generates protective levels of antibodies in patients with chronic liver disease or impaired immunity. Hepatitis A and B vaccine together (TWINRIX®) provides marked consistent immunogenicity and good safety profile.

Varicella
Impact
Varicella zoster virus (VZV) infection is more likely to lead to severe complications, such as pneumonia and secondary bacterial skin infections, in adults than in school-aged children. Almost all adults who have a history of varicella have serologic evidence of immunity. Depending on the study, many adults (47% to 93%) who do not have a reliable history of varicella actually have seroprotection, the majority of studies suggest that most (71% to 93%) are protected.

Vaccine
Adults should be assessed for immunity to varicella by asking if they have had varicella. Those who have a reliable history of varicella are considered immune. Those who do not have a reliable history of varicella are considered susceptible. Serologic testing may be performed as a cost-effective way to determine if vaccination is indicated; alternatively, varicella vaccine could be administered. Adults for whom varicella vaccination is indicated should receive 2 doses of vaccine subcutaneously, spaced 4 to 8 weeks apart.

Varicella vaccine (VARILRIX®, OKAVAX®) is recommended for the following groups, if susceptible.

- Susceptible persons who have close contact with persons at high risk for serious complications (eg, health care workers and family contacts of immunocompromised persons)
- Susceptible persons 13 years or older who live in households with children
• Persons who live or work in environments in which transmission of VZV is likely (eg, teachers of young children, daycare employees, and residents and staff in institutional settings)

• Persons who live or work in environments in which varicella transmission can occur (eg, college students, inmates and staff of correctional institutions, and military personnel)

• All nonpregnant women of childbearing age without a history of varicella or other documentation of immunity should be considered for vaccination before pregnancy to reduce the risk of congenital varicella syndrome. All women of childbearing age should be asked if they are pregnant before vaccination and advised to avoid pregnancy for 1 month after vaccination against varicella.

• International travelers. Vaccination should be considered for international travelers who do not have evidence of immunity to VZV, especially if the traveler expects to have close personal contact with local populations, because varicella is endemic in most countries.

Data indicate that varicella vaccine is effective in preventing or modifying varicella if given within 3 days and possibly up to 5 days after exposure to wild varicella.

Age 50 Vaccination Check
The ACIP and the AAFP recommend that all adults at age 50 years: (i) receive a dose of Td vaccine if they have not had a booster within the past 10 years, (ii) be screened for high-risk conditions such as chronic pulmonary or cardiac diseases that indicate the need for administration of pneumococcal vaccines, and start annual influenza vaccination if they have not previously done so.

Meningococcal Disease
Impact
The only natural host of meningococcus is man. Because nasopharyngeal carriage of meningococci is so much more frequent than meningococcal disease, nasopharyngeal carriers, rather than patients with meningitis, are the usual source of new infections. Asymptomatic carriage may occur in as many as 15 to 25% of young adults and in between 2 and 15% in civilian city dwellers. A large community survey in England found rates between 2% in children below 5 years of age and 24% in teenagers aged 15-19 years.

In countries of the developing world reporting high incidence rates of meningococcal disease, ratios of carriers to cases vary from 100:1 during epidemics, to 1,000:1 in endemic areas. This suggests that many people develop a natural immunity to the disease in regions where exposure to the organism is common. A low incidence of natural immunity might be expected in areas of low endemicity. The vast majority of travellers from areas of low endemicity to areas of high endemicity of particularly such groups as European residents travelling to parts of Africa, the Indian subcontinent and other parts of Asia, the Middle East and parts of South America, would therefore be vulnerable to meningococcal disease.

In the 1980s, an epidemic wave of meningococcal disease spread over territories in Asia (India [6 133 cases in 1985 in New Delhi, CFR 13%, 25% of cases occurring in infants], Nepal [Katmandu Valley in 1982-1984, 103 cases per 100 000 population]) and Africa (particularly epidemics in Burkina Faso, Mali, Niger and Nigeria). (Fig. 2)

Vaccines
Many different sub-unit purified meningococcal meningitis vaccines have been developed, based on the capsular polysaccharide component. These vaccines contain group-specific capsular polysaccharides, which confer resistance against meningococci of serogroups A, C, W-135 or Y.
Unconjugated Meningococcal Vaccines

The licensed polysaccharide vaccines are either bivalent meningococcal serogroup A and C (MENINGOCCAL A and C®, MENCEVAX A and C®) vaccines, or four-valent serogroup A, C, W-135, Y (MENCEVAX ACW135Y®) vaccines. In common with other polysaccharide vaccines, these vaccines:

- are weakly immunogenic in infants
- are T-cell independent
- establish little or no immune memory
- have a poor booster effect.

Conjugated Meningococcal Vaccines

Conjugated meningococcal meningitis vaccines consisting of the group-specific capsular polysaccharides being covalently coupled to a non-infectious protein carrier have been developed. The protein carrier enhances T-cell recognition of the capsular polysaccharide. Unlike, unconjugated polysaccharide meningococcal meningitis vaccines the newer conjugated vaccines:

- are immunogenic in infants
- elicit T-helper cell activation
- produce higher concentrations of PRP antibodies
- induce immunological memory and strong booster effect

Several new meningococcal serogroup C vaccines have been developed and conjugated to proteins (diphtheria toxoid, tetanus toxoid, nontoxigenic diphtheria toxin mutant CRM197).

It is indicated in travellers to Haj and Umra; to endemic and epidemic areas; college freshman staying in the dormitories in the US; staff dealing with N. meningitis.

Measles, Mumps, and Rubella Vaccines

Persons born before 1957 can be considered immune to measles, mumps, and rubella, except for women of childbearing potential, who should be vaccinated unless they have evidence of immunity to rubella.

Impact

Before introduction of a measles vaccine in 1963, approximately 3 to 4 million cases of measles and 500 deaths attributable to this disease were reported annually in the United States. After introduction of measles vaccine, the incidence of disease dropped by more than 99%.26

Despite the effectiveness of measles, mumps, and rubella (MMR) vaccine, outbreaks have been reported recently in the United States. A major measles epidemic (55, 467 reported cases and 136
deaths) occurred in 1989 to 1991, and outbreaks of rubella occurred in Massachusetts, Connecticut, and North Carolina in 1994 to 1996. Persons 15 years or older accounted for 36% of mumps cases in 1988 to 1993, and accounted for 81% of rubella cases reported from 1994 to 1996.

Vaccine
All adults born in 1957 or later should receive 1 dose of MMR (PRIORIX®, TRIMOVAX®, TRESIVAC®) vaccine unless they have documentation of at least 1 dose of vaccine containing measles, rubella, and mumps on or after their first birthday or documentation of presumptive immunity. Documentation of immunity includes physician diagnosis of measles and mumps but not rubella, or documented vaccinations against appropriate strains of measles, mumps, and rubella. In general, serologic screening to determine immunity is not recommended, is costly, and can be a barrier to vaccination. All women of childbearing potential should receive rubella vaccine unless they have received at least 1 dose of MMR or live rubella vaccine (or have serologic documentation).

Conclusion
Adults aged 18 years of age and older without contraindications should receive immunizations for the above mentioned diseases. Priorities should include public awareness of the safety and efficacy of the adult vaccines and vaccination.

References
1. The importance of adult Immunization American Pharmacy Association (Brochure) 2001.
