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SCAR SURVEYS AS A METHOD OF ASSESSMENT OF SMALLPOX ERADICATION PROGRAMME

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The assessment of the immunity status of a population to smallpox has several important meanings in the context of smallpox eradication programmes. Firstly, it is very essential, before launching this programme, to have a profile of the immunity level of a population to plan the project activities in the most needed direction. Secondly, during the implementation of the programme its assessment becomes necessary to determine the progress made and the targets yet to be accomplished.

The assessment of a smallpox eradication programme during its execution is performed usually in two ways:

(a) as a concurrent assessment of the vaccination coverage of the population, with simultaneous estimation of take rates and vaccinators' output,

(b) as an independent, periodical assessment, which is performed in an objective way by a special team.

In both kinds of assessment scar surveys offer a simple method to assess objectively:

(1) To determine if the vaccination effort during previous years was sufficient to achieve a good population coverage in general, or among specific age groups, or particular areas of the country. In this way the estimation of the proportion of the population susceptible to smallpox is obtained, which is purposeful to give proper guidance for future vaccinations activities, to direct them to the most vulnerable sectors of the population, or to priority areas within the country.

(2) The probable number of smallpox cases occurred in the past, which can be estimated from the number of persons with pockmarks. This is the way to get a comparison between smallpox cases occurred and smallpox cases reported and to estimate to some extent the degree of accuracy and efficiency in reporting of smallpox cases to health services.

The information got from such calculation is of great importance for assessment of the surveillance (containment) activities, which form one of the most important part of the smallpox eradication programme.

With the above objects in view smallpox scar surveys were introduced in the South East Asia Region in 1967 at the time of the joint Government/WHO assessment of the Indian National Smallpox Eradication Programme, and thereafter applied in other countries of the Region as an integral part of concurrent and ad hoc assessments of SEP in various areas. The information obtained was used by the national health authorities at various levels to effect corrections and adjustments in the execution of the programme.

A scar survey usually consists of three phases, each of them should be planned carefully to get the most accurate data:

- programming phase
- scar survey in the field
- analysis of data and their interpretation

During the first phase of programming, several questions have to be discussed and answered. First of all the aim of a scar survey should be defined and its necessary dimensions established. Sometimes a scar survey has to be performed on a national basis and selected areas of the whole country have to be covered. On other occasions, e.g. during short field visits, population of only a few villages in the area can be examined.

The question of the specific age groups of the population that have to be sampled deserves much attention. There is a strong evidence that 80% or more of all cases occur in children below 14 years of age, and scar surveys performe among children below 14 should give in most endemic areas epidemiologically satisfactory and adequate data. Further factors which support the limitation of a scar survey to children below 14 years are:

- the usually observed rate of vaccination scars among adults lies very close to 100%,

- the presence of a vaccination scar in adults, who might be vaccinated many years ago is virtually impossible to interpret in terms of probable immunity against smallpox,

- other skin changes, present on the face of adults, particularly after pyodermic infections can make the examination difficult and the interpretation confusing.

In endemic countries of SEA Region, the age group of 0-14 is divided into three subgroups of below 1 year, 1-4 and 5-14, and at present this gives a fairly accurate estimate of the number of unprotected among babies, pre-school children and school-going children. In particular the age group below 1 year gives a good evaluation of vaccination activities and smallpox morbidity in recent past.

If the scar survey results have to be representative for the total province or for the country the sample size and its distribution should no doubt be determined on statistical principles, for which the services of a statistician would prove invaluable. Such assistance from a qualified statistician is mostly needed when circumstances do not permit to do a pure random sampling, i.e. because of a difficult terrain, poor communication, lack of sufficient assessors/ staff, time limits and other conditions, which may be met with in many endemic countries.

In a scar survey performed in Java (Indonesia) in 1968 by Dr J. Keja, WHO Medical Officer, the determination of the size of the sample was based upon the results of an analysis of variance of findings during the pilot survey performed several months ago.

The determination of the sample area (the spread of the sample) may be estimated on the basis of population data using random numbers. In certain circumstances it may also be possible (e.g. in cities and towns, if a detailed map is available) to use map co-ordinates for determining the sampling areas.

Having determined the sample size and its distribution, the calculation of manpower, transport and time requirements should be made. Experience in countries of SEAR shows that an assessor after a short training can examine between 200-300 children a day. The exact number of assessors and vehicles needed for their transport can then be easily calculated and checked against existing possibilities. It has been found advisable to recruit, as assessors, persons engaged in programmes other than smallpox, as it would ensure a reasonable level of independent objectivity. It is profitable as well to establish at the same time the number of supervisors, who will be responsible for deployment of assessors, their concurrent supervision and collection of forms at the end of the working day. In practice the ratio of 1 supervisor to 5-10 assessors has proved satisfactory. The field visits of the assessors should be fixed and detailed material for their briefing prepared. As for the field visits the selection of a starting point for each assessor in his area (village/ward) is very useful. For this purpose usually prominent buildings/ places such as church, mosque, market, house of the village leader etc. are chosen. From this point the assessor has to proceed in a fixed manner. This may often present too difficult a problem to be solved satisfactorily in practice; and on many occasions a lot of imagination and/or commonsense is needed. There are too many differences among countries and their provinces to allow for a single and readily acceptable scheme to be adopted to a particular situation, which might be encountered in the field.

Also the estimation of the age of persons, who have to be examined, may often pose difficulties. In scar surveys conducted in Indonesia and Afghanistan, the following principles utilized by Dr J. Keja, WHO Medical Officer, were applied to with success:

(a) If upper incisors are absent - Age to be estimated as less than 1 year

(b) If the child cannot reach over its head with its hand the distance of one inch above the upper edge of the opposite ear - Age to be estimated as less than 5 years

Some definitions are as well necessary to be established regarding the households to be visited and persons to be examined. In this context a household means any place, where people are living and which possesses a kitchen. In this way the schools, offices are excluded and hotels, shops included in the scar survey and the assessors are directed to conduct examination through house-to-house visits.

As an inhabitant of a house we are accepting a person, who spent the previous night in the house.

Regarding the examination itself the following definitions are used:

(a) a person with pockmarks - a person, who has at least five visible pockmarks on his face with a base diameter of more than 2 mm,

(b) a person with vaccination scar - a person with a visible, typical vaccination scar on right or left arm.

These definitions are presented in detail during a briefing of assessors and supervisors, together with a simple instruction for the examination itself, which has to be performed in following way: examination of face, examination of right arm, examination of left arm.

In our opinion no effort should be spared for fully clarifying of all points, which may seem doubtful, or not fully understood by the assessors team.

In this respect the question of "doubtful cases" seems to be one of the most important. There is our experience, that cases in which doubts about the classification of skin changes on face or arms arises, are not met very often in practice. However it is our feeling, that under such circumstances it may be better and simpler to classify such cases as not protected, than to introduce the separate class of "doubtful cases". Therefore, in the forms which are at present in use within the Region the classification of "doubtful" cases are omitted. The forms used in a scar survey are presented in Annexes 1, 2 and 3. The form in Annex 1 is the result of various trials in this field. It has an advantage of fixed samples in each age group and used for concurrent assessment and the take rates can be as well calculated.

The form presented in Annex 2 is used for the scar surveys in India and Indonesia. The form presented in Annex 3 is used currently in India for a quick scar survey during field visits. The form in Annex 4 represents a simple summary form. The use of forms should be explained to the assessors team in detail to guarantee their proper filling and to facilitate further calculations.

Another practical point concerns the choice of the best time to perform the scar survey in the field. In this regard usually afternoons are more profitable than mornings, as many children are already home after school and the older age groups are as well easily available, thus reducing the number of absentees. Much however depends on local circumstances, which should be explored carefully in advance, to enable the best choice for the proper time of the day for a scar survey.

After the field part of a scar survey is completed and the data collected compiled, their interpretation should be made. To get the results as accurate as possible it is very important to be in possession of fairly up to date population figures for the country or area concerned, regarding the total population and its distribution by age and place. If such data are not available estimates have to be used.

For the estimation of the number of unprotected children below 14 years the following procedure was used in the interpretation of scar survey results obtained by Dr J. Keja in 1968 and by Joint Government/WHO Assessment Team in 1969 in Java:

(a) Calculation of proportion of unprotected in specific age groups in the sample,

(b) Calculation of proportion of the total population for the same age groups,

(c) Estimation from above calculations of the number of unprotected among the total population below 15 years.

An example for this procedure is given in Annex 5.

The fairly good calculation of the smallpox reporting efficiency may be performed on the basis of number of persons or children with pockmarks, encountered during a scar survey, if additional epidemiological data about smallpox incidence and case fatality rate among age groups are available. In case the national data are impossible to obtain the general estimates can be applied.

From the proportion of children with pockmarks below one year of age the estimation of the number of smallpox cases occurred during past 12 months can be accomplished, or similarly if we take into account children with pockmarks below 5 years of age, the number of smallpox cases during last five years can be calculated. The procedure is put down in Annex 6.

The limitations of these procedures should be of course kept in mind, but if the sample was sufficiently large and the necessary population and epidemiological data of reasonable accuracy were available, this way of interpretation could give very useful ideas about important aspects of smallpox control.

Similar conclusions can be drawn also from quick field surveys performed in a small area, consisting of one or few villages, or few wards of a town. On such occasions the data collected by a scar survey may form a useful basis for assessing the performance of vaccinators. It may be concluded that any properly conducted scar survey irrespective of its size reveals a good deal of information, usually not obtainable through other means in a very easy and efficient way and in a minimum of time.

NATIONAL SMALLPOX ERADICATION PROGRAM

Field Assessment Report

DATE	PROVINCE
PERFORMED BY	DISTRICT
VACCINATED BY	VILLAGE

SYMBOLS (* Children under 1 year and 1-4 years)

P = Pockmarks with or without a vaccination scar

X = Vaccination scar

* ⊛ = Recent primary vaccination take

O = No scars

* ⊙ = No scars but recent history of vaccination

TABULATION

UNDER 1 YEAR	1 - 4 YEARS

5 - 14 YEARS

	Under 1 year	1-4 years	5-14 years	TOTAL
TALLY OF ABSENTEES				

COUNT OF SYMBOLS

	Under 1 and 1-4 years
⊛	
⊙	
TOTAL	

TAKE RATE

$$\frac{⊛}{\text{TOTAL}} = \frac{\quad}{\quad} = \quad \%$$

	Under 1 year	1-4 years	5-14 years
P			
X + ⊛			
O + ⊙			
TOTAL			

Percentage unprotected

Under 1 year $\frac{O + ⊙}{\text{TOTAL}} = \frac{\quad}{\quad} = \quad \%$

1-4 years $\frac{O + ⊙}{\text{TOTAL}} = \frac{\quad}{\quad} = \quad \%$

5-14 years $\frac{O}{\text{TOTAL}} = \frac{\quad}{\quad} = \quad \%$

Assessment should be conducted on a house-to-house basis until all squares are filled. Note one symbol in each square.

Each individual is checked first for pockmarks on the face indicating previous smallpox infection. If present, a "P" is marked. If there are no pockmarks, he should be checked for presence of a vaccination scar or recent vaccination take. If present, an "X" is marked. For children under 4 years, a primary take should be noted as ⊗. If there is no scar or vaccination take, an "O" is marked. For children under 4 years, an adult should be asked if the child was vaccinated during the previous 2 to 3 weeks. If the answer is "yes", a "⊙" should be noted. If the answer is "no", the single "O" is sufficient.

If the take rate is over 95%, the result is excellent; if 90%, it is satisfactory; if less than 90%, it is unsatisfactory.

In general, if the percentage unprotected in each age group is less than 15%, the result is considered to be excellent; if it is 20%, it is satisfactory; if more than 20%, it is unsatisfactory. In densely crowded areas, a higher coverage may be required.

Annex 2

SCAR SURVEY FORM

Village

District

Date

Assessor

P- pockmarks (with or without vaccination scar)

X- vaccination scar,

O- no pockmarks, no vaccination scar

<1	1-4	5-14	<1	1-4	5-14

SUMMARY

Age	<1	1-4	5-14	Total
P				
X				
O				
Total				
% unpr.				

.....
signature

Annex 3

SCAR SURVEY FORM

Village

District

Date

Assessor

P- pockmarks with or without vaccination

X- vaccination scar

O- no pockmarks,no vaccination scar

Age	<1		1-4		5-14		Total
	marks	No	marks	No	marks	No	
P							
X							
O							
Total							
% unprotected							

.....

signature

Annex 4

SUMMARY OF SCAR SURVEY

Period

District

P- pockmarks with or without vaccinatio

X- vaccination scar

O- no pockmarks, no vaccination scar

Age / Area	<1				1-4				5-14				Total			
	p	x	o	all	p	x	o	all	p	x	o	all	p	x	o	all
total																
% unprotected																

ESTIMATION OF THE UNPROTECTED POPULATION

During a scar survey a sample of 50 000 children aged 0-14 were examined. The proportion of unprotected in particular age groups was found to be:

< 1 year	-	65%
1-4 years	-	25%
5-14 years	-	10%

The total population of the country is 20 millions. The age-wise distribution of the population according to national data is as follows:

< 1 year	-	3.5%
1-4 years	-	12%
5-14 years	-	25%

The calculation of the age distribution of the population gives, therefore, following results:

< 1 year	-	700 000
1-4 years	-	2 400 000
5-14 years	-	5 000 000

The calculated number of unprotected in the total population, applying the percentages obtained in the sample will be:

Age	Population by age	% of unprotected in the sample	Estimate of Population unprotected by age
< 1	700 000	65	455 000
1-4	2 400 000	25	600 000
5-14	5 000 000	10	500 000
Total	8 100 000		1 555 000

THE ESTIMATION OF SMALLPOX REPORTING EFFICIENCY IN PRECEEDING 12 MONTHS

During a scar survey in a country with 20 millions of population 50 000 children, aged 0-14 years were examined. It was found that among these children 5 900 were below 1 year of age and 15 among them had visible pockmarks.

If we assume, that in the age group below 1 year 20% of all smallpox cases are occurring, the case fatality rate is 40% and 5% of these children recover without visible pockmarks, then the way of reasoning is as follows:

1. The proportion of children with pockmarks aged 1 year and less in the sample is

$$\frac{15 \times 100}{5900} = 0.25\%$$

2. When the sample is representative, we can expect similar proportion in the total population in this age group. Because the age group below 1 year represents 3.5% of the total population of this country, the number of children in this age group will be:

$$\frac{20 \text{ millions} \times 3.5}{100} = 700\,000$$

3. The expected number of children below 1 year with pockmarks is therefore:

$$\frac{700\,000 \times 0.25}{100} = 1\,750$$

4. 1 750 children with visible pockmarks represent 55% of all cases of smallpox in this age group (40% died, 5% recovered without pockmarks). Therefore the total number of children aged 1 year and less, who contracted smallpox is:

$$\frac{1\,750 \times 100}{55} = 3\,182$$

5. 3 182 cases of smallpox in children below 1 year represent 20% of all smallpox cases occurred among all age groups. The number of smallpox cases, in all age groups, which took place during preceeding 12 months amounts to:

$$3\,182 \times 5 = 15\,910$$

6. As during last 12 months all over the country 10 550 cases of smallpox were reported the smallpox reporting efficiency is:

$$\frac{10\,550 \times 100}{15\,910} = 66\%$$

7. Conclusion: During last 12 months only 66% of smallpox cases occurred were reported to Health Services.