1. Introduction

Jungle yellow fever implies a situation in which the yellow fever virus circulates in wild animals, especially wild monkeys, which serve as reservoirs of the disease. The dissemination of the disease is by the monkey-mosquito-monkey cycle. Man becomes occasionally involved and may initiate an epidemic.

The habitat and breeding places of the vectors of jungle yellow fever are less easily identifiable and so the vectors are less amenable to control than the domestic Aedes aegypti. Vaccination is therefore the most practical method of preventing epidemics.

Jungle yellow fever is a problem of rural communities in the tropical regions of Africa, Central and South America. Some of the characteristics of such areas include low population densities consisting of scattered hamlets or larger but widely spaced communities. Communications are poor. The health resources in terms of trained personnel and facilities are limited. Numerous diseases of public health importance are prevalent as a result of geography, climate, illiteracy, poverty, overcrowding, cultural patterns and poor personal and community hygiene. The organization of vaccination programmes in such situations present special problems.

2. Vaccination coverage

The selection of groups which should be vaccinated is dependant on factors such as the objectives of vaccination, the available resources, the areas at risk as well as age-group priorities.

Vaccination against yellow fever has three objectives. It provides protection for an individual. For public health purposes it establishes a herd immunity as a means of preventing epidemics. It also creates a barrier against the introduction of the disease to receptive but yellow fever free areas.

It has been estimated that epidemics of yellow fever are unlikely to occur where more than 70 per cent. of the population is immunized (Smithburn, 1956). In a situation where the population of susceptibles includes an unknown number of wild animals, it may be advisable to aim at a total coverage of the human population in order to prevent outbreaks.
2.1 Priority groups

Selective vaccination may become necessary because of limited vaccine supplies. In such situations the vaccination of children above the age of one year should be given priority consideration since, it has been found that a proportion of unvaccinated adults in endemic areas show evidence of immunity without previous clinical infection. If further selectivity is required then children of urban centres may be considered before those of less dense areas. Forest workers, hunters, game wardens, migrant workers and travellers entering endemic zones are at special risk.

2.2 Priority areas

High population centres and areas with repeated histories of yellow fever outbreaks should reserve priority consideration. Transition forest areas come under this category. The results of Aedes index surveys may also be used to assess priority rating for vaccination.

3. Organization of vaccination

Immunization services may be delivered by static centres or by mobile teams.

3.1 Static centres

Vaccination centres are more suitable for areas of high population density consisting of health conscious and highly motivated groups. Such consciousness is achieved through health education.

In order to obtain a high coverage in rural areas there must exist a network of static centres so that mothers do not have to carry children over excessive distances to obtain vaccination.

Specific days must be allocated for vaccination at static centres. Attendances may be small because rural folk do not find it easy to keep to fixed times. The number of doses in each vaccine ampoule should not exceed 25 in order to avoid wastage. Suitable refrigeration must be available. Vaccination is more conveniently administered by needle and syringe.

The advantage of vaccination from static centres is that no special schedules are required to vaccinate new child entrants.

3.2 Mobile teams

The use of mobile vaccination teams permits yellow fever vaccination of rural communities with limited health facilities. The composition of the team depends on whether its function is unipurpose or multipurpose. In general a team consists of a team leader, one injector, a recorder, and a driver-mechanic. Other operators may be added according to the scope of work. For example the number of vaccinators may be increased if more than one type of vaccine is administered.

3.3 Method of vaccination

Syringe and needle vaccination may be conveniently employed in small communities. In recent years successful mass vaccination campaigns have been conducted with the Ped-O-Jet. The jet injector makes it possible to vaccinate about 500 persons in an hour. It provides speed and mobility to the teams and simplifies the problems of sterilization of equipment. Trained Ped-O-Jet teams must be capable of repairing the equipment. They must also carry spare parts. The possession of an extra complete Ped-O-Jet is an advantage.
3.4 Method of operation

Vaccination may be conducted by house to house visits using the syringe and needle and small dose ampoules of vaccine. Ped-O-Jet vaccination programmes are best based on the collecting point system. A vaccination point may be established in a town or a central village. The inhabitants of the surrounding villages are induced to journey to the vaccination point. The collecting point system excludes the extremes of age if the distances are too great.

Successful vaccination coverage using collecting points depends on good advance publicity, the co-operation of the community, the distance to the collecting point, and the degree of organization and motivation of the vaccination teams.

4. Vaccine

The 17-D vaccine is suitable for use with the Ped-O-Jet. It is supplied in ampoules of 100 doses in the dried form. It is safe for all ages above one year. It is less thermostable than the Dakar strain vaccine. Consequently the Dakar strain vaccine has been used in some countries with very hot weather for persons above 10 years. It is administered by cutaneous scarification, and may be combined with the smallpox vaccine.

4.1 Storage

Few of the yellow fever endemic countries produce their own vaccine, arrangements must therefore be made to ensure that consignments of vaccine arrive in a satisfactory condition.

The vaccines should be stored in a deep-freezer at a central depot. Sub-depots at regional or district centres may have deep-freezers or ordinary refrigerators with freezer compartment, where the vaccine may be stored.

4.2 Transportation

In the absence of suitable storage facilities at district centres, a gas-operated portable freezer may be transported to selected temporary centres along the itinerary of the teams. Vaccines may be conveyed in ice-boxes on short journeys, but care should be taken to ensure that an adequate number of "cold-packs" are used and that they are properly chilled.

4.3 Reconstitution of 17-D vaccine

The 17-D vaccine must be reconstituted just before use. For the purposes of immunization with the Ped-O-Jet, 100 doses pack of the vaccine may be dissolved in 2-3 ml of solvent and transferred into containers designed for use with the Ped-O-Jet. Additional solvent may then be added to make up to 50 ml.

Reconstituted vaccine should be kept on ice when not in use. It should be discarded if not used within one hour.

5. Cost

The cost of a vaccination campaign may be estimated as the total cost of the vaccine, equipment and supplies, transport, and the wages of the vaccination team.

The conditions in many yellow fever endemic countries favour a high prevalence of other communicable diseases. Measles, poliomyelitis, whooping cough, and diphtheria are some childhood diseases that claim attention. Smallpox and tuberculosis affect all ages. These diseases can be prevented by existing vaccines. The simultaneous administration of other vaccines with the yellow fever vaccine would result in a considerable reduction of the cost of controlling any one of the diseases.
5.1 Combined vaccination programmes

Multiple antigen administration can be done in two ways. The various antigens can be mixed in one syringe and injected or they can be given in separate syringes. Definition of the terms for the two methods have been suggested. The administration of a mixture of vaccines at a single site has been termed combined vaccination. Simultaneous vaccination has been defined as the injection of two or more vaccines at different sites on the same occasion.

Whereas immunization against pertussis, diphtheria and tetanus is as a rule completed before the sixth month of life, yellow fever immunization is preferably delayed till later. Effective immunization with the killed vaccines requires repetitions at monthly intervals. These considerations together with such factors as interference and safety tend to limit the scope of combined or simultaneous vaccination in a mobile campaign.

Although such a scheme has not yet been extensively tried, yellow fever vaccine can be administered simultaneously with smallpox and measles with effect and safety. Mass vaccination by scarification using a combination of the smallpox vaccine and the Dakar strain vaccine has been a routine practice in some African countries for many years. Children under 10 years have been excluded in this practice to avoid encephalitic complications.

5.2 Frequency of vaccination cycles

One of the important decisions in a multiple antigen vaccination programme by mobile teams concerns the frequency of the vaccination cycles. Some of the factors to be considered in arriving at a decision are:

(i) the size of territory to be covered and the population at risk;
(ii) the resources in terms of operational costs;
(iii) the duration of immunity conferred by the various vaccines;
(iv) the rate of growth of new susceptible groups.

Some recent vaccination programmes by means of the Ped-O-Jet include the following:

(i) smallpox vaccination;
(ii) BCG vaccination;
(iii) measles vaccination;
(iv) yellow fever vaccination.

5.3 The two-year cycle

The two-year cycle has been found satisfactory by a number of African countries. This implies one visit to each community within the period of two years. Smallpox vaccine is given to everyone on each visit. Measles vaccine is given to non-immunized children above the age of six months. On subsequent visits children previously vaccinated against measles when they were under a year receive a booster dose. BCG (half the normal dose) is given to children under six months and children between six and 20 years. All children in their second year who have previously been vaccinated against measles receive the yellow fever vaccine and once every 10 years the entire population above the age of 10 years is vaccinated against yellow fever again.
6. Vaccination certificates

Some means of determining the immunity status of the population becomes necessary when the range of available vaccines increases. This is important for epidemiological reasons. It also avoids wastage. Vaccination certificates have been found useful as incentives to the vaccinées and as a means of obtaining the vaccination history of the population despite the effort and cost the system involves. In the absence of such a system serological surveys remain the only means of obtaining the immunity profile of the population.

7. Summary

The principles and problems concerning the development of regular vaccination programmes in areas of jungle yellow fever have been discussed. It has been shown that combined vaccination has been developed in some countries in order to reduce the cost of control measures against individual diseases. The problems involved in such programmes have been discussed.

REFERENCES


