

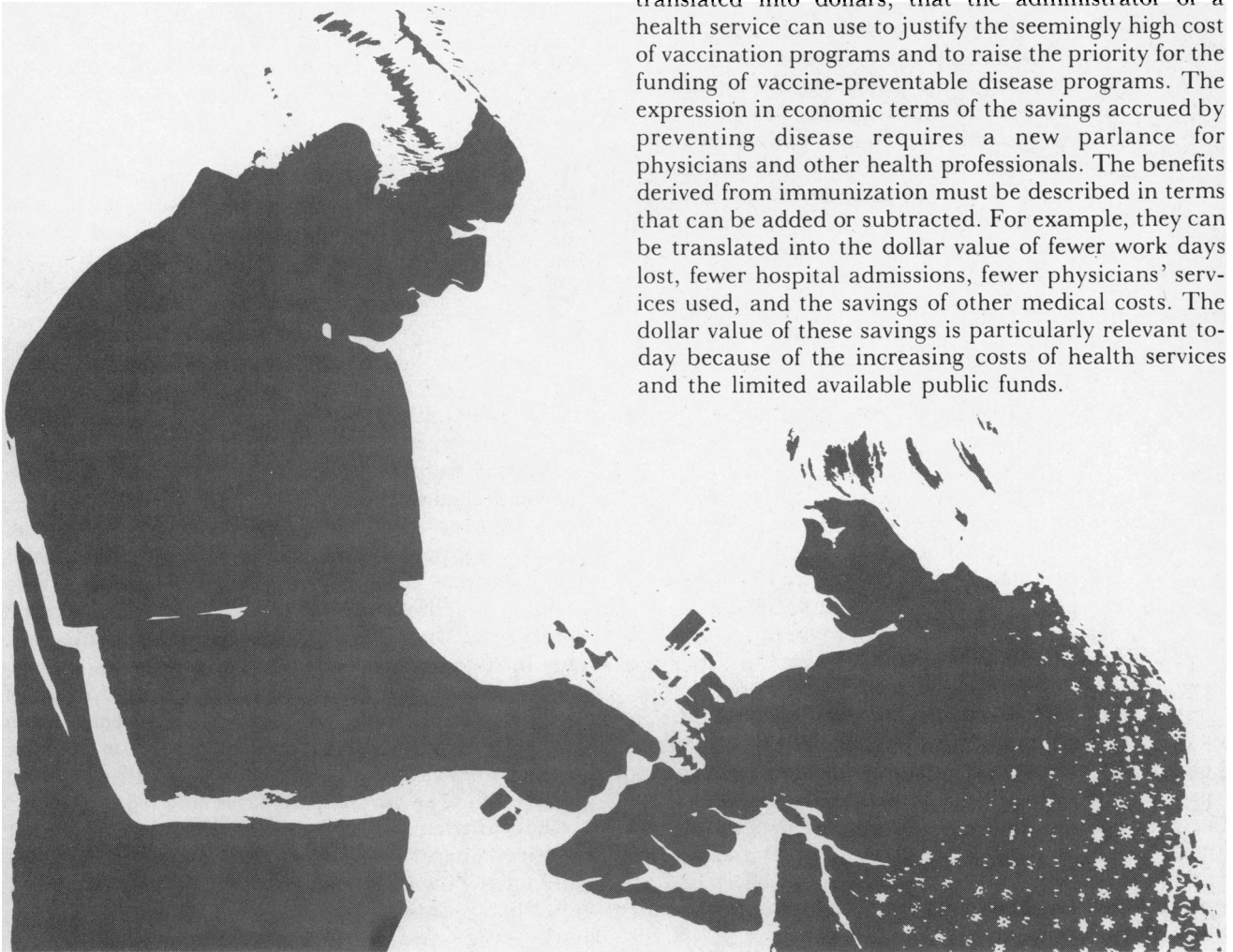
# The Benefits From 10 Years of Measles Immunization In the United States

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DRAMATIC REDUCTIONS in the morbidity and mortality from disease may follow effective immunization programs. For example, large areas of the world are now free from smallpox as a result of intensive vaccination efforts (1), and epidemic poliomyelitis is no longer a major health problem in those countries with effective poliomyelitis immunization programs (2). Extensive vaccination against measles in the United States has accounted for a sizable reduction in the number of cases of measles and measles encephalitis, as well as deaths resulting from measles (3).

The humanistic benefits resulting from prevention of these diseases are obvious. Less obvious, however, are other benefits that result from immunization, particularly economic ones. It is these economic benefits, translated into dollars, that the administrator of a health service can use to justify the seemingly high cost of vaccination programs and to raise the priority for the funding of vaccine-preventable disease programs. The expression in economic terms of the savings accrued by preventing disease requires a new parlance for physicians and other health professionals. The benefits derived from immunization must be described in terms that can be added or subtracted. For example, they can be translated into the dollar value of fewer work days lost, fewer hospital admissions, fewer physicians' services used, and the savings of other medical costs. The dollar value of these savings is particularly relevant today because of the increasing costs of health services and the limited available public funds.



Measles vaccination in the United States is an excellent example of the humanistic and economic benefits derived from immunization. Before the licensure of live measles virus vaccines in 1963, an estimated 4 million cases of measles, 4,000 cases of measles encephalitis, and 400 measles-associated deaths occurred each year. Since licensure, approximately 60 million doses of vaccine have been distributed. In this report, we analyze the benefits, both humanistic and economic, of the first 10 years of measles vaccination in the United States.

### Methodology

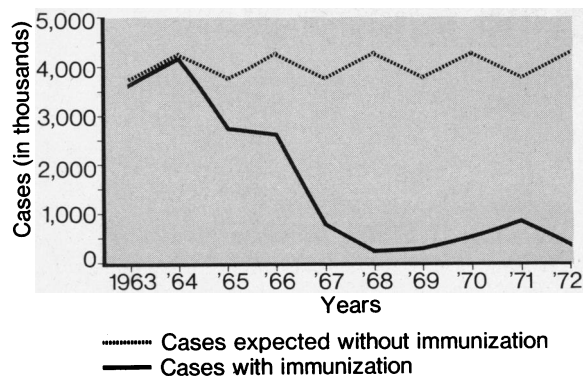
Our objective is to measure both the benefits and the costs resulting from measles vaccination. For the 10-year period 1963–72, we estimated (a) the costs the nation would have sustained without immunization against measles and (b) the actual costs of measles in terms of health and resource. The difference between these costs represents the gross immunization benefit. In other words, the estimated costs of measles without immunization minus the actual costs of measles equal the gross benefit. To determine the net economic savings due to immunizations, the costs related to immunization must be considered. Thus, the gross benefits minus the costs of immunization equal the net benefits from immunization. Included in these immunization costs are moneys spent for the purchase of vaccine, the delivery of immunization services, and if applicable, the cost of research and development.

The research costs of developing and testing the measles vaccines were excluded from our analysis. Identification of the expenditures for basic and applied research that contributed to the development of the vaccines would be difficult. Also, given the potential long-term use and global distribution of the vaccines, it would be difficult to determine what share of the research costs was applicable to the United States in the study period 1963–72.

The benefits associated with the immunization against measles include (a) savings in medical care costs for services of physicians and for long-term institutional care for the retarded and (b) avoidance of production losses incurred as a direct result of morbidity and premature mortality. In this report, we have not included an estimate of the value of the social benefits associated with the school days saved or the humanistic benefits associated with the prevention of retardation, the prevention of premature death, and the suffering resulting from measles complications—encephalitis, otitis, and pneumonia.

The methodology by which the two components (costs and benefits) are estimated is detailed in our previous paper (4). A discount rate of 4 percent was used to determine the present value of the benefits and costs which will occur in the future. In this analysis, we assume that the national immunization effort had no marked effect on the demand for medical care or on the labor force.

Figure 1. Measles incidence in the United States, 1963–72



### Savings in Morbidity and Mortality

The incidence of measles in the United States compared with the expected occurrence without immunization is shown for the years 1963 through 1972 in figure 1. The Center for Disease Control maintains a surveillance of biologics, and during the first 3 years of vaccine availability (from early 1963 until mid-1966), a total of 15 million doses were distributed. A total of 58.5 million doses of measles virus vaccine were distributed in the United States for 1963–72 as follows:

Year	Doses (millions)
1963	3.2
1964	3.8
1965	6.0
1966	7.9
1967	6.4
1968	5.3
1969	4.9
1970	4.5
1971	8.3
1972	8.2

The number of reported cases was reduced by 50 percent, and many believed that measles could be eliminated from the United States through intensive vaccination campaigns.

In October 1966, the Center for Disease Control, with the support of professional and voluntary health organizations, launched a national campaign to attempt to eliminate measles (5,6). This campaign emphasized community immunization programs, but also included intensified surveillance of the disease, control of measles outbreaks, and the establishment of continuing immunization programs for those children who were either reaching 1 year of age or entering school. These efforts resulted in a further decline of measles, to a low of 220,000 cases in 1968.

Unfortunately, the impetus for the program was not sustained after the legislation that provided the Federal fund for the measles program expired in 1968. At that time, many States did not have sufficient money for purchasing measles vaccine, and many health

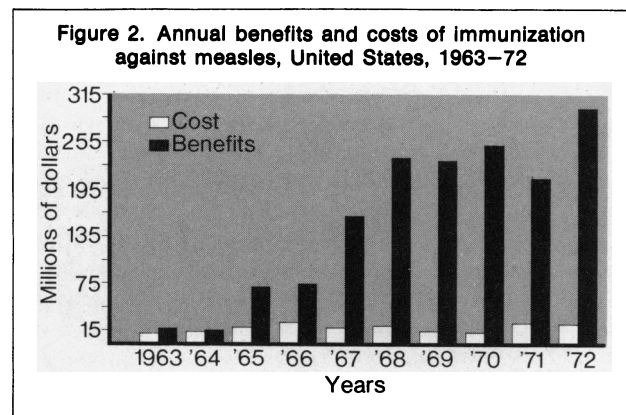
departments terminated their continuing vaccination efforts. The incidence of the disease then began to increase—530,000 cases in 1970 and 850,000 cases in 1971. Federal money for measles vaccination programs again became available in mid-1971, and intensive immunization efforts were renewed. In 1972 the number of cases declined, and in 1973 there were fewer cases than in 1972.

Without vaccine, an estimated 4.0 to 4.5 million cases of measles would have occurred each year. During this 10-year period, it is estimated that almost 24 million cases were averted. Similarly, measles mortality also declined substantially. A total of 2,400 lives were estimated to have been saved as a result of immunization. The following tabulation summarizes the health and resource savings due to measles immunizations in the United States for the years 1963–72.

Type of savings	Number
Cases averted	23,707,000
Lives saved	2,400
Cases of retardation averted	7,900
Additional years of normal and productive life by preventing premature death and retardation	709,000
School days saved	78,000,000
Physician visits saved	12,182,000
Hospital days saved	1,352,000

### Economic Savings

The annual U.S. benefits and costs of immunization against measles for 1963–72 are shown in figure 2. The costs appear to be relatively stable throughout this



period. Included in the total costs for each year are the costs of vaccine production, distribution, and administration, as well as expenses related to promotional activities. The total cost is approximately \$3 per dose of vaccine. The economic benefits rose steadily during this period and are now substantially higher than the costs. These benefits can be expected to increase even further in the future if immunization of each new birth cohort continues at a reasonable level, because the benefits from immunization are additive.

The proportion of immune persons in a population depends on the number of immunizations given in the

past. As the proportion of immune persons increases, the potential for transmission of disease decreases, because a smaller number of persons are capable of spreading infection. In this way, the immunity that inoculation against measles confers on susceptible populations increases as time passes. Additionally, every case of mental retardation averted and every death prevented provides an economic benefit for that person's expected lifespan. That person is expected to become a member of the work force and to contribute economically for many years.

In addition to the cases averted and lives saved, an estimated 7,900 cases of mental retardation were obviated, 709,000 years of normal and productive life preserved by preventing deaths from measles and the mental retardation following measles encephalitis. The savings of educational resources include an estimated 78 million days of regular academic schooling and, for the 7,900 mentally subnormal cases, substantial savings in special class or individualized schooling accrued.

The value of the net benefits achieved through immunization is \$1.3 billion saved for the 10-year period.

### Conclusion

For many years, measles was regarded by many physicians as an unpleasant but relatively benign disease. The data presented here, however, reinforce the significance of measles and the benefits of prevention. Because a number of costs of illness were not considered, the estimate of \$1.3 billion in economic savings is conservative, particularly from a health care delivery viewpoint.

Information on the relative benefits from any preventive practice is of value to the administrator who must make decisions on the priorities for spending public moneys. Clearly, the benefits derived from measles immunization are impressive. Extensive use of vaccine has resulted in substantial savings of the nation's health resources and has allowed medical, educational, and economic resources to be released for other uses.

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