A GENERAL INDEX OF HEALTH: SOME PROBLEMS AND DESIRABLE CHARACTERISTICS

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The need for quantitative indices of health status has been recognized by health workers for almost half a century. As early as the 1930's, the Health Organization of the League of Nations charged two scientists to develop expressions of health in numerical terms. The results of the scientists' efforts were three indices: vitality and health, environment, and public health activity (Stouman et. al, 1939). Since that time a variety of health status indices applicable to individuals and populations have come into being. Paradoxically, however, the burgeoning proliferation of health status indices of various descriptions and orientations in the literature has not made the task easier for health planners who must use these indices to evaluate the effectiveness of current and proposed health programs. In point of fact, the search for a usable general index of health applicable in various health planning settings is becoming ever more frenzied, as witness the spate of mail requesting information each time the Clearing House on Health Status Indexes, a quarterly publication of the National Center for Health Statistics, U.S. Public Health Service, prints a new item in its bibliography.

Nothing in the preceding paragraph should be construed to mean that there are no useful of usable health status indices on the market. Several indices, including the Activities of Daily Living or ADL (Katz et. al, 1963) and the G-index (Chen, 1973) have been applied successfully in health program evaluation, but these are special-purpose indices that do not have general applicability. There are, however, no known general-purpose health indices that have been tested and are ready for application. The stochastic models of population health status developed by Chiang (1965) and by Chiang and Cohen (1973) are mathematically elegant and logically sound and straight forward, but they have not been tested with real data nor are they testable until the problem of determining the values of various functional or dysfunctional states of health is resolved. The values are the weights for the discrete segments of a health status continuum from death to optimum health called for in the models.

The Definitional Problem

One of the basic problems of designing a general health status index applicable to individuals or populations is the problem of defining health to the satisfaction of the scientific community, and if possible, the lay public. Scientifically, health must be defined in concrete terms that are both quantifiable and consistent with the available body of medical knowledge about human health. Further, the definition must be comprehensive and inclusive of all known aspects of health and their dynamics. Such a definition would not be in the spirit of the usual "operational definition" that arbitrarily limits the scope of the definition only to parameters or aspects that are concrete and measurable. "Operational definitions," while necessary for research and scientific progress, usually reflect the orientations of the researchers who use them, and as such may not be acceptable to the majority of the scientific community.

Many attempts at defining health have been made by various scientists and organizations in the past decades. Stocks (1955) believes that the assessment of the "healthiness" of a community in terms of a numerical index useful for cross-community comparisons "poses a problem of the greatest difficulty" because it is impossible to have a clear definition of the concept of positive health as expressed in the WHO definition, "Health is a state of complete physical, mental, and social well-being and not merely the absence of disease and illness." He suggests that designers of health indices use measures based on "either freedom from illness or ability to continue living," but he makes no attempt to define illness or ability to continue living.

Wylie (1970), deploring the fact that it is circular reasoning to attempt to define health in terms of the absence of disease without trying also to define disease, offers his own definition of health as "the perfect continuing adjustment of an organism to its environment." However, he neither defines adjustment not suggests any way of measuring it.

Klarman (1965), aware of the vagueness of the WHO definition, believes that it is hopeless to attempt to have a standard definition that is universally accepted. An economist, he offers a pragmatic solution to the problem by suggesting that the definition of health be left to the health care industry and health care administrators in terms of the costs of services, personnel and facilities. This suggestion, of course, is no help to authors of health status indices because costs of health services, personnel and facilities are not legitimate proxy measures of health status.

The theory of homeostasis, both biological and social, is apparently the basis of Sigerist's (1941) definition of health as "something positive, a joyful attitude toward life, and a cheerful acceptance of the responsibilities that life puts on the individual. The imprint of this theory is even more pronounced in his later attempt to define health as "undisturbed rhythm and harmony with nature, culture and habit," (Sigerist, 1960). The vagueness of the terms used, such as "undisturbed rhythm" and "harmony,"

makes his definitions of dubious value to workers in the area of health status indices.

The American Public Health Association (1961) differentiates four stages of health as the discrete steps of an ordinal scale that comprise mortality, serious morbidity, minor morbidity, and positive health. Until the terms "serious morbidity," "minor morbidity" and "positive health" are given concrete definitions, it is unlikely that this definition of health can ever be of anything more than theoretical interest to health researchers.

This sampling of the definitions of health makes it abundantly clear that health is an elusive concept that is difficult to pin down neatly in a concise definition. Practically all the definitions employ terms that themselves require definition. Some of the definitions are oriented toward certain aspects of health. For instance, Sigerist's definition (1941) pertains to mental and perhaps social health, but has nothing to do with physical health. A Pollyanna philosopher who is dying of cancer of the lung would be considered healthy by this definition. Other definitions, such as Stock's definition, are mere tautologies. Needless to say, without a satisfactory definition of health, there cannot be a satisfactory health status index.

Methodological Difficulties

The concept of health status as a continuum is intuitively appealing because individuals can be neatly represented as points moving along this continuum toward a more or less healthy state. This is the concept used, for instance, by Chiang and Cohen (1973) in deriving their health index. This concept, however, is not a definition of health; it provides no information about factors or forces that are responsible for movements of the points along the continuum in either direction at varying speeds. In other words, the concept is merely a unidimensional representation of a phenomenon called health that is not only multidimensional, but whose multi-dimensions are most probably not orthogonal.

In terms of indices applicable to individuals, the problem then becomes the location of an individual in hyperspace and representing this location by a scalar that is some function of the various dimensions. While the statistical methodologies in multi-variate analysis are currently available for performing this task, the dimensionality of health is unknown and even if it were valid and reliable measures of these dimensions would have to be developed first. Further, a dynamic model of individual health must also take into account the dynamics of health, genetics and environment, and knowledge about this dynamics is sketchy and fragmentary at this time and will probably remain so for years to come.

As for health indices applicable to popula-

tions, the problems affecting individual health indices are further compounded by the fact that somehow values must be assigned to the graduations along the health continuum, so that the summary scalar representing population health reflects not only the distribution of people in the graduated states, but also the degree of desirability of that particular distribution. Without the assigned values, which ideally should be derived through social concensus, the scalar would be meaningless as an index because it would lack the properties of an ordinal scale along the desirability dimension. Without the ordinal properties an index cannot be used to evaluate the health status of populations or individuals.

As a dynamic model, the population index must consider, not only the distribution of people in the graduated states at a given point in time, but also shifts in the distribution within a stated time span. Information about the shifts is derived from the transition probabilities involving Markov chain processes. A formidable problem in the estimation of transition probabilities is the appropriate classification of people into the graduated states. If the graduated states are too gross, then many people may be in the same state due to vastly different underlying causes. For instance, if one graduated state were categorized as "bedridden," it would include people who sprained their ankles, people who had active pulmonary tuberculosis, and people with bad colds. The transition probabilities of these three types of people would not be the same. Yet the transition probabilities estimated from this state would be based on all types of people. These transition probabilities would be different, perhaps drastically, if a different combination of types of people were in it. Thus no stable transition probabilities could be estimated. On the other hand, a too fine graduation would reduce the numbers of people in some of the states to the degree where no reliable estimates of transition probabilities would be feasible.

The Validation Problem

Although a variety of health status indices are available, very few of them have been validated to generate evidence that they truly measure health or at least some aspects of health. As is evident from the definitions of health previously cited, the concept of health is not a discrete entity that can be directly observed. What is observable is the totality of physiological, biological, and behavioral manifestations of the underlying health status. Both inductive and deductive logic is required to establish evidence of causality between health and its manifestations. Thus establishing the validity of health status indices, whether the indices apply to individuals or to populations, is a time-consuming process.

One of the main reasons authors of health

status indices generally fail to validate their products is that a well-conceived health status index usually encompasses most of the salient aspects of health, and once these aspects are incorporated into the index, they cannot be used as criteria for validation because the relationship between the criteria and the index would be spurious. Another reason, already alluded to previously, is the lack of adequate knowledge about the interrelationships of various manifest health-related behaviors, including physiological behavior, as well as the relationships of the behaviors to the underlying health level.

This lack is particularly vexing to authors of health indices that include the mental health component. So-called aberrant behaviors in one culture are perfectly normal in another. Even within one culture the distinction between normal and deviant behavior is not all that clear and some distinctions disappear with the changes in social mores, as is the case with homosexuality in the United States. Thus a new dimension comes into the picture: cultural factors, along with the underlying health level, may influence the manifest health-related behaviors. This new dimension compounds the problems of attempts to validate health status indices.

Some Desirable Characteristics

The difficulties relative to the definition of health may appear--indeed, may actually be, insuperable. Nonetheless, general indices of health are needed by health services researchers and health planners. As a matter of fact, the National Health Planning Act (1975) specifically directs that Health Systems Agencies study the impact of health care delivery systems on the health of residents under their jurisdictions. Unless the law is satisfied with the individual health indicators such as mortality rate and/or hospitalization data, some kind of general index of health will have to be developed in spite of the difficulties discussed. What characteristics should such an index have to be useful?

At a minimum, the index must possess the properties of the ordinal scale. That is to say, the values of the index can be used to rank order communities or individuals in terms of their underlying health status, but not to determine the extent of differences among the communities or individuals. In other words, ordinal scale satisfies the following two postulates and no other: (1) if a > b, then b $\ngtr$ a, and (2) if a > b and b > c, then a > c.

As previously stated, the desirability of the states of health should reflect the values of a society comprising the individuals whose health is measured. While in general it is true that life is preferred to death (with the exception of suicide cases in which death is obviously preferred to life), it may be extremely difficult to attach preference values

to different health conditions that are acceptable to all members of society. For instance, in terms of physical health, it would not be easy to rank order the health status of two individuals, of whom one has frequent and severe colds and the other suffers an occasional, but paralyzing, arthritic pain, assuming that they are comparable in other aspects. Nonetheless, such preference values must be derived and incorporated into the index as weights for it to have ordinality.

Another basic requirement or characteristic is that the index values should reflect the underlying health status independently of the biological, physiological and behavioral manifestations of the normal aging process. Unless this requirement is met, the index may measure health status largely as a function of age: the older one gets, the less healthy one is. An index so formulated would preclude statements such as '"Some young people are sickly whereas some older folks are "hale and hearty."' Certainly there are people in their seventies or even eighties who enjoy the best of health possible among their age groups.

The practical implication of this requirement in terms of designing a general health status index is that norms must be used, since, in the words of Dubos, (1959) "health (and happiness) cannot be absolute and permanent values, however careful the social and medical planning." In fact, the World Health Organization (1957), after a lengthy discussion of the meanings and definitions of health, concluded that health would be best expressed as "a degree of conformity to accepted standards of given criteria in terms of basic conditions of age, sex, community and region, within normal limits of variation." Thus an index that fails to take into consideration these factors may indeed be a measure of demographic and geographic artifacts rather than true underlying health status of an individual or community.

Even a norm-oriented index of health may be difficult to interpret unless the range of index values, which usually are abstract or pure numbers, is known or pre-determined. Many health status indices could be cited that, because of their employment of arbitrary measurement scales, have arbitrary values that have no lower or upper bounds and that in themselves have no meaning although they can be used to rank order individuals or communities with respect to health status. Notable exceptions are the index of Chiang and Cohen (1973) and that of Chen (1976). These indices range in value in the closed range between zero and one, which enables the reader to know the relative health status of a community by its index value without reference to other communities.

If, however, the index is not a pure number and employs known units of measurement, a closed range of values is still desirable, but not crucial. For instance, Chen's G-index (1973) is

in unit of years unnecessarily lost by a population group through poor health and/or living conditions, and this is meaningful, although it would be more informative to know the numbers of years lost by other population groups.

Other desirable characteristics or attributes of a useful general index of health pertain to the feasibility of application, its validity and reliability, and its sensitivity to changes in the underlying health status. These will not be discussed here since they have been adequately treated elsewhere (Chen, 1975). Suffice it to say here that an index without such desirable attributes has rather limited utility either as a tool in health services research or for health planning purposes.

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