The Global Elimination of Measles

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ERIC HOFFER, THE AMERICAN LABORER-PHILOSOPHER, once said, "Where there is the necessary technical skill to move mountains, there is no need for the faith that moves mountains." The technology for the global eradication of measles is at hand. What is needed is the social will to undertake such a breakthrough in international public health.

To assess the subject of global measles eradication, three questions must be answered: Can we eradicate measles? Should we eradicate measles? Will we eradicate measles?

The answer to the first question rests on scientific fact. We can eradicate measles. The smallpox eradication program proved that global eradication of certain infectious diseases is possible. Although there are obvious differences, there are also epidemiologic similarities between measles and smallpox. They are both viruses that cause recognizable rashes, a characteristic which helps epidemiologic surveillance programs. They both confer lifelong immunity. Neither has an animal reservoir or inapparent chronic carrier state among human beings.

Since 1963, an effective and safe vaccine for measles has been available, and it has been widely used in the United States and other countries. In the past it has not received maximum use because it required a smoothly functioning cold chain of storage, transportation, and delivery to preserve the viability of the vaccine virus. There is now a more heat-stable vaccine that can remain potent in the freeze-dried state for 3 to 4 weeks at ambient tropical temperatures without refrigeration. The containers which maintain cold temperatures and protect vaccines have also been improved. Coupled with this technological progress is an economic advantage—the cost of measles vaccine has declined to the current World Health Organization (WHO) price of only 10 cents per dose in 20-dose vials.

Measles can be controlled through widespread and logical use of this vaccine.

The West African Precedent

There is an historic precedent for interrupting chains of transmission of measles, a first step in the direction of eradication. In 1967, 20 countries of West Africa integrated their measles immunizations programs with a coordinated regional program for smallpox eradication. Mobile vaccination teams took vaccine to the villages of West Africa rather than obliging the populace to come to stationary health facilities. The original plan, which called for measles vaccine to be given to all children 6 months to 6 years of age with a repeat cycle every 3 years, had to be changed to fit the epidemiology of measles in West Africa, a pattern dissimilar to that in the United States.

Vaccine was administered to children 6 months to 36 months of age to allow for their earlier contact with the disease in Africa. Although the approach could protect many children, in order to interrupt measles

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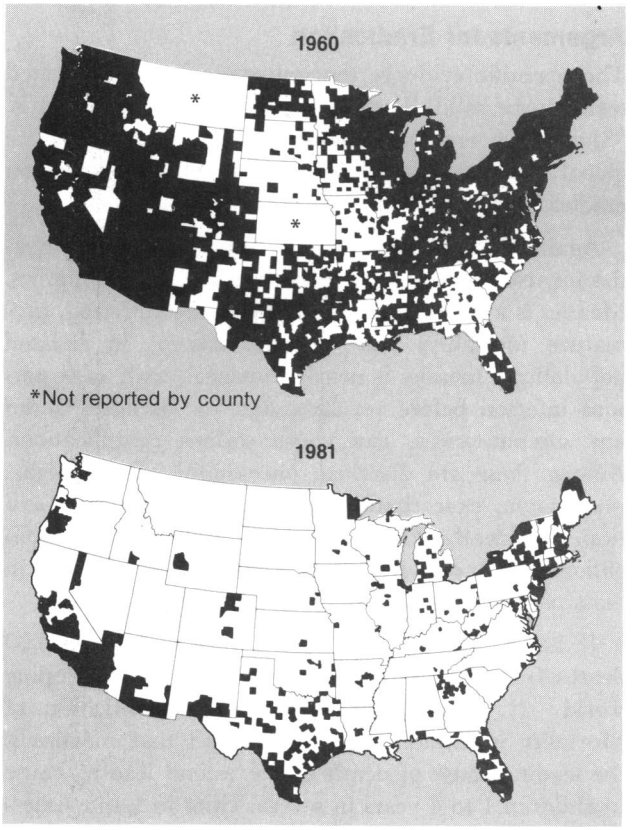
Incidence of reported cases of measles by county, United States 1960 and 1981



transmission in West African countries, computer studies indicated that vaccination cycles must be scheduled in villages as often as every 12 months.

To measure the outcome of the West African campaign after 1 year, combined results in 10 countries, representing 95 million people, were analyzed. The reduction in cases during the 12 months following immunization was conservatively calculated to be 54 percent. If that 54 percent reduction is an accurate figure, instead of a minimum as there is evidence to suggest, the reduction represents the prevention of 2.4 million cases of measles and approximately 170,000 deaths.

Results of the campaign in West Africa varied from country to country, because of the quality of immunization programs and the work of the public health teams. Perhaps the most dramatic results were in The Gambia. A small country of 350,000 people, The Gambia is almost totally surrounded by Senegal. The long international border encourages importation—a threat to measles elimination anywhere. In The Gambia, teams cycled every 12 to 18 months in the rural areas and every 6 to 12 months in the capital city. Surveillance was successful—officials investigated reported cases and instituted control measures if the cases were measles.

The result of the attack phase of the campaign was the almost total freedom from disease in every geographic area of The Gambia for a period of more than 3 years. The sporadic cases occurring after 1967 were investigated and were related to importation of the virus from other countries.

The Gambia is an example of a country with limited resources that was able to remain measles-free despite a long international boundary and despite 14 importation challenges over 3 years. It was estimated that it cost approximately $2.40 to prevent 1 case of measles in The Gambia and $34 to prevent 1 measles death, assuming a mortality rate of 7 percent in that country.

Measles Incidence in the United States

Public health officials in the United States now place high priority on the elimination of indigenous measles transmission in the nation in 1982. Reported measles incidence rates reached record low levels in 1980 and 1981. For the 4-week reporting period ending June 12, 1982, only 172 cases of measles were reported to the Centers for Disease Control, approximately 43 cases per week on the average. This total is nearly 75 percent below the number of cases reported for the same period in 1981. Only 11 of the 3,144 counties in the United States reported measles cases during the week closing June 4, 1982. There have been dramatic differences in reported cases from individual States. Pennsylvania, which last year had a cumulative total of 404 cases by mid-June, in 1982 reported a total of 4 cases in the same period. Texas, with a cumulative total of 660 cases by mid-June 1981, reported 22 for the same period in 1982.

The best means of reducing the incidence of measles, in the United States as elsewhere, is to create an immune population. Nationally, the immunization level against measles for children entering school for the first time is now approximately 96 percent.

To reach the goal of interrupting transmission within U.S. borders by October 1982, universal immunization should be completed through routine and intensive programs carried out in physicians' offices and public health clinics. Programs designed to vaccinate children against measles at about 15 months of age should be established and maintained in all communities. Official health agencies should take whatever steps are necessary, including formulation and enforcement of school immunization requirements, to assure that all persons in schools and day care facilities are protected against measles. Enforcement of such requirements has been correlated with reduced measles incidence rates.

For example, following an outbreak of measles in Texas in 1981 with a high attack rate in persons 15–19 years old, school regulations for the State were revised so that effective September 1, 1981, a history of physician-verified measles or of adequate vaccination for measles is required for all students to attend school, including high school. In May 1981 it was estimated that approximately 290,000 students in public junior and senior high schools would need measles vaccination as a result of the rule changes. From August 1 through November 30, 1981, more than 112,600 doses of measles vaccine were administered through public health clinics to students 10–19 years old, an increase of 646 percent over the number of doses delivered during the same period in 1980. It is now estimated that 98.3 percent of the 2,919,150 students currently enrolled in the school districts in Texas are in compliance with the new State immunization requirements (*1*).

Rhode Island and Oregon were among the States experiencing imported cases of measles that threatened earlier successes. Rhode Island was the first State to attempt an End Measles Campaign in 1 day. The campaign was backed up by an intensive system of surveillance which had excellent results. In 1961, approximately 3,500 cases of measles were reported from Rhode Island. In 1966 only 80 cases were reported. For 4 years the Rhode Island model proved the feasibility of measles eradication. The spectre of imported cases appeared in 1969 when increasing numbers of cases occurred in two neighboring Portuguese-speaking communities. Many members of the communities had immigrated from the Azores or Cape Verde Islands.

The initial case in the outbreak was in a child who had visited Portugal and was infected there. Investigation of the outbreak, and later surveillance, proved that a high rate of protection against measles among non-Portuguese school children of the community served as a barrier to the spread of the disease among all children. The outbreak highlighted a new group of susceptibles to measles not previously recognized—immigrants from under-vaccinated areas.

Some 3 years earlier in Washington County, Oreg., health officials reacted to a localized measles outbreak that may have been related to importation by migrant workers entering that State in 1966. Surveys of physicians, school teachers, and school children confirmed the existence of a measles epidemic in Hillsboro, Washington County. Mass immunization programs for children in kindergarten through third grade were held in county schools—2,766 doses were given to children of the county in regular clinics. The outbreak was controlled within Hillsboro and did not spread outside Washington County. These early examples of controlling importation-caused epidemics have been repeated many times in recent years.

Arguments for Eradication

The scientific evidence that measles can be eliminated seems to be solid. The second question to be asked is, "Should we eradicate measles?" In an era of scarce global resources, should money and talent be spent on eradication?

Again, the answer is yes—we should eradicate measles for reasons pertaining to both health and economics. Measles is a major source of unnecessary suffering, premature mortality, and expense. Except in isolated populations, measles is nearly universal, with most persons infected before reaching age 15. Measles, under any circumstances, can cause serious complications. Among these are diarrhea, encephalitis, otitis media, pneumonia, exacerbation of protein energy malnutrition, and death. Therapy for measles and its complications is a major drain on medical care resources in most parts of Africa, Asia, and Latin America (*2*).

It has been estimated that approximately 900,000 deaths from measles occur each year in the developing world (*2*). In the Inter-American Investigation of Mortality in Childhood it was found that measles is the leading cause of death or the second leading cause in children 1 to 4 years in several cities in Latin America (*3*). Measles outbreaks in Africa and Asia have case fatality rates of 5 to 20 percent among children, especially the malnourished ones.

Measles complications may also result in developmental retardation, lifelong handicaps, and economic loss in both direct and indirect costs. Furthermore, in children in the developing world, measles interacts with diarrheal disease and malnutrition to increase the morbidity and mortality from these conditions. In the developed nations, where the disease is less severe and there are facilities to save lives, it is still important to eliminate measles.

Following the cessation of indigenous transmissions of measles, the United States must continue to bear the costs of routine vaccination, surveillance, and response to imported cases until global eradication is achieved. It has been estimated that these costs, for both treatment and prevention, may exceed $50 million a year. The earlier the global target of eradication is achieved, the sooner the United States can discontinue these expenditures. The nation bore the considerable cost of keeping the population free of smallpox for more than 25 years before the global Smallpox Eradication Program began. The $32 million, which the United States invested in the Smallpox Eradication

Program over 12 years, is saved every 3 months because the global progress against smallpox allowed the United States to discontinue routine vaccination and other activities related to protection against smallpox (*4*). The prevention of measles by vaccination was estimated to yield an annual net savings of $130 million for the period 1963–72 in the United States. Current annual savings are estimated to be approximately $500 million. Measles vaccination in the United States is estimated to have a benefit-cost ratio of 10 to 1. The return on such an investment in the developing world, where morbidity and mortality for measles are higher, would be even greater. A preliminary analysis of vaccine programs in the Ivory Coast suggests the benefit to cost ratio may well exceed 20 to 1.

Will Global Eradication Be Achieved?

The final question to be asked about the global eradication of measles is the most difficult—will we do it? Will we muster the social will to eliminate another disease from world experience? A realistic answer is that, probably, it will not be done for a long time.

Perceptions of measles as a problem differ. However, its eradication is a goal worthy of accomplishment. A mechanism for achieving this goal already is being developed: the global Expanded Program of Immunization (EPI) coordinated by the World Health Organization. The EPI is successfully working with national governments and international donor agencies toward insuring that immunization against five diseases is routinely available to all children in the world by 1990.

Establishment of eradication as a goal might also help to stimulate increased action in many developed countries whose populations have immunization levels high enough to reduce measles incidence to a point where the disease persists but is no longer a highly visible problem. In England, for example, an average of 125,000 cases each year were reported in the period 1971 through 1980, and 24 deaths per year in the period 1971 through 1977. Although these totals represent a 70 percent decline in cases and deaths compared to the immediate prevaccine era, a concerted public health effort could further reduce unnecessary death and disability from measles in England. A realistic answer to the question "will we eradicate measles?" must also consider serious differences between smallpox and measles. Measles is a highly contagious disease, capable of causing explosive outbreaks and spreading rapidly. This characteristic contrasts with the epidemiology of smallpox, which generally spreads more slowly and could be contained by aggressive outbreak control measures. This difference in the two diseases suggests that an essential ingredient of any measles eradication program would be to attain and maintain extremely high immunization levels, probably in excess of 90 percent. Smallpox was eradicated by containment of outbreaks and cases in many areas, but the immunity rates of the general population were often less than 50 percent. Measles immunization will have to reach children in virtually all parts of a country simultaneously and successfully.

Another important difference between smallpox and measles concerns the age of infection. Smallpox frequently involves children of all ages and adults. Measles infection typically occurs in the developing world at approximately 12 to 18 months of age. Measles vaccine cannot be given effectively before the sixth or ninth month of life, and maximum serum conversion may not occur in some populations until 12 to 15 months. This restriction would suggest that a permanent primary-care infrastructure capable of routinely delivering vaccines to the majority of the population is necessary to eliminate measles transmission.

A final major difference will be the increased difficulty of surveillance operations for measles compared with smallpox. Measles is more readily confused with other rash illnesses, and it does not leave a visible, easily recognized trail such as the scars that helped to determine who was immune to smallpox. Occasional serologic surveys will be required unless reliable records are available. These requirements pose additional logistic and laboratory costs for a measles eradication program.

Worldwide measles eradication is worthy of our best endeavors. The international public health community should strive for it, but the leaders should not hold out false promises of rapid accomplishment. This achievement will be another major test of will, and failure will be measured by each case of measles that occurs. No measles case is inevitable. Each one is a failure of the public health establishment to convince society that eradication is a goal deserving of the necessary resources and support to become reality.

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