The Rationale of Emphasis on Tuberculin Testing in a Tuberculosis Control Program

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From three to five million persons die of tuberculosis every year throughout the world. It is estimated that some 50 million people have the disease, and are transmitting the organisms to other people.1 The disease has been a major scourge of mankind through all recorded history, but only since the last part of the 19th century has it been clear that it is a contagious disease. In Western civilization the death rate has been declining since 1870—that is even before the discovery of the tubercle bacillus.2

Iskrant and Rogot3 analyzing trends in tuberculosis mortality in continental United States, show that mortality is now the lowest in history, and that the greatest improvements have occurred in recent years. Nevertheless, tuberculosis ranked seventh as cause of death in 1950, and was the leading killer from disease for the 15 to 34 age group. Iskrant and Rogot3 estimated the toll of tuberculosis mortality in terms of potential years of life lost, and estimated that 900,000 potential years were lost in 1950. There are, of course years of life "lost" in morbidity, for the economic and social loss of creative productivity is particularly high in the very age groups where the morbidity is highest.

A joint committee of the National Tuberculosis Association and the Division of Chronic Disease and Tuberculosis, of the Public Health Service, has made estimates on the number of active and inactive cases of tuberculosis in the nation.4 They place the number of active cases at 400,000, with 150,000 of that number still undiscovered. As for inactive cases, they estimate that there are 800,000 such in the country, 550,000 still undiscovered. Even these estimates refer only to individuals with demonstrable x-ray shadows, and do not include the far larger group who still have clear x-ray films but who already carry the tubercle bacilli some of whom are destined to develop gross lesions.

Provisional reports on tuberculosis morbidity and mortality for 1952,5 indicate that the trends of the past several years were continued in 1952, that is, "...substantial decline in tuberculosis mortality but a comparatively small decline in the number of newly reported cases."

Since the morbidity rate and prevalence of infection have not paralleled the decrease in mortality rate, it appears6 unlikely that the present rate of decline in mortality can continue undiminished. In any event, it is clear that tuberculosis remains a major killer, a major source of incapacity and social loss, and a leading public health problem.

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Purpose of Paper

The present purpose is to examine the epidemiological rationale for emphasis of tuberculin testing in tuberculosis control.

The “Clinical” vs the “Epidemiological” approach

Instead of confining ourselves to the clinical concern with the host-parasitic reaction—that is, with those reactions sufficiently marked to be regarded as illness, and centered in that phase of the relationships occurring from the onset of symptoms, to recovery or death—we prefer to consider the subject epidemiologically, with concern for the whole host-parasite relationship, from the time the micro-parasites enter the body, until they are eliminated. Thus we are concerned with the conditions under which transmission of infection takes place, the subsequent time lapse before symptoms, the occurrence of reactions below the threshold of clinical recognition, and the duration of the infectious state.

Recognized characteristics of the host-parasite relationship

Tuberculosis is a continuum. It is a continuous process that progresses by infinitesimal degrees, from the moment that the host and parasite meet, through definite ensuing stages to recovery, chronicity, or death. The population of infected individuals may be visualized as occupants of this continuum, stationed in varying numbers at the various stages along its length. An understanding of the disease depends upon the establishment of clear concepts of the full continuum—of a working insight of the disease through its entire span.

Experimental work with animals6, 7, 8, 9 has shown that tuberculous begins within one hour after the organisms are introduced directly into the blood stream. The incoming organisms are phagocytosed by neutrophils and focalized at many points in the body. The neutrophils are poisoned in the process, and lose their ability to change shape, so that they cannot elongate for capillary passage, but remain at the capillary entrance and die. Numbers of monocytes arrive, ingest the fragments of the dead neutrophils, then remain as part of the formation of the tubercle. This focalization with tubercle formation occurs simultaneously in many parts of the body, such as brain, spleen, liver, genitourinary tract, and the bones and joints. The lungs, because of their volume and expansive capillary structure, get more foci, and thus more potential clinical tuberculosis, than elsewhere—but any of these foci, anywhere in the body, may be the starting point—or points—of destructive disease. Thus, as Myers says, '‘... tuberculosis begins within an hour after the tubercle bacilli invade the body. Future happenings depend upon how much it evolves and at what sites. It continues to be tuberculosis at every step as long as tubercle bacilli are alive in the body.''

This long range view leads to immediate consideration of the prevalence of the disease—the true prevalence, and the known prevalence.

The true prevalence at any one time would be the total number of cases at a given time, for as Anderson, Sauer, and Robertson say,10 '‘... it is these cases which, in the aggregate, represent the actual and potential reservoir of infection and which require case-finding facilities, public
health supervision, and medical care in order to prevent or alleviate disability and economic loss from the disease."

Known prevalence in this country has been arrived at through mortality and morbidity figures, both of which have inherent weaknesses in elucidating present and future tuberculosis problems.

Mortality has never been a reliable criterion of the tuberculosis situation. It is even less reliable now that current treatment methods are extending the lives of tuberculous persons. Moreover, in some states more than 25 per cent of all deaths from tuberculosis are first known to health departments through the death certificate. In addition, it must be recognized that persons with contagious tuberculosis may die from other conditions without the tuberculosis having been recognized. Dubos and Dubos' report that "... in a large series of autopsies carried out in New York on persons dying suddenly of causes other than tuberculosis, it was found that almost 5 per cent had lesions (including cavities) showing active and often advanced tuberculous disease which had remained unsuspected."

Morbidity in the past has largely been data on cases newly reported during a given year. Presently, however, there is a concern with known prevalence, i.e., "all cases which are considered by the health department at the date of tabulation to be significant for supervision, even though these cases may have been first reported as new cases many years previously. This includes not only active tuberculosis cases but also those with activity undetermined, arrested tuberculosis, or inactive tuberculosis which the health department considers significant for supervision." Even those figures do not indicate true prevalence, when by "true prevalence" one means the inclusion of unknown cases in a specified area.

In thinking of cases, unknown or otherwise, one is reminded that a case is a "host reaction of sufficiently characteristic intensity and duration to permit clinical diagnosis." In tuberculosis this clinical phase makes up only a small part of the spectrum or disease continuum, and since the host-parasite interaction varies greatly in both severity and duration, there are clinical and subclinical cases. These subclinical cases, even though they are below the level of clinical recognition, can fortunately be demonstrated by the resultant change in the response of the skin to antigenic material in the form of the tuberculin test.

The epidemiologic importance of inapparent infections is great in the propagation and survival of the parasite in relation to the human host. The opportunities for communicability increase with the length of time that the parasite and the parasites progeny can multiply and escape from a host. Long infectious periods, especially when they are mild so that the host moves about freely, become potent sources for the spread of infection.

Early diagnosis becomes of paramount importance, important not only because it gives a chance for prevention of breakdown in some persons, and for effective treatment, but also because it affords the best opportunity to prevent the spread of the disease to possible contacts. This is the keystone of tuberculosis control, and even of tuberculosis eradication,
for as was pointed out by Wade Hampton Frost in 1937, "... for eventual eradication of tuberculosis, it is not necessary that transmission be immediately and completely prevented. It is necessary only that the rate of transmission be held permanently below the level at which a given number of infections spreading (i.e., 'open') cases succeed in establishing an equivalent number (of 'open' cases) to carry on the succession. If, in the successive periods of time, the number of infectious hosts is continuously reduced, the end result of this diminishing ratio, if continued long enough, must be extermination of the tubercle bacillus." The only qualification that Frost placed on his conclusion was to the effect that, "As to the maintenance of this balance, favorable to us, unfavorable to the tubercle bacillus, there are, of course, elements of uncertainty, among them uncertainty as to the stability of our civilization."

The tools for diagnosis are: clinical findings, laboratory findings, the x-ray film, and the tuberculin test. Of these, only the tuberculin is a specific test that will indicate the presence of infection, at a time when the lesions are microscopic and asymptomatic.

Tuberculosis developing in the human body can be detected by the tuberculin test within two months after the initial invasion by the tubercle bacilli. At this time the lesions are usually still so small that no other form of examination of the living body could detect their presence.

Teague has said, "It is being recognized and widely accepted that evidence of infection—a positive tuberculin test and especially a recent conversion—becomes more helpful and significant today than in the past. This is true from the viewpoint of the epidemiologist, the diagnostician, and the therapist."

Once a tuberculin reaction is found, it is an epidemiologic agent that can set up a number of salutary reactions. Search can be instituted for the source case of tuberculosis, with the possibility that the search may avert further spread from that source, and may enable the source, himself, to get under treatment. The reactor, himself, may be given the benefits of treatment, if such is indicated, or even in the absence of clinical disease, can be recognized as a member of a high-risk population group, who once identified, can perhaps be spared some avoidable elements of stress and strain, and can be watched for the possibility of shedding organisms.

A third group of beneficiaries, are the people who might otherwise have become infected in due time by the reactor, but who may be spared if the reactor is handled in such a way as to break the chain of transmission.

*Life of the Host as a Continuum*

We have approached tuberculosis as a continuum. Now let us view the life of the host from that standpoint. The life of the host is also a continuum. It too is a continuous process that progresses by infinitesimal degrees, from its beginning, until death. It too, goes through definite ensuing stages, each of which has its own characteristics of vulnerability, its own special differences in response to the host-parasite relationship,
and therefore, its own special meaning in the overall epidemiology of a chronic disease.

A given population of individuals may be visualized as occupants of this continuum in varying numbers at various age points along its length. An understanding of a disease, depends upon the establishment of clear concepts of the full continuum, and of how that continuum varies from time to time in a given population group, bringing with its variations resultant variations in the epidemiological characteristics of any given disease.

There is need for much work to be done to elucidate the differences of host-response to tuberculous infection at the different age periods—but such material as is available even now, shows some striking features which are basic considerations in any epidemiological approach to tuberculosis control or eradication. Such features include observed differences in host response in early childhood, in adolescence, in the young adult, and in old age.

For example Krause commented that the child was “exceptionally good tolerance of tuberculosis.” Yet a child is a veritable “guinea pig” when it comes to being a responsive in vivo detector of an open case of tuberculosis in his environment. The intimacy of his life with those with whom he lives, gives ample opportunity for the seeding of the infection, and the limited number of people who touch, or who have touched, upon his life at an early age, narrows the field within which the source of his infection may be located.

The child, and the child’s relationship to tuberculosis, change strikingly with the onset of puberty. Whether growth strains are responsible—the onset of the menarche, or other demands on the organism—something happens to the young host, and the host-parasite relationship changes its characteristics, so that there is an abrupt increase in the adult form of tuberculosis in adolescence.

The reasons for these phenomena are shrouded in mysteries, among which is the question of how the host is affected by growth and development. Johnston has just published the record of 20 year nutrition and metabolic study on adolescent girls, most of whom had tuberculosis. It attempts to show that this abrupt increase is related to a failure to meet the nutritional requirements of the adolescent growth period, and that a favorable course of the disease process, once it has developed, may be conditioned to a large extent by the degree to which we succeed in promoting a normal state, and replenishing previously acquired defects. This study was begun as an attempt to determine the incidence of endogenous re-infection in reactors and exposure cases removed from contact. It soon produced evidence that such reinfections were occurring in significant frequency in girls at the period of adolescence.

Rich speaks of the relationship of tuberculosis to adolescence as follows: “The sharp rise in mortality that follows the childhood period of relative safety is associated with the following circumstances: (1) a progressive increase in the incidence of infection; (2) apparently as specific adverse effect of the state of pubesence on resistance; and (3) the be-
ginning of exposure to the stresses and strains associated with a struggle for existence and with childbearing. That other less evident factors may be operative cannot be denied. The most earnest study should be devoted to an elucidation of the factors which influence the development of progressive tuberculosis at this time of life, for the precise reasons that the disastrous effects observed during this period are still for the most part obscure, and the problem is one not only of extraordinary theoretical interest, but of the utmost importance from the standpoint of human welfare."

There is little need to mention here the significance that clinical tuberculosis assumes from adolescence on through 45 years of age, for these are the years that make up the bulk of mortality and morbidity data on which most of the tuberculosis work in this country has been focused.

There is still one more age period which is emerging with increasing epidemiological importance. Myers has shown that tuberculosis among the aged constitutes a prime problem in tuberculosis control because of its prevalence and contagiousness, the incidence of contagious tuberculosis in persons over 50 being higher than in any other period of life. In the United States the highest tuberculosis mortality rates occur among persons 70 and over, and as for morbidity, there is not only the apparent increase due to cases uncovered by more refined diagnostic methods, but an actual increase due to the greater number of infected individuals who now live to be old.

Considering these host-differences which characterize the different age periods, it becomes epidemiologically interesting to notice the population changes which are occurring in contemporary United States.

The United States is becoming a nation of old people, but even as the aged are increasing in number, we are maintaining our youth. During the last decade, while the population over 65 years of age increased 37 per cent, the population under 5 grew 55 per cent. These children now are swelling the pre-adolescent group, and in a few years will enlarge the adolescent section of the population.

The implications of these population changes are vast, for these are basic changes in the elementary epidemiological characteristics, those characteristics of time, place and person, which are the start of any analysis of mass disease in man.

Leavell says, "We still need to remind ourselves constantly that the increase of man's life span by 18 years in half a century has more profound medical, economic, and social implications than such developments as atomic energy, air transportation, and modern communication. Increased life expectancy at birth is giving this country a population with an increasing proportion of aged persons and is causing us to retool from programs for controlling communicable disease to plans for dealing with degenerative disease and long-term illness."

The already existent increase in the older age group, and the existent and predictable increases in the adolescent group, are signals for prevention, for they are recognized high-risk groups, and the demonstration of
abnormally high risk attached to a particular age group is a direct indication for preventive action.

Since the opportunity for scatter and chance transmission of the tubercle bacilli are increased in proportion to the length of time the organisms can continue to multiply and emerge from a host—particularly an apparently normal and ambulatory host—we may assume that success in preventing infection of a population will depend largely on the extent to which tuberculosis is diagnosed at an early stage.

To this end there are case-finding programs, using x-ray film, and/or tuberculin testing. X-ray has been widely used in the recent urban case-finding programs aimed at population groups 15 years and over. Such programs have been rewarded by the uncovering of previously unknown cases of tuberculosis, and through them, the location of some of their contacts, and even some of their sources.

We will not go into any detailed consideration of the fact that many of these programs largely miss two of the high-risk age groups, the threatened adolescents, and the threatening oldsters.

The adolescents are missed because the programs are set to start at 15 years of age. The older group is sought, and where it does turn up, a high prevalence of clinical tuberculosis is found. Christie reporting on a mass-chest x-ray survey in Washington, D. C., where only 41 per cent of the estimated population was examined, noted that one-fourth of those having tuberculosis were age 55 and over, although that age group made up only 10 per cent of the population examined.

Considering the place of the tuberculin test and x-ray as screening modalities in tuberculosis control, it is clear that x-ray is not a productive finder of early cases. Pulmonary lesion demonstration by x-ray is unsatisfactory in many respects. If shadows are seen, they still are not pathognomonic. On the other hand, lesion may be entirely missed, either because they are not large enough to be visible, or are not dense enough to be radio opaque, or because of the fact that 25 per cent of the lungs are not visible in the usual x-ray film, or the lesions may be extra-thoracic. (10-15 per cent of tuberculosis in the human body develops extra-thoracically.8)

The autopsy is useful in recognizing tuberculosis in the dead. The x-ray has its place in the recognition of the disease, when the disease is advanced to the point of actual illness—symptomatic or asymptomatic—but for early recognition, the sine qua non is the tuberculin test.

The tuberculin test has a remarkable high reliability. Its rare unreliability is limited to the form of negatives shown in terminal anergy that state of negative tuberculin when death is near, in a fatal case, and an occasional loss of positive reaction at the time of an intercurrent disease. Apart from these situations, the tuberculin test is one of the most reliable tools available to an epidemiologist.

Clinical tuberculosis develops only in the presence of the tubercle bacillus. The tuberculin test permits the infected individual to be identified within eight weeks after the invasion has occurred.

The conversion of reactors from negative to positive—the annual attack
rate—is now somewhat less than 1 per cent per year in most parts of the United States. In some places where control programs have reached high levels of effectiveness, the proportion of reactors has become as low as 5-8 per cent even among senior students in high school. In crowded areas with a high proportion of uncontrolled open cases the per cent of reactors runs higher.

The conversion of a tuberculin reaction from negative to positive establishes at once: (1) the reactor is at least a potential case of clinical tuberculosis, and (2) there has been a source of infection. Each of these facts warrants the attention of the epidemiologist.

The source of the infection must be sought. In general the younger the reactor, the more meaningful this phase of the epidemiological approach becomes, owing to the fact that the reactor’s youth limits the number of people with whom he may have had contact. Likewise it assures some recency of the contact. In children under 12, emphasis needs to be directed to finding the person who is the source of his infection, rather than in x-raying the child reactor.

As for the fact that the reactor himself is a potential case of clinical tuberculosis, there is a persistent myth that only 1 or 2 per cent of infected persons develop clinical tuberculosis. Longitudinal studies do not support this idea. Rathbun’s experience indicated that the small per cent of girls and boys having first-infection type of tuberculosis furnished at least 75 per cent of the adolescents developing the reinfection type of tuberculosis, which is often fatal.

Bogen in his careful analysis of the subject, concluded that “...about half of all infected individuals develop clinical tuberculosis, and from 10-20 per cent of them eventually die of the disease. The high risk of disease and death due to infection by the tubercle bacillus justifies increased effort for its prevention.”

At one time in the United States, it was thought that tuberculin testing would be useful only in children, but the present low rate of reactors, makes the tuberculin test increasingly important. Many persons are now getting their first tuberculosis infection as adults. At any age, any individual—even an elderly person—who has been a non-reactor to tuberculin, but converts, has been in all likelihood in recent close contact with an open case of tuberculosis.

Anyone, at any age, with a positive tuberculin reaction, should be examined periodically for clinically tuberculosis, for that reactor has tuberculosis just as truly as the person with “clinical” tuberculosis. The difference is one of degree.

Myers has said, “Periodic x-ray film inspection of chests of tuberculin reactors locates chronic reinfection type of pulmonary lesions on an average of two and one-half years before they cause symptoms and usually before they liberate tubercle bacilli. Lesions found in this stage of evolution can usually be successfully treated in much less time than those which have become more advanced and are contagious.” The epidemiological importance of this must not be missed in relation to that high risk-group,
the late adolescent. Tuberculosis is still the leading cause of death among the group 17 to 37. Death, in general, is preceded by symptomatic disease. If the symptomatic disease was also preceded by a period when the patient could have been identified by tuberculin testing, and his early lesion recognized roentgenologically, then tuberculin testing among these adolescents becomes highly important. The adolescent who at 17 makes up part of the tuberculosis death toll, is an adolescent who two or two and a half years earlier was in the age group which would not have been included in a mass x-ray program. The adolescent group would not ordinarily comprise a rich source of case finding by x-ray, but the fact that they are a known group of high risk, and comprise the same population group who, within a matter of months, will begin to make up tuberculosis morbidity and mortality, points to the need for childhood and adolescent tuberculin testing with x-rays of those reactors twelve and over—and always a diligent search for source of infection.

Primary infections are the starting point of all tuberculous lesions. Just as pus was once thought "laudable," so primary tuberculosis was until recently regarded as harmless or even beneficial, on the basis of an assumed immunity production. Primary infections are now recognized as the potential hazards they really are. Close and continued observation of reactors is sound epidemiology.

Gedde-Dah128 has said "It is valuable to find a case by any method. For the person concerned, however, it is of highest importance to have his infection demonstrated at the earliest possible date, and this can be done only by repeated testing of tuberculin-negative individuals."

The appropriateness of control measures vary with the characteristics of the problem, which in turn varies with time, place and person. Thus the appropriateness and efficacy of control measures for a given disease vary from time to time, from place to place, and with the differences that occur in the population groups involved.

The effectiveness of a public health program, largely depends on the nicety with which these determining factors are considered, and with which the modalities of control programs are selected and flexibly adapted to meet the specific requirements of the specific problems.

Applying these principles to the epidemiologic control of tuberculosis, one sees that there is not just one control measure useful in all times, in all places or with all population groups. The choice of control tools requires judgment. There are situations where mass x-ray is an exceedingly rewarding modality, for example as a screening mechanism in large cities. Then, there are other situations where the rate of infection is lower, where tuberculin testing with observation of reactors, and search for source cases, are so effective that they not only bring about "control" but approach true "eradication" not unlike the epidemiologic triumph in the eradication of tuberculosis in cattle.

There is usefulness to the longitudinal approach which tuberculin testing makes possible, and there is usefulness in the cross-sectional approach of mass x-ray examinations.
The recent mass x-ray surveys in cities of over 100,000 have demonstrated the efficacy of such surveys as a case finding technique, and as stimulators of community interest and action.

Examples of the impressive results attained with tuberculosis control programs built on the basis of tuberculin testing in this country are best exemplified by the eradication programs in Minnesota, where the tuberculosis mortality rate was 107 per 100,000 in 1916, but 6.8 in 1952—one of the lowest in the world.1 In Grand Rapids, Michigan, the tuberculin test has been used extensively for more than 20 years. At first it was used only for children, but later for persons of all ages. In time Grand Rapids achieved the lowest tuberculosis of any city of its size in the United States.

In Norway, Dr. Tobias Gedde-Dahl29 conducted a program of “tuberculosis matriculation,” i.e., the continuous tuberculin testing of the whole population of a west coast region which was divided at the start into a positive and a negative group, with the negative persons being retested at recurrent intervals. In this region where there was a low rate of infection, tuberculin was found more effective than mass x-ray of chests in locating new cases, and so x-ray was reserved for the reactors. It was concluded that the less frequent the occurrence of tuberculosis, the more selective the control method must be, and that the experience demonstrated tuberculosis to be “... an infectious disease which has great possibilities of being fought by purely epidemiological means, which permit early detection and treatment of primary infections and their infectious sources.”

An increasing number of workers are recognizing that it is not a matter of either/or in regard to these control modalities, but is rather a matter of when, how, where, and with whom can the methods be most useful, and under what circumstances can they be judiciously combined, as for instance in the Central Cooperative Clinic Study29 where “... as a short cut to the more elaborate longitudinal study, initial screening by mass x-ray survey provides a starting point from which a longitudinal study of a more restricted population may proceed.”

Just as has been seen in the epidemiology of typhoid, diphtheria and syphilis, in tuberculosis, as the infection rate lowers in a region, there is an increasing importance in the epidemiological approach as compared with other mass examination methods, and there is more interest in the epidemiological characteristics of the individual case.

SUMMARY

1. Tuberculosis remains a problem throughout the world, and is by no means conquered in the United States, although mortality and morbidity in this country have reached levels where refined epidemiologic methods become increasingly useful, and promise not only “control” but “eradication.”

2. The epidemiological approach demands the earliest possible recognition of the “case.” In tuberculosis, this is the individual who has his primary infection with the tubercle bacillus. The tuberculin test is the specific tool for this important case finding.
3. The majority of tuberculosis control activities in this country have been focused on the clinical-disease-phase of the long continuum or spectrum of tuberculosis. Widening the focus to include earlier pathology offers epidemiological promise.

4. An effective epidemiological approach to tuberculosis necessitates constant scrutiny of changes in population-characteristics, in order that the program may be best adapted to the prevailing population groups.

5. The majority of tuberculosis control activities in this country have been focused on the 15-45 age group, where deaths have been highest. Widening of the focus to include younger children and the aged, may close gaps in control—and in our knowledge of the nature of the disease.

RESUMEN

1. La tuberculosis sigue siendo un problema en todo el Mundo y de ninguna manera se ha dominado en los Estados Unidos, aunque la mortalidad y la morbilidad en este País han llegado a cifras en que los métodos epidemiológicos más refinados se hacen más útiles, y estos son prometedores no sólo de “control,” sino de “erradicación.”

2. El ataque del problema con miras epidemiológicas pide el descubrimiento más temprano posible del “caso.”

En tuberculosis, tal es el individuo con infección primaria del bacilo tuberculoso. El instrumento específico es la reacción tuberculínica para esta búsqueda de casos.

3. La mayoría de las actividades para dominar la tuberculosis en este País, se han encaminado hacia la fase clínica de la enfermedad del espectro o el largo padecimiento tuberculoso.

La ampliación del campo enfocado para incluir la patología más temprana, es una promesa en epidemiología.

4. Un ataque efectivo epidemiológicamente requiere un escrutinio permanente de los cambios en las características de la población a fin de que el plan se adapte mejor a los grupos en que es más prevaleciente.

5. La mayoría de las actividades para controlar la tuberculosis en este País, se han concentrado en los grupos de edad de 15 a 45 años, en los que las defunciones son más frecuentes. La inclusión de los grupos de niños más pequeños y de los hombres de mayor edad, corregiría las fallas en el control y en el conocimiento de la naturaleza de la enfermedad.

RESUME

1. La tuberculose reste un problème mondial. Elle n’a en aucun cas disparu aux États-Unis. Il faut noter toutefois que dans ce pays, la mortalité et la morbidité ont atteint des niveaux si bas qu’ils nécessitent des recherches épidémiologiques de plus en plus délicates. Ainsi on peut envisager non seulement l’arrêt du fléau mais encore son eradication.

2. L’épidémiologie exige le dépistage aussi précoce que possible de chaque cas. En matière de tuberculose, il s’agit de l’individu chez qui se manifeste une primo-infection par le bacille tuberculeux. Le test tuberculinique est un élément essentiel de cette première constatation.
3. La plus grande part de l'activité de dépistage de la tuberculose aux États-Unis a été basée sur la phase clinique de la maladie tuberculose proprement dite. En élargissant cette conception, et en faisant pénétrer dans le dépistage le premier stade de la maladie, on obtiendra des réalisations épidémiologiques pleines d'espoir.

4. Pour amener une connaissance épidémiologique efficace de la tuberculose, il est nécessaire d'étudier sans interruption les modifications qui peuvent survenir dans les caractères de la population. C'est ainsi que l'on pourra le mieux adapter le programme aux groupes démographiques essentiels.

5. C'est sur le groupe des individus âgés de 15 à 45 ans où l'index de mortalité est le plus élevé qu'a été dirigé aux États-Unis la plus large part de la lutte antituberculose. En étendant ces recherches aux enfants plus jeunes et aux gens âgés, on pourra obtenir un contrôle intégral de la tuberculose. Simultanément, nous perfectionnerons nos connaissance sur la nature de la maladie.

REFERENCES

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