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Special Communication

Adult Immunization

Summary of the National Vaccine Advisory Committee Report

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In January 1994 the National Vaccine Advisory Committee adopted a report that reviewed the status of adult immunization in the United States. Vaccine-preventable infections of adults represent a continuing cause of morbidity and mortality. Their major impact is among older persons. Effective and safe vaccines against these diseases are available, but they are poorly used. Several reasons account for low immunization levels among adults, including inadequate awareness by health care providers and the public of the importance and benefits of vaccination. Health care providers often fail to take advantage of opportunities to immunize adults during office, clinic, and hospital contacts and fail to organize programs in medical settings that ensure adults are offered the vaccines they need. Inadequate reimbursement for adult immunization by public and private health insurers and a lack of federal programs to support vaccine delivery are also major problems. The National Vaccine Advisory Committee's report includes five goals and 18 recommendations for improving adult immunization. To reach the Public Health Service adult immunization goals for the year 2000, the Committee recommends (1) improvements in public and provider education; (2) major changes in clinical practice; (3) increased financial support by public and private health insurers; (4) improved surveillance of vaccine-preventable diseases and vaccine production and delivery; and (5) support for research on vaccine-preventable diseases, new and improved vaccines, immunization practices, and international programs for adult immunization. (*JAMA*. 1994;272:1133-1137)

IMMUNIZATION programs in the United States have dramatically reduced the occurrence of many childhood infectious diseases (Table 1).[1,2] Diphtheria and childhood tetanus have practically disappeared, and fatal cases of pertussis (whooping cough) are rare.[3] No cases of indigenous poliomyelitis have been reported since 1979.[4] The occurrence of measles has been substantially reduced.[5] Cases of childhood rubella are rarely observed, and there are few reports of congenital rubella syndrome.[6] Childhood mumps is seldom encountered by physicians.[7] The recent extraordinary decline in *Haemophilus influenzae* type b meningitis is largely attributable to widespread use of *Haemophilus influenzae* type b vaccines.[8] Nonetheless, the reemergence of measles during the period 1989 through 1991,[5] the persistence of congenital rubella syndrome,[6] and lingering questions about the safety of pertussis vaccine[9] are sobering reminders that control of vaccine-preventable childhood diseases requires constant vigilance. Our nation has responded with an unhesitating commitment of resources to expand our immunization efforts, most notably the president's Childhood Immunization Initiative.[10]

The contrast between the impact of vaccine-preventable diseases of adults compared with those of children is striking. Each year, fewer than 500 persons in the United States die of vaccine-preventable diseases of childhood. By comparison, 50 000 to 70 000 adults die of influenza, pneumococcal infections, and hepatitis B (Table 2).[11] In addition, many childhood vaccine-preventable infections are now found among young adults. Outbreaks of measles,[5,12] rubella,[13] and mumps[7,14] have caused major disruptions on college campuses, in the workplace, and in institutions such as hospitals and prisons. Vaccine-preventable diseases remain an important cause of costly hospitalization, especially among the elderly.[15]

Currently, 98% or more of American children are fully immunized by the time of school entry.[1] Although in some communities the proportion fully immunized by 2 years of age is much lower, several programs have been established to address this problem.[10] In contrast, and in spite of the much heavier burden of disease, vaccines that are recommended for adults are not widely used (Table 2).[11] Several reasons have been given to explain this. First, there is a limited perception on the part of both health care providers and the general public that adult vaccine-preventable diseases are significant health problems. Second, there are doubts in the minds of some health care providers and the public about the efficacy and safety of several of the vaccines used for adults. Third, adult immunization is selective not universal; different vaccines have different target groups (Table 3). Fourth, the sizes of the adult target populations for individual vaccines vary and for some vaccines are much larger than the target population for childhood vaccination. Fifth, unlike the childhood vaccination schedule that must be completed if children are to enter school, there are no statutory requirements for adult immunization. Sixth, unlike the child health care practices in most communities, there are few programs in either the public or private sectors for vaccinating adults. Finally, reimbursement for adult immunization has traditionally been neglected by both government and private insurers; children can usually obtain inexpensive or free vaccines from public health clinics, but until recently most adults have had to pay the full costs for most of their vaccines. The public availability of vaccines, school entry vaccination requirements, and responsible parenting have given our nation a high level of childhood immunization. In the best of circumstances, it would be difficult to achieve the same for adults.

In spite of these problems, adult immunization has not been ignored. More than 10 years ago two new vaccines for adults were licensed: pneumococcal vaccine in 1977 and hepatitis B vaccine in 1983. The 1980s brought many new initiatives to promote adult immunization, including those of the Advisory Committee on Immunization Practices,[16,17] the American College of Physicians,[18] the Infectious Diseases Society of America,[18] and the US Preventive Services Task Force.[19] In 1988 the Health Care Financing Administration (HCFA) launched its Medicare Influenza Vaccine Demonstration.[20] During the next 4 years, close to $69 million was spent in a multifaceted program to increase influenza vaccination among Medicare enrollees and to evaluate its cost-effectiveness and health benefits.

A complete list of committee members appears at the end of this article.

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Table 1.—Reported Cases of Vaccine-Preventable Childhood Diseases in the United States*

Disease	Maximal No. of Cases (y)	1993 Cases†	Reduction, %
Diphtheria	206 939 (1921)	0	-100.0
Pertussis	265 269 (1934)	6132	-97.7
Tetanus‡	1560 (1923)	9	-99.4
Poliomyelitis (paralytic)	21 269 (1952)	0§	-100.0
Measles	894 134 (1941)	277	-99.9
Rubella‖	57 686 (1969)	188	-99.7
Congenital rubella syndrome	20 000 (1964-1965)	7	-99.9
Mumps¶	152 209 (1968)	1630	-98.9

*Data from the National Immunization Program, Centers for Disease Control and Prevention (CDC), Atlanta, Ga.
†Provisional data that may change because of late reporting.
‡Data from the CDC on tetanus refer to deaths not cases; CDC does not have information on the numbers of reported tetanus cases before 1947. The number of reported deaths refers to 1992. Mortality data for 1993 are not available. The provisional number of tetanus cases reported for 1993 is 42.
§Excludes an estimated four cases of vaccine-associated paralysis.
‖Rubella first became a reportable disease in 1966.
¶Mumps first became a reportable disease in 1968.

Table 2.—Estimated Effect of Full Use of Vaccines Currently Recommended for Adults*

Disease	Estimated Annual Deaths, No.	Estimated Vaccine Efficacy, %†	Current Vaccine Utilization, %‡	Additional Preventable Deaths per y, No.§
Influenza	20 000‖	70	41	8260
Pneumococcal infection	40 000	60	20	19 200
Hepatitis B	5000	90	10¶	4050
Tetanus-diphtheria	<25	99	40#	<15
Measles, mumps, and rubella	<30	95	Variable	<30
Travelers' diseases**	<10	...††	...	<10

*Adapted from Gardner and Schaffner.[11]
†Indicates efficacy in immunocompetent adults. Among elderly and immunocompromised patients, estimated efficacy may be lower.
‡The percentage of targeted groups who have been immunized according to current recommendations. Rates vary among different targeted groups. Data for influenza and pneumococcal vaccines were obtained from the 1991 National Health Interview Survey and apply to persons 65 years of age or older.
§Calculated as follows: (potential additional vaccine utilization)×(estimated vaccine efficacy)×(estimated annual deaths).
‖Variable (range, 0 to 40 000).
¶Highly variable (range, 1% to 60%) among different targeted groups.
#This estimate is based on seroprevalence data.
**Travelers' diseases include cholera, typhoid, Japanese encephalitis, yellow fever, poliomyelitis, and rabies.
††Ellipses indicate not applicable.

Discussion of how to improve adult immunization must be included in the debate over health system reform in the United States. Vaccine-preventable diseases of adults impose significant health care costs on the nation. Yet, there is strong evidence that adult immunization is highly cost-effective.[11,18] Thus, the choice we face is not simply deciding whether to pay for adult immunization, it is whether to pay more for the costs of treating unprevented illness or less for preventing it from occurring in the first place.

In January 1994 the National Vaccine Advisory Committee (NVAC) adopted a report that reviewed the status of adult immunization in the United States.[21] This article summarizes the NVAC report, including the committee's goals and recommendations (Table 4).

1. INCREASE THE DEMAND FOR ADULT VACCINATION BY IMPROVING PROVIDER AND PUBLIC AWARENESS

In 1980 the surgeon general recommended that by 1990 60% of all elderly and high-risk persons should be immunized with influenza and pneumococcal vaccines and 50% of target groups for new vaccines (eg, hepatitis B vaccine) should be vaccinated within 5 years of vaccine licensure.[22] In 1990 these goals had not been reached.

Surveys conducted during the 1980s showed that physicians generally understood the importance of vaccine-preventable diseases and knew about the efficacy and safety of vaccines recommended for adults. However, they often failed to translate their knowledge into clinical practice.[23] Several studies demonstrated that good administration and organization were the keys to the success of vaccination programs.[23] Although specific details varied, for each successful program a decision had been made to establish an organized approach for offering vaccines to adults on a regular basis.

Better public understanding of the seriousness of vaccine-preventable diseases and the benefits of vaccination is essential.[16,18] Many elderly patients fail to appreciate that influenza presents a risk of severe illness that may lead to hospital admission or death.[23] Most elderly patients have no knowledge of the frequency or severity of pneumococcal infections. Few young adults who have multiple sexual partners understand their risks for acquiring hepatitis B. Many adults are unaware of the clinical effectiveness and safety of the vaccines that can prevent these diseases. Educational programs can help increase public understanding of the need for and benefits of adult immunization. This was illustrated recently during the HCFA Medicare Influenza Vaccine Demonstration, when a letter sent to Medicare enrollees by the HCFA administrator was helpful in persuading older persons to get vaccinated.[24]

The NVAC recommends that educational programs be undertaken to improve the adult immunization practices of physicians and other health care providers. These programs should emphasize widespread dissemination of the goals and recommendations for adult immunization, periodic assessment of provider knowledge and attitudes about vaccines and immunization practices, and better understanding of the administrative and organizational features of successful vaccination programs. Greater emphasis should be given to adult immunization in professional education and certification, and more attention should be devoted to practical approaches for vaccine delivery in training programs, including appropriate immunization of students and trainees themselves. The committee recommends that the public also be better informed of the importance of vaccine-preventable diseases of adults and of the safety and benefits of immunization. This will require an understanding of factors that constitute barriers or promote easy access to vaccination services. The committee recommends educational programs and media campaigns for adult immunization, especially those that are linked to announcements routinely directed to target populations by government agencies and community organizations.

2. ASSURE THAT THE HEALTH CARE SYSTEM HAS AN ADEQUATE CAPACITY TO DELIVER VACCINES TO ADULTS

An efficacious vaccine will be effective in preventing disease only if it is given to those who will benefit. The importance of vaccine delivery has been dramatically demonstrated by the contributions of the Centers for Disease Control and Prevention (CDC) to childhood immunization. Approximately half of all children in the United States are immunized through state and local public health programs that use vaccines purchased under federal contracts negotiated by the CDC.[1] Studies by CDC investigators on the epidemiology of vaccine-preventable diseases, the susceptibility of children to infection, and the shortcomings of vaccine delivery pro-

Table 3.—Vaccines and Toxoids Recommended for All Adults*

Age Group, y	Influenza (Annually)	Pneumococcal	Measles	Rubella	Mumps	Td†
18-24	...	...	X	X	X	X
25-64	...	...	X‡	X	X§	X
≥65	X	X	...	...	...	X

*Adapted from Centers for Disease Control.[18] This report should be consulted for detailed recommendations on immunizing adults who have high-risk medical conditions; who are immunocompromised; who have special occupations, lifestyles, or environmental circumstances; or who are travelers, foreign students, immigrants, or refugees. Ellipses indicate vaccine or toxoid not universally recommended for all adults.

†Tetanus and diphtheria toxoids adsorbed (for adult use).

‡One dose of measles vaccine is indicated for persons born after 1956. A second dose is indicated for persons born after 1956 who are entering health care employment, those who are students in postsecondary educational institutions, and those who are planning international travel.

§Indicated for persons born after 1956.

grams provide the basis for the Childhood Immunization Initiative.[10] This research has shown that the majority of children and adults who develop vaccine-preventable illnesses have been seen previously by health care providers and could have been vaccinated at the time but were not.[25] Such "missed opportunities" for vaccination have several causes, including misconceptions about contraindications to vaccination and the lack of an organized approach to offering vaccines. The failure to prevent vaccine-preventable diseases is far more often due to the failure to vaccinate rather than to the failure of the vaccines themselves. The costs of these "missed opportunities" are very high.

Most vaccines given to adults are administered by generalist physicians, yet wide variations have been shown in their immunization practices.[18,22] Many adults who should be vaccinated receive their principal care from specialists rather than general physicians or from highly specialized teams of health care professionals or administrative units such as clinics. In such settings, a single focus of responsibility for offering vaccines is often difficult to identify. Thus, efforts to improve adult immunization must focus on developing workable systems for regularly offering vaccines to patients at risk, regardless of where they receive their care. Such systems should reflect practice guidelines, and their evaluation should become a common feature of quality assurance and accreditation programs.

The NVAC recommends that the CDC and other federal agencies assume increased responsibility for assuring that adults are appropriately immunized. This will require support for vaccine purchase and program administration at the state and local levels, as well as increased staff and support at the CDC itself. The committee urges that all health care providers, whether generalists or specialists, consider any contact with adult patients as an opportunity to provide recommended vaccines. The committee recommends that health care providers and the institutions in which they practice adopt administrative and organizational arrangements that guarantee the regular offering of vaccines to adults, develop and implement standards and practice guidelines for adult immunization, and include regular evaluation of immunization practices as part of their quality assurance programs.

3. ASSURE ADEQUATE FINANCING MECHANISMS TO SUPPORT THE EXPANDED DELIVERY OF VACCINES TO ADULTS

Childhood immunization programs have long received financial support from federal, state, and local governments. Public agencies have been much less involved with adult immunization; in 1991 less than 10% of all doses of influenza and pneumococcal vaccines used in the United States were given by state and local health departments (CDC, unpublished data, 1993). To address this problem, in 1981 the Congress instructed the HCFA to pay physicians for pneumococcal vaccination of elderly patients under Part B of the Medicare program.[23] In 1984 reimbursement for hepatitis B vaccination was added for Medicare patients with end-stage renal disease. In 1993 Medicare was authorized to pay for influenza vaccine and its administration.[21]

The implementation of Medicare reimbursement for vaccination has not measured up to its promise. For example, Medicare reimbursement for pneumococcal vaccination during the 1980s barely covered the cost of the vaccine alone.[23] Each year during the period 1985 through 1988, only 300 000 to 400 000 doses of pneumococcal vaccine—25% of all doses distributed nationwide—could be accounted for by the Medicare reimbursement program. Whether adequate reimbursement is important for adult immunization should become apparent in Medicare's recently established program to pay for annual influenza vaccination.

There is little information on the extent to which private health insurance companies provide coverage for adult immunization. Health maintenance organizations may provide such services, but their immunization rates are often no better than those of patients covered by traditional health insurance.[25] Reliance on regulatory approaches to improve private health insurance coverage of adult immunization may not be sufficient; businesses that self-insure their employees are not subject to regulation by state governments. Proposals for health system reform usually include coverage of childhood immunization. Similar coverage is needed for adult immunization.

The NVAC recommends that publicly funded health insurance programs adequately reimburse providers for the costs of vaccines and their administration to adults. Medicare and Medicaid reimbursement policies must be monitored to ensure that they are effectively implemented by fiscal intermediaries and providers alike. When problems are identified, technical assistance must be provided and financial or other incentives considered so that adults enrolled in these programs are appropriately immunized. Similarly, the committee recommends that private health insurance companies adequately reimburse providers for adult immunization, without requiring individual co-payments or deductibles. Business and labor leaders and state health insurance regulators should encourage inclusion of adult immunization as a cov-

Table 4.—The National Vaccine Advisory Committee's Goals and Recommendations for Adult Immunization*

1. Increase the demand for adult vaccination by improving provider and public awareness
   - Conduct effective information programs for
     - Health care providers to improve their immunization practices
     - The public to emphasize the importance of vaccine-preventable diseases and the safety and benefits of immunization
2. Assure the health care system has an adequate capacity to deliver vaccines to adults
   - Establish an adult immunization grant program to assist state and local health departments
   - Reduce missed opportunities for vaccination
   - Appropriately vaccinate adult patients in
     - Primary care settings
     - Specialty practices and institutions
   - Implement guidelines and standards for adult immunization practice
3. Assure adequate financial mechanisms to support the expanded provision of vaccines to adults
   - Adequately reimburse providers through
     - Publicly funded programs such as Medicare and Medicaid
     - Private health insurance
   - Include coverage for adult immunization in national health system reform
4. Monitor and improve the performance of the nation's vaccine delivery system
   - Expand programs for disease surveillance
   - Preserve and strengthen vaccine-manufacturing capacity to meet the nation's needs
   - Endeavor to achieve the adult immunization goals of *Healthy People 2000*
5. Assure adequate support for research
   - Support research on
     - Adult vaccine-preventable diseases
     - Efficacy, safety, clinical effectiveness, and cost-benefit/cost-effectiveness of adult immunization
     - Epidemiology of adult immunization practices
     - New and improved vaccines
     - International programs for adult immunization

*From National Vaccine Advisory Committee.[21]

ered benefit for those insured. Finally, the committee strongly recommends that all national health system reform proposals include coverage for adult immunization services and provide mechanisms to finance their delivery.

4. MONITOR AND IMPROVE THE PERFORMANCE OF THE NATION'S VACCINE DELIVERY SYSTEM

The nation's ability to control vaccine-preventable diseases requires continuing surveillance of the diseases themselves, an assured manufacturing capacity to provide the vaccines needed, and periodic assessment of whether the vaccines are reaching the persons for whom they are intended.

The effective and efficient use of vaccines in adults depends on a clear understanding of which diseases are epidemiologically important and which persons are at risk of infection. The CDC works closely with state and local health departments to monitor the occurrence of vaccine-preventable diseases. For example, it regularly provides timely advice on the identity of influenza viruses causing outbreaks and information on whether the current influenza vaccine should be protective.[27] Surveillance by the CDC has provided better understanding of the epidemiology of hepatitis B[28] and pneumococcal infections.[29] These programs could be improved if inexpensive methods were developed for more rapid diagnosis of disease. Surveillance is also essential for accurately assessing the economic impact of vaccine-preventable diseases.

The success of our nation's immunization programs depends on the capacity of our vaccine manufacturers to produce and distribute a constant supply of vaccine products. During the swine influenza program in 1976, our system for vaccine supply was severely tested.[30] In the 1980s liability costs contributed to the rise in prices for childhood vaccines and seriously threatened the economic viability of vaccine manufacturers.[31] The National Vaccine Injury Compensation Program, established in 1986, provides a mechanism by which claims for childhood vaccine-associated injuries can now be settled.[32] Although its implementation has been costly and not without problems, the program has succeeded in stabilizing the market for the vaccine manufacturers.

One reason why the 1990 goals for adult immunization were not reached may be the failure to monitor adult immunization practices. In 1989 the National Center for Health Statistics began to gather better information on vaccination levels against influenza, pneumococcal disease, tetanus, and diphtheria. Its National Health Interview Survey has shown, for example, that only 20% of elderly persons have ever received pneumococcal vaccine.[33] However, little is known about geographic variations in the use of this vaccine or about vaccination rates in persons at increased risk of disease. For hepatitis B vaccine, a great deal is known about vaccination status of health care workers, but almost nothing is known about the status of the other high-risk groups that account for more than 95% of all cases of the disease.[28]

The NVAC recommends that surveillance of vaccine-preventable diseases by the CDC and by state and local health agencies be strengthened, including the development of better methods of diagnosing disease. The committee recommends that the capacity of the nation's vaccine manufacturers to meet current and future needs for vaccines be periodically assessed to identify potential technical, regulatory, financial, legal, or political problems that could threaten adequate supplies of vaccines for adult immunization. This assessment should also determine the appropriate level of federal involvement in vaccine purchase, production, and compensation for vaccine-related adverse events. To reach the adult immunization goals of *Healthy People 2000*, the committee recommends more detailed evaluation of vaccination levels in adults with specific high-risk conditions and in specific population groups at risk. It also recommends support for programs to improve vaccine delivery where immunization rates are found to be unsatisfactory. (The adult immunization goals of *Healthy People 2000* provide for increases in immunization levels as follows: (1) pneumococcal pneumonia and influenza immunization among institutionalized chronically ill or older people to at least 80%; (2) pneumococcal pneumonia and influenza immunization among noninstitutionalized, high-risk populations as defined by the Advisory Committee on Immunization Practices to at least 60%; and (3) hepatitis B immunization among high-risk populations, including infants or surface antigen–positive mothers, to at least 90%; occupationally exposed workers to at least 90%; intravenous-drug users in drug treatment programs to at least 50%; and homosexual men to at least 50%.)

5. ASSURE ADEQUATE SUPPORT FOR RESEARCH

Basic research on the viruses and bacteria that cause disease is essential if we are to develop new and improved vaccines.[34] Equally important is research on host responses to infection and vaccination, especially the responses of older adults whose immune systems become less responsive with advancing age. For each vaccine, initial evaluation of its efficacy must be followed by an assessment of its clinical effectiveness in preventing the more serious and costly outcomes of disease. In addition, much more needs to be known about the health and economic consequences of vaccine-preventable diseases. The cost-effectiveness of adult immunization must be further assessed; current evidence suggests that influenza and pneumococcal vaccination are highly cost-effective when compared with other preventive, screening, and treatment interventions in common use among elderly persons.[23] New knowledge about the epidemiology of vaccine-preventable diseases must be accompanied by research on the epidemiology of efforts to prevent these diseases, including variations in the vaccination practices of health care providers. The importance of this research is illustrated by a recent study showing that persons at greatest risk of influenza were least likely to be vaccinated.[23]

Research has provided several new and improved vaccines that may benefit adults, including cold-adapted live influenza, pneumococcal conjugate, varicella-zoster, hepatitis A, and acellular pertussis vaccines.[18,34] Promising new methods of vaccine administration are being developed, including newer adjuvants, epitope-based strategies that reflect an understanding of antigen recognition sites, particulate antigens delivered as microcapsules, glycoconjugate preparations, immunologic boosting with cytokines and lymphokines, and the use of vaccine vectors.

Whether adults in the United States are to be protected against vaccine-preventable diseases will depend to some extent on the occurrence of these diseases in other parts of the world. Current international programs for monitoring diseases such as influenza need to be supplemented by surveillance programs for other emerging and reemerging infectious diseases, such as diphtheria in countries of the former Soviet Union,[35] a new strain of *Vibrio cholerae* in South Asia,[36] and the spread of antimicrobial-resistant *Streptococcus pneumoniae* in many countries.[37] International disease surveillance and vaccination programs have already paid rich dividends in the worldwide eradication of smallpox and the elimination of poliomyelitis in the Americas. Given the promise of new and improved vaccines, the Children's Vaccine Initiative has become the organizing focus to coordinate the transfer of new technologies for vaccine production and vaccine delivery to developing countries.[38] Many aspects of this program have direct implications for the development of new and improved vaccines for adults.

The NVAC recommends continued support of research on the microbiologi-

cal agents of and the host response to vaccine-preventable infections, including those of immunocompromised and aging individuals. The committee urges the development of better measures of the health and economic consequences of current and future vaccine-preventable diseases. The committee recognizes that the viability of our nation's adult immunization programs requires continued evidence of the efficacy, effectiveness, safety, and cost-effectiveness of current and future vaccines. The committee recommends greater attention be given to studies of the epidemiology of immunization practices. Research on new and improved vaccines for use in the United States and internationally must be assured stable and continuing support. Finally, the committee encourages greater collaboration between federal agencies, nongovernmental organizations, professional associations, and vaccine companies in the United States and their counterparts in international organizations and in countries throughout the world.

CONCLUSION

In making its recommendations, the NVAC recognizes that none of its goals for adult immunization will be reached without giving attention to all. The task is complex and the effort and resources needed to achieve success will be substantial. However, in undertaking this work, the committee is reminded that our nation's programs for childhood immunization have reduced the costs of health care and improved the well-being of all our children. We can and should expect no less from our efforts to immunize adults.

The National Vaccine Program was established in 1986 by the Public Health Service Act to achieve optimal prevention of infectious disease through immunization and optimal prevention of adverse reactions to vaccines. The program is responsible for coordination and direction of government and nongovernment activities on research, licensing, production, distribution, and use of vaccines. The director is the assistant secretary for health, with the National Vaccine Advisory Committee serving as advisor. The committee consists of 15 voting members appointed by the director, in consultation with the National Academy of Sciences, including individuals in vaccine research or manufacture, physicians, members of parent organizations, and representatives of health agencies and public health organizations. The committee also includes five nonvoting members from the National Institutes of Health, the Food and Drug Administration, the Centers for Disease Control and Prevention, the Agency for International Development, and the Department of Defense.

Members of the National Vaccine Advisory Committee are as follows:

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