was based on an analysis of course breakdowns submitted by the field training centers and the philosophy and objectives of these courses. The items were selected by the American Public Health Association and were reviewed by a committee of representative training officers. Items not considered applicable were discarded and additional items selected to conform to the emphasis of the course. Upon completion of the item analysis by APHA, the committee of training officers will meet again to set up the two comparable forms of the test.

To determine the validity of the test, one criterion to be used is the rating by training officers of trainees' knowledge in the various subject matter areas covered by the training experience. Use of other criteria such as trainees' education and experience is planned.

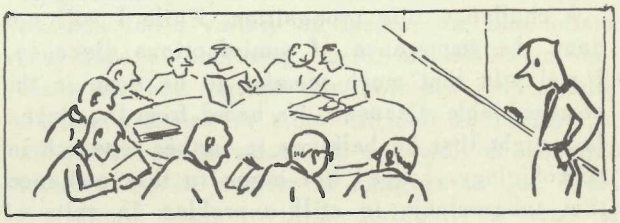
The test should be ready to accompany courses beginning in January 1952. It is hoped that the test can be used to determine the most effective training methods employed in regional and State field training centers and to assist the States in maintaining the level of instruction at established field training centers.

READABILITY OF TRAINING MATERIALS

A program to determine the readability of various training materials was initiated in July 1950 with the assistance of the Experimental and Evaluation Branch, Division of Health Education, U. S. Public Health Service. Although some of the methods used were fairly crude and frankly experimental, the results point up certain factors which indicate the value of pretesting training materials before they are published. Further study and experiments in cooperation with the Experimental and Evaluation Branch are planned.

SUMMARY

The evaluation program has been mainly experimental. As objectives become more clearly defined, evaluation methods and devices are determined and specialists called upon for assistance in their development. Some measuring devices have proved effective; others are still in the preliminary stage. It has been a slow process as there has been little precedent to follow so far as the evaluation of field training is concerned. However, the bases on which the program is being built appear to be sound, and it is believed that a useful program of evaluation will result.



The Importance of Respiratory Diseases*

ALEXANDER D. LANGMUIR**

In speaking to you, I propose to examine some of the general epidemiological principles that have led to our successful control of many communicable diseases. I shall attempt to analyze the prospects of substantial improvement in the control of the respiratory diseases that still plague us. May I quote from the book, *Plague on Us*, by Mr. Geddes Smith:

"Great and small, the respiratory infections are indubitably unfinished business. These common ailments form a nosological jungle in which bacteria and viruses roam at will, despoiling the human race and defying both classification and control. Symptoms overlap and no one knows how many different diseases lurk behind them. For some of them the doctor can do little. The epidemiologist who hacks his way into this mess

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courts frustration. The statistician has to content himself with omnibus calculations. The plain citizen talks glibly of grippe or flu, gulps or sniffs his favorite panacea, and, without any clear notion of what is happening to him, hopes for the best."

Perhaps the title of this paper should have been "Courting Frustration in a Nosological Jungle," or as you will hear, a more appropriate title would be, "The Possibilities of Eradicating Respiratory Diseases."

In considering my broad subject, I would like to start by challenging a widely held belief that has inhibited, and even frustrated, those of us who have chosen the public health profession. I refer to the proposition that the communicable diseases are now conquered and, therefore, need little further concerted effort.

Many of my good friends tell me I am wasting my efforts by working in a dying field. They say that the future lies in the noninfectious, the metabolic, and the chronic debilitating diseases of older ages.

I challenge this proposition. While I wi'l not deny the importance of noninfectious diseases, I maintain that much remains to be done in the communicable diseases. We heard from Dr. Dubes last night that he believes in further research in microbiology. I need not argue to this audience that tuberculosis is still a problem in spite of the present steep downward curves of tuberculosis mortality. I firmly believe that in the field of the infectious diseases there is a happy hunting ground for major discoveries and contributions to the welfare of mankind that for some time to come will equal, if not surpass, those to be made in the field of the degenerative diseases.

Most of the infectious diseases may be classified into three broad groups as follows: (1) the enteric infections, (2) the arthropod-borne infections, and (3) the respiratory infections.

In Western civilization, progress in the control of the first two of these three groups of diseases has been impressive. We have practically eliminated typhoid fever and the dysenteries. Yellow fever and dengue are gone from this country and Northern Europe. Typhus and plague are now trivial problems. Perhaps the most impressive of all is the story of malaria. This disease was heavily endemic and seemingly permanent in large areas of the South in the mid 1930's, but now has disappeared as a naturally spread disease.

In contrast, our control of the respiratory group is unimpressive. Smallpox is our only total success. We can take considerable pride in the record of diphtheria. We have only begun to apply our knowledge effectively against whooping cough. The seriousness of the streptococcal infections, bacterial pneumonia, meningitis, and the bacterial complications of measles and influenza has been materially reduced by the specific antimicrobial therapies; but the beginning is yet to be made in their effective control or elimination. Poliomyelitis, infectious hepatitis, mumps, chickenpox, the common cold, and that group often termed the "undifferentiated respiratory diseases" continue amongst us unabated. "Indubitably," to quote Mr. Smith again, "the respiratory diseases are unfinished business."

Why have we been so successful with the enteric and arthropod-borne diseases and yet have so largely failed with the respiratory infections? The answer is clear. The former two groups of infections depend for their survival either on gross fecal contamination of the environment, or on the close association of insects or rats with the human population. These basic conditions for survival have been eliminated both by conscious public health effort and as a beneficient concocomitant of an advancing standard of living.

The reasons for our failure with the respiratory diseases are equally understandable. These infections depend for their survival on direct person-to-person transmission which cannot readily be attacked by the broad community approach of environmental sanitation. In the few respiratory diseases which we have successfully controlled, we have depended on immunization. While all of us, even health officers, have a personal aversion to needles, I believe that the principle of immunization provides the most promising basis for future advance.

What are the prospects? I believe they are very real. Let us first apply what we now know. There is little excuse for most of the 9,600 reported cases and 634 deaths from diphtheria in 1948, (the last year for which national mortality figures are available), nor for the 74,000 reported cases and 1,100 deaths from whooping cough. These could be materially reduced and possibly eliminated by the effective application of existing knowledge. This problem is essentially one of health education of the medical and public health profession and of the general public. The National Tuberculosis Association has a long and brilliant record in these techniques.

Next, let us look at other respiratory diseases for which a generally accepted immunizing agent is not now available. The viruses of influenza and mumps can be grown in the embryonated hen egg. This means that antigen can be made available in almost limitless quantities. Thus, the major stumbling block to the preparation of a vaccine has been removed. While I do not wish to minimize the still substantial developmental problems remaining to be solved before a practicable, safe, and effective immunizing agent for generalized use among the population can be available for these two diseases, it seems wholly reasonable that this objective can be achieved for both in the near future. The isolations of the viruses of measles, infectious hepatitis, and the common cold have been reported. This means the first step toward development of vaccines has been taken, but whether adequate amounts of antigen can be produced still is problematic.

A recent development announced by Dr. Jonas Salk in Atlantic City just 2 weeks ago has direct bearing on our problem of immunization. In my judgment it constitutes a very major advance in this field. By starting with the pioneer work of Dr. Jules Freund, who opened up the field of the use of adjuvants to enhance antibody response, Dr. Salk has found that by selecting a simple mineral oil of low viscosity, and the right detergent or emulsifying agent, he can obtain, in both monkeys and man, high and sustained influenza antibody titers with but a single injection. Furthermore, the material is essentially reaction free and the total antigen required is fractional compared with the amount formerly used in influenza vaccines.

This discovery means that many other stumbling blocks to the control of respiratory diseases have been removed. One of these is that the small amount of antigen required indicates that multiple types and substrains of influenza viruses may be included in one inoculation, thereby giving a much broader antibody response than has been attainable heretofore. While still new and different antigenic strains of influenza virus may appear in the population, it would seem that we are much nearer to the development of a practical influenza vaccine than we were prior to Dr. Salk's development.

Also, this work quite adequately disposes of two commonly accepted fallacies.

The first fallacy is: that we cannot expect to achieve by artificial means a greater immunity than is created by naturally acquired infection. He has clearly produced antibody responses that regularly exceed the natural response in influenza. While I freely admit that the titer of antibody in the circulating blood may not be a direct measure of immunity, there is certainly an established relation in influenza and in a number of other infectious diseases. I believe that we can look to the future field trials with the new influenza vaccines with considerable enthusiasm.

The second fallacy is: that to achieve substantial immunity, two or more properly spaced doses of immunizing agent are necessary, the first, to condition the virgin susceptible to an initial response, and the second, to act as a booster dose to bring out the recall phenomenon and lead to higher and more sustained titers.

With Dr. Salk's preparation, antibody responses to a single dose regularly exceed the titers achieved after multiple doses of saline prepared vaccine.

Not only does this discovery lend solid prospect to great simplification of existing immunizing procedures for a variety of agents, but also offers real hope of achieving useful and effective vaccines for new agents that now are intrinsically weaker antigens or more difficult to prepare in adequate concentrations. It may well be possible to give a wide variety of antigens in one dose. We should begin to think seriously in terms of a dozen or more antigens in one reaction-free dose. This, veritably, would be a magic bullet.

May I draw the conclusion that the prospects for major advances in the future control of respiratory diseases are bright; but we still have a long way to go, both in applying what we now know and in making new discoveries.

What is the theoretical limit we can shoot for? I think this limit is clear but to discuss this I must challenge another commonly held belief, even a fetish in many circles. It is the proposition that eradication of an infectious disease is not an attainable or practical goal. If one will accept Dr. Justin M. Andrews' definition of the concept, namely area-eradication or the elimination of the natural spread of the disease in a large contiguous area, such as the United States, I maintain that eradication is a reasonable and attainable objective for a number of diseases. It was achieved for yellow fever and dengue decades ago, and within the past decade even for malaria.

In the past 5 years the Communicable Disease Center has made an intensive search for evidence

of the occurrence of mosquito-transmitted malaria in this country. While a small number of single verified cases has been uncovered, they have almost all been evident relapses, introduced cases, or transfusion malarias. A very few are unexplained but not a single instance of two or more cases occurring in epidemiological relationship has been discovered. This constitutes area-eradication as Dr. Andrews defines it.

These achievements are not limited to the arthropod-borne infections. Since 1948, less than 100 cases of smallpox have been reported each year from the entire Nation. These few cases are not concentrated along the Mexican border or in the port cities where occasional introductions may well occur; and, therefore, it is a reasonable epidemiological conclusion that they are erroneous diagnoses. The last outbreak of smallpox in this country, that I have been able to find, occurred along the Mexican border in 1949. While to the purists we cannot claim eradication, we all know that for all practical purposes this has been achieved.

I maintain that to argue, as some do, that no infection can be considered as eradicated from an area because it may be accidentally introduced from outside, shrouds the significant fact that the disease has been successfully eliminated. This rigid semantic position inhibits us from declaring our logical objectives and makes us complaisant with partial success.

Let us examine the epidemiological basis for the disappearance of smallpox. This leads to the subject of Epidemic Theory developed first by Farr, Hamer, Brownlee, and Soper in England and extended in this country, by Frost, Reed, and Wilson. It is axiomatic that, for the survival of any disease which is caused by an obligate parasite of man, one infected individual must give rise on the average to one new infected individual. This ratio, of course, may vary. If at one particular time the circumstances are such that one case gives rise to more than one case in the next generation, the incidence rises. As the epidemic progresses, however, recovered cases become immune and the susceptibles become depleted to the point where new cases no longer give rise to an equal number of subsequent cases. Then, the incidence falls and the epidemic subsides. For respiratory diseases such as measles, influenza, and many others, the epidemic terminates long before the susceptibles are exhausted. Another epidemic does not recur until the susceptibles are replenished by the addition of newborn individuals as in measles, or by waning immunity as in influenza.

The agents of this group of diseases may be said to have achieved a successful biological balance with the human race. Their incidence fluctuates over short-time intervals; but, averaged over longer time spans, it has been remarkably stable.

The epidemic theorists have written a simple equation that accounts for this waxing and waning of incidence of such diseases as measles. The incidence rate may be expressed as a function of only two factors: (1) the proportion of susceptibles in the population, (2) the contact rate.

The former is a simple concept that can be measured in at least approximate terms for several diseases. The latter is a composite of many variables including the ease of transmission of the particular infection from person to person and the frequency with which people come in contact with each other in a given time period. Thus, the contact rate is a statistical parameter determined by the biological characteristics of the host parasite relationship and the standard of living. For diseases such as measles and mumps, in which the host–parasite relationship has been stable for centuries, the important factor determining the incidence rate is the proportion of susceptibles in the population.

For each contagious disease there is a certain threshold of susceptibles which, if it is exceeded, leads to the occurrence of a rising incidence, or an epidemic; and in converse, if the proportion of susceptibles is less than the threshold, no epidemics can occur. The characteristic 2- to 3-year periodicity of measles, which occurs so regularly in many of our cities, can be adequately accounted for essentially in these simple terms.

On the basis of this theory, the eradication of respiratory disease follows logically. All that is necessary is to maintain the threshold by artificial means, such as immunization, well below that which is necessary for one case to give rise to one subsequent case. If this reduction in susceptibles is maintained effectively and generally over a large area, such as a whole Nation, and particularly in pockets of the population where the contact rate is especially high, the disease must steadily and progressively disappear. With a truly effective program of immunization, this disappearance should be rapid, a matter of only a few years.

It should be emphasized that the conditions necessary for the disappearance of such an infection do not, by any means, require that the total population be immunized. Probably a 50 percent reduction in the proportion of susceptibles, if well distributed, would be sufficient.

This is exactly what has happened with smallpox. Although 150 years have now passed since Jenner's discovery, we substantially achieved this goal many years ago. We have reached the goal in spite of the fact that vaccination is by no means universal and the immunity conferred by vaccination is neither absolute nor permanent. Vaccination is a sufficiently widespread practice, particularly as a requirement for admission to schools, to maintain the threshold of susceptibility to the disease at the level where the disease was forced to disappear as an endemic infection.

Two additional factors are important in this achievement. The first is the rigidly enforced requirement that all travelers, both immigrants and tourists, must have a recent successful vaccination before entering the country. This materially reduces the chance of introduction of the disease. The second factor is the popular clamor and demand for vaccination whenever a case of smallpox is reported. The primary factor, however, is the routine vaccination of our school children which keeps the threshold at a safe, low level. If we fail to maintain this practice, we expose ourselves to danger.

I believe these principles are epidemiologically sound and generally applicable to any acute infectious disease caused by an obligate parasite of the human race, and for which acquired immunity is the factor controlling incidence. They certainly apply to measles, mumps, and chickenpox, where a high proportion of the total infections are clinical cases and immunity is long lasting. I can see no theoretical reason why they should not apply to diseases such as diphtheria, whooping cough, and poliomyelitis where a higher proportion of infections are inapparent. The streptococcal, pneumonococcal, and meningococcal infections, and influenza, present special problems because of the multiplicity of immunologically distinct types. These may raise practical problems in the development of specific vaccines but not basic theoretical objections of an epidemiological nature. The basic requirement is an effective immunizing agent.

In summary, then, the necessary conditions for the area-eradication of the common respiratory contagious diseases are:

(1) The reduction of the threshold of susceptibles to a level where one case gives rise, on the average, to less than one case in the next generation. This implies rather widespread and continuing practice of immunization and the availability of a safe, effective, and practical immunizing agent. It does not imply universal immunity.

(2) The maintenance of effective requirements of immunization of immigrants and tourists entering the country to prevent introduction of the disease.

(3) A constant and vigilant epidemiological surveillance, supported by an informed and cooperative public to stamp out by intensified immunization any accidental introduction that may occur.

The respiratory diseases are unfinished business. Etiological discoveries, particularly the cultivation of specific agents in the chick embryo, and the simplification and enhancement of immunizing procedures, give promise of new achievements in the near future. The area-eradication of respiratory diseases is the ultimate goal which should be theoretically attainable for a number of respiratory infections. When this is achieved the noninfectious, chronic, debilitating diseases will justly command the primary attention of the epidemiologists.