The measles eradication programme in the German Democratic Republic

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After 3 years of intensive preparations the Ministry of Health of the German Democratic Republic started a national measles eradication programme in 1967. Vaccination was at first voluntary, but became compulsory in 1970. Through a vaccination campaign using Leningrad-16/SSW attenuated live vaccine, the disease was virtually eliminated throughout the country by 1972. In 1973 and 1974 only sporadic cases of measles were observed. The number of vaccination failures was negligible. Combined immunization against measles and poliomyelitis provoked no unusual reactions, and the difference between the seroconversion rates following combined or separate immunization was not statistically significant.

Epidemiological, clinical and socioeconomic considerations pointed to the need for a vaccination campaign against measles in the German Democratic Republic. Each year from 50 000 to 100 000 cases (300–600 per 100 000) were being recorded, while the real morbidity rate was much higher. Complications occurred in 6–7% of cases, and an average of nearly 50 children died of the disease annually. The yearly cost attributable to measles was estimated at 50 million marks (1).

MATERIALS AND METHODS

Measles vaccine

A live virus vaccine was developed by Starke by adapting the strain Leningrad-16 to primary dog-kidney cell culture and further attenuating it by propagation in this substrate at reduced temperatures. The sixth passage level is used as seed virus. The vaccine is produced in the VEB Saechsisches Serumwerk, Dresden, German Democratic Republic. Only kidneys from puppies bred under pathogen-free conditions are used for vaccine production. The age of the puppies never exceeds 4 weeks, and for each lot of vaccine the puppies must be from the same litter. These measures provide additional control. After dilution (1 : 5), each vaccine dose contains at least 1000 $TCID_{50}$. The vaccine is produced by the seed lot and single harvest system, to ensure that individual vaccine lots are homogeneous.

Each vaccine lot undergoes control testing at the State Control Institute for Sera and Vaccines in Berlin, in accordance with the production and control regulations approved by the Ministry of Health of the German Democratic Republic. The control regulations are based on the " Requirements for measles vaccine (live) and measles vaccine (inactivated) " drawn up by WHO (2), but also lay down additional requirements.

In June 1966 the vaccine was tested in a small field trial (4), and in 1966–67 it was tested again on a larger scale (7). In 1967 it was compared with 3 vaccines of different provenance in a further field trial (5).

The trials confirmed that the Leningrad-16/SSW vaccine produced excellent immunity and a low incidence of adverse reactions.

Eradication programme

The favourable evaluation of the vaccine prompted the Ministry of Health to begin general voluntary vaccinations against measles throughout the country in April 1967. As measles morbidity was highest in the 2–7-year age group, all children aged from

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9 months to 8 years were contacted for vaccination. By December 1969 a total of 59.4% of children in this age group had been vaccinated. However, there were considerable differences in immunization rates between districts, e.g., 75.7% in the district of Halle and 43.9% in the district of Leipzig. The consequence of the insufficient cumulative increase in the immunization rate in Leipzig was that the morbidity rate in the district was about 3 times the national average (6).

A thorough regional programme of measles eradication was started in April 1967 in the district of Halle. The programme took the form of several vaccination campaigns of short duration aimed at: first, immunizing all children in the 3–6-year age group, especially in crèches and kindergartens; secondly, immunizing all children in the 7–8-year age group in schools; eliminating epidemic foci; and achieving an equal immunization rate throughout the district. Vaccinations were carried out chiefly following the epidemic seasons. By April 1968, due to vaccinations and natural infection, the level of immunity amounted to almost 100%, and measles can now be regarded as having been eliminated for 7 years in the district (3).

The success of the elimination campaign in Halle served as an example for other districts. It became evident that measles could only be eradicated by immunizing more than 90% of the susceptible population. One of the most important prerequisites in attaining this aim is obligatory vaccination. According to legal regulations that came into force in March 1970, all children aged from 9 months to 8 years must be vaccinated. Immunization against measles was assigned a fixed place in the immunization schedule for children. Following the pattern of vaccination used in Halle, campaigns were carried out in all districts of the country. By 1970 more than 90% of all children attending crèches and kindergartens had been immunized against measles.

In 1971 the vaccination campaigns were aimed at immunizing all children who had not been vaccinated while vaccination remained voluntary. The development of the programme through voluntary and then compulsory vaccination from 1967 to 1973 proved effective, the immunization rate increasing from year to year.

RESULTS AND DISCUSSION

The eradication programme

By the end of 1973, 94.5% of all children born in 1972 had been immunized, and nearly 3 million children in the country are now protected against measles by immunization. In 1972 it was possible to end the vaccination campaigns, as only children reaching the age of 9 months needed to be vaccinated, as part of the official vaccination schedule. As a result of these efforts morbidity decreased from 169 per 100 000 in 1970 to less than 10 per 100 000 in 1974 (2.3 per 100 000) and 1975 (8.8 per 100 000), in which years only 400 and 1494 cases respectively were registered in the entire country (Fig. 1).

Immunization and evaluation of immunity

Immunological investigations carried out for a seroepidemiological surveillance programme in September 1972 yielded useful data for the assessment of immunity to measles in the German Democratic Republic. A total of 499 sera from 9 age groups (at least 50 sera from each) was investigated by the haemagglutination inhibition test [a] (Fig. 2). The investigation of the 0–1-year age group (divided into 4 3-month groups) revealed the presence of specific

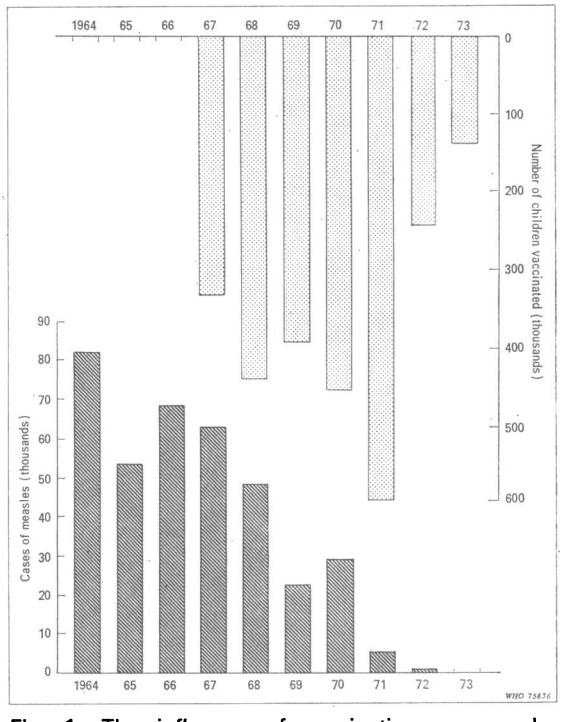

Fig. 1. The influence of vaccination on measles morbidity. Vaccination was voluntary from 1967 to 1970, when it became compulsory for children aged from 9 months to 8 years.

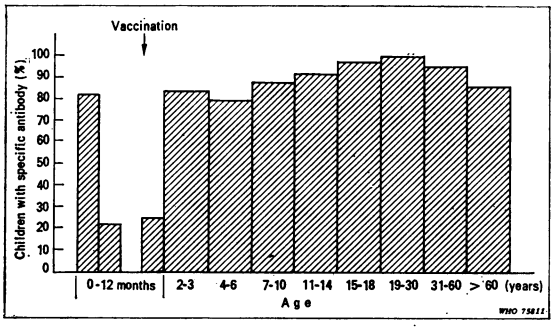

Fig. 2. Results of an immunological investigation of 499 sera from 9 age groups, September 1972.

antibody in about 45% of children up to the age of 6 months. Of these children only 6% had been given measles vaccine. As natural infection could be excluded, the antibody is assumed to have been of maternal origin. Maternal antibody is normally no longer detectable from the age of 6 months. This would explain the absence of positive results in children aged from 7 to 9 months (Fig. 2).

As children are subject to compulsory vaccination beginning at the age of 9 months, the level of specific antibody increased in the last quarter of the first year. Antibody in children up to the age of 10 years derived chiefly from vaccination. The results of our investigations of immunity levels were of the same order as the immunization rates for children of this age range (approaching 90%). The immunity to measles found in persons aged 11 to 60 years was due to natural infection.

Vaccination failures

Notification of serologically confirmed cases of measles following vaccination was made compulsory in 1967. The results of this surveillance showed that the number of vaccination failures was negligible (0.048% over the period 1967–73). From 1967 to 1971 immunization campaigns were carried out at fixed dates, but this has been changed. At present vaccinations are performed during the whole year, so that it is easier to pay attention to contraindications, to take the individual child's state of health into consideration, and to observe the proper intervals between measles and other vaccinations.

Simultaneous immunization

Simultaneous immunization against measles and poliomyelitis (oral) proved clinically feasible. No unusual reactions or complications caused by the combination were noted. In a trial of the two approaches, antibodies to poliomyelitis were detected in 83% of subjects following separate immunization (311 children) and in 80% following simultaneous immunization (196 children). Seroconversion to measles was found in 95% of the subjects following separate immunization and in 90% in the group immunized simultaneously. The differences between the two groups were not statistically significant.

Side-effects and complications

A complete register of side-effects and complications due to measles is being kept, and the results will be published subsequently. The total number of complications following 3 million vaccinations from 1966 to 1974 was 36, chiefly neurological disorders. In this period, 14 cases of encephalopathy/encephalitis, 1 case of meningitis, 11 cases of febrile convulsions, and 3 cases of other diseases of the central nervous system were recorded. The neurologic disorders were evaluated by the criteria applied in smallpox vaccination.

Conclusions

The success of the measles eradication programme in the German Democratic Republic was achieved by strenuous efforts. Measles has now been reduced to an uncommon disease in the country, and efforts will continue to maintain this satisfactory situation.

[a] The presence of antibody was determined by the haemagglutination inhibition test (microreaction of Takatsy), using measles split antigen (4 haemagglutinating units at 1 : 32 dilution) and a 0.5% suspension of monkey (*Cercopithecus aethiops*) erythrocytes. A titre of 1 : 8 is regarded as positive.

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RÉSUMÉ

LE PROGRAMME D'ÉRADICATION DE LA ROUGEOLE EN RÉPUBLIQUE DÉMOCRATIQUE ALLEMANDE

Avant la mise en train du programme national d'éradication, le nombre annuel des cas de rougeole en République Démocratique Allemande se situait entre 50 000 et 100 000 environ (soit 300 à 600 pour 100 000), la proportion des cas suivis de complications étant de 6 à 7%. Les dépenses annuelles imputables à la maladie étaient estimées à 50 millions de marks.

Un vaccin antirougeoleux vivant a été mis au point au VEB Saechsisches Serumwerk à Dresde à l'aide de la souche Leningrad-16 (vaccin antirougeoleux vivant Leningrad-16/SSW). Le virus vaccinal a été adapté à des cellules rénales de chiens puis atténué par des passages répétés à basse température. Des essais pratiques menés en 1966 et 1967 ont confirmé l'excellente immunogénicité et le faible pouvoir réactogène du vaccin. C'est en avril 1967 qu'on a commencé à pratiquer des vaccinations — à titre facultatif — dans tout le pays. Ces vaccinations ont été assurées dans le cadre de campagnes de courte durée qui étaient effectuées à la fin de chaque saison épidémique et s'adressaient aux enfants des crèches, des jardins d'enfants et des écoles ainsi qu'aux sujets vivant dans des foyers épidémiques.

La vaccination est devenue obligatoire en mars 1970. Aux termes des règlements promulgués à cet effet, tous les enfants âgés de 9 mois à 8 ans doivent être vaccinés. Les campagnes systématiques ont pu être interrompues en 1972 car seuls les enfants qui venaient d'avoir 9 mois restaient à vacciner. A la suite de ce programme d'éradication, le taux de morbidité est passé de 300–600 pour 100 000 à 2,3 pour 100 000 (400 cas) en 1974 et 8,8 pour 100 000 (1494 cas) en 1975.

Des opérations de surveillance immunologique ont fourni une évaluation de l'immunité à l'égard de la rougeole. Des anticorps ont été mis en évidence chez une proportion de sujets correspondant à peu près à la proportion d'enfants vaccinés, soit plus de 90%. La proportion de vaccinations non réussies était négligeable (0,048%).

Aucune réaction inhabituelle n'a été observée à la suite de vaccinations simultanées contre la rougeole et la poliomyélite. On n'a pas observé non plus de différence statistiquement significative entre les taux de séroconversion à la suite de vaccinations simultanées et de vaccinations séparées. Des complications ont été observées dans 36 cas seulement à la suite des 3 millions de vaccinations pratiquées entre 1967 et 1974. Ce sont essentiellement des complications neurologiques (encéphalopathie, encéphalite, méningite, convulsions fébriles).

Malgré le succès du programme d'éradication, il est nécessaire de poursuivre les efforts pour conserver les résultats acquis.

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