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SMALLPOX ERADICATION

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I INTRODUCTION

Smallpox continues to be a major public health problem in a number of countries in the world. Consequently smallpox eradication or control constitutes an important part of the work of the health administration in these countries.

Whilst smallpox is no longer endemic in European, North American and Western Pacific countries where no cases or only a few imported cases have been reported for a number of years, it is still a problem in many countries of Africa, Asia and South America.

In the African Region, epidemic outbreaks of smallpox are occurring frequently despite sustained efforts to prevent them.

In South East Asia for example, the epidemic peak years were 1951, 1957 1958 and 1963. The year 1963 proved to be a bad year as outbreaks occurred in Afghanistan, India, Indonesia and Nepal; in all 70 545 cases and 19 714 deaths were reported in that Region during that year.

In South America, it is impossible to know the actual incidence of smallpox because of incomplete and late reporting. In 1963, a total of 6 430 cases of smallpox were reported for Brazil, Columbia, Ecuador and Peru together.

In the Eastern Mediterranean, there has been a marked decline of smallpox during the last few decades, although considerable annual fluctuations are still observed.

Annex I shows the smallpox cases reported in the countries of the Eastern Mediterranean Region from 1951 to 1965 inclusive.

In East Pakistan which is highly endemic for smallpox, epidemics have broken out every four to six years. The 1957-1958 epidemic reported 100 000 cases and about 60 000 deaths; in the first six months of 1958, 44 736 cases and 20 444 deaths were reported. The highest mortality rate was among children under ten years of age, and 40% of the mortality rate were among those under five years of age.

In West Pakistan, the incidence of smallpox has shown a general decline during the last three decades, with outbreaks every five to seven years. The highest peaks of incidence occurred in 1926, 1940, 1948, 1953 and 1958.

In the Sudan, smallpox has been endemic for a long time; thousands of people crossing the country every year from West Africa on their way to the

pilgrimage in Hedjaz, regular seasonal internal movements of nomadic tribes from different parts of the country, the lengthy common borders with neighbouring countries where the disease is endemic are causes of the propagation of the disease.

The Eleventh World Health Assembly in 1958 adopted a resolution with a view to concentrating efforts on the eradication of smallpox. The Eighteenth World Health Assembly in 1965 unanimously adopted its Resolution WHA18.38 which "declares the world-wide eradication of smallpox to be one of the major objectives of the Organization".

The word "eradication" was deliberately used by that world health body which is composed of high officials of the public health administrations of the globe as the eradication of smallpox is scientifically and technically possible and feasible and in principle much easier to achieve than the eradication of other communicable diseases.

The WHO Executive Board in its 37th session recommended a ten-year programme for the eradication of smallpox throughout the world, and an appropriation of \$2.4 million to start the programme in 1967. Final approval was passed by the Nineteenth World Health Assembly in its Resolutions WHA19.16 of 13 May 1966.

During the projected ten-year campaign, it is expected that 1.78 billion vaccinations will be administered. The entire population of the countries where the disease prevails would be vaccinated.

In Asia, this would include Afghanistan, India, Burma, Indonesia, Pakistan and Nepal. In Africa, all the African countries south of the Sahara, and in South America, Brazil, Peru and Columbia.

The eradication of smallpox is scientifically and technically possible to achieve for the following important reasons:

1. The availability of a vaccine which is highly protective and provides effective immunity.
2. The non-existence of the carrier state. Inapparent infection, to the best of present knowledge, hardly exists and infection is manifest and easy to diagnose.
3. The only known reservoir is man, and man is the sole source of infection.
4. The major endemic foci remaining at present and acting as reservoir and source of infection to the world are well known.

5. Present scientific knowledge, both clinical and epidemiological, of the disease, such as diagnosis, infectious agent, reservoir and source of infection, mode of transmission, prevention and control is ample and comprehensive.

Notwithstanding all the above wealth of technical knowledge and scientific assets readily available, as well as the goodwill of most of the people of the world to co-operate with a view to attaining the proposed objective of smallpox eradication, and in spite of the technical assistance and support of the World Health Organization, progress towards the eradication of smallpox has been slow.

It is obvious from the above that the eradication of smallpox from the technical standpoint is feasible. But many endemic foci still exist in the world. A thorough analysis of the situation has shown that the major reasons for the failure of the concerned countries to develop successful eradication programme could be practically avoided and overcome.

II DIFFICULTIES ENCOUNTERED BY THE SMALLPOX ERADICATION PROGRAMME IN THE EASTERN MEDITERRANEAN REGION

1. Non-availability of basic information on the prevalence and incidence of smallpox

In many countries of the Region the basic statistical information on the prevalence and incidence of smallpox is either not available or not reliable. Therefore collecting basic data through a preliminary general survey of the country or limited well-planned surveys of locally infected areas become indispensable before the beginning of the programme.

The availability of this epidemiological data in any given country would give a clear picture of the prevalence and incidence of smallpox, thus enabling the planners of the campaign to define the magnitude of the problem, to determine the foci of infection and to set an order of priority as well as to permit a constant concurrent evaluation of the progress of the eradication campaign.

Another indispensable information that should be gathered before the beginning of the eradication programme is the status of the smallpox problem in the neighbouring countries especially in border zones.

2. Lack of proper planning, proper administration and proper organization of the programme

A smallpox eradication programme on a national level is a long-term and costly activity which should, therefore, be very well planned.

Depending on the degree of development of the general health services in the country, the smallpox eradication programme could be either integrated in the general health services or undertaken as a special independent activity, as a campaign.

In either case careful and thorough planning should precede the implementation of the programme. This as well as the organization, administration and constant evaluation of the programme should be the responsibility of an efficient central administrative organization. The latter should also be responsible for formulating the necessary laws, rules and regulations.

Whenever a country decides to implement a smallpox eradication programme as an integrated service or as a special campaign it is advisable to start a pilot project as a first step of the programme. This pilot project will enable the national health authorities to pre-practise and evaluate the proposed planning, organization and administration of their smallpox eradication programme. The advantages of planning a pilot project are:

- i. That it will allow to study the problems and difficulties which might arise from the application of the laws and the administrative and fiscal procedures in relation to the implementation of the eradication programme and consequently to devise means to overcome them.
- ii. That it will be utilized for field trial of the smallpox vaccine to test its potency and to collect information on the needs for its transportation and refrigeration.
- iii. That it will be utilized also for field training on all levels of field workers, such as supervisors, administrators, vaccinators, under conditions similar to those they will encounter in the field.

3. Lack of necessary funds and supplies

As a smallpox eradication programme is a long-term and costly undertaking, one should ascertain, right from the beginning, the availability of the necessary funds to carry out such an activity successfully, and plans should therefore be made in the preparatory phase of the programme to secure the necessary funds for the proper continuation and completion of the programme.

The provision of equipment and supplies in quantity sufficient for the successful carrying out of the smallpox eradication programme such as: vaccine, proper storage facilities, vaccination equipment, means of transport, health education material, maps, statistical and record forms should be secured before the beginning of the programme and throughout all the phases of its implementation.

Besides the initial provision of means of transport adequate in number and in quality, it is also essential to ensure at all times efficient and reliable maintenance services as this is a basic factor in the success of the programme.

4. Shortage of trained Personnel

An essential and important part of the planning of smallpox programmes is the training of health personnel.

As part of the planning, fully qualified medical personnel to occupy supervisory and administrative posts, as well as fully trained paramedical personnel to occupy secondary technical posts should be made available before the beginning of the vaccination programme.

Training of all categories of personnel and at all levels should moreover be a continuous process. In-service and field training should be continued throughout the implementation of the programme.

5. Use of a vaccine of doubtful potency

The basic technical factor that makes the eradication of smallpox possible is the availability of a potent protecting vaccine providing effective immunity.

With this effective tool in hand, if properly done, a vaccination should lead to a strong acquired immunity lasting three to five years. But a pre-requisite to that is the utilization of a fully potent vaccine.

Liquid smallpox vaccine being liable to lose some of its potency if not stored and transported under ideal conditions is not the proper vaccine for use in eradication programmes. It has been replaced by the freeze-dried (lyophilized) smallpox vaccine, which is a more stable product and the vaccine of choice for eradication programmes. Nevertheless the vaccine should be rigidly tested for:

- i. Identity - to ensure the quality of seed virus used for production.
- ii. Potency - there are three potency tests available and the vaccine should be subjected to at least one of them:
 - a. In the scarified skin of rabbits;
 - b. By enumeration of pock forming units after application of vaccine to chorioallantoic membranes of chicken embryos*;

*The minimum requirement as adopted by WHO in 1959 was 5×10^7 units/ml; this was amended in 1966 to 10^8 units/ml.

- c. By the determination of the LD50 after application of vaccine to the chorioallantoic membranes of chicken embryos.
- iii. Tests for the presence of living extraneous micro-organisms in the final bulk of the vaccine - the vaccine should prove to be free of *Clostridium tetani* and other spore forming anaerobes, *Bacillus anthracis*, haemolytic streptococci, coagulase positive staphylococci, *E. coli* or any micro-organisms which may prove harmful if introduced to the human body by the process of vaccination. The total number of bacteria, in the final bulk should not exceed 1 000 organisms per ml. (This number has now been reduced to 500 organisms per ml.).
- iv. Innocuity tests.
- v. Heat resistant test on dried vaccine where at least one container of dried vaccine from each final lot should be incubated at a temperature of not less than 37°C for not less than four weeks, after which the vaccine shall pass one of the potency tests already mentioned.
- vi. To determine the concentration of preservative or other substances added.
- vii. To determine the protein content of the vaccine.

It should be noted that when the dried-freeze vaccine is diluted, it should be treated like glycerinated vaccine as far as stability is concerned and should be immediately used.

6. Incomplete coverage of the population

Having ascertained the availability of a fully potent vaccine at all levels, the aim of a smallpox eradication programme should be the coverage of the total population. The end result of a campaign should be the vaccination of 100 percent of the population of the country. By vaccination one should mean a successful vaccination, a take that has been checked and not merely the mechanical vaccination.

Special stress should be made on the necessity of the 100 percent coverage of the population especially in densely-populated areas, and particular attention should be paid to the age group in which the disease most frequently occurs, as shown by the analysis of age specific attack rates. Efforts should be made to reach this very high proportion of protection through successful vaccination, in order to interrupt transmission. Otherwise, the remaining few unprotected persons in these areas may keep the infection alive as a potential hazard.

7. Lack of concurrent evaluation

Evaluation should be a continuous process starting with the beginning of the first phase of the implementation of the smallpox eradication programme and ending with the last phase of the programme as a final evaluation assessing the results. Evaluation, being therefore concurrent to the progress of the eradication programme, enables the administrators of the programme to discover defects and short-comings of the plans and to correct them in time.

III CHEMOPROPHYLAXIS

Chemical compounds, especially oral N. Methylisatin B. Thio semicarbazone, were found to be effective against smallpox and other related viruses. These compounds have low toxicity. The compound seems to remain effective even when given more than six days after contact.

No side effects were observed apart from nausea and vomiting. This was seen most in the persons who were given the higher dose level, particularly if the drug was not taken after meals.

Prophylactic treatment with N. Methylisatin B. Thio semicarbazone is an effective means of protecting smallpox contacts who have never been vaccinated.

However, it should be stressed that chemoprophylactic substances do not lessen the need for routine vaccination. Their main importance is to supplement the protection afforded to contacts by vaccination after exposure to the disease.

IV CONCLUSION

Having reviewed and analyzed very briefly the problems encountered in the implementation of a smallpox eradication programme, and having proposed tentative possible solutions to these problems, it becomes imperative to consider the different methods of implementation.

It is easy to recommend the collection of reliable statistical data, the proper preservation and transport of the vaccine, the attainment of 100 percent coverage of the population through vaccination, the adequate preparation of the technical personnel, the proper maintenance of the means of transport, the establishment of a well-organized central administration as well as other measures to ensure the success of the smallpox eradication programme. However, one should

consider the problems of implementation of these recommendations in relation to the local resources available in the interested countries.

Taking into consideration that the existing limited financial means and the lack of technical manpower, in most of the countries of the Region as well as in most of the countries of Asia, Africa and South America where smallpox is endemic, resulted in the slow progress of the smallpox eradication programmes, and having realized the importance of these reasons the Nineteenth World Health Assembly approved the resolution enabling WHO to participate actively and substantially in the smallpox eradication programmes of interested countries and on a global basis.

Assuming that a country has decided to undertake the eradication of smallpox, should this eradication be done through a special campaign or as an integral part of the health services? This depends on the degree of development of the basic health services of the country concerned.

In a country where the general health services are well organized and are in a position to cope with an additional activity, the eradication of smallpox should be integrated within the general health services in the country.

The prerequisite for the integration of health services at the local level is therefore the existence of an organized basic health service in which one could integrate additional special activities such as BCG vaccination, malaria eradication, smallpox eradication, communicable eye disease control, and others. The integrated health services if properly organized, besides requiring a smaller number of trained personnel and being, in general, less costly to operate than separate control programmes under the form of special campaigns, have the great advantage of ensuring the maintenance of the results achieved.

On the other hand, in a country where the basic health services are not adequately developed the integration of special health activities would be rather difficult. As non-fully developed health services in developing countries - with which goes either the lack of funds or lack of qualified staff or both - cannot cope with an additional activity, smallpox eradication in such countries should be conducted as a special campaign provided that follow up and maintenance of the results achieved is given thorough consideration.

The main conclusion to be arrived at is that smallpox eradication being scientifically and technically feasible, it is hoped that through special efforts particularly with proper planning and execution of the programme by affected countries, this scourge would soon be eradicated from the world.

ANNEX I

SMALLPOX CASES REPORTED IN THE COUNTRIES OF THE EASTERN MEDITERRANEAN FROM 1951 TO 1965

Countries	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Aden (former Colony)	2 (2)	-	-	66	1 (1)	-	13	75	8 (6)	8	1 (1)	-	-	-	-
Aden (former Protect.)	-	-	-	-	-	-	57 (16)	117 (56)	62 (10)	5	-	-	-	-	-
Bahrain	-	-	-	-	1	62	4	-	-	-	-	-	-	-	-
Ethiopia	44	80	188	378	282	555	1778	573	367	293	761	360	232	104	58
Iran	295	237	142	98	540	1616	1001	426	311	378	123	28 (5)	1	12 (6)	-
Iraq	469	157	251	27	72	2173	1924	6	23	-	-	-	-	-	-
Israel	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jordan	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Kuwait	...	...	...	...	...	8	23	-	10	-	-	1 (1)	-	-	-
Lebanon	-	-	-	-	-	84	108	-	-	-	-	-	-	-	-
Libya	...	...	1	51	-	-	2	-	-	-	-	-	-	-	-
Muscat and Oman	...	...	...	...	...	22	4	9	8	-	-	8 (1)	-	-	-
Pakistan	43620	14589	5065	2568	3262	5323	25770	49884	7803	1998	3041 (8)	3989	5779	896	1348*
Qatar	...	...	...	...	...	...	2	1	1	-	1 (1)	-	-	...	...

() Figures between brackets are imported cases and are included in the totals

... Data not available

* Preliminary figures

♀ Data for the period 1 July - 30 June of the following year, except 1964 and 1965.

ANNEX I (Cont'd)

SMALLPOX CASES REPORTED IN THE COUNTRIES OF THE EASTERN MEDITERRANEAN FROM 1951 TO 1965

Countries	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Saudi Arabia	1	-	162	5	1	9	65	156	115	32	17	1 (1)	-	-	-
Somalia															
N. Region	...	-	240	818	-	-	3	-	94	2	...	...	...	-	-
S. Region	-	-	-	737	391	84	88	-	-	-	...	...	...	-	-
French Somaliland	-	-	-	-	-	-	6	-	110	-	-	-	-	-	-
Sudan ♀	346	3670	3030	4200	1427	25	295	380	336	162	95	70* (3)	26 (3)	-	74 (5)
Syria	2	2	3	7	-	-	41	-	-	-	-	-	-	-	-
Tunisia	5	7	7	1	-	2	-	-	-	-	-	-	-	-	-
U.A.R.	2	-	-	-	-	-	1	-	30	7 (7)	1 (1)	4 (4)	2 (2)	-	-
Yemen	...	...	...	...	...	...	...	...	...	...	...	...	5	5	-

() Figures between brackets are imported cases and are included in the totals

... Data not available

* Preliminary figures

♀ Data for the period 1 July - 30 June of the following year, except 1964 and 1965.