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VACCINATION AGAINST SMALLPOX

Sub-Committee A of the Regional Committee for the Eastern Mediterranean, at its meeting in Alexandria last year adopted a resolution requesting the Organization to collect experimental data on the question of immunity after vaccination in connection with:-

"(a) the time taken for satisfactory immunity to develop after primary vaccination;

(b) the time taken for satisfactory immunity after the revaccination, after one year, two years, three years and thereafter, as this has a very important bearing on spread of smallpox from one country to another."[1]

In response to this request, the Regional Director, after investigating the subject submits the results of his investigations:

The question of immunity after vaccination and revaccination was previously raised by one of the WHO Member States during the first session of the Committee on International Quarantine in 1953. The Committee, finding that the elucidation of these technical points could only be sought from experts on immunization against smallpox, recommended that they be referred to appropriate experts for their observations. This was endorsed later by the Seventh World Health Assembly. The Director-General, in accordance with the requests of the Seventh World Health Assembly and of the Committee on International Quarantine, consulted a number of experts, including experts in smallpox, virologists, epidemiologists and hygienists, as to their views on the subject.

Considerable difference of opinion came to light, due, in part, to the absence of sufficient factual information and, in part, to the different meanings attributed to the word immunity. However, a compromise could be made between the different views, the word immunity in the above connection being interpreted as meaning resistance to the disease.

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[1] RC4A/EM/R.12 para.(3)

The results of these consultations were then submitted to the second session of the Committee on International Quarantine (October-November 1954). The Committee, after studying them expressed its opinion in its second report to the Eighth World Health Assembly, noting "....that on this matter the experts could give no exact information which could apply to all individual cases. Consequently, the rules in Appendix 4 of the Regulations (International Certificate of Vaccination against Smallpox) though they may lack a firm scientific basis, are nevertheless administratively expedient in order to avoid delay to persons on an international voyage".

The opinions of experts on the subject may be summarized in the following:

1. As regards the first question concerning the time taken for satisfactory immunity to develop after primary vaccination, it is generally accepted that by the time the vaccinal vesicle is formed the vaccinated person is resistant to smallpox. This takes 5 - 7 days in the primary reaction. However, this statement must be qualified if the person has been exposed to smallpox. As a general rule, persons who develop a vesicle as the result of primary vaccination may be considered to have satisfactory resistance about six days (5-7 days) after vaccination, but there will be the occasional person who may develop smallpox up to twelve days after vaccination as a result of exposure before or on the day of vaccination. The present period of eight days after vaccination for the International Certificate to become valid seems to be a reasonable compromise.

2. As for the development of satisfactory immunity after revacoination, this depends in the first place on the time elapsed since the previous vaccination and the loss of resistance to smallpox after this vaccination. This loss of resistance can be assessed mainly in two ways: by the cutaneous reaction to revaccination, and by epidemiological and clinical observation.

   (a) It is generally accepted that there is a relationship between the cutaneous reaction of an individual to revaccination and his resistance to smallpox. A primary reaction indicates that little or no resistance was present at the time of vaccination; the accelerated reaction indicates partial resistance; the allergic (immediate) reaction or the absence of any reaction may indicate substantial resistance to the disease provided that it is certain that the vaccine used was fully active and properly applied.

   The results of experiments on these lines have shown that two years after successful vaccination about one in twenty

vaccinated persons have little or no resistance to revaccination, about one-third have partial resistance, and about two-thirds have substantial resistance. Five years after successful vaccination about one in twelve have little or no resistance to re-vaccination but only about one-third still have substantial resistance, the remainder having partial resistance.

(b) Epidemiological and clinical observations have also shown that there is a wide variation in the degree and duration of resistance to smallpox following vaccination. The variation depends in part on the response of the individual as shown above in the results of revaccination, and in part on the degree and intensity of exposure to infection and on the characteristics of the infecting variola virus. Therefore, individual exceptions to the general rule must be anticipated. With that proviso it may be said that epidemiological and clinical observations suggest that the resistance to smallpox of successfully vaccinated persons may have decreased within a period of between two and five years to such an extent that an appreciable number of them will be susceptible to infection, although a degree of resistance may persist as shown by attenuation of the disease.

There is reasonable agreement between the two methods of assessment. Since compromise is always necessary in the application of observed facts to administrative regulations, it would appear that the present period of validity of the vaccination certificate of three years is reasonable.

The development of satisfactory immunity after revaccination presents no problem in the case of persons who have not been exposed to smallpox. It is only in the case of those who have been exposed to smallpox that the problem is more difficult.

Experience has shown that revaccination of a susceptible person before exposure will prevent the disease and that revaccination on the first or second day after exposure to smallpox may, but by no means always does, protect against the disease, though it usually produces some modification of it. Revaccination on the third and fourth day after exposure may produce some modification but will not usually prevent the disease in a susceptible person.

It follows from what is mentioned above that a person who is successfully revaccinated before a period of three years since the previous vaccination has expired, may reasonably be considered to be satisfactorily protected against smallpox for a further three-year period from the day of revaccination. If, on the other hand, revaccination is performed at lengthening periods after this time has expired, an increasing proportion of persons must be assumed to be susceptible to infection at the time of revaccination, and therefore cannot be considered satisfactorily protected immediately on revaccination.

Since the average incubation period of smallpox is twelve days, there will be a period during which it is uncertain whether such an exposed person has been successfully protected or not by revaccination.

Clearly a compromise is necessary for this small but important group of those who have been exposed to smallpox. The number of days after revaccination accepted as giving a reasonable margin of safety for this group would appear to be an administrative and not a technical decision. It should, however, be stressed that since protection by vaccination depends in part on the response of the individual and in part on the degree of exposure to variola, both factors being very variable, whatever decision is taken absolute security cannot be assured.

It is noteworthy that the Eighth World Health Assembly, by its resolution on International Quarantine[1] referred to the Committee on International Quarantine for further consideration, the question of the progressive loss of immunity following vaccination and the time and degree of development of immunity following revaccination.

The Regional Director will follow up this matter and inform the Regional Committee of any further developments.

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[1] WHA8.35