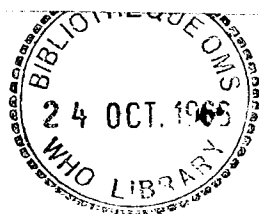


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GLOBAL ERADICATION OF SMALLPOX*

K. Raska, M.D., D.Sc.

World Health Organization, Geneva

The continuing success of the control and prevention of some communicable diseases permits hope of their eradication. In recent years public health workers have been often speaking and writing on this subject and the word "eradication" of diseases becomes too fashionable. However, some of them have failed to realize the complexities of the problem they are discussing. When reading their papers, the impression is given either that the term "eradication", and the difference between control, elimination and eradication, is misunderstood or that there is a failure to realize the complexities of a problem which must be considered from an ecological, technical, political, economical and organizational point of view.

The control of communicable diseases is defined by Andrews and Langmuir as a purposeful reduction of specific disease prevalence to relatively low levels of occurrence, although transmission occurs frequently enough to prevent its permanent disappearance. The object of control is to reduce to a low level the incidence of a given disease and to maintain this level permanently. Control means an endless operation (Cockburn). Exactly what is meant by a low level is not, however, stated. It is tacitly understood that this level or its acceptability as sufficiently low will vary for different diseases and in different countries.

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The second step in the successful control of a disease is its elimination. In 1956 J. Holm proposed a criterion for the elimination of tuberculosis which in 1959 was accepted by the WHO Expert Committee as follows: "The elimination of tuberculosis as a public health problem can be considered when the prevalence of natural reactors to tuberculin among children in the 14 year age group has become less than one per cent (the natural reactor being defined as a person showing a significant reaction to a standard dose of tuberculin)".

In poliomyelitis for example elimination means the absence of paralytic disease, with no reference to the extermination of causative agents if their continued existence is compatible with the absence of disease. The stage of elimination must therefore be well defined for each specific disease or group of diseases.

The eradication of a disease or better of the infection literally means its "tearing out by the roots", its complete, absolute extirpation, tantamount to the annihilation of the infectious agent as a biological species and thereby the elimination of its circulation to the human and animal population and their environment. When eradication is achieved, the costly burden of recurring control measures may be dropped (Soper, Moskovskij).

Eradication of a disease as a final target of communicable disease control is not a new idea, especially in veterinary public health. No epidemiologist opposes eradication as a principle. There is practical value, however, in recognizing eradication for what it is - a hope, a laudable ambition, a goal to which to aspire but which, for even the first infectious disease of man, lies a long way ahead (Gordon).

A programme to eradicate a given infectious disease can be directed either against:

- the protection of the host;
- or against the vector or reservoir animals,
- or the environment.

In discussing the aims of public health efforts and the technical feasibility of the eradication of individual diseases, the following considerations should be kept in mind:

- (a) Natural history and ecology of the disease (acute or chronic, persistence of the agent in the human or animal body, the manifestation rate of the disease, its sequelae and fatality rate, and the role of vectors and animal reservoirs);
- (b) Diagnostic facilities permitting surveillance (follow-up of the spread of infection in man and animal populations);
- (c) Specific prevention of the disease; including all aspects as efficacy, stability of vaccine, duration of immunity, side effects, etc.
- (d) Antimicrobial drugs (their use in treatment and prophylaxis);
- (e) In the event of infections with natural foci, also the facilities for control of reservoir animals and vectors.

Payne enumerates six reasons why eradication might be preferred as an objective rather than elimination or control. He proposes as the best candidates for eradication man made diseases due to chemical or physical agents created or introduced by man himself because ecological considerations can be largely discounted. Removal of these agents from the environment should restore the ecological balance.

Biologic reasons according to Payne are the best arguments for desirability of eradication concept, while the economic ones cannot be so easily demonstrated.

Apart from the technical feasibility of eradication as a target for infectious diseases control (whether it is to be mere control, or elimination as a public health problem, or eradication - local or global) it is desirable from the points of view of:

- (a) Public Health : the importance of the disease depends on the number of patients, deaths and disabled individuals resulting from it, and on the number of complications connected with preventive vaccination or other health measures;
- (b) Biology: the annihilation of the etiological agent must not have unexpected negative ecological consequences;
- (c) Economy: when the stage of elimination has been reached, the final eradication of the remaining few cases and infectious can be extremely difficult and expensive. In the case of smallpox, on the contrary, the existence of endemic areas creates a permanent danger of reintroduction and the rapid spread of this disease necessitates the continuation of preventive vaccination in smallpox-free countries.

For practical reasons we can in several diseases divide eradication into two stages:

- (a) local eradication (limited to a country, area, region or continent);
- (b) global eradication.

Local eradication is achieved when the etiological agent ceases to circulate and exist in the human and animal populations and in nature in the area for some length of time (five years or more). Until global eradication is achieved, however, the danger of a reintroduction of the disease persists. Whether this stage is relatively stable or labile depends on the natural history and ecology of the disease and on the complex natural and socio-economic conditions in the given area. If it is too labile and specific, control measures to prevent a reintroduction of the infection must be maintained, then it is preferable not to use the term "local eradication" but rather "elimination" or absence of the disease.

Successes and failures in eradication efforts in the past provide us with very useful experience and information. The efforts to eradicate smallpox can be taken as an example.

Smallpox is a disease which is generally regarded as extremely suitable for eradication. It is an acute disease, transmitted person to person, without persistence of the virus in the human body after recovery from illness and with very limited survival of the virus outside the human body and with no other reservoirs in nature. The availability of the good freeze-dried vaccine facilitates the vaccination programmes in the tropics. On the other hand, the highly contagious nature of the disease and the facilities and the speed of modern travel necessitate its eradication on the global scale.

It is clear that the global eradication of smallpox is technically feasible. It is also desirable, not only for biologic or public health but also for economic reasons. Therefore the unanimously accepted resolution at the Eleventh World Health Assembly in 1958 seems to be fully justified. However, evaluating its progress since 1958 we must admit that it has been far from satisfactory. Why is this so?

1. Although the implementation of the eradication of smallpox is much more simple than for example of malaria, the question cannot be simplified so far. Of course, the availability of potent vaccine is a prerequisite of the whole programme. But talking about vaccine, we must differentiate between the potency of vaccine at the place of production, then in central storage level and finally in the time of its application in the field. It is also impossible to use for the whole world one too simplified recommendation about vaccination coverage. Logistics in planning, implementation, surveillance and continuous assessment of the programme and necessary flexibility to react in a proper epidemiological way in any unexpected situation should correspond to the different ecological and socio-economic conditions in a given country or groups of countries.

2. In spite of the unanimous acceptance of the resolution on eradication; the whole programme has suffered, until now, from insufficient support from developed countries.

Highly developed countries which for several decades have been smallpox-free must vaccinate and revaccinate their populations with a risk of fatal or injurious side effects. Moreover, vaccination and revaccination expenses in all smallpox-free countries are so high that the additional cost of three years' routine vaccination would be sufficient to cover a ten-year eradication programme which would lead to the eradication of smallpox from the globe. To express it in another way, the increased expenditure on the smallpox eradication programme in developed countries would pay itself back within three years after the achievement of eradication. Permanent interruption of smallpox vaccination and revaccination will mean considerable and permanent savings.

Seen retrospectively, however, with the exception of a few countries which have given substantial bilateral aid to certain other countries, WHO has until now received only very limited financial or material support for the global smallpox eradication programme. Unfortunately it cannot be expected that the developed countries will share the benefits of accomplished eradication without helping to share the costs of national operations in developing countries.

3. It is understood that intensified national efforts to eradicate smallpox represent a contribution to international health and that the entire world benefits from national campaigns which are themselves an integral part of a world-wide eradication programme.

On the other hand, however, in some developing countries smallpox is not the most important public health problem. It cannot, therefore, be expected that the limited financial and human resources in such countries would be concentrated, without substantial help from outside, on a problem which is not of high priority. This might explain the fact that some developing countries have not yet joined the WHO smallpox eradication programme.

4. Efforts to achieve the global eradication of smallpox assume an excellent co-ordination of programmes between neighbouring countries. Smallpox has been repeatedly reintroduced into smallpox-free countries only because such co-ordination was lacking. It is hoped that the growing awareness of mutual responsibilities and obligations between countries, in recognizing the right of another country to be protected against smallpox re-infection, will in the future be of greater assistance.

The importance of co-ordination is manifoldly greater in the programme of global eradication. This, of course, does not assume only a formal agreement to the programme but necessitates long-term co-operation and support which is to the advantage of all mankind.

5. Biological and economic reasons fully justify the global concept of eradication of smallpox. The decision on the global eradication programme implements also the decision on the time when the target should be reached.

Although vaccination provides good protection for a number of years, the duration of immunity is relatively short. The high infectivity of smallpox in an era of rapid transport in the world and population boom in many endemic countries further supports the necessity to achieve the eradication target in the shortest period of time.

The World Health Organization has prepared a ten-year plan for the global eradication of smallpox and now depends on the support of developed countries and the co-operation of developing endemic countries if the programme is to succeed. Any prolongation of this 10-year period when the programme has started would mean extra financial and material expenditure.

The national eradication programmes must rely first of all on their own public health networks. Bearing in mind what has already been said, if the global eradication programme were started it would not be possible to postpone the national programme until the basic health services of that country had been developed. Even if the programme were carried out by special staff, it should be organized from the beginning in such a way as to create or strengthen epidemiological services as a whole.

6. The importance of participation in the global eradication of smallpox should be well understood and must be popular in the country. Many countries where smallpox is endemic are preparing to intensify their eradication programmes with the help of WHO and bilateral help. However, this necessitates in all cases an extraordinary concentration of means and efforts. This is possible only for a relatively short period of time and requires assurance that the achieved disappearance of the disease will not be challenged by reinfection from neighbouring countries. This again demonstrated the importance of international co-operation and of the role of the World Health Organization in the guidance and co-ordination of this unique health operation.

This also clearly illustrates how complex and difficult is the realization of the programme of global eradication of smallpox, a disease which is generally considered most suitable for eradication. It is also the reason why, before a decision on the eradication of any other disease is undertaken in the future, all aspects of the problem should be carefully considered. For several other diseases for the time being a well-defined target of elimination as a public health problem (tuberculosis, poliomyelitis (Raska)), or local eradication (brucellosis, etc.) should be chosen.

REFERENCES

- (1) Andrews, J.M. & Langmuir, A.D., The philosophy of disease eradication, *Am. J. Pub. Hlth*, 1963. 53. 1.
 - (2) Cockburn, A., The evolution and eradication of infectious diseases, Baltimore, John Hopkins Press, 1963.
 - (3) Gordon, J.E. & Ingalls, T.H., Communicable Diseases Control: Old principles in a new setting, *Am. J. Med. Sciences*, 1965, 250. 138-156.
 - (4) Holm, J., *Chest and Heart Bull.*, 1962, 18. 25.
 - (5) Moskovskij, S.D., Principles and organizational problems of eradication of infections, *Z.M.E.I.*, 1962, 2. 130-135 (in Russian).
 - (6) Payne, A. M.-M., Basic concepts of eradication, *Am. J. Resp. Dis.*, 1963, 88. 449-455.
 - (7) Raska, K., On the methodological aspects of tuberculosis eradication, *J. Hyg. Epid. Microb. Imm.*, 1963, 7. 452-471.
 - (8) Soper, F.L., Problems to be solved if the eradication of tuberculosis be realized, *Am. J. Pub. Hlth.*, 1962, 52. 734-745
 - (9) WHO Expert Committee on Tuberculosis VII Report, Tech. Rep. Ser., 1960, 195, Geneva.
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