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Prevention of Measles in Israel: Implications of a Long-Term Partial Immunization Program

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Synopsis

Following the introduction of routine measles immunization in Israel in 1967, rapid and persistent modifications in the pattern of the disease were observed, including much more limited and more widely spaced epidemics, a change in the age distribution of measles

cases, and a progressively increasing herd immunity that was estimated, following the 1982 epidemic, at 91.6 percent for the first 26 generations.

This pattern supports the expectation that measles can be eliminated in Israel provided a herd immunity ≥ 94 percent can be achieved before the next epidemic, which is predicted for 1988–89. A logistic approach to the elimination of measles in Israel requires (a) maintenance of an immunization rate of at least 90 percent in each newborn generation; (b) identification and immunization of still susceptible children in the 1–5 year and 6–9 year age groups, to attain vaccination coverage for at least 97 percent of this population (which should result in immunity among at least 94 percent); (c) provision of similar coverage for older, susceptible individuals in selected groups of children, adolescents, and young adults at high risk; (d) disease surveillance based on an early identification of the main sources of infection and monitoring of the active foci of disease in the neighbouring territories, which are an important potential source of the introduction of infection.

INTRODUCTION OF ROUTINE MEASLES VACCINATION in Israel in 1967 had a rather rapid effect on control of the disease. Routine immunization of 1-year-olds, using the attenuated live virus vaccine, brought about rapid and persistent modifications in the pattern of the disease (1), including much more limited and more widely spaced epidemics, a change in the age distribution of measles cases, and a progressively increasing herd immunity.

Differently conceived and unequally implemented programs in other countries (2-5), have also led to an obvious decrease in the morbidity and mortality associated with the disease. A persistently low incidence of measles in the United States, resulting from immunization of more than 90 percent of the population less than 15 years of age, led the U.S. Public Health Service to announce several years ago that "elimination of indigenous measles from the nation is sought by 1982" (6). The tactics that were implemented to achieve this goal are well known. Successful measles control achieved by

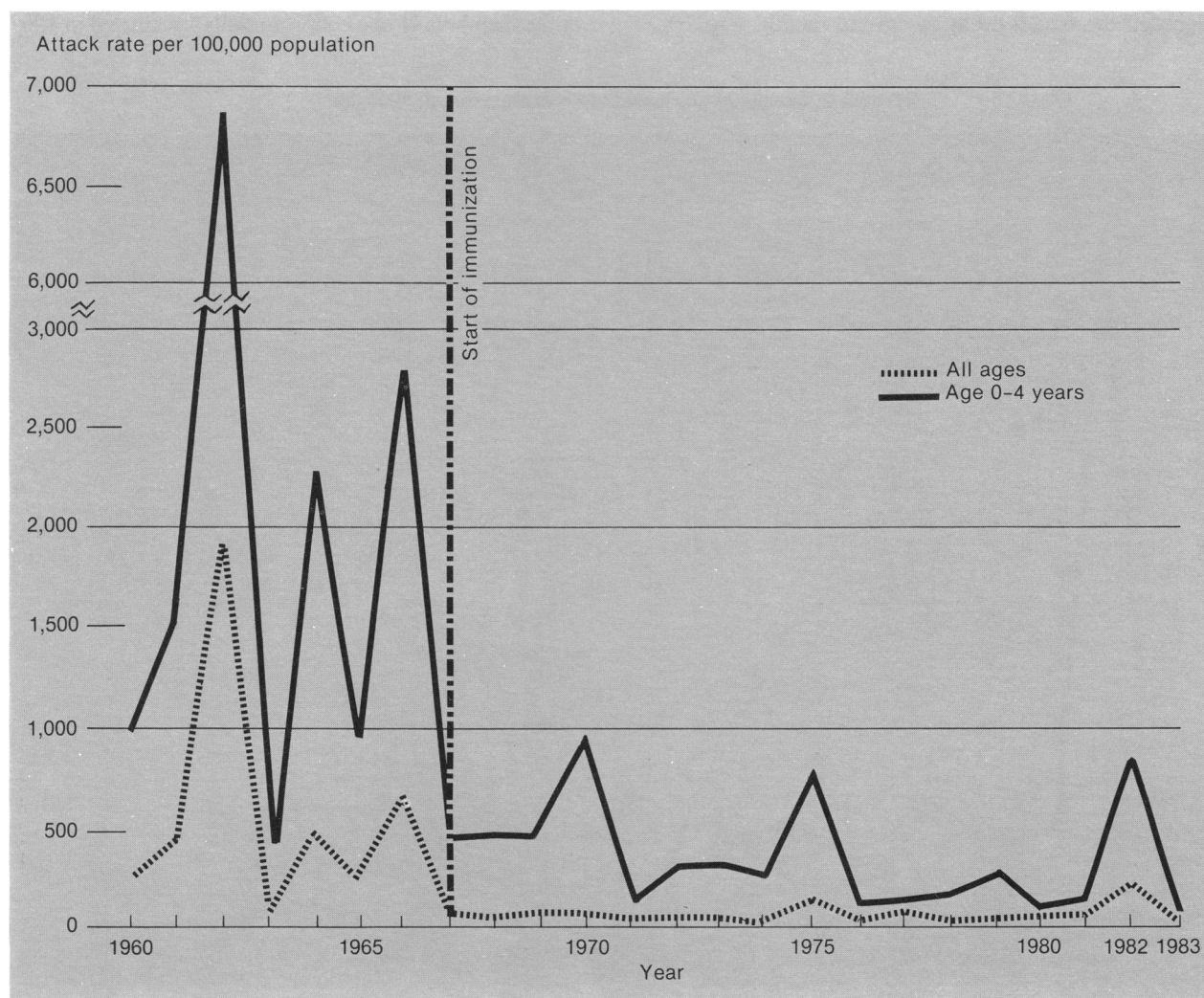
other national health services has also been an incentive for revision of Israeli measles prevention policy.

As far as Israel is concerned, progress in the control of measles has advanced to a point where the presently observed level of disease should be thoroughly weighed so that correct decisions for the future can be made. This paper presents data on the Israeli experience with measles prevention. These data form a basis for redefining the strategy and logistics of measles prevention in Israel in order to eliminate the disease.

Epidemiologic Observations

Since the inclusion of measles vaccine in the routine immunization program, several changes have occurred in the epidemiology of the disease. The most evident are:

- Disappearance of the massive epidemics of the past (fig. 1).



- Disappearance of the pattern in which epidemic waves of measles recurred every 2 or 3 years. Intervals of 5 to 7 years with very limited measles activity have been noted between the epidemics that have occurred since routine immunization began. The last epidemic was recorded in 1982, and it is expected that a new epidemic event will not take place before 1988–89 (fig. 2).

- Change in the age group distribution of cases observed. There has been a significant increase in the proportion of cases among the 0–<1 year age group, as well as an increase in the percentage of cases among persons 15 years old and over (table 1).

It should be stressed that besides the threat from local persistence of the virus, as expressed by interepidemic morbidity, the population of Israel is at persistent risk of exposure to virus introduced from neighbouring areas whose populations have established close social contact with the Israelis. Like cholera, poliomyelitis, and other enteric infections that in the past have been introduced into Israel from the controlled territories, the 1982 measles epidemic was associated chronologically with the Gaza strip and Judea and Samaria outbreaks, which preceded the Israeli event by several months (fig. 3).

Table 1. Percentage distribution of measles in Israel, by age group, 1956–60 and 1975–82¹

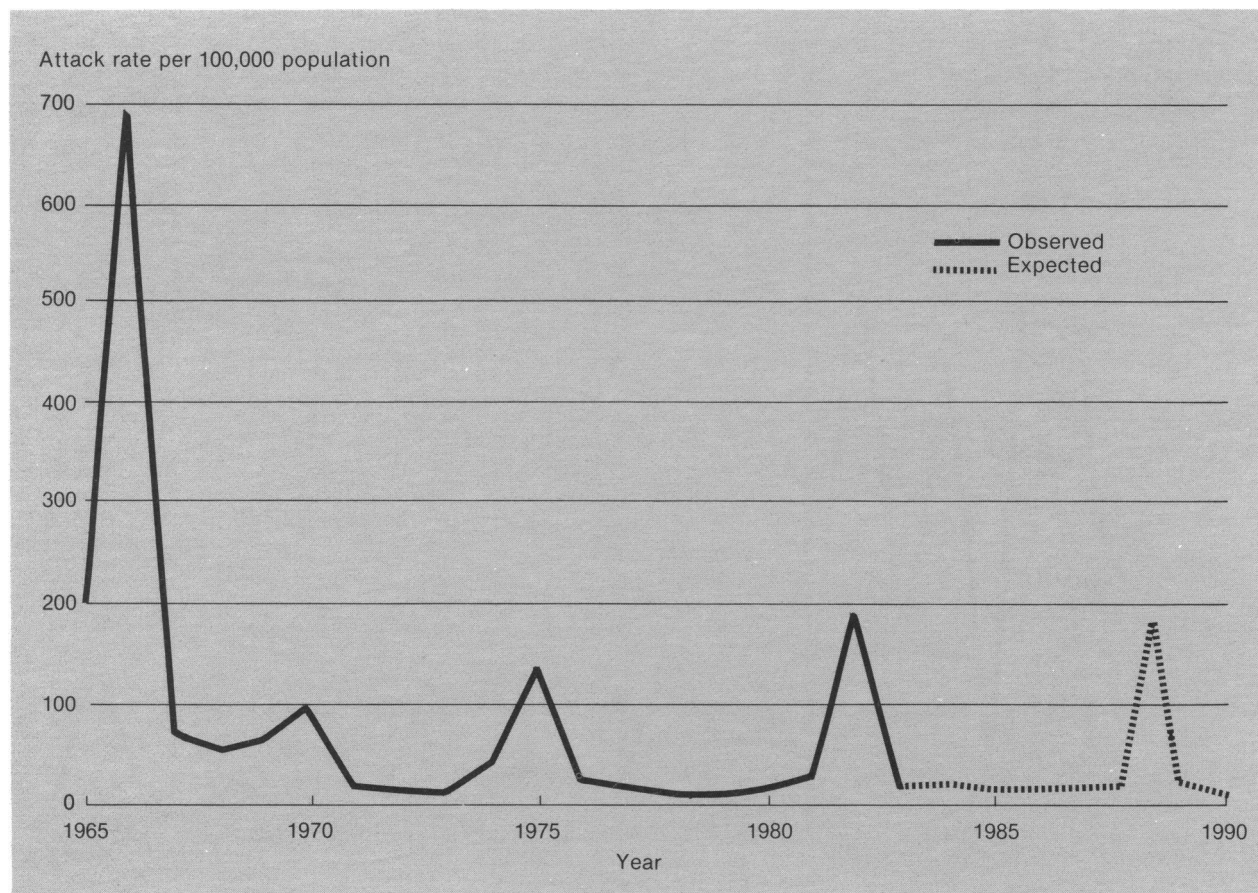
Age group (years)	1956–60	1975 epidemic	1976–81	1982 epidemic
Under 1	6.9	5.4	4.1	14.6
1–4	36.2	21.6	44.5	34.6
5–9	34.1	19.3	23.4	18.7
10–14	16.6	37.8	10.4	10.2
15 and over	6.2	15.9	17.6	21.9
Total	100.0	100.0	100.0	100.0

¹ Routine measles immunization was initiated in Israel in 1967.

Immunological Evaluation

After the beginning of the immunization program, coverage increased quickly from 60 percent for both Jews and non-Jews to 83–91 percent of the Jewish segment of the population and 76–90 percent of the non-Jewish segment. The effectiveness of the vaccine was proved by (a) a persistent active immunity in 90 percent of the members of one cohort initially vaccinated in 1967

Figure 2. Observed and expected measles, Israel, 1965–90



and followed up to 1982, and (b) the protective efficacy of the vaccine—measured in the 1976 and 1982 outbreaks—which was 96.1 percent in the former and 94.8 percent in the latter.

The low herd immunity observed after the 1975 epidemic (table 2) clearly explains the persistence of measles activity; however, following the 1982 epidemic the herd immunity was estimated to be higher than 90 percent, except for infants under 1 year of age.

It is presently accepted that only a very high immunization level, resulting in immunity for 94 percent or

Table 2. Estimate¹ of herd immunity (percent) to measles in Israel following the 1975 and 1982 epidemics

Age group (years)	1975	1982
Under 1	5.9	35.6
1-15	59.2	91.2
16-25	90.3	98.7
Under 1-25	68.4	91.6

¹ Based on 85 percent vaccine coverage and 95 percent seroconversion, and on 45 percent and 90 percent exposure of susceptible individuals in the 1-9 and 10-14 year age groups, respectively.

'Since the interpersonal contact necessary for the spread of infectious agents, including measles, is in fact established in smaller groups and not in the entire community at risk, the herd immunity of small groups should be taken into consideration.'

more of each newborn cohort, will interrupt transmission of the infection (7,8). Therefore, it is of interest to speculate on what the herd immunity of the Israeli population up to age 25 will be in 1988, shortly before the next epidemic is predicted to occur (table 3). Assuming that there is no change in the present immunization program, a protective level of immunity is expected in the age groups above 10 years, in contrast to an immune status below the presently accepted protective level in age groups 0-1 year, 1-4 years, and 5 years—and, to some extent, in the 6-9 year group also.

Figure 3. Monthly attack rate during the 1982-83 measles epidemic, Israel

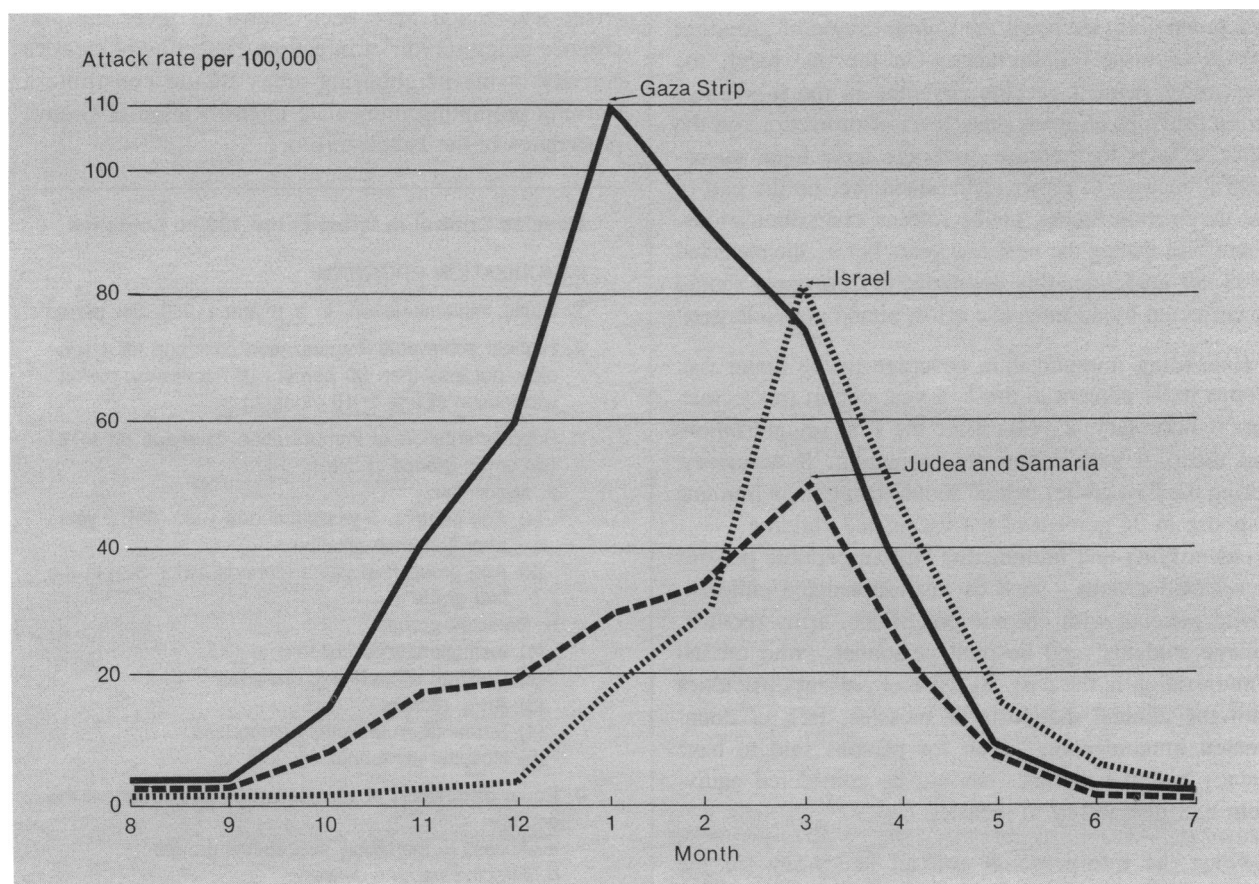


Table 3. Estimate¹ of herd immunity to measles in Israel, 1988

Age group (years)	Population ²	Number ² immune following vaccination	Number ² immune following natural exposure	Total immune	
				Number ²	Percent
Under 1.....	100	5	5	5.0
1-4.....	400	330	7	337	84.2
5.....	95	79	2	81	85.3
6-9.....	380	313	33	346	91.1
10-14.....	456	376	73	449	98.2
15-19.....	410	329	74	403	99.2
20-21.....	140	101	37	138	98.6
22-25.....	205	195	195	95.2
Total.....	2,186	1,528	426	1,954	89.5

¹ Based on 85 percent vaccine coverage and 97 percent seroconversion, and an attack rate of 10, 50, 90, and 95 percent in the 1-5, 6-9, 10-14, and ≥ 15 year age groups, respectively.

² In thousands.

Strategy and Logistics for Measles Prevention

The data that have been presented provide a reliable basis for reevaluation of measles control policy in Israel. A realistic objective seems to be the elimination of indigenous disease by interrupting the transmission of infection, as indicated by phase 2 of the strategic program of the U.S. Public Health Service for measles eradication (2,9,10).

Among the components of a logistic approach to measles protection (see box), the immunization of groups at risk is of utmost importance. On the one hand, the present 90 percent vaccine coverage in the 0- <1 age group provides an inadequate level of protection; on the other, efforts to increase coverage have been unsuccessful because of rather rigid adherence, on the part of the vaccination teams, to the routine contraindications. Therefore, during the next few years before the expected 1988-89 epidemic, this unsatisfactory coverage should be corrected by an intensive effort aimed at two targets:

- Expanding immunization coverage in the major risk groups to 97 percent in the 1-5 year cohort (revaccinating, if necessary, 2 years after the first immunization) and the 6-9 year cohort (revaccinating, if necessary, during the first grade), which should result in an immune response in 94 percent of the vaccinated children.
- Identifying and immunizing still susceptible persons in selected groups—such as institutionalized children, young patients with chronic conditions, army recruits, college students, and hospital personnel—who missed immunization in the past. Because of present difficulties with the clinical diagnosis of measles, lack of documented immunization—even for persons said to have already had the disease—should be considered equivalent to vulnerability to measles.

Since the interpersonal contact necessary for the spread of infectious agents, including measles, is in fact

established in smaller groups and not in the entire community at risk, the herd immunity of small groups should be taken into consideration. Therefore, a prime objective of the immunization program should be distribution of the vaccination effort throughout the country as equally as possible, in order to reach most of the susceptible groups.

Particular consideration should also be given to disease surveillance activities in Israel and in the controlled territories, which have been shown to favor the persistence of a reservoir of infection. Detection of measles activity in the neighboring areas should constitute a warning prompting immediate intensification of control procedures in the Israeli territory.

Measles Control in Israel in the 1980s: Logistics

IMMUNIZATION PROGRAM:

1. Rapid implementation: in a 6-year (1983-88) period
2. Highest achievable immunization coverage for 1-year-olds: not less than 90 percent (If necessary, perform vaccination at age ≥ 10 months.)
3. Supplementation of immunization coverage up to 97 percent in groups at risk
 - a. Major risk:
 - (1) Age group 1-5 years (cohorts 1983-88): 2 years after first immunization
 - (2) Age group 6-9 years (cohorts 1979-82): in the first grade
 - b. Selected groups:
 - (1) Institutionalized children
 - (2) Children with chronic diseases
 - (3) Army recruits
 - (4) Students on university campuses
 - (5) Hospital personnel
4. Equal distribution of vaccination effort throughout the country
 - a. Access to the highly susceptible groups
 - b. Effective vaccine delivery

In a country like Israel, which is deeply committed to achievement of an expanded immunization program, the effort to reach this objective should be weighed within the national program aimed at elimination of the diseases controlled by mass immunization. Analysis of present achievements clearly shows that measles, together with poliomyelitis and rubella, deserves to be included among the first priorities of a program whose objective is elimination of clinical disease.

Conclusions

A 17-year-old immunization program has created the basis for elimination of measles in Israel, provided that (a) the control policy is adapted to the seroepidemiology of the infection, and (b) a concentrated logistic effort is mounted in the period preceding the next expected epidemic. Under this effort:

- The nearly 90 percent vaccination coverage of each newborn cohort that has already been achieved should be maintained.
- A 97 percent immunization coverage should be aimed at for the target groups formed by preschool and elementary school children who missed the routine immunization at age 1 year.
- Similar coverage should be achieved by immunization of susceptible persons in selected groups of children, adolescents, and young adults at high risk.
- The immunization program should be complemented by disease surveillance aimed at early identification of

the main sources of infection, among them active foci still present in the neighboring territories.

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Substance Abuse by Adolescents In Israel and France: A Cross-Cultural Perspective

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Synopsis

Household surveys of urban youths 14–18 years of age were conducted in 1979 with 609 Israeli adolescents and

in 1977 with 499 French adolescents. The overall order in the prevalence of use of legal and illegal drugs was identical in both countries. Cigarettes and alcohol were used by a larger proportion of young people than the illegal drugs; marijuana was used much more frequently than any other illicit drug. The same cumulative sequence of drug use appeared in the survey data for French and Israeli adolescents as in comparative data for adolescents in the United States—cigarette and alcohol use preceded the use of illicit drugs.

Striking cross-cultural differences appeared in the overall lifetime and current prevalences of use of all drugs, in the frequency of use, and in the age- and sex-specific rates for adolescents in Israel and in France. French youths uniformly reported greater lifetime and current use of all alcoholic beverages, cigarettes, and illegal drugs, more extensive involvement, and smaller sex differences than the Israeli youths.