CHAPTER 3 - ELIMINATION STRATEGIES

In the arena of measles elimination in developing countries, the experiences of the Americas stand out. Measles elimination strategies have been developed by the Pan American Health Organisation (PAHO) and have been found to be successful, both in the developing and the developed country health care settings. Detailed descriptions of these strategies were published in the *Journal of the American Medical Association*[57] and are quoted here.

These strategies aim to rapidly interrupt measles transmission by initially conducting mass campaigns and to maintain interruption of transmission by sustaining high population immunity through vaccination of infants at routine health service facilities supplemented by periodic mass campaigns. Disease surveillance, measles virus surveillance and outbreak response are other key elements of the strategy.

3.1 Mass immunisation campaigns

3.1.1 "Catch-up" campaigns

The "catch-up" campaign is a one-time initial vaccination conducted to rapidly interrupt chains of measles transmission. This campaign is generally conducted during periods of low measles transmission ie. the winter months. All children 9 months through 14 years of age, irrespective of vaccination history or reported history of measles infection, are vaccinated with measles vaccine within a short period, usually 1 week to 1 month in duration. The campaign is coordinated by the Ministry of Health and conducted by the local health services. Mass media communication is used to attract the target population to the vaccination sites. National government finances the campaign, and in some countries external resources have complemented government funding, in which case national resources accounted for more than 80% of the total costs of the campaign. In some instances these campaigns are used for the delivery of other vaccines and interventions, such as oral polio vaccine and Vitamin A supplementation.

These campaigns result in a rapid increase in population immunity, and if high enough coverage is achieved, measles transmission is interrupted.

3.1.2 "Mopping-up" campaigns

After a catch-up campaign has been conducted, groups of susceptible children may remain. An evaluation is conducted to identify these children, and special vaccination ("mop-up") is carried out in such areas to increase their level of coverage. These mop-up campaigns, which aim at increasing vaccination in areas of low coverage, differ from the ones used during the polio eradication program that aimed to interrupt polio virus transmission in areas with persistent transmission despite high vaccination coverage.

3.1.3 "Follow-up" campaigns

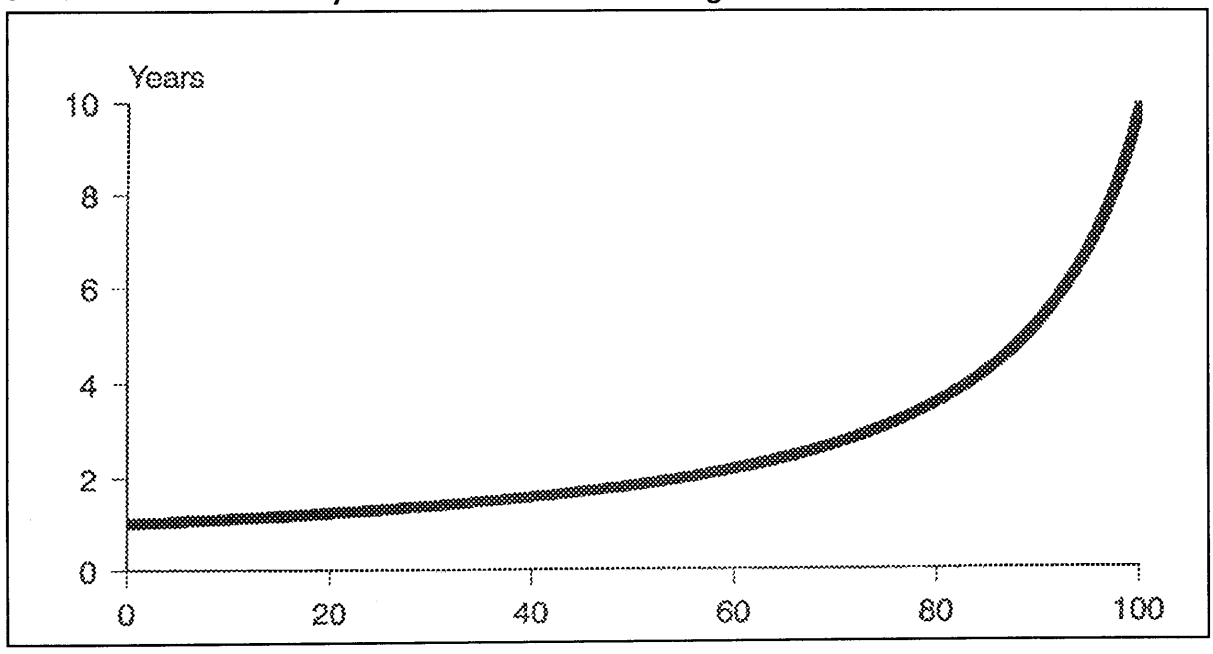
However diligent the immunization efforts, susceptible preschool-aged children will accumulate over time. Two major factors contribute to the accumulation of susceptible children. Firstly, measles vaccine is not 100% effective, thus leaving some children unprotected despite vaccination. Secondly, measles vaccination coverage for each birth cohort will fall short of 100%, however effective the programme.

The accumulation of susceptible pre-school-aged children can be illustrated by the following hypothetical situation in a country with a population of 20 million and 500 000 births per year. If 90% of newborns receive measles vaccination through routine health services at 12 months of age, and measles vaccine effectiveness is 90%, then each year 405 000 children (81%) of the newborn cohort will be protected (500 000x0.9x0.9) against measles and 95 000 children will be added to the pool of susceptible persons. In approximately 5 years, the cumulative number of susceptible children persons will approximate the number of children in one birth cohort. Almost certainly this number represents enough susceptible children to permit an outbreak to occur should the virus be reintroduced.

Thus, the present strategy calls for periodic vaccination campaigns to be conducted among preschool-aged children. This strategy is recommended whenever the number of susceptible preschool-aged children (children younger than 5 years) approaches the size of an average birth cohort. The interval between campaigns will depend on the vaccination coverage obtained among infants through routine services since the last campaign. Thus, if only 60 % coverage is obtained during routine vaccination services offered to all children younger than 2 years, a follow-up mass campaign would be needed approximately every 2 years; if 80% coverage, approximately every 4 years; and if 90% coverage, approximately every 5 years (Figure 4). It is recognized that setting the epidemic danger point is an arbitrary approximation. Further experience may eventually suggest either a higher or lower threshold.

"Follow-up" campaigns are conducted similar to that of the "catch-up" campaigns described above, with the exception that the target age group is narrower. For example, if 4 years have passed since the "catch-up", the target for the follow-up may

Figure 5: Required frequency of "follow-up" measles campaigns according to annual mean under 1 year vaccination coverage (Source: JAMA, 17 Jan 1996)



be children 1 to 4 years of age. Similar to "catch-up", after a "follow-up" campaign there

may be remaining pockets of susceptible children. When such pockets still exist it is necessary to carry out a "mop-up" vaccination efforts as discussed in section 3.1.2 above on page 31.

3.2 Routine vaccination programme

After the initial catch-up and mop-up campaigns, routine immunization services should ensure that all new birth cohorts of children receive the routine doses of measles vaccine as specified in the childhood immunisation schedule. Various approaches are used to ensure that at least 90% of each new birth cohort receives measles vaccine. These approaches include improving access to vaccination, reducing missed opportunities for vaccination, and where necessary, mobile house-to-house vaccination services.

Missed opportunities are generally caused by the following four main reasons, although many other reasons for missed opportunities exist:

a) The limited hours or days which some health centres are open are a commonly cited example that has prevented access.
b) Health workers often do not find out whether a child who visits a clinic for some other reason is fully vaccinated. Others may be reluctant to open a multi-dose vial of vaccine for a single child because they believe it would be a waste of resources.
c) False contraindications to vaccination include mild fever, diarrhoea, vomiting, colds, and coughing. Despite clear national standards, health workers often do not vaccinate children with these symptoms because they erroneously fear that they will be exacerbated.
d) Sometimes the supply and distribution of vaccines to health centres is inadequate.

The level of coverage reached with the routine vaccination services is critical in the

elimination of measles transmission, as it determines the rate at which the susceptibles increase. As soon as sufficient children are left unimmunised, outbreaks are likely.

3.3 Surveillance

Routine reporting is the backbone of a surveillance system. Monitoring suspected cases should be carried out by an established network including health facilities, private practitioners, hospitals, and laboratories. Follow-up of reported cases should take place rapidly (within 24 to 48 hours) and is the responsibility of the district level staff. The monitoring system should include at least one reporting source identified in each "village/township" (or comparable small geo-political unit).

It may be necessary to convince public and private health personnel of the importance of measles reporting since many consider the disease an unavoidable fate of childhood and subsequently leaving suspected measles cases go unreported. Additionally, many private practitioners may not have seen a measles case or remember what one looks like, and therefore may be reluctant to report. To increase physician and nurse participation, visits should be made by district coordinators to association meetings, and if necessary directly to clinics. It is advisable to provide a specific form displaying key information to report. It is crucial that when ZERO cases are detected in a reporting unit, a ZERO REPORT is nevertheless sent in to reflect the absence of suspected cases.

3.5 Laboratory support

3.5.1 Serological testing

Measles-specific IgM antibodies can be detected using both indirect and capture EIA's. There are several indirect measles assays available as commercial kits (Behring, Clark, Organon, etc). These tests are relatively easy to perform, require only 2-3 hours and have a high sensitivity and specificity for measles. The major shortcoming of the

indirect assays, however, is that in periods of low measles incidence, false-positive results are to be expected because of the less than 100% specificity of the tests.

The measles laboratory of the Centers for Disease Control and Prevention has developed a capture IgM EIA assay. Overall, sensitivity and specificity have been found to be over 97%. This test has been found to detect IgM antibodies in about 75% of measles cases on the first day of rash; by day three of rash, the test will detect close to 100% of measles cases. Moreover, false-positive results are extremely rare with this assay.

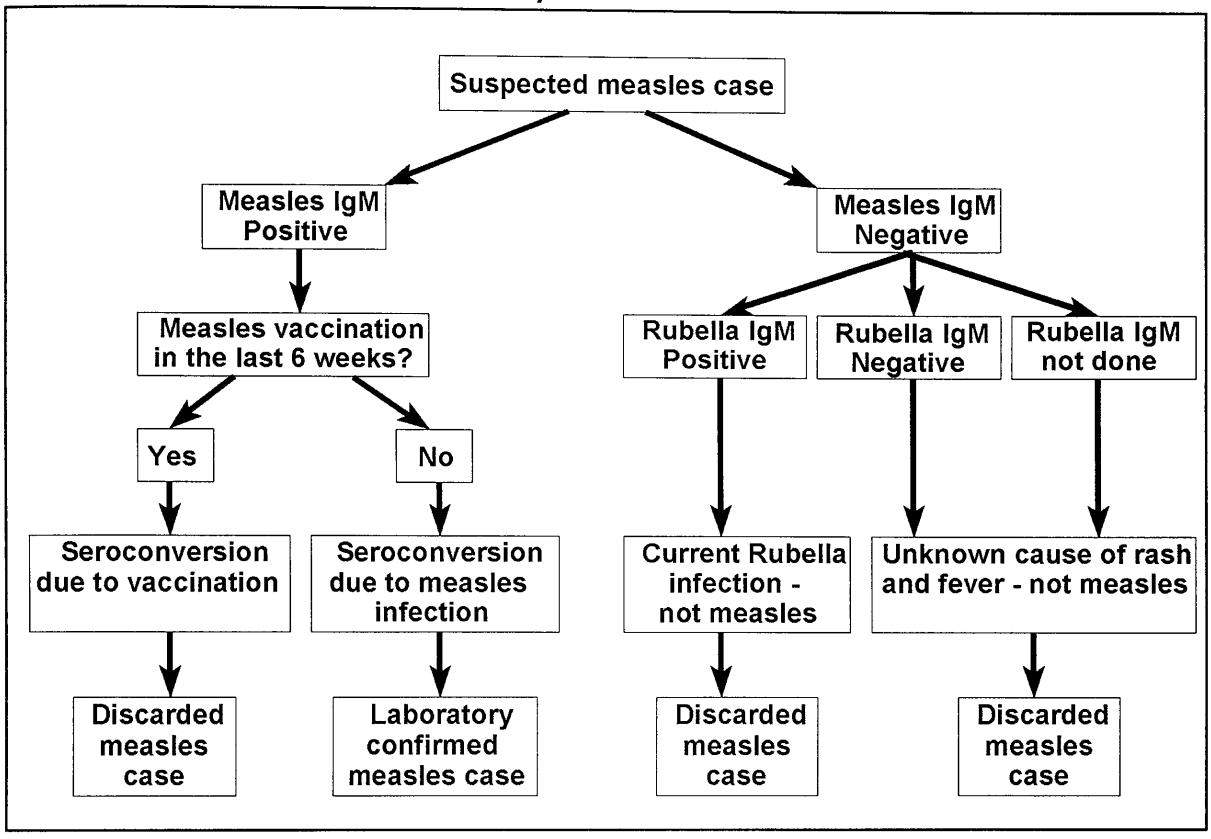
While the CDC capture assay has produced excellent results in regional reference measles laboratories in the Americas, the relative complexity and length of the test (6-7 hours) have made it difficult to implement this assay further afield.

IgG testing for measles requires the demonstration of a rise in the titre of antibody against measles. Two serum specimens per case are always required. The first specimen should be drawn as soon after rash onset as possible, at the latest within 7 days after rash onset. The second specimen should be drawn 10–30 days later. The tests for IgG antibody should be conducted on both acute and convalescent specimens at the same time. The same type of test should be used on both specimens. The specific criteria for documenting an increase in titre depends on the test. ELISA values are not titres and increases in ELISA values do not directly correspond to four-fold or greater titre rises.

Because tests for IgG require two serum specimens and a confirmed diagnosis cannot be made until the second specimen is obtained, IgM tests are generally preferred.

The interpretation of the serology should be based on the following diagram (Figure 6):

Figure 6: Interpretation of laboratory results



3.5.2 Measles virus isolation

Although isolation of measles virus is not recommended as a method to diagnosis measles, virus isolates are extremely important for molecular epidemiologic surveillance to help determine

- the origin of the virus,
- which viral strands are circulating in the country, and
- whether these viral strains have become endemic in the country.

Isolation of measles virus is technically difficult and is generally performed only in research laboratories, in the case of South Africa, at the National Institute for Virology (NIV).

The isolation of measles virus from clinical specimens can also be used to confirm measles diagnosis, but is relatively time consuming and requires more sophisticated laboratory support than serology. However, recent advances in the molecular epidemiology of measles virus has made it possible to analyse viral nucleotide sequences and classify measles isolates according to probable geographic origin.

During periods of low measles incidence, the isolation and molecular analysis of measles isolates can provide very important information concerning the likely geographic source of measles importation. Information obtained through molecular epidemiology can complement information obtained from the standard epidemiologic investigation.

Although technically more difficult than serologic assays, the culture, isolation, and genetic analysis of the measles virus obtained from measles outbreaks can provide important information concerning the circulation of measles virus. Indeed, information obtained from molecular epidemiology can well complement information obtained from the classic epidemiologic investigation. Therefore, efforts must be made to collect appropriate clinical specimens for viral culture from every chain of measles transmission.

3.6 Outbreak investigations and response

Because measles virus continues to circulate in many parts of the world and international travel is readily available, it is virtually impossible to completely protect a population against measles. However, maintaining high levels of population immunity will decrease the possibility of extended measles transmission following an importation, should one occur into a measles free area.

Experience has shown that due to the very high communicability of measles, many susceptible persons will already have been infected with measles virus before the outbreak is recognized and control activities can be implemented. Although effective

control of an outbreak may not be possible, and resources are best expended on Outbreak Prevention, some appropriate response needs to be made.

STEPS IN OUTBREAK RESPONSE

- **Confirm the Diagnosis**
- **Investigate Suspected Measles Case(s)**
- **Isolate Case(s)**
- **Inform other Health Authorities**
- **Assess Coverage in Affected and Surrounding Areas**
- **Define Target Groups and Immunize Unvaccinated Persons**
- **Enhance Surveillance**
- **Analyse/Summarize Outbreak**
- **Develop New Outbreak Prevention Strategy if Necessary**