

Adult Immunization: The Need for Enhanced Utilization



By Steven Marks
November 2009



The American Council on
Science and Health

ACSH, 1995 Broadway 2nd floor,
New York, NY 10023

THE AMERICAN COUNCIL ON SCIENCE AND HEALTH
GRATEFULLY ACKNOWLEDGES THE
CONTRIBUTIONS OF THE REVIEWERS
NAMED BELOW.

Bruce Gellin, M.D., MPH
*Director, National Vaccine
Program Office
U.S. Department of Health
and Human Services*

**William Paul Glezen,
M.D.**
*Department of Microbiology
and Immunology
Baylor College of Medicine*

Paul A. Offit, M.D.
*The Children's Hospital of
Philadelphia
University of Pennsylvania*

William Schaffner, M.D.
*Professor and Chair, Dept.
of Preventive Medicine
Vanderbilt University
School of Medicine*

David R. Smith, M.D.
*President, SUNY Upstate
Medical University
Prof. of Pediatrics, U.
of Cincinnati College of
Medicine*

**Raymond A. Strikas,
M.D., FACP**
*Captain, U.S. Public Health
Service National Vaccine
Program Office, HHS*

Litjen Tan, Ph.D.
*Director of Medicine and
Public Health
American Medical
Association*



ACSH accepts unrestricted grants on the condition that it is solely responsible for the conduct of its research and the dissemination of its work to the public. The organization does not perform proprietary research, nor does it accept support from individual corporations for specific research projects. All contributions to ACSH—a publicly funded organization under Section 501(c)(3) of the Internal Revenue Code—are tax deductible.

Copyright © 2009 by American Council on Science and Health. This book may not be reproduced in whole or in part without permission. Inquire for bulk purchases of hard copies: ACSH@ACSH.org.

CONTENTS

Abstract.....	1
Introduction.....	1
Raising Awareness, improving Access.....	2
VPDs: Characteristics, Health Impact, and Vaccination Schedules.....	3
Influenza.....	3
Pneumococcal Infections.....	4
Herpes Zoster.....	5
Human Papillomavirus.....	6
Hepatitis B.....	7
Tetanus, Diphtheria, and Pertussis.....	8
Improving the Delivery of Adult Vaccines.....	9
Toward the Future.....	10
Conclusion.....	10
References.....	11

ABSTRACT

Immunization against vaccine preventable diseases is one of the most important and beneficial public health measures available. However, utilization rates among adults remain low, well below Department of Health and Human Services' target levels. Nearly 50,000 adults die each year in the U.S. from one of the 10 vaccine preventable diseases identified by the Advisory Committee on Immunization Practices of the Centers for Disease Control and Prevention. Each year, the direct (medical) and indirect (lost productivity) costs of influenza alone top \$87 billion, while medical expenditures and productivity losses associated with hepatitis B reach \$700 million. The barriers to adult immunization are high and involve a number of financial, informational, and operational obstacles. Vaccines are now available to prevent the most common diseases, including influenza, pneumococcal infections, herpes zoster, human papillomavirus, hepatitis B, and tetanus, diphtheria, and pertussis, although vaccination remains a low priority for both physicians and patients. To address these problems, new public-private partnerships have been formed to increase awareness of the importance of immunization, and additional initiatives are under consideration to reduce the financial and operational barriers to broader vaccine delivery.

INTRODUCTION

Although vaccination is acknowledged to be one of the most cost-effective public health strategies available to prevent many communicable viral and bacterial infections, large numbers of Americans above the age of 18 remain vulnerable to vaccine-preventable diseases (VPDs). Whereas upwards of 90% of children receive most of the vaccines recommended by the Advisory Committee on Immunization Practices (ACIP) of the Centers for Disease Control and Prevention (CDC) (NFID 2009), variable and generally low rates of coverage are the norm for adults.

For example, only 10% of women in the target population of 18 to 26 years have been vaccinated against human papilloma virus (HPV), a major cause of cervical cancer (CDC Nat Immun Survey 2008). The rate is not much higher for tetanus and diphtheria toxoids; only 44% of American adults have been vaccinated (CDC Nat Immun Survey 2008). Even for influenza, the illness for which the value of immunization is best recognized by the public, and which annually

takes the lives of over 30,000 Americans, coverage is erratic: rates of coverage range from 37% in younger adults to almost 70% of those age 65 or older. Among racial and ethnic minorities, utilization is even lower (Schiller 2009). These figures fall well short of the goals established by the Department of Health and Human Services' (HHS) Healthy People 2010 program (Schaffner 2008, HHS 2001)

Table 1.
Adult vaccination rates and Healthy People 2010 targets

Disease	Recent Vaccination Rate (%)	Health People 2010 Goals (%)
Influenza		
≥ 65 years of age	64	90
18-64 years	31	60
Pneumococcal	57	90
Tetanus, diphtheria, pertussis		
– Td	44	90
– Tdap	2	*
Herpes zoster	2	*
Human papilloma-virus	10	*
Hepatitis B		
Dialysis patients	56	90
Men who have sex with men	13	60
Healthcare workers	75	93

*Vaccines approved subsequent to report.
Adapted from Schaffner 2008.

Vaccine-preventable diseases cause substantial morbidity and mortality, and contribute to excess health-care spending for medical treatment and hospitalizations. Nearly 50,000 adults die each year from one of the 10 VPDs identified by the ACIP (CMMS Adult Immunization Overview 2008). More than 6 million young women are infected annually with HPV (Weinstock 2004), and more than 1 million older Americans every year get herpes zoster, or shingles (CDC 2008). Furthermore, the direct and indirect costs of an average seasonal outbreak of influenza alone are estimated to be close to \$10 billion (Thompson 2004) and \$87 billion (Molinari 2007), respectively (the costs of a pandemic could be even higher), while medical expenditures and productivity losses associated with hepatitis B reach \$700 million annually (HHS 2007). Despite the ready availability of clinically proven interventions to prevent a host of potentially life-threatening illnesses, utilization rates by adults continue to be disappointing.

Table 2.
Immunizations for adults

Disease	Vaccines	Age Group	Frequency
Influenza	Injectable •Fluarix •FluLava •Affuria Intranasal spray •FluMist	All adults ≥50 yrs Adults age 19 – 49 with risk factors	1 dose annually
Pneumonia and other streptococcus infections	Pneumovax 23	All adults ≥65 yrs Adults age 19-64 with risk factors	1 dose 1 or 2 doses
Herpes zoster (shingles)	Zostavax	All adults ≥60 yrs	1 dose
Human papillomavirus	Gardasil	All females age 19 – 25	3 doses
Hepatitis B	Recombivax HB Engerix – B	All adults age 19 and above	3 doses
Tetanus, diphtheria, pertussis (Whooping cough)	Tdap •Boostrix •Adacel	All adults age 19 – 64 All adults ≥65 yrs	1-time dose of Tdap for Td booster, then boost with Td every 10 years Td booster every 10 yrs

One reason for the difference in child and adult coverage is that vaccination regimens are well entrenched in routine pediatric care. Another is that insurance programs cover pediatric vaccine costs, while government support is available for the uninsured. A third explanation is that public schools require proof of immunization for enrollment. The barriers for adults, on the other hand, are high. For example, adult vaccination is not a high priority for many primary care physicians. Many people are unaware of their need for immunization, and providers often fail to recommend vaccination even when indicated (Ahmed 2007). Further, insurance coverage by public and private payers is erratic. As a result, adults are needlessly vulnerable to illness, diminished quality of life, and death, even though new vaccines are now available for HPV, shingles, and combination tetanus, diphtheria, and pertussis (or “whooping cough”), and others are in the pipeline. Adults may perceive that VPDs are a matter for infants and children, and that the health risks from common transmissible viral and bacterial infections are high only for children. The weight of epidemiological evidence, however, suggests otherwise.

This report will examine the current status of VPDs in the US. It begins with an explanation of the causes for low rates of use and continues with a description of the most common VPDs, including their character-

istics, health impact, and current immunization recommendations. Next, the paper describes a number of educational and informational initiatives designed to reduce the barriers to adult vaccination. Finally, the report takes a brief look at new vaccines now in clinical development. As we shall see, the evidence is overwhelming that increasing adult immunization rates can improve public health, even as they reduce the enormous expense of these serious, and preventable, diseases.

RAISING AWARENESS, IMPROVING ACCESS

Why do so many adults remain unvaccinated against the most common VPDs? There are several barriers to immunization; they may best be grouped as financial, informational, and operational.

Financing. Payment for the cost and administration of adult vaccinations is frequently unavailable. Although most private insurance plans cover recommended vaccines, many do not. Moreover, high deductibles and co-payments often discourage people from following the recommended schedules. Public sector financing is subject to the vagaries of state and local politics. Unpublished data from the CDC showed that in 2006, only 22 states used their resources to purchase vaccines for adults (Orenstein 2007). And even though upwards of 90% of Medicaid plans provide coverage of the recommended adult vaccines, physician reimbursements vary widely between the states, ranging from \$2 to \$18 per dose (Orenstein 2007). Consequently, compensation often falls short of the total cost of the vaccine, plus back-office expenses (eg, ordering, storage, record keeping, and administration). For seniors, although Medicare part B or D covers the recommended vaccines (influenza, hepatitis A and B, shingles, and pneumococcus) for adults at 65 years and above, payments fail to meet the administrative costs of delivery. Medicare also does not pay for establishing or maintaining inventories, and physicians must purchase vaccines in advance (Orenstein 2007).

Information. There is a general lack of awareness of the need for, and merits of, adult immunization. Physicians are often unaware of the recommendations, and health professionals have

not been effective in educating the public about the benefits of vaccination. As a consequence, opportunities to inform adults about the merits of immunization and then provide vaccinations or a referral are missed frequently during office visits. In fact, a 2007 National Foundation of Infectious Diseases survey reported that although 87% of respondents said they would be vaccinated if their doctors recommended it, only 41% indicated they would ask to be immunized on their own (NFID 2007).

In addition, adults are often ignorant of the serious health and medical problems associated with VPDs. At the same time, many question the safety of available vaccines. Furthermore, the immunization schedule can be difficult for some patients – and even some providers – to fully comprehend. Those with language barriers and the elderly have particular trouble deciphering the recommendations. And patients are often surprised to learn that booster doses are required to maintain maximum protection.

Operational. The American healthcare system, which emphasizes acute treatment, is poorly equipped to deliver preventive medicine to the population as a whole, especially to adults. Access to preventive services, when they are in place, is limited, and neither the government nor the private sector has been able to develop a sustained adult–vaccine delivery infrastructure. In particular, primary–care practices, including those specializing in prenatal care, can be better used as points of vaccination. And, unlike schools, which require immunizations records as a condition of enrollment, few employers demand the same coverage of their workers. Medicare and Medicaid do not require immunization protection as a criterion for protection as well.

Thus, multiple structural problems must be resolved before immunization rates begin to approach the targets established by public health officials. Yet there is one exception to this bleak analysis – influenza – and the relatively high vaccination rates reported year in and year out can serve as a model for how a concerted public/private partnership can function successfully. Working together, the government, medical orga-

nizations, consumer groups, the mainstream media, and alternative delivery sites such as drugstores and supermarkets, have educated adults, particularly those age 65 and above, about the need for immunization (NFID 2009). Supplies are usually available at an affordable price. As a result, utilization for seniors now approaches 70%, a rate substantially higher than those for most other VPDs.

VPDs: CHARACTERISTICS, HEALTH IMPACT, AND VACCINATION SCHEDULES

What follows is a brief description of the 8 most common adult VPDs and their impact on society. It also includes a discussion of risk factors, health consequences, and the ACIP's most recent immunization recommendations. A short discussion of the relevant vaccines is offered as well. For suggestions about sources of more information, see the sidebar "Other Reliable Sources" near the end of this booklet.

Influenza

The economic and health burdens from influenza are substantial. In addition to the direct medical costs of more than \$10 billion spent each flu season, another \$16 billion in lost earnings due to illness has been attributed to influenza (Molinari 2006). Among adults over the age of 50, about 226,000 people are hospitalized, and somewhere between 30,000 and 40,000 Americans die as a result of pneumonia or other complications from the disease (Thompson JAMA 2003).

Most of these serious illnesses and deaths occur in those over the age of 65 and in the immune compromised, the populations at the highest risk (Thompson JAMA 2003). Vaccination can prevent most flu–related complications, including the exacerbation of coexisting illnesses.

Influenza is characterized by the abrupt onset of constitutional and respiratory symptoms such as fever, myalgia, headache, malaise, nonproductive cough, sore throat, and rhinitis (CDC 2008). These symptoms typically resolve in a few days, although cough and malaise may linger for several weeks or more. Influenza viral infections can lead to primary influenza viral pneumonia or aggravate pre–existing medical conditions, such as pulmonary or cardiac disease. It also can lead to a number of serious com-

plications, including:

- Secondary bacterial pneumonia;
- Sinusitis;
- Otitis media;
- Other bacterial or viral co-infections.

Distinguishing respiratory illnesses caused by influenza from those triggered by other pathogens using disease signs and symptoms is challenging. The positive predictive value of clinical definitions for influenza range from about 30% in the community to 50% in hospitalized patients (CDC 2008), although one recent study from the University of Michigan School of Public Health reported that symptoms such as cough and fever positively predicted influenza virus in 79% of those evaluated (Ohmit 2006). For this reason, people with respiratory symptoms during flu season should be considered for a diagnosis of influenza and undergo laboratory confirmation (CDC MMWR 2008).

The current ACIP guidelines recommend that all adults 50 years or older receive an annual influenza vaccination (MMWR Guidelines 2009). Yearly vaccination also is advised for individuals between 19 and 50 years at high risk due to medical, occupational, or lifestyle factors (including those with pre-existing heart or lung conditions), household contacts of those at high risk. Healthcare workers, residents of long-term care facilities, and pregnant women. Two types of vaccines are available, an injectable (ie, “flu shot”) formulation containing inactivated (killed) virus (Fluarix, GlaxoSmithKline [GSK]; FluLava, GSK; and Affuria, CSL Biotherapies; Fluzone, Sanofi Aventis; Fluvirin, Novartis) and a nasal spray containing live attenuated influenza vaccine (FluMist, MedImmune). Each vaccine contains antigens from three influenza viruses, two type A and one type B virus : an A(H3N2) virus, an A(H1N1) virus, and a B virus. (The 2009 swine-origin influenza is an A(H1N1) type virus.) The precise formula varies from year to year, based on the recommendation of international surveillance scientists, who estimate the type and strain of virus likely to circulate in a given flu season. Changes in the viral strain during each annual influenza epidemic explain why annual vaccinations are necessary. Antibodies that provide protection develop about two weeks following inoculation and persist through the influenza season (CDC 2009). Vaccine effectiveness

ranges from 70–90% when the match between the antigen and the epidemic virus is high to 0–50% when it is low (Glezen 2006). Vaccine effectiveness also is indirectly related to age: although the clinical efficacy of influenza vaccines ranges from 70–90% in young adults, depending on the circulating viruses, it falls to 17–53% in the elderly because of their diminished antibody response (Goodwin 2006). Efforts to increase the efficacy of influenza vaccines in adults over age 65 are focusing on such as proposed strategies as the use of higher doses and adjuvants to improve immune function. Overall, both the intramuscular shot and intranasal spray are well tolerated.

Although influenza vaccination coverage for older adults now approaches 70%, mortality and hospitalization rates remain high enough to pose an ongoing public health concern (Glezen 2006). Infectious disease researchers have offered a variety of theories for this paradox, ranging from selection bias in the studies of vaccine effectiveness to waning immune response in the elderly (Jackson 2006a, Jackson 2006b, Goodwin 2006). Although the controversy remains unresolved, the fact that high morbidity and mortality from influenza are reported when effective vaccines are available points to the need to develop improved strategies for delivering influenza vaccines to the most vulnerable elderly patients (Glezen 2006).

Pneumococcal Infections

Streptococcus pneumoniae bacteria colonize the upper respiratory tract. They can be spread from person-to-person through contact with respiratory droplets transmitted by coughing, sneezing, or skin-to-skin contact. Autoinoculation in individuals carrying pneumococci in the upper respiratory tract also is common. Pneumococci are the leading cause of community-acquired pneumonias, bacteremia, meningitis, otitis media, sinusitis, and other bacterial infections. Although the precise immunologic mechanism involved in the onset of these illnesses is unknown, most patients have a predisposing condition, particularly chronic pulmonary, heart, or renal disease; smoking; or impaired immune function (CDC Pink Book 2009).

The most common clinical presentation of pneumococcal disease leading to hospitalization is pneumonia. Following a short (1–3 day) incubation period,

patients experience a rapid onset of fever and chills. Other typical symptoms include chest pain, productive cough, rusty sputum, dyspnea (shortness of breath), hypoxia (poor oxygenation) tachypnea (rapid breathing), tachycardia (rapid heart rate), malaise, and weakness (CDC Pink Book 2009).

Even though the use of the pneumococcal vaccine in children, which is designed to protect against 7 important pneumococcal strains, has helped indirectly protect their parents and grandparents (an effect called “herd immunity”), pneumococcal infections still occur frequently in adults. About 175,000 patients are hospitalized annually for community-acquired pneumonia, while 50,000 cases of bacteremia and 6000 of meningitis are reported each year (NFID Fact Sheet 2002). More important, the case-fatality rate from pneumococcal disease is high, ranging from 5–7% for community-acquired pneumonia to 30–80% for bacterial meningitis. Each year about 6000 people with invasive pneumococcal disease die; experts estimate that vaccination could have prevented more than half of those deaths (see below). Unless vaccination utilization improves, the mortality rate is expected to rise in the future as the incidence of antibiotic resistance increases. Although the current rate of coverage has reached nearly 60% among adults above age 65 as a result of efforts to raise awareness, that figure is still far too short of the 2010 goal of 90%.

All adults above age 65 without evidence of immunity (ie, documentation of prior immunization or evidence of prior infection) should receive the 23-valent polysaccharide pneumococcal vaccine (PPSV23 or Pneumovax 23, Merck) (see Table 1, above). Vaccination is also recommended for younger adults (<65 years) who are immunocompromised, residents of long-term care facilities, or those at high risk for pneumococcal disease (eg, people with chronic cardiovascular, liver, or pulmonary diseases; diabetes mellitus; functional or anatomic asplenia [eg, sickle cell disease]; or other immunocompromising condition). Although antibody levels decline after 5–10 years, the current evidence does not demonstrate a benefit from revaccination except for selected persons with rapid antibody loss or at very high risk of pneumococcal infection (CDC MMWR 2009).

In general, the PPSV23 vaccine is well tolerated and

highly efficacious: more than 80% of healthy adults develop antibodies against the vaccine serotypes within two weeks. Although estimates vary, the CDC reports that the vaccine prevents 60% to 70% of cases of invasive disease (CDC Pink Book 2009).

Herpes Zoster

Infection by the varicella zoster virus causes two discrete clinical conditions, varicella and herpes zoster. The former, also known as “chicken pox,” is a contagious rash that typically infects children, while the latter, commonly called “shingles,” usually emerges in adults decades following an initial varicella infection as the body’s natural immunity begins to wane. Shingles is characterized by a localized, unilateral, and painful skin rash, accompanied by blistering. Clinical signs of the disease are usually preceded by a prodromal period marked by headache, light sensitivity, malaise, abnormal skin sensations, itching, and pain of varying severity. The rash begins with the appearance of erythematous lesions that develop into clusters of clear vesicles, most commonly localized on the chest, neck, and ophthalmic regions. The rash typically lasts 7–10 days, with complete resolution occurring within 2–4 weeks in most cases. However, changes in pigmentation and scarring may be permanent. The primary risk factor for shingles is increasing age (above 60 years). Women, Caucasians, and individuals with a pre-existing inflammatory or immunodeficiency condition, such as human immunodeficiency virus (HIV) or cancer, also have an elevated risk (CDC MMWR 2008).

The most debilitating complication of shingles is postherpetic neuralgia (PHN), a persistent pain that follows the resolution of the rash. PHN is believed to be a consequence of neuronal (axonal) cell damage in the central nervous system stemming from ongoing viral replication. Pain related to PHN may continue for weeks, months, and even years. Shingles patients with severe pain, an extreme rash, or most important, advanced age have the greatest likelihood of developing PHN. Between 10% and 25% of herpes zoster patients may also have eye involvement, a condition known as “herpes zoster ophthalmicus,” which includes various ocular disorders (CDC MMWR 2008). In some cases, herpes zoster eye infection may cause vision loss due to corneal scarring.

Postherpetic neuralgia can have pronounced effects

on quality of life, disturbing daily activities and altering one's mental and physical health and well being. Although antiviral therapy can minimize the severity of shingles if used immediately after the rash appears, the treatment does not prevent PHN. Other drugs that are used for PHN, such as anticonvulsants, antidepressants, and topical ointments, provide only partial relief and are associated with side effects of their own, especially in older adults.

Although not a reportable disease, shingles is estimated to affect about 1 million American adults each year (CDC MMWR 2008). Difficulties in distinguishing cases in which zoster was the cause of or incidental to hospital admission make precise hospitalization rates hard to determine. Mortality is rarely seen in healthy adults; those deaths that do occur are found mainly in patients above age 65.

The herpes zoster vaccine (Zostavax, Merck) can reduce the risk of shingles, PHN, disfiguring scarring, bacterial superinfections, vision-altering complications of the eye, as well as the severity and duration of the disease. The vaccine has a favorable side-effect profile (the most common adverse events are injection-site reactions and headaches) and has been shown to reduce the burden of illness by more than 60% and incidence of PHN by 67% (Oxman 2005). Current guidelines recommend vaccination for all individuals age 60 or above (CDC MMWR 2009). However, people who are seriously immunocompromised (eg, those with leukemia, lymphoma, or other bone-marrow malignancies; people with AIDS; or individuals taking immunosuppressive drugs) should not receive Zostavax.

At present, the durability of protection of Zostavax is unknown. Ongoing longitudinal studies are expected to determine whether a booster dose will be necessary. Current rates of immunization are low, about 2% (see Table 1, above), although experts expect this figure to improve once patients and physicians become more familiar with the vaccine, which was approved for use in 2006 (Schaffner personal communication). Worth noting, too, is the recent finding that Zostavax can be administered in conjunction with influenza vaccines without compromising the immune effect of either agent (Kertzner 2007). In the future, co-administration may improve coverage rates in eligible patients. Unfortunately, many private

insurance plans still fail to cover this vaccine and its inclusion under Medicare Part D presents great difficulties in providing the vaccine.

Human Papillomavirus

Human papillomavirus (HPV) is the most common sexually transmitted infection in the US and the primary cause of cervical cancer in women. About 20 million Americans are already infected and, each year, about 6.2 million people acquire HPV. The infection is most common in adolescents and young adults, with up to 75% of new infections occurring among persons from 15 to 24 years of age. Overall, about 65% of women and 27% of men are infected with the virus (CDC MMWR 2008). The CDC estimates that about \$4 billion a year is spent on managing the medical consequences of HPV infection, a figure greater than the economic burden of all other sexually transmitted infections save for HIV (CDC MMWR 2008)

Different types of HPV carry different risks, so the virus is classified according to its oncogenic (cancer-causing) potential: high-risk or low-risk. The two most common types of high-risk HPV (types 16 and 18) trigger many cervical, anogenital (vulvar, anal, penile), and oral cancers. For instance, squamous cell carcinoma and adenocarcinoma, the two leading types of cervical cancer, are both caused by HPV, and 90% of anal cancers have been attributed to the virus (CDC MMWR 2008). Lower-risk HPV strains are associated with the vast majority of cases of genital warts and other low-grade cervical abnormalities (Schaffner 2008).

The HPV vaccine is the first to be developed explicitly to prevent cancer. Multiple large-scale clinical trials have shown the quadrivalent HPV vaccine (Gardasil, Merck), which protects against viral types 6, 11, 16, and 18, is safe and highly immunogenic in young women (FUTURE II 2007, Garland 2007). In these trials, vaccine efficacy ranged from 95% to 100%, depending on the viral type or cervical cancer precursor lesions studied. Although the trials demonstrated that Gardasil is effective in uninfected women, they offered no evidence of efficacy in women with pre-existing infection. The vaccine also is safe and effective in males. Although no clinical efficacy data are available at present, clinical studies in young men are now underway and an application for FDA approval may be filed in 2009. The most

common side effects seen in the clinical trials were mild-to-moderate injection-site reactions, such as pain, swelling, and erythema (FUTURE II 2007, Garland 2007). Nausea, dizziness, myalgia, and malaise also were reported, although the rates for those receiving vaccine and placebo were the same.

Current ACIP guidelines recommend a 3-dose course of HPV vaccine for all girls and women between the ages of 11 and 26, although immunization can begin as early as age 9 (see Table 1, above). The vaccine can be administered at the same time as others suggested for this cohort (eg, Tdap, meningococcal conjugate, hepatitis B). Older women up to age 45 who are sexually active might also benefit from vaccination, although the vaccine is not yet approved for these adults. All women receiving Gardasil should be given the second and third doses at 2 and 6 months, respectively, following the initial injection. A bivalent HPV vaccine, developed by GSK, Cervarix, has proven effective and been approved in the EU; it is expected to be distributed here within the next year or so.

Hepatitis B

Hepatitis B is a leading cause of liver diseases, including chronic hepatitis, cirrhosis, and liver cancer. HBV is transmitted through the blood and serous fluids via sexual activity, exposure to contaminated needles, transfusions, and from mother to child at birth. Indeed, perinatal transmission is highly efficient – 70–90% of all infants born to mothers who are positive for two hepatitis B antigens (HBsAg and HBeAg) will become infected without postnatal vaccination (prophylaxis) (CDC MMWR 2008). Healthcare workers, people getting tattoos, and household contacts of people with chronic HBV are also at increased risk, as are those who engage in sexual intercourse with multiple partners and inadequate protection. Public health officials estimate that more than 1.25 million Americans are infected with HBV, with 5000 to 8000 new cases reported each year (CDC 2007). Thanks to mandatory infant and child vaccination, as well as measures to decrease HIV/AIDS transmission, the incidence of acute hepatitis B has declined by 75% since 1990. The highest rate of new hepatitis B infections occurs in adults aged 25 – 45 years, nearly 80% of whom are known to engage in the high-risk sexual behaviors or use injection drugs (CDC MMWR 2008).

The initial clinical manifestation of acute hepatitis B infection is jaundice, which is usually preceded by a 3–10 day prodromal phase that is marked by such symptoms as malaise, anorexia, nausea, vomiting, fever, headache, and right upper-quadrant abdominal pain. The icteric (jaundice) phase lasts from 1–3 weeks and is characterized by the presence of light or gray stools and hepatic tenderness and enlargement. Feelings of malaise and fatigue often persist for weeks and months during the recovery period, while other symptoms (eg, jaundice and anorexia) resolve (CDC Pink Book 2009).

Most acute HBV infections result in full recovery. In these cases, anti-HBs antibodies are produced, providing lifetime immunity. However, 1–2% of patients with acute infection develop fulminant hepatitis, 63–93% of whom (200–300 Americans) die from the disease. About 5% of acute HBV infections develop into chronic hepatitis B, with the highest risk occurring in younger patients. In fact, nearly 90% of infants who are infected perinatally will become chronically infected. As noted above cirrhosis and liver cancer are the most serious consequences of chronic HBV infection; thus the HBV vaccine should be seen as another vaccine to prevent cancer. Up to 25% of chronic carriers of HBV will die prematurely from either of these conditions, an estimated 1000 to 1500 persons a year in the US (CDC MMWR 2008)

There is no cure for chronic hepatitis B. Thus, completion of the 3-dose HBV vaccination series (Recombivax HB, Merck; Engerix-B, GSK) is the best means of prevention; more than 90% of healthy adults who complete the course develop antibody responses. Immunogenicity declines with age, however, so that by age 60, only 75% of vaccinated individuals develop protective antibody titers (CDC MMWR 2008). The first two doses should be given at least 4 weeks apart, followed by the final injection 4 to 6 months later. Booster doses are not recommended for adults with normal immune status. The most common side effects of vaccination are injection-site reactions and mild fatigue, headache, and irritability (CDC Pink Book 2009).

At present, only 35% of adults in the critical 18-to-49 age group have been immunized. Higher rates of coverage (about 45%) (Schaffner 2008) are seen in

healthcare workers or in those with an elevated risk due to lifestyle choices, but the numbers are still far below public health goals (see Table 1, above). In an effort to improve utilization, the ACIP now recommends vaccination for: (a) all sexually active individuals who are not in a long-term monogamous relationship, or (b) for those seeking evaluation or treatment for a sexually transmitted disease (MMWR 2009).

Tetanus, Diphtheria, and Pertussis

Although unrelated, these three bacterial diseases will be discussed together, as all can be prevented by the same combination vaccine, Tdap (Boostrix, GSK; Adacel, sanofi pasteur). The two approved approved formulations will be reviewed below as well.

Tetanus is an acute, often fatal illness caused by a toxin produced by the bacterium *Clostridium tetani* (“lockjaw”). The disease is characterized by generalized rigidity and convulsive muscle spasms, initially involving the jaw and neck and then descending downward through the body. Other symptoms include fever, elevated heart rate and blood pressure, and sweating. Tetanus can interfere with breathing, produce bone fractures from sustained convulsions, and lead to essential hypertension (CDC MMWR 2008).

Diphtheria is another acute toxin-mediated illness provoked by the microbe *Corynebacterium diphtheriae*. Toxigenic bacilli typically are acquired in the nasopharynx and then absorbed into the bloodstream, whence they are disseminated throughout the body. The toxin produced by these bacilli are responsible for the major complications of diphtheria, including myocarditis, neuritis, proteinuria, and thrombocytopenia (low platelet count) (CDC MMWR 2008).

The third disease covered by the combination Tdap vaccine is pertussis (whooping cough), an infection caused by the bacterium *Bordetella pertussis*. The bacteria bind with cilia on lung epithelial cells, leading to inflammation of the respiratory tract and impaired clearance of pulmonary secretions. Pertussis is highly communicable, with secondary attack rates of 80% in susceptible household contacts, and is most severe in younger adults and children. The most common complication of pertussis, and the leading cause of death, is secondary pneumonia (CDC MMWR 2008).

The incidence of tetanus and diphtheria in the US is very low due to the availability of effective vaccines. Since 2000, the number of cases of tetanus reported yearly has been about 30, 73% of which followed acute injury or wounds. For diphtheria, the corresponding figure is 1 (CDC MMWR 2008). In contrast, the annual incidence of pertussis reached a low of 2,900 cases during the period 1980–1990. Since then, the rate has been increasing, reaching a high of 25,827 cases in 2004, the largest number since 1959. The reasons for the rising frequency are uncertain, although waning immunity may be a contributing factor. Although many pertussis patients are infants or young children, about 60% of reported cases occur in persons above age 11. The higher incidence in older individuals has been attributed to increased recognition and diagnosis in this cohort (CDC MMWR 2008).

Vaccination with either Tdap vaccine – Boostrix or Adacel – is the best way to prevent these 3 bacterial infections. The vaccines are effective and extremely well tolerated, with the most common side effects being local reactions at the injection site (eg, pain, redness, swelling), mild fever, and headache. Boostrix and Adacel are FDA approved for a single booster dose for older children and adults (10–64 years for Boostrix, 11–64 for Adacel) who completed the recommended childhood DTP/DTaP vaccination series. The ACIP recommends that adults aged 19 to 64 years receive a single dose of Tdap for booster immunization against tetanus, diphtheria, and pertussis after a period of no more than 10 years following administration of the last tetanus toxoid-containing vaccine (MMWR 2009). This schedule is especially important for adults who have close contact with infants, such as childcare or healthcare workers and parents. In sum, all adolescents and adults should have documented completion of at least 3 doses of tetanus and diphtheria toxoids during their lifetime. Individuals without this documentation should be given a 3-dose course, the first of which should be Boostrix or Adacel and the remaining two should be adult formulation Td (tetanus/diphtheria) (MMWR 2009).

IMPROVING THE DELIVERY OF ADULT VACCINES

As we have seen, even though effective and safe vaccines are available, the system for immunizing

adults is less than ideal. On the demand side, patients do not request vaccinations during visits to their doctors, and physicians do not aggressively promote their use. Employers do not require proof of immunization as a condition of work. Private insurance coverage is inconsistent, and public sector financing often falls below the cost of the vaccine plus back-office expenses. On the supply side, the availability of vaccines, particularly those for influenza, can be erratic, and when supplies are on hand, physicians often lack the facilities (eg, refrigerators and supply space) to store them. There is substantial wastage as well. For instance, each year, many millions of doses of influenza vaccine are returned to the manufacturer for credit or scrapped as medical waste. In 2008, about 29 million vials had to be discarded (Aleccia 2009).

To help address these issues, a number of medical professional societies have endorsed programs and protocols to heighten awareness of the importance of adult immunization. Among them are:

- The Institute of Medicine, which published a set of recommendations to improve the vaccine infrastructure, enhance government funding and purchasing of adult vaccines, and assess public and private sector immunization performance.
- The Infectious Diseases Society of America (IDSA) and American College of Physicians (ACP), which issued a joint statement to their members stressing the importance of adult immunization against VPDs.
- The Partnership for Prevention, a group of corporations, non-profit organizations, medical and health professional societies, and government agencies active in promoting disease prevention, which has developed a set of policy recommendations to improve the vaccine infrastructure;
- The National Foundation for Infectious Diseases, along with several other interest groups, governmental agencies (eg, the CDC), and the lobbying group American Association of Retired Persons, recently launched a public and health professional education program on adult immunization called “Saving Lives.” The program’s Web-

site, www.adultvaccination.com, includes portals with links to fact sheets, immunization schedules, along with other background information on the role of vaccines in improving health and quality of life.

- The US Preventive Services Task Force, which has issued recommendations to improve vaccination uptake (<http://www.thecommunityguide.org/vaccines/universally/index.html>). These include the use of such tactics as standing orders, reminder recall, and home medical visits to increase utilization rates.

These initiatives are the first wave of novel programs developed to overhaul the adult immunization infrastructure. Other approaches under consideration include model insurance contracts providing payment for all ACIP vaccines, vouchers to patients to guarantee payment, liability protection for pharmaceutical companies, new research to gather data on the true costs of vaccine delivery, deferred payment plans for vaccine purchasers, and manufacturer/government “buy-back” of unused influenza vaccine following flu season. Several of the current legislative proposals to re-structure US health care guarantee “first-dollar” coverage for adult immunizations, as recommended by the ACIP.

Taken together, these proposals have several objectives. In addition to bolstering the immunization of adults against VPDs, they also have a broader purpose – to shift our thinking about healthcare delivery from one grounded in acute-care treatment to one focused on disease prevention. Such a change in emphasis will undeniably contribute to lower rates of morbidity and mortality. However, the short-term costs of such care may be considerable, even if the long-term savings justify the change. Whether such an approach will prove viable may well depend on the contours of the debate on healthcare reform now underway and the shape of the legislation that ultimately emerges from Congress.

TOWARD THE FUTURE

Newer vaccines, such as those for HPV, HBV, and herpes zoster, have the potential to reduce morbidity and mortality from a host of serious infectious

Adult Immunization: The Need for Enhanced Utilization

diseases and their sequelae. Looking ahead, pharmaceutical companies are exploring the safety and effectiveness of a number of additional vaccine candidates and strategies. First to arrive will likely be improved influenza vaccines. These could include more potent vaccines to better protect high-risk adults and people who are immunocompromised, as well as those that trigger a stronger immune response. Also on the horizon is the availability of improved pneumococcal conjugate vaccines that will allow protection against more bacterial strains. For example, Wyeth is developing a new formulation that will provide coverage against the 13 most prevalent serotypes associated with pneumococcal disease (Wyeth 2009); FDA licensing is anticipated in the near future. At earlier stages of development are vaccines to protect against herpes simplex; staphylococcal (*S. aureus*) infections, including possibly methicillin-resistant staphylococcus aureus (MRSA); and traveler's diarrhea. Unfortunately, a vaccine to prevent HIV remains elusive, as are those against malaria and tuberculosis, two diseases that continue to ravage the developing world.

sons, our system does a poor job of delivering them to the populations in need of vaccination.

The pharmaceutical industry has brought to market a wide array of vaccines to prevent a number of serious infectious diseases, and new and improved products are on the way. Although the pediatric vaccine infrastructure is not perfect, it has been highly effective, although a few parents still refuse to vaccinate their children due to unwarranted concerns about vaccine safety (Omer 2009). For adults, the story is dramatically different, with gaps in perception, understanding, delivery, administration, and financing causing low rates of coverage that fall well short of current public health targets. Today, infectious disease specialists from the public and private sectors are joining together to try to resolve some of these outstanding issues. If these programs are successful, a growing number of adults may come to benefit from the protection afforded them by these safe and potent vaccines.

CONCLUSION

Despite serving as the pharmaceutical foundry of the world and the leader in the development of new medical technologies, the US often fails to allocate its healthcare resources efficiently. This observation is especially apt in the case of adult immunization. The vaccines are available. But for a variety of rea-

Figure 1. Recommended adult immunization schedule by vaccine and age group – United States, 2009

Vaccine ▼	Age Group ►	19 – 26	27 – 49	50 – 59	60 – 64	≥64
Tetanus, diphtheria, pertussis (Td/Tdap) ^{1,*}		Substitute 1 – time dose of Tdap or Td booster; then boost with Td for 10 years				Td booster every 10 yrs
Human papillomavirus (HPV) ^{2,*}		3 doses (females)				
Varicella ^{3,*}		← 2 doses →				
Zoster ⁴					← 1 dose →	
Measles, Mumps, Rubella (MMR) ^{5,*}		← 1 or 2 doses →		← 1 dose →		
Influenza ^{6,*}		← 1 dose annually →				
Pneumococcal ^{7,8}		← 1 or 2 doses →				1 dose
Hepatitis A ^{9,*}		← 2 doses →				
Hepatitis B ^{10,*}		← 3 doses →				
Meningococcal ^{11,*}		← 1 or more doses →				

* 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 infection)



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



No recommendation

OTHER RELIABLE SOURCES

The Website of the Centers for Disease Control and Prevention (CDC) is an excellent source of reliable information on adult vaccination.

<http://www.cdc.gov/vaccines>

Once there, you can also click on the CDC's vaccination and immunization partners, including:

The American Association of Family Physicians
<http://www.aafp.org/online/en/home.html>

The American College of Obstetricians and Gynecologists
<http://www.acog.org/>

The American Nurses Association
<http://www.nursingworld.org/>

Association of State and Territorial Health Officials
<http://www.astho.org/>

Association for Professional in Infection Control & Epidemiology
<http://www.apic.org//AM/Template.cfm?Section=Home1>

Institute of Medicine
<http://www.iom.edu/>

American Association of Occupational Health Nurses
<http://www.aaohn.org/>

Infectious Diseases Society of America
<http://www.idsociety.org/>

National Alliance for Hispanic Health
<http://www.hispanichealth.org/>

National Association of County & City Health Officials at <http://www.naccho.org/>

World Health Organization – Vaccines
http://www.who.int/immunization_delivery/en/

National Network for Immunization Information
<http://www.immunizationinfo.org>

National Foundation for Infections Disease
<http://adultvaccination.com>

Steven Marks would like to thank

Litjen (LJ) Tan, William Schaffner, Lisa Jackson, and W. Paul Glezen, four leaders in the field of infectious diseases, who offered their time, shared their perspectives, and thus helped ensure that this report would be accurate and useful for readers.

REFERENCES

Ahmed F. Attitudes about and barriers to adult immunization. National Vaccine Advisory Committee, 2007. Centers for Disease Control and Prevention. Atlanta, GA.

Available at:

<http://www.hhs.gov/nvpo/nvac/documents/2007oct/Ahmed.ppt#303>

Attitudes About and Barriers to Adult Immunization.

Aleccia JN. "Regular Flu Lingers, But It's Not Too Late For Shots." MSNBC.com, May 20, 2009.

Available at:

<http://www.msnbc.msn.com/id/30828566/>

Centers for Disease Control and Prevention. 2008–09 Influenza prevention and control recommendations: clinical signs and symptoms of influenza.

Available at:

<http://www.cdc.gov/flu/professionals/acip/clinical.htm>.

Accessed June 10, 2009.

Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. Atkinson W, Wolfe S, Hamborsky J, McIntyre L, eds. 11th ed. Washington DC: Public Health Foundation, 2009.

Centers for Disease Control and Prevention. Prevention of herpes zoster: Recommendations of the Advisory Committee on Immunization Practices. MMWR. 2008;57:1–40.

Centers for Disease Control and Prevention. Recommended adult immunization schedule – United States, 2009. MMWR. 2009;57: Q1–4.

Centers for Disease Control and Prevention. Seasonal flu. Available at:

<http://www.cdc.gov/FLU/protect/keyfacts.htm>

Accessed June 10, 2009.

Centers for Disease Control and Prevention, National Foundation for Infectious Diseases. Results of CDC's National Immunization Survey [press conference]. Washington, DC; January 23, 2008.

Department of Health and Human Services. Healthy People 2010: Understanding and Improving Health. Volume 1. Washington, DC: US Department of Health and Human Services, 2001.

Available at:

<http://www.healthypeople.gov/Publications/>

Accessed May 15, 2009.

Department of Health and Human Services. Centers for Medicare & Medicaid Services. Adult immunization overview.

Available at:

<http://www.cms.hhs.gov/AdultImmunizations/>

Accessed May 18, 2009.

Adult Immunization: The Need for Enhanced Utilization

Department of Health and Human Services. National Vaccine Advisory Committee. *Adult Immunization Action Plan*. Revised August 2005. Washington, DC: US Department of Health and Human Services.

Available at:

<http://www.hhs.gov/nvpo/nvac/adult4.html>

Accessed May 18, 2009.

FUTURE II Study Group. Quadrivalent vaccine against human papillomavirus to prevent high-grade cervical lesions. *N Engl J Med*. 2007;356:1915–27.

Garland SM, Hernandez-Avila M, Wheeler CM et al for the FUTURE I Investigators. Quadrivalent vaccine against human papillomavirus to prevent anogenital diseases. *N Engl J Med*. 2007;356:1928–43.

Glezen WP. Prevention and treatment of seasonal influenza. *N Engl J Med*. 2008;359:59–66.

Glezen WP, Simonsen L. Commentary: Benefits of influenza vaccine in US elderly – new studies raise questions. *Int J Epidemiol*. 2006;35:352–53.

Goodwin K, Viboud C, Simonsen L. Antibody response to influenza vaccination in the elderly: a quantitative review. *Vaccine*. 2006;24:1159–69.

Institute of Medicine. *Calling the Shots: Immunization Finance Policies and Practices*. Washington, DC: National Academies of Science. 2000.

Jackson LA, Jackson ML, Nelson JC, Neuzil KM, Weiss NS. Evidence of bias in estimate of influenza vaccine effectiveness in seniors. *Int J Epidemiol*. 2006;35:337–44.

Jackson LA, Nelson JC, Benson P et al. Functional status is a confounder of the association of influenza vaccine and risk of all-cause mortality. *Int J Epidemiol*. 2006;35:345–52.

Langreth R. “Booster Shot.” *Forbes.com*, November 11, 2007.

Available at:

<http://www.forbes.com/global/2007/1112/124.html>.

Kertzner B, Murray AV, Chang E et al. Safety and immunogenicity profile of the concomitant administration of ZOSTAVAX and inactivated influenza vaccine in adults aged 50 or older. *J Am Geriatr Soc*. 2007;55:1499–1507.

Ohmit SE, Monto AS. Symptomatic predictors of influenza virus positivity in children during the influenza season. *Clin Infect Dis*. 2006;43:564–8.

Orenstein WA, Mootrey GT, Pazol K, Hinman AR. Financing immunization of adults in the United States. *Nature*. 2007;82:764–8.

Molinari NAM, Ortega-Sanchez IR, Messonnier ML et al. The annual impact of seasonal influenza in the US: Measuring disease burden and costs. *Vaccine*. 2007;25:5086–96.

National Foundation for Infectious Diseases. *American adults’ awareness about immunization CARAVAN omnibus survey, conducted October 25–8, 2007*, by Opinion Research Corporation. Cited in *Saving Lives: Integrating Vaccines for Adults into Routine Care*. NFID 2009.

National Foundation for Infectious Diseases. *Facts about pneumococcal disease*.

Available at:

<http://www.nfid.org/factsheets/pneumofacts.shtml>

Accessed May 18, 2009.

“New Phase 3 Data Continue to Indicate that Wyeth’s Investigational 13-valent Vaccine has the Potential to Broaden Coverage Against Pneumococcal Disease.” News release, June 11, 2009. Wyeth Pharmaceuticals, Collegeville, PA.

Available at:

<http://www.prnewswire.com/cgi-bin/storiespl?ACCT=PRNI2&STORY=/www/story/06-11-2009/0005042180&EDATE=>

Omer SB, Salmon DA, Orenstein WA et al. Vaccine refusal, mandatory immunization, and the risks of vaccine-preventable diseases. *N Engl J Med*. 2009;360:1981–8.

Oxman MN, Levin MJ, Johnson GR, et al. A vaccine to prevent herpes zoster and postherpetic neuralgia in older adults. *N Engl J Med* 2005;352:2271–84.

Saving Lives: Integrating Vaccines for Adults into Routine Care. Bethesda, MD: National Foundation for Infectious Diseases. 2009.

Available at:

<http://www.nfid.org>

Accessed May 15, 2009.

Schiller JS, Euler GL. *Vaccination coverage estimates from the National Health Interview Survey: US, 2008*. Centers for Disease Control and Protection.

Available at:

http://www.cdc.gov/nchs/data/hestat/vaccine_coverage.pdf

Accessed August 25, 2009.

Thompson WW, Shay DK, Weintraub E et al. Influenza-associated hospitalizations in the United States. *JAMA*. 2004;292:1333–40.

Thompson WW, Shay DK, Weintraub E et al. Mortality associated with influenza and respiratory syncytial virus in the United States. *JAMA*. 2003;289:179–86.

Weinstock H, Berman S, Cates W Jr. Sexually transmitted diseases among American youth: incidence and prevalence estimates, 2000. *Perspect Sex Reprod Health*. 2004;36:6–10.

Winstein KJ. “Fear of Vaccines Spurs Outbreaks, Study Says.”

Wall Street Journal, May 7, 2009.

Available at:

<http://online.wsj.com/article/SB124165229009493675.html>

Adult Immunization: The Need for Enhanced Utilization

ACSH BOARD OF TRUSTEES

<p>Nigel Bark, M.D. <i>Albert Einstein College of Medicine</i></p> <p>Elissa P. Benedek, M.D. <i>University of Michigan Medical School</i></p> <p>James E. Enstrom, Ph.D., M.P.H. <i>University of California, Los Angeles</i></p> <p>Robert Fauber, M.B.A. <i>Moody's Corporation</i></p>	<p>Elizabeth McCaughey, Ph.D. <i>Committee to Reduce Infection Deaths</i></p> <p>Henry I. Miller, M.D. <i>The Hoover Institution</i></p> <p>Rodney W. Nichols <i>The New York Academy of Sciences, President Emeritus</i></p> <p>George F. Ohrstrom <i>The Ohrstrom Foundation Kenneth M. Prager, M.D. Columbia University Medical Center</i></p>	<p>Elizabeth Rose <i>Aim High Productions</i></p> <p>Lee M. Silver, Ph.D. <i>Princeton University</i></p> <p>Thomas P. Stossel, M.D. <i>Harvard Medical School</i></p> <p>Harold D. Stratton, Jr., J.D. <i>Dykema</i></p> <p>Glenn Swogger, Jr., M.D. <i>The Menninger Clinic (ret.)</i></p>
--	---	---

W. Lawrence Beeson, Dr.P.H.
Loma Linda University

Sir Colin Berry, D.Sc., Ph.D., M.D.
Institute of Pathology, Royal London Hospital

William S. Bickel, Ph.D.
University of Arizona

Steven Black, M.D.
Kaiser-Permanente Vaccine Study Center

Blaine L. Blad, Ph.D.
Kanosh, UT

Hinrich L. Bohn, Ph.D.
University of Arizona

Morris E. Chafetz, M.D.
Health Education Foundation

Sam K. C. Chang, Ph.D.
North Dakota State University

Bruce M. Chassy, Ph.D.
University of Illinois, Urbana-Champaign

Martha A. Churchill, Esq.
Milan, MI

Emil William Chynn, M.D., FACS., M.B.A.
New York Eye & Ear Infirmary

Dean O. Cliver, Ph.D.
University of California, Davis

F. M. Clydesdale, Ph.D.
University of Massachusetts

Merle L. Diamond, M.D.
Diamond Headache Clinic

Seymour Diamond, M.D.
Diamond Headache Clinic

Donald C. Dickson, M.S.E.E.
Gilbert, AZ

Ralph Dittman, M.D., M.P.H.
Houston, TX

John E. Dodes, D.D.S.
National Council Against Health Fraud

John Doull, M.D., Ph.D.
University of Kansas

Theron W. Downes, Ph.D.
Okemos, MI

ACSH FOUNDERS CIRCLE

<p>Christine M. Bruhn, Ph.D. <i>University of California</i></p> <p>Taiwo K. Danmola, C.P.A. <i>Ernst & Young</i></p> <p>Thomas R. DeGregori, Ph.D. <i>University of Houston</i></p>	<p>A. Alan Moghissi, Ph.D. <i>Institute for Regulatory Science</i></p> <p>Albert G. Nickel <i>LyonHeart (ret.)</i></p> <p>Stephen S. Sternberg, M.D. <i>Memorial Sloan-Kettering Cancer Center</i></p>	<p>Lorraine Thelian <i>Ketchum</i></p> <p>Kimberly M. Thompson, Sc.D. <i>Massachusetts Institute of Technology</i></p> <p>Robert J. White, M.D., Ph.D. <i>Case Western Reserve University</i></p>
---	---	--

Ben W. Bolch, Ph.D.
Rhodes College

Joseph F. Borzelleca, Ph.D.
Medical College of Virginia

Michael K. Botts, Esq.
Alexandria, VA

George A. Bray, M.D.
Pennington Biomedical Research Center

Ronald W. Brecher, Ph.D., C.Chem., DABT
GlobalTox International Consultants, Inc.

Donald G. Cochran, Ph.D.
Virginia Polytechnic Institute and State University

W. Ronnie Coffman, Ph.D.
Cornell University

Bernard L. Cohen, D.Sc.
University of Pittsburgh

John J. Cohrssen, Esq.
Arlington, VA

Gerald F. Combs, Jr., Ph.D.
USDA Grand Forks Human Nutrition Center

Michael P. Doyle, Ph.D.
University of Georgia

Adam Drewnowski, Ph.D.
University of Washington

Michael A. Dubick, Ph.D.
U.S. Army Institute of Surgical Research

Greg Dubord, M.D., M.P.H.
Toronto Center for Cognitive Therapy

Edward R. Duffie, Jr., M.D.
Savannah, GA

CHAIRMAN

John Moore, Ph.D., M.B.A.
Grove City College, President Emeritus

PRESIDENT

Elizabeth M. Whelan ScD., M.P.H., ACSH

ACSH STAFF

<p>Judith A. D'Agostino <i>Executive Assistant to the President</i></p> <p>Matt Johnston <i>Development Assistant</i></p> <p>A. Marcial C. Lapeña <i>Accountant</i></p>	<p>Anthony Manzo <i>Art Director</i></p> <p>Cheryl E. Martin <i>Associate Director</i></p> <p>Curtis Porter <i>Research Intern</i></p>	<p>Gilbert L. Ross, M.D. <i>Executive and Medical Director</i></p> <p>Todd Seavey <i>Director of Publications</i></p> <p>Jeff Stier, Esq. <i>Associate Director</i></p>
--	---	--

Robert L. Brent, M.D., Ph.D.
Thomas Jefferson University / A. I. duPont Hospital for Children

Allan Brett, M.D.
University of South Carolina

Kenneth G. Brown, Ph.D.
KBinc

Gale A. Buchanan, Ph.D.
Adel, GA

Patricia A. Buffer, Ph.D., M.P.H.
University of California, Berkeley

George M. Burditt, J.D.
Bell, Boyd & Lloyd LLC

Gregory Conko, J.D.
Competitive Enterprise Institute

Michael D. Corbett, Ph.D.
Omaha, NE

Morton Corn, Ph.D.
John Hopkins University

Nancy Cotugna, Dr.Ph., R.D., C.D.N.
University of Delaware

H. Russell Cross, Ph.D.
Texas A&M University

William J. Crowley, Jr., M.D., M.B.A.
Spicewood, TX

Leonard J. Duhl, M.D.
University of California, Berkeley

David F. Duncan, Dr.P.H.
Duncan & Associates

James R. Dunn, Ph.D.
Averill Park, NY

John Dale Dunn, M.D., J.D.
Carl R. Darnall Hospital, Fort Hood, TX

Herbert L. DuPont, M.D.
St. Luke's Episcopal Hospital

Robert L. DuPont, M.D.
Institute for Behavior and Health

Henry A. Dymsha, Ph.D.
University of Rhode Island

ACSH BOARD OF SCIENTIFIC ADVISORS

<p>Ernest L. Abel, Ph.D. <i>C.S. Mott Center</i></p> <p>Gary R. Acuff, Ph.D. <i>Texas A&M University</i></p> <p>Casimir C. Akoh, Ph.D. <i>University of Georgia</i></p> <p>Peter C. Albertsen, M.D. <i>University of Connecticut</i></p> <p>Julie A. Albrecht, Ph.D. <i>University of Nebraska, Lincoln</i></p> <p>Philip Alcabes, Ph.D. <i>Hunter College, CUNY</i></p> <p>James E. Alcock, Ph.D. <i>Glendon College, York University</i></p>	<p>Thomas S. Allems, M.D., M.P.H. <i>San Francisco, CA</i></p> <p>Richard G. Allison, Ph.D. <i>Federation of American Societies for Experimental Biology</i></p> <p>John B. Allred, Ph.D. <i>Ohio State University</i></p> <p>Philip R. Alper, M.D. <i>University of California, San Francisco</i></p> <p>Karl E. Anderson, M.D. <i>University of Texas Medical Branch, Galveston</i></p> <p>Jerome C Arnett, Jr., M.D. <i>Elkins, WV</i></p>	<p>Dennis T. Avery <i>Hudson Institute</i></p> <p>Ronald P. Bachman, M.D. <i>Kaiser-Permanente Medical Center</i></p> <p>Heejung Bang, Ph.D. <i>Weill Medical College of Cornell University</i></p> <p>Robert S. Baratz, D.D.S., Ph.D., M.D. <i>International Medical Consultation Services</i></p> <p>Stephen Barrett, M.D. <i>Pittsboro, NC</i></p> <p>Thomas G. Baumgartner, Pharm.D., M.Ed. <i>University of Florida</i></p>
---	---	--

Edward E. Burns, Ph.D.
Texas A&M University

Francis F. Busta, Ph.D.
University of Minnesota

Elwood F. Caldwell, Ph.D., M.B.A.
University of Minnesota

Zerle L. Carpenter, Ph.D.
Texas A&M University

Robert G. Cassens, Ph.D.
University of Wisconsin, Madison

Ercole L. Cavaliere, D.Sc.
University of Nebraska

Russell N. A. Cecil, M.D., Ph.D.
Albany Medical College

Rino Cerio, M.D.
Barts and The London Hospital Institute of Pathology

James W. Curran, M.D., M.P.H.
Rollins School of Public Health, Emory University

Charles R. Curtis, Ph.D.
Ohio State University

Ilene R. Danse, M.D.
Bolinas, CA

Sherrill Davison, V.M.D., M.S., M.B.A.
University of Pennsylvania

Elvira G. de Mejia, Ph.D.
University of Illinois, Urbana-Champaign

Peter C. Dedon, M.D., Ph.D.
Massachusetts Institute of Technology

Robert M. Devlin, Ph.D.
University of Massachusetts

Michael W. Easley, D.D.S., M.P.H.
Florida Department of Health

George E. Ehrlich, M.D., M.B.
Philadelphia, PA

Michael P. Elston, M.D., M.S.
Western Health

William N. Elwood, Ph.D.
NIH/Center for Scientific Review

Edward A. Emken, Ph.D.
Midwest Research Consultants

Nicki J. Engeseth, Ph.D.
University of Illinois

Stephen K. Epstein, M.D., M.P.P., FACEP
Beth Israel Deaconess Medical Center

Adult Immunization: The Need for Enhanced Utilization

- Myron E. Essex, D.V.M., Ph.D.**
Harvard School of Public Health
- Terry D. Etherton, Ph.D.**
Pennsylvania State University
- R. Gregory Evans, Ph.D., M.P.H.**
St. Louis University Center for the Study of Bioterrorism and Emerging Infections
- William Evans, Ph.D.**
University of Alabama
- Daniel F. Farkas, Ph.D., M.S., P.E.**
Oregon State University
- Richard S. Fawcett, Ph.D.**
Huxley, IA
- Owen R. Fennema, Ph.D.**
University of Wisconsin, Madison
- Frederick L. Ferris, III, M.D.**
National Eye Institute
- David N. Ferro, Ph.D.**
University of Massachusetts
- Madelon L. Finkel, Ph.D.**
Weill Medical College of Cornell University
- Kenneth D. Fisher, Ph.D.**
Office of Dietary Supplements
- Leonard T. Flynn, Ph.D., M.B.A.**
Morganville, NJ
- William H. Foege, M.D., M.P.H.**
Seattle, WA
- Ralph W. Fogleman, D.V.M.**
Savannah, GA
- Christopher H. Foreman, Jr., Ph.D.**
University of Maryland
- Glenn W. Froning, Ph.D.**
University of Nebraska, Lincoln
- Vincent A. Fulginiti, M.D.**
Tucson, AZ
- Robert S. Gable, Ed.D., Ph.D., J.D.**
Claremont Graduate University
- Shayne C. Gad, Ph.D., D.A.B.T., A.T.S.**
Gad Consulting Services
- William G. Gaines, Jr., M.D., M.P.H.**
College Station, TX
- Charles O. Gallina, Ph.D.**
Professional Nuclear Associates
- Raymond Gambino, M.D.**
Quest Diagnostics Incorporated
- J. Bernard L. Gee, M.D.**
Yale University School of Medicine
- K. H. Ginzel, M.D.**
University of Arkansas for Medical Science
- William Paul Glezen, M.D.**
Baylor College of Medicine
- Jay A. Gold, M.D., J.D., M.P.H.**
Medical College of Wisconsin
- Roger E. Gold, Ph.D.**
Texas A&M University
- Reneé M. Goodrich, Ph.D.**
University of Florida
- Frederick K. Goodwin, M.D.**
The George Washington University Medical Center
- Timothy N. Gorski, M.D., F.A.C.O.G.**
University of North Texas
- Ronald E. Gots, M.D., Ph.D.**
International Center for Toxicology and Medicine
- Henry G. Grabowski, Ph.D.**
Duke University
- James Ian Gray, Ph.D.**
Michigan State University
- William W. Greaves, M.D., M.S.P.H.**
Medical College of Wisconsin
- Kenneth Green, D.Env.**
American Interprise Institute
- Laura C. Green, Ph.D., D.A.B.T.**
Cambridge Environmental, Inc.
- Richard A. Greenberg, Ph.D.**
Hinsdale, IL
- Sander Greenland, Dr.P.H., M.S., M.A.**
UCLA School of Public Health
- Gordon W. Gribble, Ph.D.**
Dartmouth College
- William Grierson, Ph.D.**
University of Florida
- F. Peter Guengerich, Ph.D.**
Vanderbilt University School of Medicine
- Caryl J. Guth, M.D.**
Advance, NC
- Philip S. Guzelian, M.D.**
University of Colorado
- Terryl J. Hartman, Ph.D., M.P.H., R.D.**
The Pennsylvania State University
- Clare M. Hasler, Ph.D.**
The Robert Mondavi Institute of Wine and Food Science, University of California, Davis
- Virgil W. Hays, Ph.D.**
University of Kentucky
- Cheryl G. Heaton, Dr.PH.**
Mailman School of Public Health of Columbia University
- Clark W. Heath, Jr., M.D.**
American Cancer Society
- Dwight B. Heath, Ph.D.**
Brown University
- Robert Heimer, Ph.D.**
Yale School of Public Health
- Robert B. Helms, Ph.D.**
American Enterprise Institute
- Zane R. Helsel, Ph.D.**
Rutgers University, Cook College
- James D. Herbert, Ph.D.**
Drexel University
- Richard M. Hoar, Ph.D.**
Williamstown, MA
- Theodore R. Holford, Ph.D.**
Yale University School of Medicine
- Robert M. Hollingworth, Ph.D.**
Michigan State University
- Edward S. Horton, M.D.**
Joslin Diabetes Center/Harvard Medical School
- Joseph H. Hotchkiss, Ph.D.**
Cornell University
- Clifford A. Hudis, M.D.**
Memorial Sloan-Kettering Cancer Center
- Peter Barton Hutt, Esq.**
Covington & Burling, LLP
- Susanne L. Huttner, Ph.D.**
University of California, Berkeley
- Lucien R. Jacobs, M.D.**
University of California, Los Angeles
- Alejandro R. Jadad, M.D., D.Phil., F.R.C.P.C.**
University of Toronto
- Rudolph J. Jaeger, Ph.D.**
Environmental Medicine, Inc.
- William T. Jarvis, Ph.D.**
Loma Linda, CA
- Elizabeth H. Jeffery, Ph.D.**
University of Illinois, Urbana
- Geoffrey C. Kabat, Ph.D., M.S.**
Albert Einstein College of Medicine
- Michael Kamrin, Ph.D.**
Michigan State University
- John B. Kaneene, D.V.M., M.P.H., Ph.D.**
Michigan State University
- P. Andrew Karam, Ph.D., CHP**
MJW Corporation
- Kathryn E. Kelly, Dr.P.H.**
Delta Toxicology
- George R. Kerr, M.D.**
University of Texas, Houston
- George A. Keyworth II, Ph.D.**
Progress and Freedom Foundation
- F. Scott Kieff, J.D.**
Washington University School of Law
- Michael Kirsch, M.D.**
Highland Heights, OH
- John C. Kirschman, Ph.D.**
Allentown, PA
- William M. P. Klein, Ph.D.**
University of Pittsburgh
- Ronald E. Kleinman, M.D.**
Massachusetts General Hospital/Harvard Medical School
- Leslie M. Klevay, M.D., S.D. in Hyg.**
University of North Dakota School of Medicine and Health Sciences
- David M. Klurfeld, Ph.D.**
U.S. Department of Agriculture
- Kathryn M. Kolasa, Ph.D., R.D.**
East Carolina University
- James S. Koopman, M.D., M.P.H.**
University of Michigan School of Public Health
- Alan R. Kristal, Dr.P.H.**
Fred Hutchinson Cancer Research Center
- Stephen B. Kritchevsky, Ph.D.**
Wake Forest University Baptist Medical Center
- Mitzi R. Krockover, M.D.**
SSB Solutions
- Manfred Kroger, Ph.D.**
Pennsylvania State University
- Sandford F. Kuvin, M.D.**
University of Miami School of Medicine/ Hebrew University of Jerusalem
- Carolyn J. Lackey, Ph.D., R.D.**
North Carolina State University
- J. Clayburn LaForce, Ph.D.**
University of California, Los Angeles
- Robert G. Lahita, M.D., Ph.D.**
Mount Sinai School of Medicine
- James C. Lamb, IV, Ph.D., J.D., D.A.B.T.**
The Weinberg Group
- Lawrence E. Lamb, M.D.**
San Antonio, TX
- William E. M. Lands, Ph.D.**
College Park, MD
- Lillian Langseth, Dr.P.H.**
Lyda Associates, Inc.
- Brian A. Larkins, Ph.D.**
University of Arizona
- Larry Laudan, Ph.D.**
National Autonomous University of Mexico
- Tom B. Leamon, Ph.D.**
Liberty Mutual Insurance Company
- Jay H. Lehr, Ph.D.**
Environmental Education Enterprises, Inc.
- Brian C. Lentle, MD., FRCP, DMRD**
University of British Columbia
- Scott O. Lilienfeld, Ph.D.**
Emory University
- Floy Lilley, J.D.**
Fernandina Beach, FL
- Paul J. Lioy, Ph.D.**
UMDNJ-Robert Wood Johnson Medical School
- William M. London, Ed.D., M.P.H.**
California State University, Los Angeles
- Frank C. Lu, M.D., BCFE**
Miami, FL
- William M. Lurch, Ph.D.**
Oregon State University
- Daryl B. Lund, Ph.D.**
University of Wisconsin-Madison
- John R. Lupien, M.Sc.**
University of Massachusetts
- Howard D. Maccabee, Ph.D., M.D.**
Alamo, CA
- Janet E. Macheledt, M.D., M.S., M.P.H.**
Houston, TX
- Henry G. Manne, J.S.D.**
George Mason University Law School
- Karl Maramorosch, Ph.D.**
Rutgers University, Cook College
- Judith A. Marlett, Ph.D., R.D.**
University of Wisconsin, Madison
- Lawrence J. Marnett, Ph.D.**
Vanderbilt University
- James R. Marshall, Ph.D.**
Roswell Park Cancer Institute
- Roger O. McClellan, D.V.M., M.M.S., DABT, DABVT, FATS**
Toxicology and Risk Analysis
- Mary H. McGrath, M.D., M.P.H.**
University of California, San Francisco
- Alan G. McHughen, D.Phil.**
University of California, Riverside
- James D. McKean, D.V.M., J.D.**
Iowa State University
- Joseph P. McMenamin, M.D., J.D.**
McGuireWoods, LLP
- Patrick J. Michaels, Ph.D.**
University of Virginia
- Thomas H. Milby, M.D., M.P.H.**
Walnut Creek, CA
- Joseph M. Miller, M.D., M.P.H.**
Durham, NH
- Richard A. Miller, M.D.**
Pharmacycics, Inc.
- Richard K. Miller, Ph.D.**
University of Rochester
- William J. Miller, Ph.D.**
University of Georgia
- Grace P. Monaco, J.D.**
Medical Care Ombudsman Program
- Brian E. Mondell, M.D.**
Baltimore Headache Institute
- John W. Morgan, Dr.P.H.**
California Cancer Registry
- Stephen J. Moss, D.D.S., M.S.**
New York University College of Dentistry/ Health Education Enterprises, Inc.
- Brooke T. Mossman, Ph.D.**
University of Vermont College of Medicine
- Allison A. Muller, Pharm.D.**
The Childrens Hospital of Philadelphia
- Ian C. Munro, F.A.T.S., Ph.D., FRCPATH**
Cantox Health Sciences International
- Harris M. Nagler, M.D.**
Beth Israel Medical Center/ Albert Einstein College of Medicine
- Daniel J. Ncayiyana, M.D.**
Benguela Health
- Philip E. Nelson, Ph.D.**
Purdue University
- Joyce A. Nettleton, D.Sc., R.D.**
Denver, CO
- John S. Neuberger, Dr.P.H.**
University of Kansas School of Medicine
- Gordon W. Newell, Ph.D., M.S., F.-A.T.S.**
Cupertino, CA
- Thomas J. Nicholson, Ph.D., M.P.H.**
Western Kentucky University
- Robert J. Nicolosi, Ph.D.**
University of Massachusetts, Lowell
- Steven P. Novella, M.D.**
Yale University School of Medicine
- James L. Oblinger, Ph.D.**
North Carolina State University
- Paul A. Offit, M.D.**
The Childrens Hospital of Philadelphia
- John Patrick O'Grady, M.D.**
Tufts University School of Medicine
- James E. Oldfield, Ph.D.**
Oregon State University
- Stanley T. Omaye, Ph.D., F.-A.T.S., F.A.C.N., C.N.S.**
University of Nevada, Reno
- Michael T. Osterholm, Ph.D., M.P.H.**
University of Minnesota

Adult Immunization: The Need for Enhanced Utilization

- Michael W. Pariza, Ph.D.**
University of Wisconsin, Madison
- Stuart Patton, Ph.D.**
Pennsylvania State University
- James Marc Perrin, M.D.**
Mass General Hospital for Children
- Jay Phelan, M.D.**
Wyle Integrated Science and Engineering Group
- Timothy Dukes Phillips, Ph.D.**
Texas A&M University
- Mary Frances Picciano, Ph.D.**
National Institutes of Health
- David R. Pike, Ph.D.**
University of Illinois, Urbana-Champaign
- Steven Pinker, Ph.D.**
Harvard University
- Henry C. Pitot, M.D., Ph.D.**
University of Wisconsin-Madison
- Thomas T. Poleman, Ph.D.**
Cornell University
- Gary P. Posner, M.D.**
Tampa, FL
- John J. Powers, Ph.D.**
University of Georgia
- William D. Powrie, Ph.D.**
University of British Columbia
- C.S. Prakash, Ph.D.**
Tuskegee University
- Marvin P. Pritts, Ph.D.**
Cornell University
- Daniel J. Raiten, Ph.D.**
National Institute of Health
- David W. Ramey, D.V.M.**
Ramey Equine Group
- R.T. Ravenholt, M.D., M.P.H.**
Population Health Imperatives
- Russel J. Reiter, Ph.D.**
University of Texas, San Antonio
- William O. Robertson, M.D.**
University of Washington School of Medicine
- J. D. Robinson, M.D.**
Georgetown University School of Medicine
- Brad Rodu, D.D.S.**
University of Louisville
- Bill D. Roebuck, Ph.D., D.A.B.T.**
Dartmouth Medical School
- David B. Roll, Ph.D.**
The United States Pharmacopeia
- Dale R. Romsos, Ph.D.**
Michigan State University
- Joseph D. Rosen, Ph.D.**
Cook College, Rutgers University
- Steven T. Rosen, M.D.**
Northwestern University Medical School
- Stanley Rothman, Ph.D.**
Smith College
- Stephen H. Safe, D.Phil.**
Texas A&M University
- Wallace I. Sampson, M.D.**
Stanford University School of Medicine
- Harold H. Sandstead, M.D.**
University of Texas Medical Branch
- Charles R. Santerre, Ph.D.**
Purdue University
- Sally L. Satel, M.D.**
American Enterprise Institute
- Lowell D. Satterlee, Ph.D.**
Vergas, MN
- Mark V. Sauer, M.D.**
Columbia University
- Jeffrey W. Savell**
Texas A&M University
- Marvin J. Schissel, D.D.S.**
Roslyn Heights, NY
- Edgar J. Schoen, M.D.**
Kaiser Permanente Medical Center
- David Schottenfeld, M.D., M.Sc.**
University of Michigan
- Joel M. Schwartz, M.S.**
American Enterprise Institute
- David E. Seidemann, Ph.D.**
Brooklyn College
- David A. Shaywitz, M.D., Ph.D.**
The Boston Consulting Group
- Patrick J. Shea, Ph.D.**
University of Nebraska, Lincoln
- Michael B. Shermer, Ph.D.**
Skeptic Magazine
- Sidney Shindell, M.D., LL.B.**
Medical College of Wisconsin
- Sarah Short, Ph.D., Ed.D., R.D.**
Syracuse University
- A. J. Siedler, Ph.D.**
University of Illinois, Urbana-Champaign
- Marc K. Siegel, M.D.**
New York University School of Medicine
- Michael Siegel, M.D., M.P.H.**
Boston University School of Public Health
- Michael S. Simon, M.D., M.P.H.**
Wayne State University
- S. Fred Singer, Ph.D.**
Science & Environmental Policy Project
- Robert B. Sklaroff, M.D.**
Philadelphia, PA
- Anne M. Smith, Ph.D., R.D., L.D.**
Ohio State University
- Gary C. Smith, Ph.D.**
Colorado State University
- John N. Sofos, Ph.D.**
Colorado State University
- Laszlo P. Somogyi, Ph.D.**
SRI International (ret.)
- Roy F. Spalding, Ph.D.**
University of Nebraska, Lincoln
- Leonard T. Sperry, M.D., Ph.D.**
Florida Atlantic University
- Robert A. Squire, D.V.M., Ph.D.**
Johns Hopkins University
- Ronald T. Stanko, M.D.**
University of Pittsburgh Medical Center
- James H. Steele, D.V.M., M.P.H.**
University of Texas, Houston
- Robert D. Steele, Ph.D.**
Pennsylvania State University
- Daniel T. Stein, M.D.**
Albert Einstein College of Medicine
- Judith S. Stern, Sc.D., R.D.**
University of California, Davis
- Ronald D. Stewart, O.C., M.D., FRCPC**
Dalhousie University
- Martha Barnes Stone, Ph.D.**
Colorado State University
- Jon A. Story, Ph.D.**
Purdue University
- Sita R. Tatini, Ph.D.**
University of Minnesota
- Dick Taverne**
House of Lords, UK
- Steve L. Taylor, Ph.D.**
University of Nebraska, Lincoln
- Andrea D. Tiglio, Ph.D., J.D.**
Townsend and Townsend and Crew, LLP
- James W. Tillotson, Ph.D., M.B.A.**
Tufts University
- Dimitrios Trichopoulos, M.D.**
Harvard School of Public Health
- Murray M. Tuckerman, Ph.D.**
Winchendon, MA
- Robert P. Upchurch, Ph.D.**
University of Arizona
- Mark J. Utell, M.D.**
University of Rochester Medical Center
- Shashi B. Verma, Ph.D.**
University of Nebraska, Lincoln
- Willard J. Visek, M.D., Ph.D.**
University of Illinois College of Medicine
- Lynn Waishwell, Ph.D., C.H.E.S.**
University of Medicine and Dentistry of New Jersey, School of Public Health
- Brian Wansink, Ph.D.**
Cornell University
- Miles Weinberger, M.D.**
University of Iowa Hospitals and Clinics
- John Weisburger, Ph.D.**
New York Medical College
- Janet S. Weiss, M.D.**
The TaxDoc
- Simon Wessley, M.D., FRCP**
King's College London and Institute of Psychiatry
- Steven D. Wexner, M.D.**
Cleveland Clinic Florida
- Joel Elliot White, M.D., F.A.C.R.**
Danville, CA
- John S. White, Ph.D.**
White Technical Research
- Kenneth L. White, Ph.D.**
Utah State University
- Carol Whitlock, Ph.D., R.D.**
Rochester Institute of Technology
- Christopher F. Wilkinson, Ph.D.**
Wilmington, NC
- Mark L. Willenbring, M.D., Ph.D.**
National Institute on Alcohol Abuse and Alcoholism
- Carl K. Winter, Ph.D.**
University of California, Davis
- James J. Worman, Ph.D.**
Rochester Institute of Technology
- Russell S. Worrall, O.D.**
University of California, Berkeley
- S. Stanley Young, Ph.D.**
National Institute of Statistical Science
- Steven H. Zeisel, M.D., Ph.D.**
University of North Carolina
- Michael B. Zemel, Ph.D.**
Nutrition Institute, University of Tennessee
- Eckhard E. Ziegler, M.D.**
University of Iowa

THE OPINIONS EXPRESSED IN ACGS PUBLICATIONS DO NOT NECESSARILY REPRESENT THE VIEWS OF ALL MEMBERS OF THE ACGS BOARD OF TRUSTEES, FOUNDERS CIRCLE AND BOARD OF SCIENTIFIC AND POLICY ADVISORS, WHO ALL SERVE WITHOUT COMPENSATION.
