VACCINATION PROGRAMS: CHOICE OF TECHNIQUES AND ESTABLISHMENT OF OBJECTIVES[1]

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The fact that an immunizing agent exists does not of itself imply that a communicable disease can be reduced to the point of eradication. Factors at least as important are a sound knowledge of the most efficient means of carrying out immunization, proper technical and administrative resources, and a health service structure so organized as to make the best use of the procedures available.

Factors Governing the Choice of Work Procedures

A number of factors enter into the choice of work procedures in vaccination programs: effectiveness of the vaccine, cost, ease of administration, possible side-effects, public acceptance, and the structure, organization and stage of development of the public health agencies responsible for administration of the vaccine. The choice of the techniques or methods of administering a given vaccine cannot be based exclusively on any one of these factors alone. Once the epidemiological conditions that justify a vaccination program are recognized in the light of the real or potential importance of the problem, it is essential to ascertain all the above determinants before the program is begun.

Protective capacity. Obviously, any vaccination program presupposes the existence of a vaccine with sufficient protective capacity to make frequent re-immunization unnecessary. However effective the vaccine, if the protection is of short duration, this alone casts doubt on its desirability. Such is the case with typhoid vaccines and to a certain extent with influenza vaccines.

Administration technique. The procedure for administering the vaccine must be easy. This is most important, especially in large-scale programs, where the personnel in charge of the operation may not have a high level of skill and training, as is often the case in the Americas.

Safety. If a vaccine produces excessively severe local or general reactions, or causes frequent or serious accidents, this may warrant abandoning the program even though the epidemiological problem involved indicates the need for it. Furthermore, the safety factor is very important for the success of the program and more than anything else influences public acceptance of the vaccine.

Cost. The cost of the vaccine is a factor that cannot be disregarded. Although vaccination programs against measles are very effective, and help to keep within bounds a problem that is extremely serious in some countries, they are still limited in many parts of the world because of the high cost of the vaccine. To lay down a program under such conditions is usually a difficult matter, even if it is realized that from the purely economic standpoint the cost would be amply offset by the reduction in the number of bed/days, drugs, medical care/hours, etc.

Stability. The immunizing agent must be sufficiently stable to allow it to be satisfactorily stored under the conditions prevailing in the place where it is to be used. Examples could be cited of programs that have failed

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because of careless storage of the vaccine, even though the programs were otherwise efficiently conducted, with effective vaccines and adequate funds, and even a useful level of coverage. Advances in the technique of freeze-drying various biological products have made it possible to overcome what was a serious problem in the past, namely, storage. It must be emphasized that preference should be given in vaccination programs to freeze-dried products whenever they are available.

The short life of BCG vaccine is one of the factors which for a long time affected its prestige and limited its use. The same was true of smallpox and other vaccines based on live virus, prior to the advent of the freeze-dried product, which is much more stable. One of the immunizing agents that best fulfills the requirements is the oldest and most traditional—smallpox vaccine. It is nearly 100 per cent effective, its cost is low, its side-effects are within an acceptable range, and it enjoys favorable public acceptance in a properly informed community; and its administration is simple, especially when modern mechanical means such as jet injectors are used.

It is outside the scope of this article to assess the value of each vaccine, but the selection of vaccines, their combination, the optimum time for their administration, and the work procedures to be followed, are clearly variable factors which depend closely on:

a) The Organization and degree of development of the public health services.
b) The question whether the program is to be carried out in rural or urban areas.
c) The cooperation that other organizations or institutions can provide.
d) The cultural level and receptivity of the population.

Before a vaccination program is started, careful consideration must be given to the following important points:

a) It must not interfere with other programs of equal or greater importance.
b) There should be some assurance that sufficient human and material resources are available to ensure a satisfactory level of operations.
c) The program must be capable of being maintained over an indefinite period.

Accordingly, before a vaccination program is begun, it is essential to have accurate information on the resources needed to implement it, and also some assurance that it is not simply a matter of passing interest stirred up by its novelty value. Failure to keep funds flowing steadily will cause the program to be suspended, with the consequent waste of the initial effort.

In referring to human resources, what is meant first and foremost is technical personnel such as epidemiologists, public health administrators, nurses, and auxiliaries. Also included is any manpower that may be provided by other public or private institutions or by the community itself, whether for the actual administration of vaccines or, in the case of more complicated techniques, for ancillary work such as registration, preparing or guiding the public, and creating incentives.

The application of the above principles will call for special study of each vaccine recommended for use in the developing countries, but only considerations of a more general nature will be discussed here.

The immunizing agents currently in use in national immunization programs are the smallpox, DPT, poliomyelitis, measles, and BCG vaccines. There are others, but although they are widely used and their use is justified, they will not be examined in this article for the following reasons:

- Their use is limited to specific circumstances, or to certain high risk groups, e.g., typhoid antitoxin, at any rate the traditional type of preparation.
- They are not used in special programs but in response to specific demand (rabies vaccine).
- The diseases against which they afford protection are not in themselves serious enough to justify mass vaccination programs (rubella and mumps).
- The disease against which they provide protection is unusual or has disappeared from the Americas (cholera and yellow fever).
- They are used only in ephemeral and changing epidemiological circumstances (influenza vaccine).

Immunization Levels

There is general agreement, and the Expert Committees of the World Health Organization have confirmed this, that vaccination of 70 to 80 per cent of the population would make it possible to prevent epidemic outbreaks of the diseases transmitted through the respiratory system. Nevertheless, it is frequently observed that in countries that have achieved this level of coverage, nation-wide epidemics occur and spread at times over wide areas. There are several reasons for this:

a) Annual revaccination covers the same population groups each time, especially schoolchildren, who are easier to reach than others.

b) Coverage is satisfactory in the urban centers, but inadequate in rural areas. Satisfactory coverage may be obtained over an extensive area, but islands may persist within the area where coverage is low because they are less accessible, or because the population group is less receptive.

c) Vaccination is not synonymous with immunization. Faulty technique or use of ill-prepared or poorly-preserved vaccines may negate the results of a program with an apparently useful level of coverage.

When vaccines are administered in two or three doses, the percentage of coverage must be calculated on the basis of the final dose rather than the first. However satisfactory the organization and efficiency of the responsible health service, only a certain percentage of children inoculated later return for the second dose, and the percentage drops further with the third dose.

The importance of a useful level of booster doses given at the proper intervals must be emphasized; otherwise morbidity and mortality are not reduced but are simply shifted to later age groups.

Age-Limits

Programs to vaccinate newborn infants against smallpox have been introduced in some countries, though the protection afforded at this age is not always satisfactory. This has come about because it is easier to reach infants born in maternity wards or under the control of health services personnel, and they do in this way receive some protection, even if only partial, before reaching preschool age, the no-man's land of preventive programs.

In countries having more advanced procedures for supervision of unweaned infants, vaccination against smallpox can be deferred until the second six months, the ideal age for a good immunity response. The optimum age for the initiation of DPT vaccination is the third month, the second dose being administered 30 to 60 days later and, if this is the technique selected, the third dose after a similar interval. Immunolgical surveys show that an interval of 60 to 90 days between doses produces a higher level of antibodies than is observed when the intervals are shorter. The same considerations of age and spacing of doses apply to poliomyelitis vaccine, under the conditions prevailing in Latin America, the age-limits established for this vaccine being three months to seven years. Beyond this age, whooping cough and poliomyelitis cease to constitute important epidemiological problems, and vaccination and revaccination of children can be continued using diphtheria toxoid alone or in combination with tetanus toxoid. Booster doses of DPT and poliomyelitis vaccines should be administered a year after the primary inoculations, and again at three or four years of age.

The age for and use of BCG vaccination is conditioned by the prevalence of both tuberculosis and leprosy. If this is high, the intradermal vaccination of newborn infants with BCG is clearly indicated. Obviously for such a program, countries where a high proportion of births are professionally attended, and especially where the percentage of hospital births is high, enjoy a privileged position.

Vaccination of newborn and unweaned infants in the first few months has the advantage that no prior sensitivity test is required. The latter is a complicating factor in the administration of BCG, since in addition to the double inoculation the PPD reading needs to be taken 72 hours later by a trained technician. Vaccination against measles based on live virus of the

attenuated Edmonston A or B strains, the only vaccine now recommended, because of its recognized efficacy, should be given in a single dose administered after the ninth month.

The marked drop in fatality after the age of five or six years makes the immunization of older children unnecessary, unless the cost of the vaccine should be greatly reduced in the future, or a combination with other agents such as smallpox vaccine should make it desirable to immunize other groups.

Combination of Two or More Vaccines

By reason of the greater operational facility offered, it has become the practice to combine vaccines that are compatible if the method of adminstration of each permits and the optimum age for administration, the number of doses, the intervals between them, and other factors, all coincide.

Diphtheria antitoxin is customarily administered to unweaned infants and to preschool-age children in combination with tetanus toxoid and whooping-cough vaccine. Even though the methods of administration are different, there is a tendency to combine these with oral poliomyelitis vaccine. In doing so it is desirable to administer the poliomyelitis vaccine first, and to inject the triple vaccine a few minutes later. In this way the child's visit to the immunization center is utilized to best advantage. Research is well advanced on the combination of smallpox and measles vaccines, administered by jet injector; this is giving excellent immunization without increasing local or general reactions from either vaccine. The combination of BCG and smallpox and several other vaccines indicated by factors of a local nature is also being employed.

Abnormal Reactions in Programs

It is important to determine once and for all the percentage of abnormal reactions produced by a vaccine. Most vaccines now in use, with perhaps the sole exception of the oral poliomyelitis vaccine, produce local or general reactions. If these increase, or the reactions become more severe, or complications appear in percentages above the acceptable maximum, it may be necessary to suspend the program and re-examine the vaccine so as to determine the causes of the phenomenon.

There are many factors responsible for variations in reactions to vaccines. It is a known fact that primary smallpox vaccinations cause more severe reactions when administered after early infancy. It can readily be imagined, therefore, that a program of mass primary vaccination in a virgin population will inevitably produce higher percentages of local reactions, or more severe and more frequent complications, than those observed in primary vaccination of younger children in routine immunization programs.

BCG inoculations produce abnormal reactions in previously sensitized subjects, and this has led to tuberculin investigation in cases where the vaccine is not administered to newborn infants or in the early months of life. Nevertheless, the fear of the intensified reactions produced by BCG in tuberculin-positive subjects appears to have been overestimated, since the number of those advocating such vaccination in all age groups, without prior determination of sensitivity, is growing every day.

The presence of aluminum salts in combined whooping cough and diphtheria vaccine may give rise to small subcutaneous aseptic nodules, but these are of little importance and are spontaneously absorbed. However, there is a possibility that such reactions may be intensified, especially because of faulty procedure, as may occur when multiple-dose containers are used and their contents are not properly shaken. With the use of individual doses, decantation dangers disappear.

Whether the abnormal reactions are due to the production of vaccine under substandard conditions or to its faulty administration, it is in any case essential for the vaccination program to be accompanied by a continuing survey of local and general reactions.

Measles vaccine, whether the attenuated Edmonston A or B strain is used, will produce a febrile reaction in a certain proportion of children, at times accompanied by cutaneous exanthema, inflammatory processes in the mucous membranes, and other symptoms associated with the disease itself, although less severe and free of complications. The fact that a vaccine based on live virus is used, and that the attenuation makes it impossible to predict the precise itensity of the reaction, indicates the need for a follow-up survey of vaccinated children, as far as possible covering at least 10 per cent. Because of these reactions, it is not advisable to attempt a measles vaccination program designed to obtain maximum coverage in the shortest possible time—the procedure recommended in poliomyelitis. If this is done, the simultaneous appearance at the control center of large numbers of children with fever or other reactions may cause general alarm in the community and even among pediatricians.

Working Methods

The procedure followed in order to obtain satisfactory coverage within a specified period will depend on the circumstances and characteristics of the individual country. Ideally, immunization should be made a part of routine health programs such as maternal and child health that cover pregnant mothers and unweaned infants, preschool-age children, as well as of other programs with well-defined annual goals. To achieve this where no integrated institutions exist, it is essential that steps be taken to bring about the best possible coordination of all institutions that in one way or another engage in health activities in the community. There is no doubt that this is the only type of program ensuring the continuity and maintenance or improvement of the immunization levels achieved year by year.

When medical and health conditions in a given country are such that vaccination programs cannot be conducted in this way, the only course is simply to protect the population by means of sporadic and intermittent campaigns, a method that can also be combined with that described above so as to constitute the first stage in a new program to be incorporated in due course into the regular health activities. In any case, such campaigns have the advantage of making impressive results possible in a short period, although at the same time they do raise an important query, confirmed by the experience of nearly all the countries: program failures are attributed to the fact that action, even though taken at a useful level, is not maintained over a long period. Accordingly, special campaigns should be undertaken only when the administrative organization and the medical resources of the country are such that the programs cannot be incorporated into routine health activities, or as a temporary measure until such time as the favorable conditions described above can be attained.

Once this principle is clearly established, we can examine vaccination campaigns on the basis of the different methods considered so far.

The most practical methods are: (1) door-to-door vaccination campaigns; (2) establishment of mobile posts; and (3) installation of teams in places where large numbers of people customarily congregate for other reasons.

1) Door-to-door vaccination campaigns are undoubtedly the method which shows the best results in terms of coverage and the possibility of reaching useful levels. But at the same time it gives the lowest yield per individual vaccinator, and thus it is the most costly and time-consuming. Like the other methods, it must be supported by a simultaneous campaign to provide information and incentives, supplemented in this case by the canvassing of individuals by the vaccination team.

2) The system of establishing a mobile post for every so many city blocks in urban areas, and at points within walking distance in rural areas, is primarily dependent for its success on the efficiency of the publicity employed. The best device is probably the mobile loudspeaker roving through neighboring sectors explaining the benefits of vaccination and indicating the whereabouts of the post.

3) Similarly, vaccination can be successfully carried out on large groups of people concentrated in particular places. As an example, excellent results are obtained in the

administation of smallpox vaccine at the gates of cemeteries on the days when people visit these places in large numbers to pay their respects to the dead. A similar opportunity is offered at religious processions and fairs and at the entrances to sports grounds; or a vaccination certificate can be required for visiting patients in hospital, etc.

Public response is generally satisfactory, and unfavorble reactions or resistance are attributable rather to the loss of time involved than to fear of vaccination, especially in the case of smallpox vaccination, which people generally know about and accept. The same may be said of oral poliomyelitis vaccination.

To complete as promptly as possible the vaccination and registration of persons who congregate in places where inoculation is carried out, it is important that the necessary personnel should be available, either from the health services themselves or from cooperating agencies. It is also important to choose the appropriate techniques. We know that for smallpox, intradermal or multiple-pressure injection is highly satisfactory; but in a mass program carried out under the conditions described, it can be slow or it may require a high level of staff training. In these circumstances the use of jet injectors is preferable. If they are not available, the old method of scarification has the advantage of making staff training easier, although it has technical disadvantages.

It is important to eliminate registration of unnecessary data, certificates with excessive details, and forms that cannot later be used for tabulation purposes or that contain non-essential information. It is frequently observed in vaccination programs carried out under the conditions described above that the delay is not attributable to the actual administration of vaccine, but to related work such as registration and the issue of certificates. Hence the advantage of any particular procedure will depend on the peculiar characteristics of the population, the human or material resources available, and the organization or structure of the public health services.

Whatever the method selected, experience has shown that in order to carry out a successful vaccination program, in urban or rural areas, it is generally desirable to combine methods, especially when passing from the attack to the consolidation phase. Certain age groups are notoriously more readily reached than others. These differences are accentuated as the social and economic conditions of the country and the organization of its health services progress. BCG programs carried out in maternity clinics can attain satisfactory coverage in regions or countries where virtually all deliveries are attended by physicians. A useful level of coverage of unweaned infants is also feasible where a sufficiently high proportion regularly visit the control centers.

Programs designed to reach preschool-age children are more difficult, and it is only in exceptional cases that a useful level of coverage is achieved in the maintenance stage. School-age children are in general easier to reach, but this naturally depends on the school attendance rate in the country or region. As noted above, the programs carried on in the schools entail the risk of excessive vaccination, which in turn artificially inflates the statistics. After school age, the problem again becomes more difficult, and urgent measures are required to maintain a useful level of immunization. Satisfactory results have been achieved in Chile by requiring smallpox vaccination for obtaining an identity card, a document which all must possess and which must be renewed every 10 years. Similarly, typhoid vaccination is required of food handlers before they can be issued with permits to work in this capacity. Other means of maintaining useful levels of immunization include the rule that smallpox vaccination is required prior to registration for military service; from workers at their place of employment; and from parents when registering newborn infants at the Register Office. When in spite of such measures levels drop off gradually until they are below the prevention limit for epidemic outbreaks, they should be supplemented by campaigns utilizing any of the methods described earlier.

Vaccine Administration Techniques

These will depend on the nature of the program to be carried out. In the case of smallpox, a choice must be made between the traditional methods of scarification, multiple-pressure and multipuncture, and the various types of jet injectors, especially those operated by a foot pump, which are very efficient but expensive. They must operate at maximum capacity and constantly if their use is to be economical; otherwise they defeat their purpose. Similar examples could be given for other vaccines.

Vaccination Schedules

When the vaccination programs described above are part of the regular supervision of the child from birth by well-organized health services, a schedule can be established showing the different immunizations required at any given time. Schedules of this kind have been prepared by the National Health Service of Chile and are posted in hospitals, maternity and child care centers, and outpatient clinics, and also distributed to pediatricians for private consultation. They indicate the order of priority and the age at which each vaccine or combination of two or more vaccines should be administered (see Annex).

Timetables

Whatever the method followed to achieve a useful level of immunization against disease, it is obvious that the activities must be programmed, the various stages being established together with the number of immunizations in each time unit, at the local as well as the intermediate and national levels. If the program forms part of maternity and child care, and is carried out in health centers set up for the purpose, it is easy to forecast when a certain level of immunization will be achieved, since this is closely bound up with the number of children under supervision, the frequency of their visits to the center, and the age indicated for each immunization. If maternal and child care centers are in regular operation, the rate of immunizations in them over the year can be estimated. Given the infant population under supervision in each center, we can determine in advance the number requiring protection.

The situation is different if the vaccination program is not part of a regular scheme such as a maternal and child care service, or if certain aspects of it are not included in other types of activity. It has already been pointed out that some coverage, especially of adults, may be obtained in special circumstances, e.g., before an identity card can be issued, or at public gatherings on specific and pre-determined dates. Programs for the protection of school-children also include certain vaccination arrangements or the completion of programs initiated at an earlier age.

But let us turn to the situation that occurs when the program, or rather the immunization campaign, is carried on outside the framework of regular or routine activities in the form of sporadic or intermittent action. Such campaigns demand a meticulous chronological study of the plan of action and its various stages of implementation. This calls for timetables, which help not only in determining whether the plan laid down is being followed, but also in forecasting how long it will take to complete and judging whether it is keeping pace with the original calculations. They also make it possible to ascertain when satisfactory coverage has been attained.

The timetable for a vaccination campaign, or several carried out more or less simultaneously, must be prepared with the utmost care. It must pay due regard to the exact synchronization of the various complementary activities which help to achieve the final result, namely, the immunization of the population of a given geographic sector of the country within a specified period. This is very similar to the study of the logistics of a military operation, where the delivery of supplies, food and ammunition, the evacuation of the wounded, and other tasks required as the troops advance

must be carefully timed beforehand. If any of these tasks is performed out of order it will wreck the whole operation.

In any vaccination campaign it must be borne in mind that there are preliminary stages. One is preparing the public. Another is dispatching the vaccine, forms, materials, etc., to be used in the campaign. Then comes the stage of immunization proper, during which the teams of vaccinators will have to be moved from one point to another, again in accordance with a previously established timetable. Finally, a prior study must likewise be made of the appropriate time to initiate a survey of the reactions produced by the vaccine and the success obtained in protecting the population. The complexity of this task, in which each activity in a particular sector overlaps with different stages in other sectors, can be readily understood. Thus it implies something much more difficult than merely determining the percentage of vaccinations to be administered to a given population sector and adding together the weekly totals until a numerical target figure is obtained.

Once the timetable is worked out, it is the responsibility of the authorities in charge of the program to maintain the work schedule stage by stage. Any delay in one stage may mean the breakdown of the entire process, work overloads at various points, lack of adequate funds or supplies at a particular place—in a word, the total disruption of the program, with the inevitable consequence that it cannot be completed in the form and by the target date established at the outset.

In examining these tables, it must be remembered that there are certain variables, such as vacations, periods of heavy rainfall, and hot months when summer diarrhea in infants increases to a notable degree, and all these factors interfere with the tempo of the work. Another important point is to work out correctly the number of Saturdays, Sundays, and national and local holidays, since the vaccinating teams cannot work effectively on such dates.

Establishing Objectives for Mass Vaccination Programs

Two types of objectives are to be sought in a vaccination program:

a) Long-term results by way of eradication or reduction of the disease. Attainment of this objective means completing the vaccination program, with a useful level of coverage determined in advance, within a given period and using a vaccine that meets the requirements described earlier. The many factors that can produce spontaneous variations in the incidence of a disease are liable to lead to premature and possibly wrong conclusions if an analysis of the results is made too quickly. A series of techniques exist, based on statistical principles, for reducing such errors and shortening the period of investigations, but they will not be discussed here.

b) Short-term objectives, as the program develops, consisting of checking the efficacy of the vaccine in a given number of cases, and the proportion of abnormal local or general reactions produced. Once the program is concluded, epidemiological surveillance must be established, and appropriate studies made to evaluate the cost, yield, etc.

Establishing Numerical Targets

It has already been observed that every communicable disease, according to its liability to spread, its epidemiological characteristics, the most susceptible age groups, seasonal variations, etc., calls for a useful immunization level that varies with each case. Assessment of the percentage of potential sufferers to be inoculated so as to assure protection of the community against the possible appearance of an epidemic outbreak is a factor of great importance. If a useful level is not obtained, the effort to protect the community against the possible spread of an epidemic outbreak will have been wasted, even though the vaccinated individuals may have been protected; this is, after all, not the ultimate purpose of an

immunization program. If, on the other hand, an attempt is made to achieve the complete immunization of the population, the goal is over-ambitious, extremely difficult to accomplish, and requires a disproportionate expenditure of funds, since costs rise sharply when higher percentages of coverage are sought. To raise the percentage of immunized persons from 80 to 90 per cent usually costs more than to achieve the initial 60 per cent of coverage.

To fix a practicable target, it must be remembered that often only part of the objective is achieved, and the progressive whittling away of the figures brings them below the numerically satisfactory level. In other words, if the target in a smallpox vaccination program is 80 per cent of the population, and it is proposed to operate on the basis of this target, perhaps only 80 per cent of the figure will be achieved, thus reducing the final percentage to 64 per cent of the population. For this reason it is recommended that higher levels be fixed at the programming stage, in the certainty that for one reason or another they will not be reached and the original objective will be reduced, with the consequences pointed out.

The establishment of numerical targets depends on the type of vaccine. For example, oral poliomyelitis vaccine raises the percentage of the population immunized beyond that estimated, since intestinal multiplication of the virus encourages its propagation in the environment. Unfortunately, this advantage does not apply to other immunizing agents, because they do not spread spontaneously through the natural propagation routes of the disease. In the case of smallpox, 80 per cent coverage of the susceptible population, which is the accepted useful level, can only be obtained if immunization of the entire population is set as the objective of the program. In the case of protection against whooping cough, diphtheria, and measles, a target of 70 per cent would appear to be adequate, but in order to reach this figure the goal must be set somewhat higher.

Where vaccines are administered in several doses, it must be borne in mind that the numerical target must be calculated on the last dose, not the first, since there is an inevitable falling off from dose to dose. In Chile, this problem has led to the combined use of whooping cough-diphtheria vaccine in two doses only, with increased concentrations of each component.

In discussing the establishment of objectives, emphasis must be placed on the importance of the gradual standardization of vaccination programs, replacing the traditional rapid and intermittent campaigns by continuing immunization.

When the percentage of the population immunized against a given disease is initially low, the program should be preceded by a campaign designed to obtain a useful level over a very short period, and this level should be maintained afterwards by constant immunization of other susceptible subjects.

Any vaccination program must be accompanied by a parallel survey to determine systematically the effectiveness of the vaccine on the population to be kept immune. It is not enough for this purpose to make a simple determination *in vitro* of the efficacy of a vaccine.

Errors in technique or deficiencies in the transport and preservation of the vaccine can lead to unfortunate results, such as the waste of the effort expended and the false impression that the population has been immunized, when in fact it continues to be exposed. It is therefore essential to control the efficacy of the vaccine in a percentage of vaccinated subjects, even though this complicates the program and is customarily difficult, especially where small children are concerned. If the vaccination program covers a high percentage of the population, a proper sample of 1 or 2 per cent of those vaccinated should be sufficient.

In the case of smallpox it is easy to determine the efficacy of the vaccine; visual examination of the local lesion is sufficient, this being supplemented if necessary by a second inoculation, in a sample percentage of

those vaccinated, to see whether or not the typical immunity reaction is produced.

An attempt has been made here merely to study some of the more important factors which, when properly evaluated and put into practice, can bring about a substantial reduction in morbidity and mortality from infectious diseases. In Chile the measures indicated have been applied, as described above, and have succeeded in bringing about the substantial reduction shown in Table 1.

Clearly, communicable diseases continue to be important factors in mortality figures in the Americas. No less clearly, immunology, virology, and other related sciences have placed at the disposition of the public health services extremely valuable tools for their control. Progress in these sciences has been so rapid in the last few years that at the present time there is an ample list of products, with high immunizing capacity and sound characteristics, that are unfortunately not being fully utilized because of poor organization, administrative problems, shortage of funds, or other reasons. This brings to mind comments made by Abel Wolman at the Second PAHO/WHO Lecture on the Biomedical Sciences:[3]

> International conferences all result in agreement that there is an unfortunate time lag between knowledge and application...Most of the agencies, however, while keeping an eye on the year 2000, are beset by the plagues of 1967 and 1968...The scientific and technological resources are already available in rich amounts to convert the environment from a hostile one to a beneficent ally. The conversion has been dismally slow. We should not accept the present rate of change with fatalistic patience.

Until a few years ago, control of communicable diseases depended primarily on the discovery and delivery to the market of immunizing products that were satisfactory from the standpoint of protection, safety, ease of application, length of immunity conferred, and cost compatible with the resources available. Today the problem is no longer the same. Except for two or three diseases which continue to be epidemiological problems and for which there are no satisfactory immunizing agents, there are products for all the others that, if properly utilized, could bring about the control and even the eradication of these diseases.

If this is the case, why do these diseases continue to figure among the principal causes of death in the majority of our countries? The reply is simple: the mere availability of an adequate immunizing product is not sufficient to reduce a communicable disease to the point of eradication. It is at least as important to be fully acquainted with the best procedures for its application, to possess satisfactory technical and administrative resources, and to have public health services whose structure and organization are such that full use can be made of them.

[3]Wolman, Abel. *The Unreasonable Man. Scientific Publication PAHO* 152 (1967), 10, 13.

TABLE 1—Reduction of mortality rates for some infectious diseases in Chile, 1960-1967.

(Per 100,000 inhabitants)

Year	Total immunization	Whooping cough	Polio-myelitis	Diphtheria	Measles	Total infectious diseases[b]
1960	2,158,613	4.7	1.3	5.3	27.7	54.5
1961	3,138,435	2.5	1.3	4.2	23.4	50.2
1962	5,157,848	2.3	1.3[a]	4.4	30.4	55.6
1963	3,214,980	4.5	0.6	3.0	27.3	49.7
1964	4,410,930	3.5	0.8	2.1	38.6[a]	60.0
1965	4,167,730	3.8	0.5	1.4	14.0	34.0
1966	5,019,005	1.7	0.4	1.1	19.7	34.5
1967	5,393,310	0.8	0.2	0.6	12.4	35.1

[a]Year in which the vaccination program was initiated.
[b]Not including TB.

Summary

The success of a vaccination campaign depends on the efficacy, safety, and cost of the vaccine, ease of administration, possible secondary effects, community acceptance, and degree of development of the public health services responsible for the campaign. The campaign should not interfere with others of equal or greater importance, and both human and material resources should be made available at the required levels so as to ensure that it can be maintained indefinitely. Suitable coverage of both urban population centers and remote rural areas is recommended, and practical methods of effecting this are discussed: door-to-door campaigns, mobile posts, vaccination facilities at places where crowds congregrate, etc. The article discusses the various techniques for the administration of the immunizing agents of most interest to the Hemisphere—in particular, smallpox, DPT, and poliomyelitis vaccines—and weighs their relative value and practicability. Stress is laid on the need for educating the public to accept vaccination, on the importance of proper timing of initial administration and booster doses of the various vaccines, and on the importance of sound logistics for a successful campaign. The availability of an effective immunizing agent is only a beginning. There must be a thorough knowledge of the latest techniques, a realistic assessment of short- and long-term objectives, and adequate and coordinated resources.

Annex

Schedule of Inoculations for Children up to Seven Years of Age

Age	Type of vaccine	Route of administration
Newborn and unweaned, under 2 months	BCG	Intradermal
3 months	Combined (DP or DPT), 1st dose	Subcutaneous
3 months	Trivalent polio vaccine, 1st dose	Oral
5 months	Combined vaccine, 2nd dose	Subcutaneous
5 months	Polio vaccine, 2nd dose	Oral
9 months	Smallpox and measles vaccine	Intradermal and subcutaneous (jet injector)
18 months	Booster of combined and polio vaccine (trivalent)	Subcutaneous and oral, respectively
3 to 4 years	Booster of combined and polio vaccine (trivalent)	Subcutaneous and oral, respectively
7 years	Diphtheria toxoid	Subcutaneous
7 years	Smallpox vaccine	Multiple-pressure or scarification
7 years	BCG (with preliminary tuberculin test)	Intradermal
	After seven years of age, periodic revaccination against smallpox and typhoid is continued as required.	