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SMALLPOX ERADICATION - PROSPECTS FOR THE FUTURE

In introduction, I felt it might be appropriate to show a few pictures of what we hope may soon be an extinct species - smallpox - a disease which, I suspect, many here have not seen. The pictures are from a slide series just completed last week and now being distributed to the field. The pictures are unique as they depict the development of rash from the first day until recovery.

Before we view the future prospects for smallpox, a word or two about the progress to date is important to place the situation today in perspective.

The programme began in January 1967. During that year, 42 countries reported 131 000 cases of smallpox - 30 of these countries were endemic. In fact, by subsequent surveys, we estimate that less than 5% of all cases were being reported. Thus, at least 2.5 million cases are assumed to have occurred that year. At the same time, vaccination programmes of a more or less intensive nature were being conducted in essentially all countries. No health administration could afford, in fact, to do otherwise for smallpox, through the centuries, has been the most pervasive and feared disease known to man. As it is caused by a virus which spreads from man to man, it may travel, with man, literally anywhere - to any country. All are potentially susceptible and once the disease occurs, there is no treatment. Between 15 and 30% of those acquiring variola major die; of those acquiring intermediate forms as found in Africa, about 10% die and of those acquiring variola minor, about 1%. It is a wholly reasonable and understandable fear of smallpox which has sustained vaccination throughout Europe and North America and has made the smallpox vaccination certificate the sine qua non for international travel. Similarly, for decades in the endemic countries, some semblance of control has been politically if not sensibly required.

As the programme began, the most urgent requirement was an assured supply of potent, freeze-dried vaccine. We found, on survey that less than 20% of the vaccine in use in endemic countries met accepted standards. Some vaccine from otherwise reputable laboratories was found, in fact, to contain particles of dirt and hair but no detectable live vaccinia virus. The obvious solution was to purchase vaccine but an estimated 250 million doses was required. The cost for this somewhat exceeded the total WHO smallpox budget. Thus, as a policy, it was decided to buy no vaccine whatsoever but to endeavour to strengthen

production in the endemic countries to the extent possible and to seek the balance of the vaccine requirements from Member Countries. International testing centres for vaccine were obviously required and the Rijks Instituut, Netherlands and Connaught Laboratories, Canada agreed to serve in this capacity. Three hundred lots of vaccine are now tested annually and efforts are made to test at least eight lots of vaccine each year from each laboratory supplying vaccine to the endemic countries. Production in the endemic countries has steadily improved both in quality and quantity and donations have been received from some 30 member governments - the most substantial coming from the USSR, the USA and Canada. Within three years after the programme began, essentially all vaccine in use in the endemic countries met accepted standards.

As we endeavoured to improve the vaccine simultaneously we sought to obtain better vaccination devices. The jet gun was introduced for use in South America, West Africa and the Congo and it proved highly effective although causing a constant headache in terms of maintenance, repair and spare parts. Late in 1967, we began to experiment with the forked or bifurcated needle and this proved to be as revolutionary a device as the safety pin, in its day. We found the technique could readily be taught in an hour or less, take rates were equal or superior to those obtained by any other device and only one-fifth as much vaccine was required. The needles could be repeatedly sterilized and, in fact, appear to be virtually indestructible. How rapidly vaccination could be accomplished with these was not appreciated until the programme in Rwanda got under way. There, vaccinators averaged between 1 000 and 1 500 vaccinations per day per man. However, they did complain that their fingers got sore and requested thimbles. The bifurcated needles are now in use throughout the endemic countries and are now replacing the jet injector.

As the vaccine problems and vaccination techniques gradually were sorted out, plans for programmes were developed and, eventually, some 40 WHO-assisted programmes came into being.

In the past, smallpox eradication programmes were equated quite simply with mass vaccination. It was assumed that if one simply set about the business of vaccinating everyone, the disease would vanish. Of course, one is never able to vaccinate everyone in any programme and the campaigns sometimes proved effective but more often not. From somewhere in the early mists of medicine,

the concept had been propogated that if 80% were vaccinated, transmission would stop. Yet in Central Java in Indonesia, a survey showed more than 92% with vaccination scars at the same time over 1 600 cases were occurring. More than 90% of these cases had never been vaccinated. At the same time, Ceylon was free of smallpox with less than half of its childhood population vaccinated. The difference quite simply was that smallpox in Ceylon prompted immediate field investigation and intensive containment activities. In Indonesia, the programme had been simply one of indiscriminate vaccination and yet more indiscriminate vaccination.

Thus, in this programme we have relegated mass vaccination to a supportive rather than a primary role. While effective in erecting a partial barrier of immunity and thus facilitating surveillance, vaccination alone has been demonstrably ineffective. The essential element has been surveillance - involving reporting, field investigation and containment of outbreaks. This, of course, requires participation of the general health services to the extent they exist. But the key element, the catalyst, is one to three trained national or provincial surveillance teams, headed by a physician or health inspector, and consisting of only a few people who travel constantly to promote the reporting system, to investigate and contain outbreaks and to search for cases. One such team normally can do all that is required in a population of 2 to about 10 million persons. It is worth remarking that to date, when a surveillance programme has been established in a state or country, transmission has usually been interrupted within 12 months - at most, within 24 months.

The four essential elements in development of this programme, as I would view it, thus have been:

First - the use of vaccine of assured potency;
Second - a simple, virtually foolproof technique for vaccine administration;
Third - the change in strategy to one which utilizes surveillance as the "cutting edge" of the programme;
Fourth - effective and continuing <u>field</u> supervision by staff at all levels of the programme.

Programmes are now in progress in all endemic countries. The situation today may be summarized with a map and a few figures.

As you will recall, in 1967, 42 countries reported smallpox and 30 of these were considered to be endemic. This year only 16 countries have reported smallpox and endemic transmission appears to be confined to only 6.

The number of cases reported this year will be approximately 45 000. With improved reporting of cases we estimate that at least 30% of the cases actually occurring are being reported and therefore the total number of cases of smallpox in real figures would be at most 150 000. In 1967, as you will recall, the total of cases was estimated to be over 2.5 million.

In South America, Brazil in recent years has been the only endemic country. A vaccination programme began there in 1967 and a surveillance programme in July 1969. With the development of the surveillance programme, incidence rose sharply and then declined throughout 1970 until November when the last cases occurred. In March 1971, however, one last focus was discovered in suburban Rio de Janeiro, tracing back to known previous outbreaks. All cases had occurred in two clusters of houses not 200 metres apart in a lower socio-economic area. Extensive containment measures were applied and no further cases have been recognized. During the past six months, an extensive search for possible hidden foci has been in progress in Brazil and in neighbouring countries. None has been found. While we cannot yet say definitely that transmission in the Americas has been finally stopped, it seems increasingly probable.

In west and central Africa, an area embracing 20 countries and 120 million persons, a regional smallpox programme was begun in January 1967 with USA bilateral assistance. Surveillance activities were initiated in earnest in August 1968. Smallpox incidence decreased rapidly and in October 1969, a nil incidence was recorded for the first time. However, eight months later, a single case of smallpox in Kano, Nigeria was recognized and investigation revealed an outbreak of 70 cases in the central part of the country tracing back to previously known foci. Extensive containment measures were taken and since May 1970, no further cases of smallpox have been identified in these countries.

In the southern and eastern part of the African Region, programmes have been in progress in all countries. Transmission in most was interrupted by late 1970. Zaire remained the last major endemic country until this year but, following completion of an exceptionally effective programme of systematic vaccination just completed, transmission appears to have been interrupted. Recently, however, three cases have occurred in Botswana, along the border with South Africa.

The exact source of these cases has not been identified although it is suspected to have been Transvaal Province in South Africa which last recorded cases in January. No cases have now been reported by any of the countries in the African Region for more than a month and, while this is encouraging, we cannot yet be confident that a few remote endemic foci do not still persist which may flare up. Intensive surveillance and maintenance vaccination must continue to be actively persued, particularly, as two of the major endemic countries of the world, Sudan and Ethiopia, continue to pose a threat to countries throughout the African continent. But, about these, I will speak later.

In Asia, notable progress has been made by several countries. In Indonesia where a programme began just three years ago, smallpox is now confined to a very limited area at the tip of the island of Sulawesi. Transmission is expected to be interrupted by the end of this year. East Pakistan has detected no cases since August 1970, despite continuing intensive search by five specially trained surveillance teams.- and no cases have been reported among refugees in India. Afghanistan has been executing a model eradication programme in some of the geographically most difficult areas of the world and expects to record a nil incidence within the next 6 months. In Nepal, outbreaks this year have been near the border with India and mainly, if not totally, appear to have resulted from importations. No cases have been detected since June.

The problem areas at present appear to be four - West Pakistan, India, Ethiopia and Sudan. A fifth problem is represented by the occasional importation of cases into non-endemic areas. What is the status of activities in these areas and what are the prospects for success?

1. West Pakistan

Programmes are in progress in three of the four provinces of West Pakistan and, in two, constituting over 60% of the population, transmission should be fully interrupted by the end of the year. A third province is making excellent progress but in a fourth, Sind Province, the programme has only begun. If the programme in Sind is developed as planned, we feel there is every reason to believe that transmission in West Pakistan could be interrupted within 12 to 18 months.

2. India

India presents difficult problems and almost more than any other country, has found it difficult to effect the transition from a mass vaccination programme to one which emphasizes surveillance. The concept of surveillance has begun to make effective headway only in the past year. The reporting system which potentially could be the best in any developing country is antiquated and inadequate. The smallpox eradication staff is more than sufficient in number but is overstaffed with vaccinators and understaffed in regard to state and national level directorate staff. It is like an army composed of privates and sergeants but with almost no officers. Remarkable results have followed, however, when only a few persons from national and state levels have begun to visit the field regularly to teach, to stimulate, to encourage. And, in fact, in a number of areas, dramatic progress has recently been made - to the extent that by the end of this year fully half of India's population should reside in non-endemic areas. The planned provision of additional directorate staff in all states, albeit consisting of only a few additional persons, could very rapidly result in the interruption of smallpox transmission throughout the country - perhaps in as little as two years.

3. Ethiopia

Ethiopia has recorded 18 000 cases this year and, for 1971, will account for more than 50% of the world's total of cases. The programme in Ethiopia only began in January and, emphasizing surveillance activities, has developed more rapidly than almost any other programme to date. A reporting system has been developed; all outbreaks are being actively investigated and contained by one or more of the national staff which, in fact, consists of only 75 persons; by the end of the year, at least 6 million persons will have been vaccinated. Prospects for the future are still difficult to assess as the programme has been operative for only a comparatively short period, travel and communication are difficult and, in contrast to many countries, little vaccination has been performed in the past. Recent appraisals by national staff suggest that a nil incidence could be reached in 18 to 24 months but a more exact assessment must await at least another 6 to 12 months of experience.

4. Sudan

Sudan is perhaps the most uncertain and problematical endemic country. While having more in the way of health services than many African countries, and an eradication programme which has been operative for over three years, progress has been disappointing. The vaccination programme is far behind schedule; surveillance activities have been only minimally developed; and national support is limited. Efforts are being made to strengthen the programme but the results cannot yet be anticipated.

5. The fifth problem which I should like to note relates broadly to that of the occurrence of cases in non-endemic countries. If we are to assure ourselves of the gains made to date and prevent re-establishment of endemic disease (as, for example, occurred in Sudan), every case in a non-endemic area must be immediately and competently investigated and contained. This really sounds much easier than it is in fact. When so many cases have occurred in the past, it is difficult in some instances to persuade both national and international authorities that a single case represents a valid public health emergency. Too frequently we are told that a sporadic case is of no great concern and that extensive vaccination will handle the problem.

However, as we know smallpox passes from person to person in an uninterrupted chain of transmission, one case in a non-endemic area means only one of two things - an importation has occurred or an unknown reservoir of infection persists. The last foci in Brazil of 20 cases, in Sumatra of over 100 cases and in Nigeria of 70 cases were discovered as a result of identification of a single case.

Finally, the direction of the programme as areas have become non-endemic is of considerable interest. In East Africa, the smallpox teams are now also administering BCG; in West Africa, BCG, measles, yellow fever and cholera vaccines; pilot projects for BCG and smallpox vaccination in Indonesia and Afghanistan are in progress or planned. The surveillance activities are continuing in these countries but the units are increasingly becoming more broadly concerned with communicable disease control services and the reporting network with other diseases of national importance. And this we encourage and support so long as smallpox and smallpox vaccination is not forgotten or ignored.

In conclusion, it is apparent that the programme, as a whole, has made considerable progress in the past 5 years and, for this, due credit must be extended to both national and WHO colleagues who are working intensively in the field with incredible dedication under the most adverse circumstances. Recognition of this progress has recently been afforded by the USA and the UK who have decided that the risk of importation is now so low that routine vaccination in these countries can be terminated. These are, of course, countries with good medical services and geographically distant from endemic areas. It cannot at this time, be recommended to all non-endemic countries. However, if the progress of the past 5 years can be sustained and let us recognize that this may indeed be difficult, as the residual problems are often the most resistant, I believe that two years from now we should be at or near enough to a nil incidence that a final mobilization of resources might rapidly complete this effort. And then - smallpox vaccination for all countries might well be relegated to history.