

Conceptual Problems in Developing an Index of Health

Consideration of essential characteristics of an index using measures indicative of changing health status in the United States population, with review of previous studies of general health indexes. Problems in deciding what to measure are discussed and a method of measurement is proposed.

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IN THIS REPORT the problem of measuring levels of health is discussed with a view to identifying measures indicative of changing health status in the United States population. Traditionally, mortality rates have been used for this purpose but changing health problems and programs have impaired their utility as a measure of the need for and adequacy of health programs. If new indexes are to be devised the question of what to measure must be resolved.

Two essential characteristics of an index of health status are identified. It must: (1) be sensitive to the need for and adequacy of health activities; and (2) be composed of measurable components. Several concepts of a population's level of health are examined in view of these requirements. A measure of health in terms of mortality and morbidity seems appropriate. This requires an operational definition of morbidity. Examination of various methods of defining and measuring morbidity suggests that formulation of a concept of the total impact of illness might serve this purpose. The impact of illness is defined in terms of forms of disability which might be measured by cross-sectional surveys. Sources of data, problems of reliability and validity, and the use of such a measure in construction of an index are discussed.

This report is presented in the hope that discussion will delineate the problems involved and assist in their solution.

SYMBOLS

Data not available-----	---
Category not applicable-----	...
Quantity zero-----	-
Quantity more than 0 but less than 0.05----	0.0
Figure does not meet standards of reliability or precision-----	*

CONCEPTUAL PROBLEMS IN DEVELOPING AN INDEX OF HEALTH

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INTRODUCTION

A population is generally considered to have a level of health which rises or falls over time and can be compared to that of other populations. Health is positively valued in our society and improved health status is an accepted goal of communities and the nation. Public health programs invoke this notion to compete with each other and with other government activities for budget allocations. Both administrators and legislators attempt to allocate resources and evaluate health programs by considering their contribution to the overall health of the population. An index of health status is a specific measure of selected health characteristics which purports to be useful in such assessments. Since the notion of health levels is a difficult one to define precisely, and a realistic index must select and summarize measures which can be obtained, a single index cannot reflect the full range of meanings associated with the idea of health levels. It can only approximate the idea and attempt to reduce the assessment of health activities to a rational and empirical formula.

Indexes based on mortality, such as crude and age-adjusted death rates, infant mortality rates, and the expectation of life, have traditionally been used as measures of levels of health. Control of mortality has always been a paramount goal of health activities and variations in death rates are a direct measure of progress toward that goal. The assumption is often made that changing mortality reflects changes in other aspects of health as well. Recently, however, crude and age-ad-

justed death rates for the U.S. population have shown little change after a long period of decline over the years 1900-1954.¹ Moriyama has analyzed the mortality patterns involved in this change of trend. He concludes that mortality from chronic diseases and accidents is likely to sustain the death rate near its present level until major advances are made in the control of deaths from these causes. The same analysis shows that patterns of age-cause specific mortality are shifting but producing little net change.

Stability of the death rate would not imply no change in health status. It would merely emphasize a difficulty inherent in the use of mortality statistics as measures of health status. They tell little about the living, while the health of the living has become a very important aspect of health status. As mortality has declined the scope of public and private health services has increased and new objectives have been established. The economic and social consequences of illness now receive more attention than formerly in evaluating levels of health and the importance of health problems. The chronic diseases have become relatively more important. Their consequences include not only death but reduced productivity, prolonged disability, and the need for care.

These considerations suggested that a more sensitive and informative measure of levels of health might be obtained with an index based on health characteristics of the living as well as mortality. To proceed further it was necessary to specify the comparisons to be made with such an index. The availability and relative compa-

rability of mortality statistics make them a feasible basis for comparisons between nations, between areas within nations, and between successive years for the same population. As yet, the classification systems and procedures used to measure other health characteristics are much less uniform, and no one index based upon them is likely to be as versatile. Constructing a health index for the specific purpose of measuring trends in the health level of the U.S. population was chosen as the limited objective for examination here.

An index for this purpose should fulfill two requirements:

- (1) It should show changes over time in significant aspects of the health of the living as well as in mortality.
- (2) It should be subject to analysis into components which provide a useful description of health problems underlying index values.

Construction of such an index requires selection of the concepts to be measured, specification of operational definitions for these concepts, and determination of the measures to be used and a method of combining them into a single index. Death is a well-defined event and the major problems associated with mortality indexes are those encountered at the final stage—problems involving the accuracy and adequacy of data and methods of summarization. To measure other aspects of health the most difficult problem is to determine what can and should be measured. The meaning of health is not a matter of universal agreement. A discrepancy exists between many frequently quoted goals of health programs and the operational criteria and procedures now feasible in measuring health characteristics of large populations. This report does not propose a method of constructing an index, but attempts to delineate problems and formulate a measurable concept of health which might be taken as the basis of the index desired.

PREVIOUS STUDIES OF GENERAL HEALTH INDEXES

Reexamination of existing indexes of health has been influenced by other developments coinciding with the decline of mortality from infectious diseases. Among these are increased emphasis on

prevention within medicine, technical improvement in survey techniques for the measurement of population characteristics, and growing awareness of certain difficulties in the definition and measurement of chronic diseases. These have been recurrent issues in recent studies of health measurement.

Developments Influencing Health Measurement

Renewed awareness that social factors influence the occurrence of disease and illness and emerging interest in the use of medical knowledge to prevent disease and improve normal functioning have produced an orientation within English and American medicine often designated as social medicine. Associated with social medicine is the goal of promoting positive health—a goal reflected in the World Health Organization definition of health:²

Health is a state of complete physical, mental and social well being and not merely the absence of disease and illness.

Positive health has been defined in various ways but the concept generally implies existence of identifiable levels of health among those free of apparent morbidity.³⁻¹⁰ From this point of view morbidity and mortality statistics are inadequate in that they measure the negative complement of health rather than the degree to which optimum health is achieved in a population.^{3,7,9,11} The possibility of measuring health status in this sense has received attention in most recent studies of general health indexes.¹²⁻¹⁵

Interest in health measurement has also been stimulated by the rapid development of sample survey techniques and their application in health surveys.¹⁶ Sample surveys have been used to collect national statistics on the health of the living in several countries and the continuing National Health Survey now includes coordinated surveys involving different sources of health information on the United States population.¹⁷⁻²⁴ While such surveys can provide much information not otherwise obtainable they usually must be designed to provide data for many needs and purposes. The concepts and definitions used in measurement must often be modified to suit survey methods. If this source of information is to

be used for a health index, the qualities desired in the index must be reconciled with the limitations of multipurpose surveys.

A third factor of importance in recent studies of health measurement is the interest focused on chronic diseases and the difficulties encountered in measuring these conditions and quantifying the problem they present. They are often slow in onset, progress gradually, and may exist for months or years before death occurs. During this interval a chronic disease may be classified according to various manifestations and measured along many dimensions. One troublesome consequence of the time dimension is that neither incidence, prevalence, nor mortality adequately represent the problems associated with chronic conditions. Another is that many of those diseased may be functioning adequately, and reveal no signs of "sickness" or disability. The chronic diseases also raise a question of the relation of disease to health status. Some diseases, such as diabetes, can be medically controlled if not cured. Others, such as arthritis, are generally not fatal, and lowered general mortality serves to lengthen the lives of diseased individuals. This poses the dilemma of prevalence of disease increasing as a result of successful medical intervention.

For many chronic diseases diagnostic criteria are not uniform, but vary from study to study. Measuring these conditions in a population raises the problem of which criteria to use for identification of cases. Any criteria chosen may fail to suit the needs of some persons interested in the resulting data. Where interest centers on trends in incidence or prevalence, criteria upon which experts can agree when the time series is begun may become obsolete as knowledge of the disease and techniques of detection improve. A related measurement problem is that of identifying comparable cases of the various chronic conditions. If a measure of the chronic disease problem in terms of incidence or prevalence were desired, it would be reasonable to count cases of each disease at comparable levels of severity. But clinical measures of severity vary with the disease in question and no one is common to the many chronic conditions. With the emergence of chronic diseases as more prominent health problems these difficulties have aroused increasing concern among investigators.

Attempts to Define and Measure a Nation's Health

In the United Kingdom the Survey of Sickness was initiated during World War II as a means of maintaining surveillance over the health status of a population subjected to wartime conditions of scarcity and stress. The entire Survey was referred to as a "Health Index."^{22,23,25} Its continuing operation from 1943 to 1952 represents the first attempt to supplement mortality data by collection of annual morbidity data representative of a national population. The Survey demonstrated the feasibility of extending regular collection of health information beyond mortality. Its periodic reports were a series of statistical tables representing various aspects of morbidity. No method of summarizing the various types of information into one or a few figures which provided a comprehensive measure of health status emerged from this effort.

The relation of available health indicators to the concept of health received more systematic study as a result of efforts by a United Nations Committee of Experts to recommend statistical indicators of a nation's level of living. The Committee identified health—including demographic conditions—as one of 12 areas it was essential to measure in comparisons of level of living.¹² The World Health Organization subsequently appointed a study group to recommend suitable indicators of a nation's health. The scope of their study was limited by the need to recommend indicators based on information sources likely to be available for a number of nations. Only three generally accessible indicators—all measures of mortality—were considered sufficiently comprehensive to receive a cautious and limited endorsement for this purpose. These were: (1) expectation of life at birth and at one year of age; (2) the crude death rate; and (3) the proportional mortality ratio. The last measure, defined as deaths at age 50 and above as percent of all deaths at all ages, was proposed by Swaroop and Uemara, primarily for use where lack of adequate information precluded use of death rates or other measures in comparisons of health status.^{26,27} The study group recognized, however, that these were at best very limited measures and recommended studies directed toward the development of more

adequate indexes in countries where more abundant data could be obtained. Health surveys were considered a very promising means of obtaining data suitable for comprehensive health indicators where they are feasible.^{15,28}

Means of reducing the broad notion of health to a set of measurable criteria, such as might be incorporated into a sample survey, received considerable attention from two subcommittees appointed by the U.S. National Committee on Vital and Health Statistics.^{13,14} Both of these groups took as their starting point the general ideas of positive health or wellness and attempted to analyze them into component areas within which measurable indicators could be found or devised. Neither group was able to recommend specific operational criteria for the measurement of these concepts, and their deliberations and recommendations are primarily valuable for revealing the great diversity of meanings which can be concealed by these terms.

Two Proposals for a General Health Index

Recently several authors have taken a more pragmatic approach and proposed methods of combining mortality data with some specific indicator of the health of the living derived from survey measurements.

A method suggested by Sanders proceeds from recognition of the fact that improved health care may actually increase the prevalence of disease in a community.²⁹ Rather than measures of disease he recommends measures of "functional adequacy" as an indicator of the health status of the living. These would be obtained by determining whether the individual is capable of fulfilling the requirements of a social role appropriate to his age and sex. The number of days each year a living individual could fulfill his role might then be taken as the measure of his health status. Rates based on this information would be used together with mortality rates in the creation of a modified life table. In this table a cohort of births would be exposed to the probability of time lost through functional inadequacy as well as the probability of death at each age. The outcome of such a table is referred to by Sanders as a measure of "effective" life years and would constitute a

measure of the current health of the population which reflects both mortality and the effects of morbidity. This procedure successfully avoids the problem of interpreting measures of disease prevalence by measuring the effects of disease rather than the existence of disease. Since the proposed method has not as yet been presented in detail, it is not clear what the criteria of capacity to fulfill a social role would be at each age, nor how the required probabilities might be estimated. The author suggests the criteria might be physiological measurements of capacity, although this does not seem a necessary part of such an approach. The idea of combining mortality and morbidity information through some extension or modification of life table procedures, however, may be a promising direction in further efforts at development of a single index.

Another general index of health has been proposed by Chiang.³⁰ This index is a weighted average of age-specific components derived from the death rate and a measure of average duration of illness within each age group during a year. The index results from consideration of probabilistic models of the frequency of illness, the duration of illness, and the monthly distribution of mortality during a given year. The author presents a detailed description of the models derived, but how well they fit empirical data on illness is still uncertain. In the models illness is assumed to be a recognizable state of measurable duration but how it is to be measured is not specified. It is also assumed that the frequency and the duration of illness are independent random variables. Whether these assumptions can be made may depend upon the definition of illness used for measurement. The fit of the model needs to be tested against data from sources using different definitions of illness before this question can be settled.

These studies, taken together, clarify the problem somewhat. International comparisons of health must be limited to a few indexes, primarily mortality indexes, at present. A more comprehensive national index of health may be possible for the United States, but what it should measure is still not clear. Sanders' and Chiang's approaches suggest methods of using data similar to that collected by existing sources, but neither defines specifically the variables to be measured.

The following section will attempt to identify concepts which serve the purpose of a national health index and which can be measured with existing techniques.

THE SITUATION TO BE MEASURED

Purpose and Conditions of Measurement

Measurement of health implies some set of procedures for classification of individuals. The "health" of individuals is classified by very different procedures in different situations, however. Possibly the simplest procedure is to accept the individual's judgment of his own state of health as is frequently done in everyday life. A physician's judgment based on observations, clinical examining procedures, and evidence from laboratory tests is another procedure by which health might be classified. Although this might seem to be a very objective and unambiguous method very different classifications can be built upon physicians' evaluations. A physician in private practice may classify individuals as healthy if no signs or symptoms of disease are revealed by examination. The scope of his examination, however, may depend upon the patient's initial complaints, the conditions he expects to find in individuals of that age and sex, and the facilities available. An industrial physician may classify an applicant's health primarily with reference to his presumed ability to meet the demands of a particular job, and his classification might not be influenced by conditions irrelevant to job performance. In contrast, physicians examining military recruits may have very rigorous criteria of health and attempt to predict adjustment to many conditions not found in civilian life.

In other situations other criteria will be emphasized. Actuaries may use criteria selected solely for their value in predicting specific future occurrences such as death, an accident, or incapacity for work. In the evaluation of mental health or mental illness, both observations and classification criteria used may differ greatly from those used in clinical medicine. Judgments of mental health and illness are usually inferences based upon behavior in interviews, test situations, and everyday life. Another very different concept of health is implied when measures of poverty,

crime, and vice are taken as indications of the social health of a community. Reference to such classifications as health classifications generally rests upon an assumed analogy between communities and biological organisms and should not be confused with such measures as death and morbidity rates which are community averages derived from classifications of the health of individuals. Health classifications can be based on many other procedures, such as those used in health interview surveys, or observations of growth and development in children, or classification of sanitary practices in the individual's environment.

It is apparent that an individual classified as healthy by one set of criteria may be labeled unhealthy by another. This occurs frequently when classifications of mental health and physical health are compared. It proves more disconcerting when two systems of classifying physical health produce inconsistent results. It may even be newsworthy if a star athlete is rejected for military service because of a "minor" physical defect. Such inconsistencies appear because an individual's classification is meaningful only within an implicit or explicit frame of reference. The frame of reference of a health classification includes the purpose, some rules for selecting and classifying observations, and the assumption that certain observations can be made. Systems of health classification differ in these respects and the meaning of health varies with these differences. Health is often spoken of as if it were a directly observable characteristic existing within the individual, but measurement of health, in fact, requires selection from many potentially measurable characteristics of a person or a population. How the measure is to be used is one consideration in the selection of these indicators. Another, equally important, is the complex of circumstances surrounding the measurement process. These set limits on what it is possible to observe and measure.

Variables selected as the basis of an index must be ones that can be measured satisfactorily in a large population. The goals of the index imply that the component measures of an index be representative of conditions in the entire population. Some rich sources of health information such as hospital and insurance company records relate

only to selected segments of the population. Sample survey methods can provide representative data but their use requires acceptance of their technical and practical limitations. Many procedures useful in evaluating the health of individuals or small groups are not well suited to survey conditions. Medical diagnostic techniques, for example, have been developed primarily for use in clinical situations on patients strongly motivated to cooperate. Sick individuals are willing to endure painful, embarrassing, or burdensome examinations for the sake of recovery. Many would not be acceptable to volunteer members of a survey sample where they would be applied to sick and well alike. Similarly, evaluation of health in individuals or small groups is often carried out in relatively favorable circumstances. If school children, military personnel, industrial employees, or similar groups are being studied, members may be relatively accessible for repeated observations over time. In a population geographic mobility, the need for a sample of adequate size, and the need for sustained cooperation combine to make measurements based on repeated observations a much more complex and expensive operation. If sample surveys are to be used it would be desirable, if possible, to base an index on variables which can be measured from a cross-sectional survey.

In evaluating variables which might be used to construct an index of health, these two criteria of relevance and accessibility of the necessary data were primary considerations.

Conceptions of Health Levels

One conception of the level of health of a population equates the notion to a measure of environmental circumstances conducive to health. Thus, a high ratio of physicians and nurses to population, a large proportion immunized against infectious disease, and provision of facilities for detecting and referring cases of chronic disease to physicians would denote a high level of health. Conversely high levels of air pollution and water pollution, inadequate sewage facilities, or unsanitary conditions for marketing of food might be taken as indications of a low level of health. An index of health levels might be constructed by setting standards in a number of these areas,

measuring the degree to which such standards are met, and combining the measures into a single figure. But the resulting measure would be largely a measure of the amount of activity and money expended to improve health rather than a measure of the outcome of these activities. Since it would be based upon application of existing knowledge and techniques it would fail to show where new knowledge is needed or new techniques are called for. It would provide no measure of the importance of the various components relative to general goals and to each other. In fact, judgments of the prospective health effects and importance of a larger number of environmental factors would be necessary in deciding whether they should be used as components in the index. Population health levels defined and measured in this sense are useful in evaluating the effort and efficiency of health agencies relative to accepted standards. In order to evaluate the effectiveness of such effort, however, more knowledge of what is happening to individuals in the population is needed.

An alternative view of health levels that has received much attention is the idea of measurable levels of positive health. The model of health as a continuum extending from death to some optimum state of well-being was apparently first used by Reed.⁸ He carefully identified it as a heuristic device which greatly oversimplified a situation characterized by many possible axes of measurement. This qualification has not always received enough emphasis. Some definitions imply that health is an underlying characteristic of individuals with some "true" measure independent of the purpose of measurement. In fact a healthy-unhealthy dimension can be recognized in many characteristics studied by the biological, psychological, and social sciences. It conveniently designates regions of measurement considered favorable and unfavorable, but the terminology can be applied to concepts and variables which are theoretically and operationally distinct. The interrelationships of these variables are likely to be complex ones, where they exist, and must be empirically demonstrated. There is little empirical justification for the assumption that a unidimensional continuum underlies and relates the measures referred to as healthy and unhealthy in different contexts. Health, defined

without reference to a specific situation or purpose of measurement, may be merely a verbal artifact.

Failure to designate the concrete frames of reference within which health is to be measured may account for the variety of meanings assigned to positive health and the difficulties encountered in efforts to arrive at an operational definition. In the World Health Organization definition of health quoted above, for example, levels of positive health embrace the broad areas of physical, mental, and social well-being.² Gordon, on the other hand, suggests that positive health levels correspond to the much more restricted notion of levels of resistance to disease.³¹ Attempts to reduce these general notions to some practical combination of operationally defined measures of a population have generally led to one of two results. Some conclude that only indirect measures of "the absence of health," such as measures of morbidity and mortality, are available and positive health is immeasurable at present.^{5,11,32,33} Others have suggested research directed toward development of a measurable definition.^{7-9, 31,34} Neither group of studies has provided a definition that seems useful for the present purpose.

Possibly the situation can be clarified somewhat by considering specific measurement contexts. The notion of positive health levels seems a potentially fruitful means of studying variations within groups characterized by low mortality and infrequent serious morbidity. Freedom from disease and illness are minimal conditions of positive health common to many definitions and these conditions can sometimes be approximated in selected groups such as normal children, young workers, and military recruits. Medical facilities and personnel designated to serve such groups may have the capacity to do more than treat the cases of serious illness that arise. They can realistically set themselves more ambitious goals such as reducing susceptibility to disease or increasing the functional efficiency of the individual. If such goals are set, measure of progress will be needed, but these need not be restricted by the requirement that they be capable of application to the population at large. For large populations as they exist today, however, disease, illness, and death are still ever-present problems. The occurrence of these events is a

more compelling guide for allocation of resources than variations in positive health. Moreover, knowledge of these negative aspects of health is more useful information in the delineation of current health problems. Negative measures still seem to be the most appropriate measures where the health problems of a population are under study.

A schema of levels of health that seems well suited to our purpose has been proposed by a Work Party of the American Public Health Association.³⁵ Although their purpose was to describe successive stages of development in public health programs, their analysis suggests a useful hierarchy of goals implicit in private health activities as well. They identified four stages of concern and activity which emerge in turn as public health programs develop in an area.

(1) *Mortality*.—The conservation of life is of paramount importance at this stage.

(2) *Serious morbidity*.—The goals at this stage are prevention, control, and treatment of conditions that disable, cripple, or produce chronic illness.

(3) *Minor morbidity*.—Concern is focused here on minor illnesses and conditions that cause inconvenience, economic loss, personal tension, annoyance, or impaired social relations.

(4) *Positive health*.—This stage involves programs intended to help all persons attain physical vigor, mental well-being, and constructive and wholesome relations with others in a safe and pleasant environment that promotes longevity and happiness.

In this schema the stages are overlapping ones and activities at a later stage are added as available resources increase, but do not replace the concerns of earlier stages. The rather vague definition of positive health implied here can safely be overlooked, because the committee realistically judged the United States in 1960 is ready to *begin* health activities at the third stage—that of minor morbidity. While the report emphasizes initial steps that can be taken to extend effective health work into the area of minor morbidity, it makes it clear that mortality and serious morbidity continue to be major areas of concern.

The order of these stages reflects a hierarchy of goals that is widely used in forming official policies, conducting medical practice, and

making everyday decisions in health matters. Death and morbidity are overriding considerations in that they seldom take second place to other aspects of health. This clearly involves a value judgment, but it is one widely held by persons interested in the evaluation of health programs. Variations in measures of death and illness might be a widely acceptable indication of progress in health activities and of health problems demanding attention.

An index reflecting both morbidity and mortality seemed worth pursuing but these components needed measurable definitions. Mortality measures are generally clearly related to death, a well-defined event with adequate operational referents for our purposes. Morbidity, however, is a diffuse and general term which requires clarification.

Measurement of Morbidity

Just as health is a general term embracing a number of methods of classifying and measuring individuals, morbidity can also refer to different procedures for identifying and classifying persons considered "sick" or "ill." Several attempts have been made to classify the various concepts of morbidity which result from different definitions and sources of information. Elinson lists six distinct types of morbidity measures and recognizes that others may exist.³⁶ In his evaluation of morbidity data based on interview surveys, Feldman distinguishes five different sources of information upon which a "diagnosis" may be based.³⁷ Most morbidity concepts seem to involve some combination of three types of evidence, which can be labeled for discussion as: (1) clinical evidence; (2) subjective evidence; and (3) behavioral evidence. For the present purpose it will be sufficient to consider some of the measurement problems posed by each class of evidence and the suitability of such evidence for an index of health status.

Clinical evidence consists of signs, symptoms, laboratory test results, and observations of tissue pathology which have been evaluated by a physician and organized according to diagnostic categories or syndromes. The extensive system of diagnostic categories developed in clinical

medicine has proven a valuable tool in prognosis, treatment, and the investigation of causes of illness. Its value has produced a tendency to think of illness as equivalent to existence of disease and has obscured the process of selective observation and abstraction which physicians carry out in arriving at a diagnosis. Clinical classifications select those characteristics of the patient useful in treatment of his illness and may necessarily omit other characteristics of importance to the individual himself or to society.

Conditions classified together on the basis of clinical evidence are not uniform in their effects upon individuals. Examination can and does reveal diseases and abnormalities unsuspected by the individual. Individuals can vary considerably in their subjective and behavioral responses to the same disease. On the other hand illness experienced by the individual or reflected in his behavior may not be subject to clinical classification for many reasons. In some cases medical care is not available and in others the individual may choose self-treatment. Where a physician is consulted the signs and symptoms may be too irregular or too transitory to permit a diagnosis with available facilities, or they may respond to a nonspecific treatment prior to diagnosis. How thoroughly episodes of illness experienced by individuals can be allocated to established categories is unknown.

Valid measures of illness based on clinical evidence require that at some stage in the measurement process there be an expert judgment based upon clinical observation, examination, and/or testing of the individual. This requirement is difficult to reconcile with the need for measures representative of the population. Most potential sources of valid clinical information—such as private practitioners, clinics, hospitals, and insurance systems—relate not to the population at large but to selected individuals and selected groups of clinical conditions. The decision to seek medical care may be influenced by income, attitudes toward health care, accessibility of facilities, perceived seriousness of the complaint, or other factors. The nature and extent of bias introduced into clinical data from a given source is generally uncertain. Moreover the bias associated with similar sources may depend upon location, auspices, or policies. No feasible

method exists for correcting biases in data from the wide variety of sources serving the U.S. population. Data from these sources are useful for the study of conditions as they are encountered in clinical practice, but cannot be safely taken as measures of conditions as they occur in the population.

Conditions reported by individuals will be clinically valid only if: (1) a valid diagnosis occurred; (2) it was reported to the individual; and (3) he repeated the information accurately at the stage of data collection. Obviously such data contains the same sources of bias inherent in medical care sources, and, in addition, the possibility of other biases in transmission of the information. Reliability and validity of clinical classifications based on interview reports may vary considerably with the nature and refinement of the diagnostic categories used.³⁸ Whether such data are adequate will depend upon the need for diagnostic accuracy. Here it is sufficient to note that reports of diagnoses are not operationally equivalent to clinically recorded diagnoses. As criteria of morbidity in the population they also select in favor of medically attended conditions.

Representative measures of some clinical observations and some clinically defined diagnostic categories have been obtained by combining clinical examination procedures and sample survey methods.³⁹ While this can be done successfully for some single conditions, it cannot readily be extended to obtain meaningful clinical measures of the existence of morbidity in general. A survey can accommodate only a limited number of examination procedures, and there is no apparent means of selecting a "representative sample of diseases" to be sought from the many diseases recognized in clinical medicine. Diseases vary greatly in the amount of time, observation, and technical equipment required for accurate diagnosis. Some would require painful or embarrassing examinations conducive to a high refusal rate among volunteer examinees. Others would strain both the time requirements of a survey and the patience of volunteers by requiring protracted observation. To obtain valid clinical data on the presence of morbidity, examination surveys must concentrate on one or a few conditions which have well-defined criteria susceptible to measurement under survey conditions.⁴⁰ Clinical medicine has

numerous diagnostic categories but no widely accepted general criteria of morbidity which could be readily measured by an examination survey.

Were there fewer problems in the measurement of disease, there would still exist the problem of ambiguity in the meaning of existing cases of disease mentioned earlier. Improved detection of disease and improved means of controlling mortality can both serve to increase the number of cases of disease found in a population. An index based on the existence of disease could penalize rather than favor these desirable activities.

These considerations suggest that a concept of morbidity based on other sources of evidence might be more readily measured and might provide a better indication of the adequacy of health programs. Health surveys have frequently measured illness in terms of the personal and social consequences of disease, rather than the existence of disease. Such concepts of illness are less familiar ones than the diagnostic categories of clinical medicine, and, of course, would not serve as well for the treatment of patients or for many epidemiologic investigations into causation. Nevertheless they measure dimensions of illness which are important to the individual and society and often are not indicated by a clinical diagnosis.

Subjective evidence of morbidity here refers to indicants such as an individual's report of symptoms or feelings of illness or his opinion of his health status. These subjective states also influence a person's behavior and may constitute part of the evidence a physician considers in making a diagnosis. In some health surveys, however, the report itself has been used as a sufficient indication of morbidity.^{17,19,21,23,41} Where this is done the resulting measure of morbidity is very difficult to interpret.

How individuals verbalize their health status may be an important determinant of when they seek health care, and, therefore, a variable deserving study in its own right. It is not clear, however, what factors influence the expression of verbal complaints. Two studies of older persons indicate that self-evaluations often differ from physicians' evaluations, but the studies disagree on the extent of the difference.^{42,43} These studies and others indicate that verbal state-

ments about health reflect a complex of attitudes, situational determinants, and background factors such as education and social status.^{44,45} The major determinants of verbal descriptions of health status have yet to be identified and—more important—may be completely irrelevant to any objective criteria of health status or the need for health care.

Use of subjective evidence of morbidity would require a complex and uncertain process of inference wherever measures of morbidity varied between groups or over time. The implications for utilization of health resources would be doubtful, at best, until the relations of verbal responses to more objective indicators are more firmly established.

Behavioral evidence of morbidity includes such indications as absenteeism, restriction of specified activities, medical expenditures, seeking medical care, or institutional confinement. It is often not possible to observe these behavioral indications as they occur. The data obtained, therefore, are generally based on interviews or on records maintained by the individual or by an outside source. Definitions of morbidity based on behavioral evidence have generally been used, and some have been devised for the specific purpose of avoiding the difficulties of clinical and subjective definitions. They are better suited to survey measurement techniques than clinical concepts, yet try to reduce the ambiguity of purely subjective reports of health status by using public observable events as referents, even where the individual is the only source of information available.

The information contained in many record systems implies a behavioral concept of morbidity. Numerous organizations maintain records of sickness absenteeism, utilization of medical care, expenditures covered by insurance, disability compensation claims, or other items indicative of morbidity. These records contain observations of behavior serving some organizational purpose and may or may not include clinical information. They can be exploited in many ways for health studies. They fail, however, as a source of representative data on morbidity in the population. The records frequently relate to episodes rather than persons and may show only that portion of an illness important

in administration. Coverage is determined by administrative or financial policy decisions. No one record system covers more than a segment of the population and overlapping coverage is common. Variation in terms and definitions and incomplete and overlapping coverage makes combination of data from various sources an impractical means of obtaining representative national estimates.

Behavioral measures of morbidity can also be based upon interview reports obtained from representative samples of the population by health surveys. Here morbidity is inferred from behavioral evidence but the source of information is the individual's report rather than a recorded observation. Information on many behavioral indicators can be collected by interviews but some indicators are better suited to a general concept of morbidity than others.

Reports of medical care or medical expenses are one basis for inferring the existence of morbidity. As with clinical data based upon medical care sources, however, there are many selective factors at work. A concept based on care or costs would exclude all untreated episodes and would include some minor episodes where the decision to seek care was primarily a result of convenience, legal protection, or personnel policy.

Loss of time from school or work is also an indicator of morbidity which can be reported in interview surveys. These criteria apply only to a part of the population, however, and cannot be used for preschool children, housewives, or retired persons, nor can they be applied to holidays and vacations. To overcome this difficulty, general concepts of disability have been devised which identify morbidity in terms of conditions reported as interfering with the usual activity of the individual or with activities commonly expected of persons within broad population groups. These provide criteria of morbidity applicable to varied individual situations.

Use of disability reported in interviews as an indicator of morbidity results in a measure of the consequences of disease and injury. Disability criteria can be stated so that medical care is not a necessary condition and the bias of selection associated with measurements based on medically attended cases is avoided. They seek

to avoid the ambiguity of purely subjective reports of illness by providing the respondent with an objective frame of reference for describing his experiences. While a period of restricted activity is a more objective event than a report of "feeling ill" it also has a subjective aspect which must be recognized. The decision to reduce his usual activities reflects the individual's attitude toward illness and self-care, the expectations or demands of his family, his employer and his associates, his knowledge or beliefs about the symptoms present, and other social and cultural factors. Where interview reports accurately describe behavior they measure a complex phenomenon involving the individual's subjective assessment of his situation as well as physical incapacity. This complexity is a characteristic of the phenomena being measured, however, and not an artifact of the method of measurement. Disability occurs in a social setting and, like other social phenomena, cannot be measured in isolation from the setting. It has social consequences regardless of the non-medical factors which may influence its occurrence. A condition which disables a salaried worker may not disable a person paid on a daily basis—this makes the disability no less real for the salaried worker and his employer. Disability measures reflect the impact of morbid conditions as they influence the social participation of members of the population. In this respect they measure an aspect of morbidity important in any evaluation of the health status of a population.

Several concepts of morbidity based upon different forms of disability reported in interviews are now being measured in samples representative of the U.S. civilian, noninstitutional population by the Health Interview Survey.³⁸ Since that Survey provides a stable source of annual estimates applicable to a large segment of the U.S. population, the operational definitions used are pertinent to the problem of defining morbidity for use in a national index of health status. This was considered a promising source of data for a national index if an adequate concept of morbidity could be defined in operational terms suited to interview survey measurement.

In our culture very general roles can be assigned to broad population subgroups defined in terms of age, sex, and other characteristics. One concept of disability used in the Health Inter-

view Survey defines such roles for four categories of individuals: preschool children, school-age children, housewives, and workers (including all others).³⁸ Each role is defined in terms of a designated "major activity" for the group involved. These are play, school attendance, housework, and work or business, respectively. This schema is now used to determine long-term disability status only for persons reporting specified chronic diseases or impairments. Individuals are classified by the survey respondent into one of four categories ranging from "unable to carry on major activity for their group" to "not limited in activities." It should be noted that the response is in terms of the individual's ability to occupy the designated role, and not whether it is, in fact, occupied at the moment. Broad social roles are used here as a frame of reference for classifying an individual's usual health status relative to social expectations.

The Health Interview Survey uses two other methods of measuring disability which may be useful in forming a unitary concept of disabling morbidity.³⁸ Chronic mobility limitation is also classified for those reporting chronic conditions. This is measured by having the respondent classify the individual into one of four categories descriptive of his usual degree of mobility. The categories range from "Confined to the house" to "Not limited in mobility." This classification does not depend upon the major activity of the individual's group. The mobility limitation item is not used in each year of the Survey.

The third general concept of morbidity used is that of a day of restricted activity, which is applied to all individuals covered by the Survey regardless of activity or mobility limitation. Respondents are asked to report any day during a 2-week-recall period when the individual cut down on his usual activities for the whole day. This item is used in each year of the Survey and is a basic survey criterion of short-term morbidity. Usually these three classifications are not interrelated in survey reports since the first two are meant to apply to persons with chronic conditions while the third is intended for measuring current variation in health status.

Each of these survey items classifies individuals from a different viewpoint and measures a part of the total impact of illness upon the popu-

lation. For an index of health status it would be desirable, if possible, to obtain a unified concept of morbidity in terms of disability. A schema of the total impact of illness will be outlined. It is an attempt to integrate these methods of measuring disability and relate them coherently to each other. The concept is a measurable one, although measurement will require some additional sources of data and some modification of current Health Interview Survey procedure.

A General Concept of Morbidity in

Terms of Disability

Consider a single day. Those disabled for that day might be classified into the following mutually exclusive categories:

- (1) Persons confined to resident institutions because of ill health. This category should include only those unable to leave the institution for health reasons, and exclude residents free to come and go, prisoners confined for punishment, well children living in institutions, and similar individuals not disabled. Persons excluded should be classified according to the following categories.
- (2) Persons—not classified in (1)—with serious continuing limitation of mobility. This might be defined to include all persons whose mobility limitations are classified by the respondent as "Confined to the house," and "Cannot get around alone." Its measurement would require that the limitation of mobility classification be used for all persons not classified in (1) above. (See reference 38, page 47.)
- (3) Persons—not classified in (1) or (2)—with serious continuing activity limitation. This category might be defined in terms of the two activity limitation categories, "Persons unable to carry on the major activity for their group" and "Persons limited in the amount or kind of major activity performed." Measurement would require classification of degree of limitation of activity for all persons not classified in (1) or (2) above. (See reference 38, pages 46, 47.)

- (4) Persons—not classified in (1), (2), or (3) above—who are reported as restricting their usual activities for the day in question. This would correspond to the "day of restricted activity" concept used in the Health Interview Survey, but should be applied only to persons whose usual activities or mobility are not already seriously restricted by continuing conditions. It would include those hospitalized, bed-disabled, or absent from work or school because of transient conditions, as well as those who cut down on recreational or other activities on the given day. When desired this category could be further subdivided according to these varieties of disability. (See reference 38, pages 45, 46.)

The particular definitions above could be made broader or narrower by changing the degree of disability used as a criterion in categories (2), (3), and (4), so long as the categories remain mutually exclusive. Since they are mutually exclusive and the reference period is a single day, the number of persons in each category is additive and a measure of all persons disabled on that day is theoretically possible. This would be a single measure of the impact of morbidity among the living for that day, and the concept described might be taken as the unified concept of morbidity desired.

In practice, a measure for a longer period such as a year would be desirable and the concept would be measured in a different manner. Units of time rather than persons would seem to be the most satisfactory units of count. Annual numbers or rates for persons or episodes would be of doubtful meaning or utility unless the variable duration of episodes is taken into account. All episodes of disability during a year, however, can be measured in terms of days and, since the categories are mutually exclusive, the estimated number of days in each disability category can be summed to obtain an estimate of total number of days of disability during the year. For categories (1), (2), and (3), this might be obtained simply by estimating the annual average prevalence of persons so disabled and multiplying that estimate by 365. For category (4), which includes transient disability, current survey

methods of estimating annual days of restricted activity could be used, but persons in categories (2) and (3) should first be excluded from the data to avoid duplication in counting. Summing disability days in these four categories automatically weights each episode according to its duration and provides a measure of the burden of disability during the year. This might be expressed as an average number of days per person per year or by some other index.

Use of time units to measure morbidity may also facilitate the combination of morbidity and mortality measures into a single index. Although death and disability are not completely commensurable events, some life table values are also expressed in units of time.

Potential Sources of Data

The concept of morbidity outlined above is closely related to measures obtained by the Health Interview Survey. Its measurement, however, would require some additional sources of data and some modifications in current Survey techniques and concepts.

The Health Interview Survey covers the civilian, noninstitutional population rather than the entire population.³⁸ If this source of information is used to obtain data on disability for an index, coverage of institutional residents and the military population needs attention. The institutional population, in particular, is a group for which supplementary sources of periodic information are essential. Since many institutions exist for the care of the disabled, estimates omitting this population would underestimate the total amount of disability in any given year. Furthermore, patterns of utilization of institutional care may change and the bias introduced by omission would be a variable one distorting comparisons over time. As the definition of category (1) implies, estimates of the size of the population residing in various types of resident institutions would not be adequate. Residence in many institutions does not necessarily imply disability. Homes for the aged, for example, may provide nursing care for some residents but only room and board for others. Adequate coverage of morbidity among institutional residents is a problem that must be resolved for any index of health status based on direct measurement of individual characteristics.

In the Health Interview Survey chronic activity limitation is an annual item but data on chronic mobility limitation are collected only at intervals of several years. The respondent is asked to classify activity status only for persons reported as having a chronic disease or impairment. An index using the morbidity categories described above would require frequent, possibly annual, collection of data on these items. It would be desirable to classify individuals whether or not chronic conditions are reported. The latter change in procedure would produce greater conceptual consistency, since disability as it is defined here is not a clinical variable. Disability may be apparent where the underlying clinical conditions cannot be validly determined without clinical examination. This might be the case with many aged persons where feebleness is accepted as an inevitable concomitant of aging and neither a diagnosis nor medical care is sought. Classifying the long-term disability status of all persons covered by the Survey would not interfere with the classification of those reporting chronic conditions for other purposes.

The criteria of chronic activity limitation applied to the aged might also be reexamined. For other groups the major activity used as a reference point is a realistic one and describes behavior commonly expected of members of the group. There is no role or major activity designated for the aged as such. They are, presumably, classified according to the criteria used for "workers" or "housewives"—ability to perform work or housework, respectively. Retirement and some reduction of activity are generally accepted in our society as age increases. Parsons has pointed out the many problems involved in defining a role applicable to the varied life situations of older persons in the country.⁴⁶ Unlimited work or housework, however, are not generally expected. Retirement is often mandatory at some age for working men and women and performance of strenuous household chores is frequently discouraged among older homemakers. A working solution to the problem of defining long-term disability for this age group might be to consider institutional confinement and mobility limitation as the only criteria of disability at ages 65 and over. Thus those disabled might be those confined to institutions or to the house and those unable to move around outside without

assistance. This would assume that the aged who can move about freely in the community are generally able to care for themselves and carry on other activities expected in their particular life situations.

It will, no doubt, trouble many that morbidity measured in terms of interview reports of disability cannot always be allocated to refined clinical categories in the manner customary with deaths. Such allocation, however, is possible with deaths only by adopting the arbitrary convention of assigning each death to a single cause. While this is often necessary and useful for vital statistics tabulations it has been criticized as a misleading oversimplification of the situation in many cases.^{47,48} The idea of a single cause may be even less suitable for morbidity than mortality. It would be convenient to be able to analyze a measure of morbidity according to the contributions of specific diseases, but for the purpose of an index, this seems less essential than obtaining a single unitary measure of morbidity. A measure of disability, as it is defined here, could be analyzed to show the relative contribution of each category of disability and its distribution according to age, race, sex, geographic, and other characteristics. In this manner, changes in index values could be traced to changes in specific forms of disability in well-defined population subgroups. The clinical information obtained from interview survey reports would not always be adequate to identify the specific diseases involved, but the effects of broad diagnostic categories such as injuries and respiratory infections might be recognizable. Moreover, knowledge of the distribution of disability among demographically defined subgroups is itself useful in delineating the nature and extent of health problems. It would indicate segments of the population where health programs could produce the greatest effect. It would also point out areas where more needs to be known, and the kind of information needed for a more precise description and analysis of the problem presented.

Reliability and Validity

A measure of morbidity based upon disability criteria is primarily a social rather than a medical or biological measurement. The value

of such an index depends upon the reliability and validity of the component disability measures under discussion. Both characteristics are matters for empirical investigation, but some general considerations in evaluation will be mentioned here.

Reliable measurement requires elimination or control of extraneous factors influencing the measurement. Since a primary purpose of a health index is comparison over time, evaluation of reliability should take into consideration both factors influencing measurement under current circumstances and the possibility of measurements over time being distorted by irrelevant social changes. Methodological studies have shown that many aspects of survey procedure influence the measures obtained. Among these are length of recall period; relation of respondent to the individual for whom he is reporting; emphasis upon specific survey items; duration and inconvenience attendant upon episodes of ill health; and differences between interviewers. In the Health Interview Survey control for some of these factors is built into the design of the Survey and control for others is achieved through various field procedures.^{49,50} Whether interviews or other sources of data are used for an index, the measures obtained will be dependent upon many procedural details. A stable system of data collection is necessary to provide both continuity of procedure and opportunity for evaluative studies.

Both long-term and short-term disability, as defined above, reflect individual decisions which take into account such factors as need for income, availability of sick leave, pensions and other support during illness, and the amount of physical effort involved in the individual's occupation and other activities. Over long periods of time, changes in prevailing personnel policies, in legal regulations, or in the distribution of occupations and income could produce artifactual changes in the measures obtained. The only means of dealing with such eventualities are continuous examination of the data for evidence of such effects and modification or replacement of the index if it no longer serves its purpose.

The validity of disability measures based on interview reports is difficult to evaluate because there is often no criterion for comparison. If a

housewife reports the omission of several chores she planned to carry out, there is no way to test the accuracy of her statement. If a worker reports that an upset stomach caused a day of work loss 2 weeks ago, there may be no way of knowing whether he was malingering. If interviews are used as a source of clinical data, the problem of accuracy arises and can be resolved by comparison of interview data and data derived from clinical examination—a preferred source. Clinical data are not an appropriate criterion here, however, since the individual is asked not to diagnose his ailment but to state how it affected his behavior. In many of the instances reported he will be the only person in a position to know the answer and no better source of information is available for a test of validity by comparison of sources.

Since the validity of disability measures cannot be tested by direct comparison with a criterion "preferred" source of information, it must be established by showing that the variable measured has a necessary position in a theoretical scheme from which empirically verifiable predictions can be made. Such a relation has been labeled "construct validity."⁵¹ This can seldom be established from a single study or source of data but must rely on the weight of evidence from diverse methods and sources.

The validity of disability data based on interview reports will be open to question until extensive use of such measures in a variety of studies has established their relation to clinical measures on the one hand and social variables on the other. Feldman in evaluating disability measures points out the need for more methodological studies and voices a suspicion that data of this type are ". . . labile reflections of unstable situational forces." (See reference 37, page 553.) Mechanic, however, sees the interaction of social and biological factors in the causation of disability as a process which can be fruitfully investigated and ultimately understood by means of appropriate social research techniques.⁵² To resolve such conflicting evaluations more information is needed on how reported disability varies as clinically determined disease arises and progresses in individuals. If patterns of disability reported in interviews are coherently related to the onset, the progress, and the state of control of disease in individuals, they can be

used as measures of the impact of morbidity in a population with greater assurance. Information is also needed on the personal and social factors which influence an individual's decision to restrict his activity temporarily or permanently. Study of the interaction of these factors in relation to interview reports of disability carried out in small groups could provide information useful in validating and interpreting disability measures on large populations.

CONCLUSION

The problem of finding a more satisfactory index of changing levels of health for the United States population arises from recent changes in mortality trends and a gradual shift in the emphasis of health programs toward concern with nonfatal illness. These developments have impaired the value of mortality measures as indicators of the need for and adequacy of health activities and stimulated interest in finding a measure which reflects not only the level of mortality but also conditions among the living.

The notion of health levels is a very general one and difficult to define precisely. Nevertheless, it is widely used in deciding practical questions concerning the scope and direction of both private and governmental programs. Its use implies some method of measurement. To accomplish this, however, the level of health of a population must be defined and the definition must be a measurable one. The considerations discussed in this report suggested that a definition of health levels in terms of mortality and morbidity would be realistic and useful in view of today's health problems. Morbidity, however, is also a general term which has been given a variety of meanings. A concept of morbidity defined in terms of the disabling consequences of disease and injury seemed both measurable and pertinent to the proposed use of a health index. Such a concept has been outlined.

Disability, as it has been defined here, measures the effects of disease and illness as they manifest themselves in disruption of social activities. There is general agreement in our society that disability is per se undesirable. Reduction of disability ranks with prolongation of life as an ultimate goal of medical research and practice and a justification for organizations engaged in

these activities. Since disability has this position in our value system measures of disability can be interpreted as indications of the need for and the adequacy of such organized efforts. While this aspect of disability makes it theoretically suitable, it also seems to meet the need for a measurable concept of morbidity. Periods of disability can be identified and reported by the individual concerned when suitable interview items have been devised. Moreover, socially meaningful subclassifications of disability—such as institutional confinement and home confinement—can be measured in relation to other characteristics of the individuals affected. Such possibilities of analysis are important if a measure of morbidity is to provide a guide to the nature and extent of health problems. These advantages, of course, depend upon the presumed validity of disability data derived from interview reports and more empirical evidence supporting this presumption is needed.

If the level of health of the United States population is to be measured by an index more sensitive and more comprehensive than mortality indexes, a measurable concept of morbidity seems essential. The approach outlined here defines "morbidity" in terms of the total impact of illness upon the population and leads to measures of the volume of disability during a year. These measures can, if desired, be combined with measures of mortality to obtain a single index reflecting both mortality and morbidity. An index of this type might use the formula proposed by Chiang or other methods reflecting different assumptions and models.³⁰ Before any index can be constructed and evaluated, however, there must be a clear definition of what is to be measured. This report has reviewed conceptual problems encountered in deciding what to measure and proposed one method of measurement that seems both suitable and feasible.

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