



Reprinted by the
U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES
Public Health Service



from JAMA, September 18, 1991, Vol. 266, No. 11, pp. 1547-1552

Special Communication

The Measles Epidemic

The Problems, Barriers, and Recommendations

The National Vaccine Advisory Committee

The nation has experienced a marked increase in measles cases during 1989 and 1990. Almost one half of all cases have occurred in unvaccinated preschool children, mostly minorities. The principal cause for the epidemic is failure to provide vaccine to vulnerable children on schedule. Major reasons for the low vaccine coverage exist within the health care system itself, which creates barriers to obtaining immunization and fails to take advantage of many opportunities to provide vaccines to children. Ideally, immunizations should be given as part of a comprehensive child health care program. However, immunization cannot await the development of such an ideal system. Essential changes can and should be made now. Specific recommendations include improved availability of immunization; improved management of immunization services; improved capacity to measure childhood immunization status; implementation of the two-dose measles vaccine strategy; and laboratory, epidemiologic, and operational studies to further define the determinants of decreased vaccine coverage and to develop new combinations of vaccines that can be administered earlier in life. The measles epidemic may be a warning flag of problems with our system of primary health care.

(JAMA. 1991;266:1547-1552)

REMARKABLE progress has been made in the effort to control measles since 1963 when measles vaccines became available for use (Fig 1). However, during the past 2 years, measles cases and deaths have risen sharply. During 1989, more than 18 000 cases and 41 deaths were reported, the largest number of reported cases since 1978 and the largest number of deaths in almost two decades.¹ The epidemic intensified during 1990—with more than 25 000 cases and more than 60 deaths.¹

The current epidemic has hit the nation's youngest and most vulnerable children hardest. The recent increase in cases has been greatest among children younger than 5 years of age (Fig 2).¹

During 1989, outbreaks among preschool children predominated with three inner-city epidemics (Chicago, Ill, Houston, Tex, and Los Angeles, Calif) accounting for one third of all cases. This trend accelerated during 1990, with nearly half of all cases occurring among children less than 5 years of age (Fig 2).¹ Minority children are disproportionately affected with Hispanic and

black preschool children, particularly in urban areas, facing seven to nine times the risk of contracting measles as white children.¹

This represents a change from the mid 1980s when most measles cases occurred among a small proportion of

school- and college-age students who had not been vaccinated or who had been vaccinated unsuccessfully. Because vaccine failure remains a problem, beginning in 1989, a second dose of vaccine was recommended to be administered at the time of enrollment in either primary school or middle or junior high school.^{2,3} Since this is a long-term solution requiring 7 to 13 years to reap the full benefits, aggressive revaccination during school-based outbreaks will be needed in the interim.

Studies reveal no change in the effectiveness of the vaccine during recent years (G. E. King, MD, unpublished data, 1991). The vaccine, licensed and in use since 1963, protects about 95% of those who receive it. About three fourths of those with measles during 1990 were unvaccinated (Fig 3).¹ For this unvaccinated group of children, more than 17 000 cases could easily have been prevented with the currently available, highly safe and effective vaccine.

The principal cause for the measles epidemic is failure to provide vaccine to

THE NATIONAL VACCINE ADVISORY COMMITTEE

The National Vaccine Program was established in 1986 by the Public Health Service Act to achieve optimal prevention of infectious diseases 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, the Agency for International Development, and the Department of Defense. (This committee report has been submitted to the assistant secretary of the Department of Health and Human Services.)

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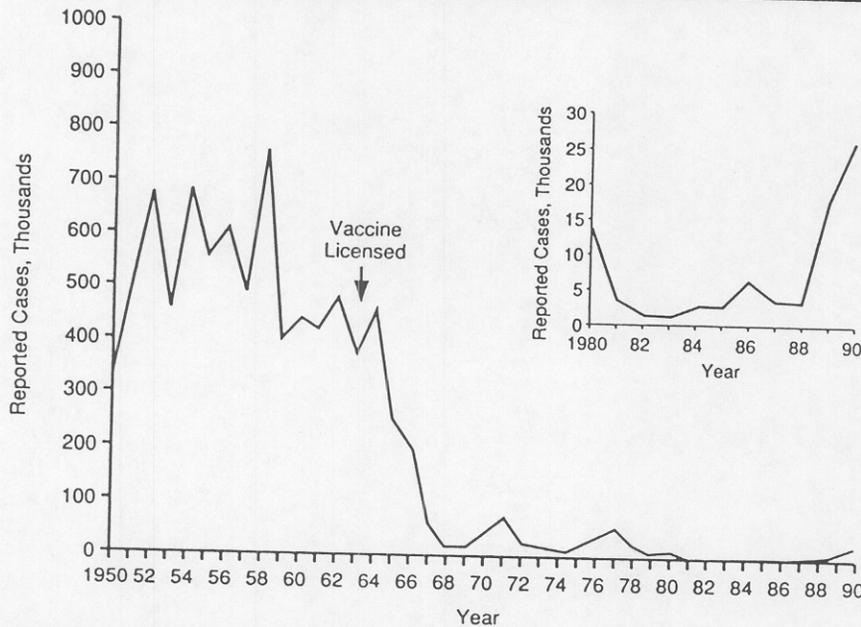


Fig 1.—Reported number of measles cases in the United States by year, 1950 through 1990. (Data from the Centers for Disease Control¹; unpublished 1990 provisional data also supplied by the Centers for Disease Control, Atlanta, Ga.)

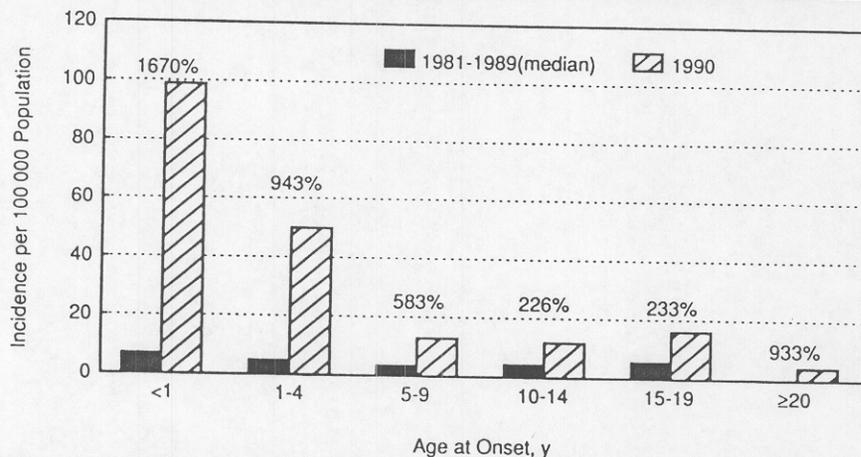


Fig 2.—Age-specific measles incidence (percent increase) in the United States, 1981 through 1989 and 1990. (All data, including unpublished 1990 provisional data through week 52, provided by the Centers for Disease Control, Atlanta, Ga.)

children at the recommended age.^{4,5} Although immunization levels are 97% to 98% at the time of enrollment in school, they are reported to be as low as 50% among 2-year-old children in some inner-city populations.^{4,6} As a result, these vulnerable children remain susceptible, and a highly contagious disease such as measles spreads rapidly and widely. Limited data suggest that the problem in inner cities is not uniform and that some inner cities have achieved immunization coverage high enough to prevent significant transmission of measles.⁵

The measles epidemic is cause for serious concern. But measles, being the most contagious of the vaccine-preventable diseases,⁷ is also an indicator that signals a failure in the system of vaccination. Given low immunization levels among young children, it is reasonable to suspect that there are substantial numbers of children now also susceptible to pertussis, poliomyelitis, mumps, and rubella. Likewise, *Haemophilus* disease, which is now preventable by vaccination, continues to be a serious problem (oral communication, S. L. Cochi, MD, 1991).

THE NATION'S CHILDHOOD IMMUNIZATION SYSTEM

The current childhood immunization system in the United States is a patchwork of public and private sector efforts that include participation of private physicians and local, state, and federal governments.⁸ The vaccination system consists of two major components: (1) vaccine purchase and (2) vaccine administration to children. Half of all vaccines are administered in the private sector and half are administered in the public sector.

Since 1963, the federal government, through the Centers for Disease Control (CDC), in Atlanta, Ga, has provided grants to states and some large county and city health departments to assist with the purchase of adequate supplies of vaccines and to supplement their immunization efforts. Federal immunization grants currently support purchase of approximately half of the total public sector vaccine needs, although the proportion varies by specific vaccine. State and local resources are used to meet the remaining vaccine needs. Federal immunization grants also support administrative activities such as assessment of immunization coverage, promotion of vaccination, and surveillance of disease and adverse events.

Actual provision of vaccines in the public sector is primarily a state and local responsibility, although federal funds provide support for provision through Medicaid, the Maternal and Child Health block grants, the Prevention block grants to states and designated localities, and as federal grants directly to community health centers. Although the total federal resources being provided for immunization are considerable, there is presently no formal national coordination of the federal role in vaccine provision.

It is not possible to determine precisely how much money is used for immunization. It is clear, however, from available evidence that publicly funded clinics are essential as a source of preventive care for low-income families and that many clinics lack the resources to adequately serve all families in need of low-cost or free immunizations.⁸

WHY ARE CHILDREN NOT BEING VACCINATED?

The current system of vaccination is complex and varies from city to city and state to state. There is no universal approach to reach all children. Known barriers to successful immunization for all children include four key types,⁸ including (1) missed opportunities for administering vaccines; (2) shortfalls in the

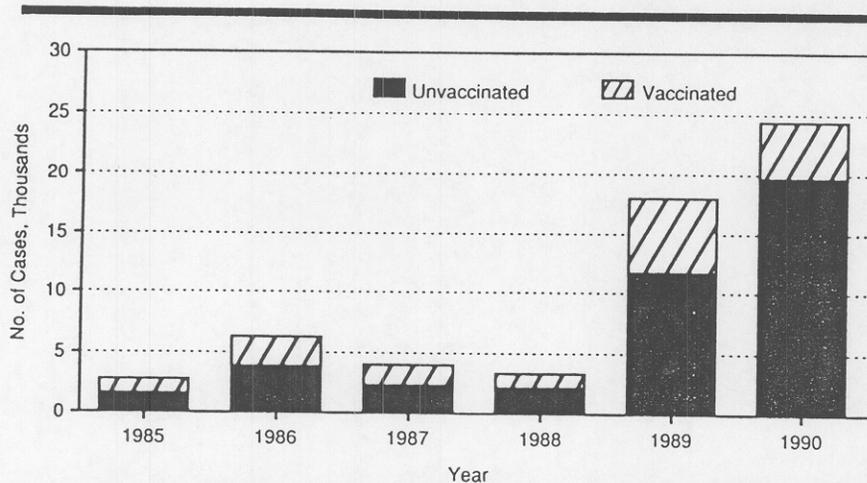


Fig 3.—Number of measles cases in vaccinated vs unvaccinated persons, 1985 through 1990. (Unpublished data provided by the Centers for Disease Control, Atlanta, Ga.)

Table 1.—Percentage of Measles Cases Occurring in Unvaccinated Children Who Were Enrolled in Low-Income Assistance Programs and Were Eligible for Measles Vaccination*

Program Type	Dallas (n = 160)	Milwaukee (n = 128)	Chicago (n = 71)	Los Angeles (n = 38)	New York (n = 40)
WIC	25	54	61	57	50
AFDC	19	86	...	60	63
Food stamps	31	51	53
Medicaid	22	45	75
Public housing	12	26	...	3	25
Any program	40	91	61	71	78

*WIC indicates Supplemental Food Program for Women, Infants, and Children; and AFDC, Aid to Families With Dependent Children. (Unpublished data from the Centers for Disease Control, Atlanta, Ga.)

health care delivery system with barriers to immunization; (3) inadequate access to care; and (4) incomplete public awareness of and lack of public request for immunization. Each can be addressed.

Missed Opportunities to Vaccinate Children

Parents are often blamed for the poor immunization status of their children, but the evidence suggests that the health care system must assume substantial responsibility for failure to vaccinate.⁸ Many opportunities to provide needed vaccines are missed. Two types of missed opportunities are of particular importance: (1) a child brought to a center for immunization is not vaccinated because of inappropriate contraindications such as minor illness, or only one or two vaccines are given when, in fact, others are also needed and should be given; and (2) a child in need of vaccination has contact with a health care provider for other reasons, but his or her immunization status is not assessed and immunizations are not offered.

Studies of unvaccinated measles patients in some epidemics have shown

that about one third of these children had one or more visits at which an opportunity was missed for vaccination⁹ (K. M. Farizo, MD, unpublished data, 1991). Failure to vaccinate children in emergency departments and acute care clinics is particularly important because many inner-city children use such settings as a primary source of care.¹⁰ National survey statistics for 1988 reveal that infants in inner-city areas were twice as likely as suburban or rural infants to be brought to such clinics (including hospital outpatient clinics, other clinics and health centers, or emergency departments). Nearly half of all black or Hispanic infants received routine care in a clinic setting.¹¹

Although inner-city preschool children are often described as hard to reach, many of these children are in regular contact with public assistance programs that typically see enrolled families every month. Opportunities exist through these programs to screen for immunization and, where practical, vaccinate children on-site. This is infrequently done, however, as each of the programs is administered by different agencies. Recent investigations of in-

ner-city measles outbreaks in Chicago, Dallas, Tex, Los Angeles, Milwaukee, Wis, and New York, NY, indicate that 40% to 91% of unvaccinated preschool children who developed measles were enrolled in one or more public assistance programs, most commonly Aid to Families With Dependent Children (AFDC) (and consequently Medicaid), as well as the Supplemental Food Program for Women, Infants, and Children (WIC) (Table 1)⁸ (CDC, unpublished data, 1991).

The failure to adequately vaccinate many children currently enrolled in public assistance programs suggests that many of the potential benefits gained by recent expansions in Medicaid eligibility to a much larger group of poor and near-poor preschoolers may not be realized unless steps are taken to assure that immunization is an integral part of program activities. Nearly one of every three children younger than 6 years of age—more than 6 million children in all—can now be covered by Medicaid if their families apply for medical assistance.

The lack of national coordination of vaccine provision has led to fragmentation in policies and absence of centralized monitoring of the impact of each federal program involved with immunization. Policies that maximize opportunities for vaccination at each clinic visit may not be receiving the priority that is required because of the absence of strong national coordination. Recognizing this need, the secretary of Health and Human Services has recently promulgated nine strategic program directions, two of which use immunization as an indicator of success: (1) to improve the health and well-being of individuals through improved preventive health care, which includes examining the potential of expanding Medicaid coverage for immunization, and (2) to improve access of young children and their families living in poverty to a wide array of developmental and support services, including health.

To improve integration of efforts to enhance immunization, the Interagency Coordinating Group to Improve Access to Immunization comprising all agencies involved in vaccine provision or serving high-risk populations has recently been formed. The group includes various Department of Health and Human Services agencies and the Departments of Agriculture, Housing and Urban Development, and Education.

Shortfalls in the Delivery System: Barriers to Immunization

The CDC surveyed immunization program managers from 54 of the 57

Table 2.—Prices for Vaccines Purchased Through the Federal Government Contract vs Representative Catalog Prices*

Vaccines	Contract Price, \$†	Catalog Price, \$‡
Diphtheria-tetanus-pertussis vaccine	6.25	9.97
<i>Haemophilus b</i> conjugate vaccine (HbOC)‡	5.16	14.55
(PRP-OMP)§	8.25	16.00
Measles-mumps-rubella vaccine	15.33	25.29
Oral polio virus vaccine	2.00	9.45

*As of June 30, 1991. (Unpublished data from the Centers for Disease Control, Atlanta, Ga.)

†Price per dose.

‡Diphtheria CRM₁₁₉, Protein Conjugate (HbOC), manufactured by Lederle-Praxis Biologicals, Inc, Wayne, NJ.

§Meningococcal Group B Outer Membrane Protein Conjugate (PRP-OMP), manufactured by Merck Sharp and Dohme, West Point, Pa.

largest immunization projects in May 1990 to identify barriers leading to low immunization levels among preschool children.⁸ Only two states reported inadequate vaccine supplies in the public sector for routine immunization of preschoolers, despite the prevalent belief that this was a major problem. These difficulties were subsequently resolved.

The major unsolved problems identified in this survey were obstacles to vaccination. Of the 54 immunization program managers surveyed, half cited resource and/or policy barriers that limited access to vaccinations in one or more communities in their project areas. Policy barriers for these 27 projects included the following: immunizations being available by appointment only, 93%; requirements for physical examination prior to immunization, 56%; need for physician referral in order to be vaccinated, 41%; requirements for enrollment in well-baby clinics in order to be immunized, 37%; and administration fees, 22%. State and local resource problems that were cited included the following: insufficient clinic personnel, 70%; inadequate clinic hours, 56%; and too few clinic locations, 15%.

National survey data of Hispanic families report inconvenient clinic hours and locations as leading barriers to care.¹² Other reported problems include cultural and language barriers between local clinic personnel and some of the populations they serve, compounded by inappropriate health educational materials. In brief, many immunization settings are simply not user-friendly.

In addition, many public sector clinics have inefficient immunization record-keeping systems that do not allow programs to track or notify families routinely when vaccinations are due. Computerized systems that would facilitate rapid assessment of immunization and outreach are often absent.

Problems in the public sector are compounded by difficulties in vaccinating children in the private sector. The high costs of vaccines to private physicians are often passed on to parents (Table 2) because the majority of insurers fail to cover vaccination.¹³ A survey conducted in 1989 by the Health Insurance Association of America indicated that between 45% and 98% of children were covered for the basic childhood vaccination series depending on the type of insurance plan. The employment-based plan with conventional health insurance covered 45%; preferred-provider plans, 62%; and health maintenance organizations, 98%.¹³ This plus concerns about liability has led some physicians to discontinue immunization as an office-based service.¹⁴ (The recently established National Vaccine Injury Compensation Program should alleviate this problem.) This set of circumstances leads in turn to greater fragmentation of care as private sector patients are forced to seek immunizations in already overtaxed public clinics.

Inadequate Access to Care

Because many families have no ongoing relationship with a health care provider, low immunization rates reflect, in part, inadequate access to care. National survey statistics¹¹ show that preschool children from more affluent families (family incomes above \$35 000) were far more likely to have had a routine health care visit, including prevention services, than were those children from families with incomes below \$10 000. In 1988, black infants were two to three times more likely than white infants to have had no well-baby care or visits.

Inadequate Public Awareness and Lack of Public Demand for Immunizations

In some communities, the low demand for immunization and a limited appreciation of the importance of beginning immunization in infancy has been reported among parents who may be isolated from the health care system.¹⁵ Low demand for immunization by such parents further reduces immunization coverage levels.

VOLUNTEER PARTICIPATION IN IMMUNIZATION EFFORTS

Many parents of inner-city preschool children, particularly those from minority groups, lack information about the importance of immunizing their children at the recommended ages.¹⁶ Public sector agencies such as health departments often lack the resources and expertise to develop, produce, and dis-

seminate culturally sensitive and linguistically appropriate educational materials. Volunteer organizations and other private sector groups can play a major role in assisting health departments in effectively getting the immunization message out. In addition, they can help build local support for the resources needed to enhance the immunization services in their respective communities. Volunteer groups can also help improve clinic efficiency by providing additional clerical and nursing support to existing clinics.

To increase immunization levels rapidly, some cities, with the assistance of volunteer groups, have attempted campaigns where vaccines are offered in multiple sites outside of routine clinics usually over a 1- to 2-day period. To date, such approaches have generally proved disappointing with only small proportions of the estimated target populations vaccinated. Moreover, such campaigns do not build the permanent improvements in the vaccine delivery system essential to sustain the high coverage levels required to provide present and future vaccines. While vaccination campaign approaches may still be explored, volunteer efforts are more likely to be productive if targeted toward permanent improvements in vaccine provision and appropriate recordkeeping.

STUDIES

Activities that could be expected to have a marked impact in reducing measles cases include studies to develop vaccines that are safe and effective at younger ages; studies to ensure that the current vaccine continues to be effective; and studies to design cost-effective ways to reach more children with available vaccine in and out of the comprehensive health care system.

COMMENT

The major reason for the resurgence of measles is failure to administer vaccines to children at the appropriate age. Studies are under way by the CDC and others to better assess the role of consumer education and motivation, provider practices, and local agency policies in contributing to low immunization coverage. As these data become available, strategies for vaccine provision can be refined. Available information, however, indicates that the major cause can be found in the health care delivery system itself.

Parents who seek immunization for their children face many obstacles. One barrier results from policies that make immunization difficult to obtain, such as the need to schedule appointments, enroll the child in a well-child care pro-

gram, or have a prior physical examination that is not immediately possible. Other barriers to immunization are inadequate numbers of clinic personnel to provide vaccination and the scheduling of clinics at inconvenient hours. Immunization services should be provided at all times during weekday working hours and at times when working parents can bring their children for services, such as evenings and weekends. Providing adequate personnel to accomplish these goals is difficult for large urban health departments in particular, most of which have severe fiscal constraints caused by eroding tax bases and increasing service demand. In addition, many opportunities to vaccinate children who interact with the health care system are missed. Finally, little effort has been made to enhance access of the disadvantaged to immunization services through other public assistance programs.

Immunization benefits not only the child who is vaccinated but society as a whole. The vaccine-preventable diseases are contagious, and outbreaks among inner-city infants and toddlers threaten not only their health but the health of all susceptible children and adults, whether they live in urban, suburban, or rural areas. Because disease in any part of this country is a threat to all, federal, state, and local governments share responsibility for improving deficient delivery systems.

Ideally, immunizations should be given as one part of a comprehensive child health care program. This is the ultimate goal toward which the nation must strive if all of America's children are to benefit from the best our health care system has to offer. The lack of adequate resources represents a principal barrier. However, the provision of immunization, our most cost-effective health service, cannot await the development of the ideal comprehensive child health system. Essential changes in the childhood immunization system can and should be made now.

RECOMMENDATIONS

Improve Availability of Immunization

1. Additional federal financial support should be provided through immunization grants to state and local health departments to enhance the vaccine delivery infrastructure (eg, professional staff and community outreach workers). These funds should be distributed to areas most in need, particularly large cities. New policies should assure that resources are used to improve current immunization provision rather than to substitute for current state and local

efforts.

2. Vigorous efforts should be made, including legislation if necessary, to assure that insurers provide or reimburse for immunization as part of their basic health benefits package and that all managed health care systems, including health maintenance organizations, provide routine vaccination services.

3. Medicaid, and its child health component, the Early and Periodic Screening, Diagnosis, and Treatment (EPSDT) program, should be integrally involved in tracking children in need of immunizations and providing adequate reimbursement for the service. Thus, Medicaid should assess immunization levels of clients served by individual providers as a measure of quality and to assure compliance with federal EPSDT requirements. Medicaid providers should either be given vaccine through the public sector or be adequately reimbursed for the cost of purchasing vaccine and its administration. To reduce these costs, vaccine used by Medicaid providers should be purchased at low federal contract prices.

State EPSDT programs should better comply with federal guidance to make aggressive efforts to enroll families; recruit and retain health care providers; provide appointment scheduling and transportation assistance; and establish a recommended well-child visit schedule that follows the guidelines of the American Academy of Pediatrics.

4. Health departments should reach out to volunteer groups and community-based organizations to build grass roots support for adequate resources for immunization and to enhance local request for, and prioritization of, immunization. The current national and community-level efforts to build public awareness of the importance of preschool immunization and the efficacy of vaccines and their safety should be intensified.

Improve Management of the Provision of Immunization

5. The National Vaccine Advisory Committee should issue a formal set of minimum standards for immunization practice in collaboration with the Interagency Coordinating Group (see recommendation 6) and private sector groups (see recommendation 8) for the provision of vaccine.

The minimum standards of immunization practice for all public sector clinics should include the following: (1) immunizations should be available on request without required appointments; (2) immunizations should be given to all children who have no known contraindications and appear to be in good health

without requiring routine physical examinations or measuring temperatures; (3) each clinic should have a prominently posted list of valid contraindications, and all providers should be familiar with valid contraindications; (4) accepted procedures for informing parents or legal representatives regarding benefits, risks, and contraindications of vaccination should be followed in all instances; (5) simultaneous administration of all needed vaccines should be the norm; (6) adequate staff must be available to provide needed immunization services during routine working hours and, where needed, at times more convenient to parents such as evenings and weekends.

6. The Interagency Coordinating Group to Improve Access to Immunization, chaired by the National Vaccine Program, should develop and implement a coordinated plan to ensure high immunization levels for the clients they serve. Immunization coverage should be used as one major indicator of the quality of services provided. Periodic reports of the group's activities should be made to the National Vaccine Advisory Committee. Appropriate interagency coordinating groups should also be formed at regional and state levels.

7. Federal participation is needed to support determination of immunization status of WIC and AFDC recipients, particularly in urban areas. Children with incomplete immunization should either be referred for vaccination with appropriate follow-up or be vaccinated on-site in WIC or AFDC clinics and offices. Projects that evaluate the feasibility, effectiveness, and cost-effectiveness of approaches toward improving immunization coverage in these populations should be encouraged, including conjoined location of WIC, AFDC, and immunization services ("one-stop shopping"). Results of successful efforts should be brought to the attention of all interested groups.

8. The National Vaccine Program should assure collaboration through the CDC with major health care provider organizations including the American Academy of Pediatrics, the American Medical Association, the American Academy of Family Physicians, and other key physician and nursing organizations to develop policies among their members to facilitate the provision of immunization. These groups should participate in developing minimum standards for immunization practice and a checklist of valid contraindications for vaccination. Organization endorsements should be sought especially for provision of immunizations outside of comprehensive care settings when

such care is either not available or difficult to obtain, particularly in acute care settings, and to encourage members to take advantage of all opportunities.

9. State and/or local governments that have not as yet done so should enact legislation to mandate appropriate immunization prior to enrollment in licensed day-care centers.

Ongoing Measurement of the Children's Immunization Status

10. National immunization coverage should be assessed annually through the National Health Interview Survey. Immunization coverage assessments are also required in all states and should be conducted in high-risk urban and rural local areas. The CDC should explore feasible and economical ways of measuring immunization coverage of 2-year-old children at state and local levels. Federal resources should be used to enhance surveillance, particularly in high-risk inner-city areas, in order to obtain better information on vaccine-preventable diseases and so design the most appropriate control strategies.

Other Measles Prevention Needs

11. The two-dose schedule, recommended as measles-mumps-rubella vaccine, should be fully implemented across the country. Some cases of measles will occur in schools and colleges as long as students have not received a second dose of vaccine. In most areas, two age groups are being vaccinated each year—one school-age group (either entrants to primary school or entrants to middle or junior high school) and college entrants. The 1991 congressional appropriation allocated immunization grant funds to purchase approximately one half of the needed measles-mumps-rubella vaccine provided in the public sector. Additional funds should be provided as required.

12. A rotating fund should be established for outbreak control so that funds

would always be immediately available. This would eliminate the need to wait for emergency appropriations before responding to an outbreak. Because the two-dose schedule is a long-term solution and its full impact will not be achieved for perhaps 7 to 13 years, funds will be needed in the meantime for revaccination during outbreak control.

Need for New Information

13. Optimal measles prevention requires greater knowledge about how best to provide vaccine and more information on measles virus, measles disease, and measles vaccines.

More studies on immunization program operations and outcomes should be conducted to help in designing the most cost-effective measures to improve vaccine coverage and to better understand the key barriers to full immunization among preschool children, particularly minority populations living in inner cities. Innovations, ranging from small changes such as provision of vaccine on an "express lane," walk-in basis, to the use of birth certificate information for tracking of infants by computer, and better coordination of public programs should be tested for their ability to increase immunization coverage.

Laboratory and epidemiologic studies should be conducted to address both the problem of measles in highly vaccinated populations and of measles in young children. Such studies should include the following: (1) development of techniques to rapidly diagnose measles and to effectively measure protective immunity; (2) studies of disease and vaccine strains to ensure that existing vaccines continue to provide a high degree of protection against circulating wild-type measles; (3) studies on the response to a second dose of measles vaccine provided at various ages and intervals, and other investigations to determine whether implementation of the two-dose schedule will eliminate

measles in school-age populations; and (4) studies to develop vaccines capable of providing long-lasting protection when given to children 6 to 12 months of age or younger.

Infants younger than 12 months of age accounted for about one of every eight cases reported in 1989 and 1990, and 30% of all cases in preschool children. Currently, the age of measles vaccination is often lowered from 15 to 12 months in cities at risk of preschool measles and to 6 months during large outbreaks. However, vaccination at 6 months of age is less effective, due to interference by maternal antibodies remaining in the infant's system, and necessitates revaccination at 15 months of age. The availability of measles vaccines that more reliably protect children under 12 months of age would allow more effective control of measles.

Many of the above recommendations can and should be implemented without the need for new resources. For example, some policy changes can be executed with existing funds and may have substantial impact. Some recommendations such as having Medicaid assure that vaccines are purchased from low-cost federal contracts should actually be cost-saving. Nevertheless, some recommendations will require new resources. To enhance the vaccine delivery infrastructure, inner cities without a sufficient supply of nurses will need funds to hire them. New staff will be needed to assess vaccination in WIC clinics and AFDC offices. Funds will be needed to address some of the key information needs. Accurate resource estimates for implementing the above recommendations will need to be developed. Based on a partial examination of available information, the National Vaccine Advisory Committee estimates that implementation of all of the recommendations will require a net increase of immunization funds by \$40 million to \$50 million annually.

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