An Indicator to Aid Management in Assigning Program Priorities

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THE CHANGES that have occurred in the health field during the past few years almost defy enumeration. The number of persons employed has grown fantastically, and the proportion of our gross national product spent for health purposes has greatly increased. The technological improvements that have been made stagger the imagination.

New Focus of Strategic Decisions

These changes have brought better health to the nation, or at least, have placed greatly improved levels of health in the realm of current possibility. But another change is also occurring, one that we do not always recognize or consider in our deliberations and planning for the immediate future. This change involves the management of health services and is manifested in the gradual, but none the less significant, transfer of health-related administrative decisions from the individual physician to a more centralized focus of health care management. It would seem that this change is not necessarily the result of advances in medical technology and the state of the art, but rather is due to the increased involvement of the general community. Public awareness of the capabilities of medicine has been accelerated through mass communications. The public has also recognized, and is in fact insisting, that health services do not terminate with the resolution of acute need. More important still is the gradually evolving philosophy that good health may be a right and not a privilege, or at least that adequate health services should be assured for everyone.

The result is an increasing activity in the political arena and an ever-increasing proliferation of health-oriented organizations, both public and private. Voluntary agencies have flourished, government-supported programs have increased in size and scope, and in a number of instances national or State agencies have established standards for health care. In some States, a permit will be granted to construct a health facility or to operate a health program only after an operating plan is formulated which coordinates the health-related activities in the public and private sectors.

Consequently, the focus of strategic decisions is slowly moving to a more centralized position, away from the actual delivery site of the service and also further removed from the individual recipient of the service. Such a system can result in more effective and efficient health services. It can also, however, result in gross misallocation of health resources and in an insensitiv-

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ity to the priorities for service. Within this system, communications can very well mean the difference between success and failure. Clearly, the situation demands application of the management sciences and quantification of those variables required in scientific decision making. The need for objective assessment, which has been obvious for years, is becoming more critical as health care becomes more complex, both technologically and socially.

Need for Objective Information

Quantitative decision-making tools can play a most important role in helping health professionals and the general community arrive at better decisions regarding the effectiveness of health care services, the priorities of various programs, the allocation of available resources, and the design of delivery programs. During the past few years, the systems approach has been used on several occasions in designing treatment units and determining operational requirements for health facilities. The internal operations of hospitals have also received considerable attention from the operations researcher so that measures of efficiency can now be obtained for many of the operating characteristics of a hospital. In practically every instance, operational costs have declined or benefits have increased as a result of such attention. The out-of-hospital or nonhospital community programs, however, have not received commensurate attention from the operations researcher.

Little objective information is available to describe either the efficiency or the effectiveness of community health services. Some work on models has been done in communicable and chronic diseases based on epidemiologic information. But only recently has work been undertaken seeking to describe mathematically an optimum program for control of specific diseases. A major obstacle to the rational determination of community health priorities is the absence of a common denominator or reference scale to which all health problems can be related.

For years the health field has been searching for an index that would incorporate measures of output, input, and benefit in such a way that benefit-cost relationships would be easy to assess (*1, 2*). Such a measure would simplify the task of apportioning limited resources so that they are consistent with expected results. It would also facilitate ranking the needs of various programs in terms of overall objectives. In short, such an index would enable us to apply program planning and budgeting to the health field. It could help create an environment conducive to scientific decision making, helping to reduce the inefficiency of decision making in which emotionalism plays a major role.

The administrator of community health programs is faced with the problem of assigning priorities among his many programs. If possible, he would like to optimize the allocation of additional funds to support the objectives and priorities of the several programs. In this

Table 1. Traditional health data, by classes of disease

Classes of disease [1]	Inpatient days (1,000's)	Outpatient visits (1,000's)	Deaths
Infective and parasitic diseases	193	110	219
Neoplasms	53	5	371
Endocrine, nutritional, and metabolic diseases	39	48	147
Diseases of the blood and blood-forming organs	8	4	18
Mental disorders	29	21	51
Diseases of the nervous system and sense organs	85	91	337
Diseases of the circulatory system	49	32	830
Diseases of the respiratory system	147	237	436
Diseases of the digestive system	119	75	386
Diseases of the genito-urinary system	52	31	103
Complications of pregnancy, childbirth, and the puerperium	88	39	12
Diseases of the skin and subcutaneous tissue	36	54	9
Diseases of the musculoskeletal system and connective tissue	38	28	7
Congenital anomalies	19	2	89
Certain causes of perinatal morbidity and mortality	14		284
Symptoms and ill-defined conditions	17	26	309
Accidents, poisonings, and violence	128	84	1,104

[1] International Classification of Diseases, 8th revision. Adapted for use in the United States. PHS Publication No. 1693. U.S. Government Printing Office, Washington, D.C., 1968.

Table 2. Classes of disease ranked by traditional health data

Classes of disease [1]	Rank order of class by number of—		
	In-patients	Out-patients	Deaths
Infective and parasitic diseases	1	2	9
Neoplasms	12	14	5
Endocrine, nutritional, and metabolic diseases	9	7	10
Diseases of the blood and blood-forming organs	17	15	14
Mental disorders	13	13	13
Diseases of the nervous system and sense organs	6	3	6
Diseases of the circulatory system	8	9	2
Diseases of the respiratory system	2	1	3
Diseases of the digestive system	4	5	4
Diseases of the genito-urinary system	7	10	11
Complications of pregnancy, childbirth, and the puerperium	5	8	15
Diseases of the skin and subcutaneous tissue	11	6	16
Diseases of the musculosketal system and connective tissue	10	11	17
Congenital anomalies	14	16	12
Certain causes of perinatal morbidity and mortality	16	17	8
Symptoms and ill-defined conditions	15	12	7
Accidents, poisonings, and violence	3	4	1

[1] International Classification of Diseases, 8th revision. Adapted for use in the United States. PHS Publication No. 1693. U.S. Government Printing Office, Washington, D.C., 1968.

optimization, he must consider both the economy of a program's operation as well as the needs of the people served. The data to which he usually has access, however, are for the most part biased both statistically and subjectively. The few objective data are usually restricted to figures on the workload of the facility and mortality data such as exemplified by the National Vital Statistics program. The morbidity and disability data at his disposal are reliable only for large population groups and are as a rule useful only in a tangential fashion. At best, the administrator will know how many persons were hospitalized in a given period and for what diagnoses and the number of deaths that occurred and their causes; he may even know also how many outpatient visits took place and the reason for these visits.

Table 1 arrays, by classes of disease, the data to which the administrator has access. It illustrates the difficulty of deriving priorities for the various diseases from such data.

If the administrator assigns priorities according to deaths, he would select accidents as the top priority. If he elects to use hospital data, he would concentrate on infective diseases. If outpatient figures are selected, he would emphasize respiratory diseases.

Table 2 shows the rank order of the classes of disease according to each of the categories of traditional health data. It is apparent that, with few exceptions, there is poor agreement among these categories in the rank order of diseases. Obviously, if priorities were assigned on the basis of mortality, they would conflict with the need reflected by the data on inpatients and outpatients. On the other hand, assignments made according to the data on inpatients or outpatients would conflict with the need indicated by the data on deaths.

The question remains of how to integrate or combine these data so that a fairly consistent ranking of the classes of disease can be made. Diseases that are assigned high priority need to be manageable within the current state of the art and current technology. It does not appear that, in general, we should assign a very high priority to the delivery of a community service if the benefit cannot be objectively identified or if the requirements for the service cannot be described. Consequently, we should give higher priority to diseases amenable to treatment or prevention. We need also to take into consideration the time lost by the patient in obtaining health services since this loss has a real impact upon his usual activities.

The Q Index

Faced with the problem of assigning program priorities, the Indian Health Service, which provides comprehensive health services to more than 400,000 Indians and Alaskan Natives, constructed a numerical index. This index, which we label Q, has been used as one tool for management in deciding program priorities. Q provides a rationale for combining considerations

of mortality and morbidity in a single index number. Q is defined as:

$$Q=\frac{M_i}{M_a}DP+\frac{274A+91.3B}{N}$$

where

M_i=age- and sex-adjusted mortality rate for the target population, that is, the Indian population,

M_a=age- and sex-adjusted mortality rate for the reference population, that is, total U.S. population,

D=crude mortality rate (per 100,000 population) for the target population,

P=years of life lost because of premature death for the target population,

A=hospital days for the target population,

B=outpatient visits for the target population,

N=number of individuals in target population, and

274 and 91.3=constants used to convert A and B to years per 100,000 population; 3 outpatient visits are equated in time to 1 hospital day.

If we can assume that the mortality of some defined population group reflects a desirable and practical attainment and that the health status of this group reflects the state of the art and the current technology of health services, then data from this population can be used to help distinguish the diseases that are amenable to treatment from those that are not. We can also further project that the differences between this reference population and our own target population can be reduced or eliminated within our current capabilities in health services. Accepting these premises, we can compute for each class of disease the relative difference between the target population and the reference population.

In the case of Q, this computation is done by first adjusting mortality rates for the differences due to dissimilarities in the distribution of ages in the two populations. Second, the rates for both populations are adjusted for differences in the distribution of the sexes. These adjustments yield mortality rates that are relatively free of biases due to age and sex. The ratio of these adjusted death rates for the target population to the reference population is then used to weigh the remainder of the factors included in Q. The more that the target population exceeds the reference population in mortality attributable to a given class of disease, the greater will be the Q value for that class. And, also, if our assumptions are valid, the greater will be the disease's amenability to treatment.

The second factor, D, insures that the absolute number of persons affected will have an influence on Q. If we relied solely on the mortality ratio M_i to M_a, we might assign top priority to a disease that was comparatively rare in our population and which consequently would have relatively little effect upon the population's health status. By including the absolute value of mortality in the target population, Q will increase as the absolute number of deaths in the target population increases.

If one views a death from the standpoint of its effect on a population, to count it as an occurrence is insufficient. Its real effect is that of removing a definite number of man-years from the population over a predictable span of time. Therefore, the lost man-years or "years of life lost" due to a specific class of disease should also be a consideration in assigning priorities. Tentatively, we have proposed that, while all years of life are equal, those diseases producing the greater loss in years of life should receive the higher priorities. The factor P provides for this consideration; it is based on the difference between the average age at death of the target population and the average life expectancy at that age within the reference population. Consequently, the younger the age at death, the larger will be the Q value.

The Q index will increase as the deaths in the target population exceed those in the reference population. Q will also increase as the absolute number of deaths in the target population increases or as the age at death decreases. In general, an index with such characteristics is consistent with the system of values of our society and for the most part represents a feasible method for measuring the impact of mortality on a given population. Our experience to date indicates that when mortality is considered in

this fashion in establishing and evaluating program priorities, the results are generally consistent with those arrived at on the basis of professional judgment.

The determination of priorities, however, cannot be based entirely on the impact of mortality. Before death occurs, some diseases produce years of impairment, of disability, and of requirements for periodic treatment. Other diseases, such as diabetes and arthritis, seldom result in death but produce severe disability and require continuous treatment and personal health services. Years before death, diabetes often results in amputation and loss of mobility, blindness, and severe circulatory impairment. Arthritis can produce severe impairment and complete loss of mobility years before the patient dies from a neoplastic or coronary condition or some other disease. The common cold accounts for an amazing amount of disability. Yet, while it may precipitate a mortal disease, it almost never directly causes death.

The need for considering morbidity in assigning program priorities is generally accepted. There is little agreement, nevertheless, on how much weight to give to it or even on how to relate it to mortality so as to reflect the combined impact of these two measures. The situation is further confused by the lack of data specific to small population groups on disability, impairment, and physician visits. While the National Center for Health Statistics publishes data on these variables, the methods of collection and sampling impose serious restrictions on their use. In many instances, the administrator of a county, a city and, in some cases, a State health program cannot derive accurate data for his population group. The cost of collection also usually prohibits him from conducting his own survey.

A few statistics are available to the health administrator—for example, on hospitalization and outpatient clinic visits. He can accept these data as a minimum, realizing that this minimum does not necessarily represent the total picture, and use them to arrive at an estimate of morbidity. Combining this estimate with available measures of mortality, he can then derive a first approximation of program priorities.

The last two factors of Q represent our attempt to accomplish this approximation. Hospital days for each class of disease are converted into days per 100,000 population and added to the mortality factor. For outpatient visits, our experience indicates that our Indian patients spend, on the average, one-third of a day obtaining outpatient care, including travel to and from the outpatient facility. Consequently, we have equated three outpatient visits to 1 hospital day. (In most populations, this equation would not be applicable, and a different ratio would have to be used.) We then calculate outpatient visits per 100,000 population and add this rate to the previous result. Obviously, we should also have another factor to reflect the degree and length of the related disability, as well as some measure of the "unknown" disability that exists in the population. Unfortunately, as mentioned, this information is not available. We must keep this deficiency in mind when using the Q values to arrive at program priorities.

Ranking Diseases With the Q Index

When Q is computed for each of the 17 classes of disease, the five most important classes, in the order of their importance, are accidents, poisonings, and violence; infective and parasitic diseases; diseases of the respiratory system; diseases of the digestive system; and symptoms and ill-defined conditions.

Classes of disease	*Rank order*
Infective and parasitic diseases	2
Neoplasms	15
Endocrine, nutritional, and metabolic diseases	9
Diseases of the blood and blood-forming organs	17
Mental disorders	11
Diseases of the nervous system and sense organs	6
Diseases of the circulatory system	12
Diseases of the respiratory system	3
Diseases of the digestive system	4
Diseases of the genitourinary system	10
Complications of pregnancy, childbirth, and the puerperium	7
Diseases of the skin and subcutaneous tissue	13
Diseases of the musculoskeletal system and connective tissue	14
Congenital anomalies	16
Certain causes of perinatal morbidity and mortality	8
Symptoms and ill-defined conditions	5
Accidents, poisonings, and violence	1

If we compare these ranks with those derived from the traditional data on deaths, inpatients, and outpatients, taken separately, considerable differences are observed. In fact, while the product-moment correlations are significant, as shown by the following list, the unexplained variation is rather high.

Correlation of Q with inpatient days_____ R=0.70
Correlation of Q with outpatient visits_____R=0.54
Correlation of Q with number of deaths_____R=0.73

While no single relationship is particularly strong, Q appears to be, generally speaking, sensitive to all three elements of crude data. This sensitivity suggests then that although the arithmetic manipulations performed in the computation of Q resulted in a different arrangement of ranks, these manipulations did not destroy the relationship of the Q values to the original input data.

Discussion

The validity of priorities based on the Q values has never been rigorously determined and, in the absence of an objective criterion, probably cannot be assessed. In general, however, the Q value correlates closely with determinations based on professional judgment. In at least one instance when the value was used on an experimental basis in a slightly different form than described here, the index was judged applicable and beneficial in an urban setting (*3*).

Q is certainly not adequate to serve as the only determinate of program priorities. Health and the delivery of health services are, and must be, intimately associated with the political and cultural components of a society. Needs perceived by a community do not always correspond with needs identified by the health professional. These differences in perception of needs are difficult to identify, much less to quantify. Nevertheless, the most rigorously defined and justified health program will not attain its objective unless they are considered. Obviously, the greater the agreement on program priorities between the provider of health services and the recipient, the greater will be the success of the program.

Many administrators believe that as communication between the provider and recipient improves, so will the agreement between them. It is precisely to this point that Q, or some better quantifier, can contribute. If the data used in such an index are easily obtainable and its structure is simple enough for the mathematically unsophisticated to comprehend, then, as an objective statement, the index will provide better communication between the community and the health profession than pages of narrative or hours of dialog.

Summary

The administrator of health programs is faced with the need for deciding how to allocate funds among the several program areas. Optimal funding schemes will take into consideration not only the economy of operation of the health program but also the program's impact upon the health status of the target population. Efficient analysis of the benefits derived by the target population from various health programs requires comparison of the data pertaining to the various classes of disease with equivalent data from other programs. The statistical data generally available which satisfy this requirement are limited to figures on the number of persons hospitalized, reason for hospitalization, number of deaths and cause, length of hospitalization, and number of outpatient visits with the accompanying diagnoses.

An index has been created in which this traditional information is used in such a way that a value, termed Q, increases as the impact of disease upon the population increases. The amenability of the disease to treatment or prevention is also incorporated into the index.

Program priorities can be derived from the computed Q value; higher values represent the higher priorities. The priorities derived from the Q index, however, should be interpreted as representing only a first approximation. Determination of final priorities will still require the exercise of administrative and professional judgment.

REFERENCES

(*1*) Chiang, C. C.: An index of health: mathematical models. PHS Publication No. 1000, Ser. 2, No. 5. U.S. Government Printing Office, Washington, D.C., May 1965.

(2) Sullivan, D. F.: Conceptual problems in developing an index of health. PHS Publication No. 1000, Ser. 2, No. 17. U.S. Government Printing Office, Washington, D.C., May 1966.

(3) Booz, Allen & Hamilton, Inc.: Demonstration study of data available for systems analysis. Maryland State Department of Health, Annapolis, February 1968. Mimeographed.

Tearsheet Requests
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Grants for Construction of Health Education Facilities

Grants totaling more than $55 million have been awarded by the Health Professions Educational Construction Program and the Nurse Training Facilities Program, National Institutes of Health, to 10 colleges and universities for construction of health education facilities.

Six schools received grants totaling $54,281,980 for construction of educational facilities for health professions, and grants totaling $1,604,582 went to four schools for construction of educational facilities for nurses. The awards will provide space for an additional 544 students in those institutions.

Under study are ways by which the construction program can be changed to provide for expansion of facilities essential to increase enrollment in existing schools while still assisting creation of new schools in areas of greatest need. Other than on an exceptional basis, the health professions construction program will no longer support construction of teaching hospitals.

Of the six awards, four went to the following schools of medicine and osteopathy to expand educational facilities:

University of Cincinnati, Ohio—$34,690,190 to assist in construction of a medical science building.

Kirksville College of Osteopathy and Surgery, Missouri—$488,482 to assist in construction of osteopathic clinical teaching space.

University of Miami, Florida—$3,823,051 to assist in construction of a medical library and a medical science building.

University of Texas (Southwestern) Medical School, Dallas—$12,725,436 to assist in construction of a new basic science teaching facility.

The following two awards went to schools of pharmacy to expand their educational facilities:

Ferris State College, Big Rapids, Mich.—$1,466,700 to assist in construction of a pharmacy building.

Corporation of Mercer University, Macon, Ga.—$1,088,321 for the Southern School of Pharmacy in Atlanta, Ga., to assist in construction of a new pharmacy undergraduate teaching facility and library.

The four grants to expand training facilities for nurses are:

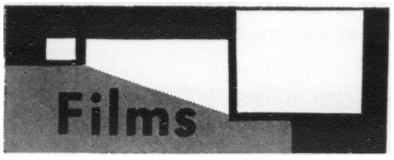
Montana State University, Bozeman—$264,347 to assist in construction of a new nurse training facility.

Bristol Community College, Fall River, Mass.—$402,648 to assist in construction of nursing space in a new health technology building.

Cape Cod Community College, Hyannis, Mass.—$13,972 to assist in equipping the nurse training center in a new science building.

Department of Community Colleges, Commonwealth of Virginia, Richmond—$923,615 for a facility at Northern Virginia Community College to assist in construction of a teaching facility for nurse education.

The six awards for construction of educational facilities for health professions under the Health Manpower Training Act of 1968 bring expenditures of Federal funds in this program to $675 million, which has enabled 147 schools to accommodate the addition of 5,449 students. The four awards to schools of nursing under the Nurse Training Act of 1964 bring expenditures of Federal funds in that program to $78 million, which has enabled 130 schools to accommodate the addition of 5,442 students.



Basis of Diagnosis of Peripheral Nerve Injuries to the Upper Limb. *Order No. F–1717—filmstrip; S–1717—slides. 73 frames, 35 mm., color, with ¼-inch sound tape 7½ inches per second, 22 minutes, 1969. Produced by the National Medical Audiovisual Center.*

AUDIENCE: Of particular interest to orthopedic surgeons, neurologists, and medical students; also of interest to house staff and general physicians.

SUMMARY: Presents a logical approach to the understanding of peripheral nerve development and demonstrates how this information may be used as a background for clinical analysis of peripheral nerve injury of the upper extremity. Depicts development of the peripheral nervous system and the development of the epaxial and hypaxial musculature and illustrates the information and innervation of the upper limb. Considers methods of examination of the muscles of the upper extremity.

Richard A. Pollock, M.D., Emory University School of Medicine, supplied research, basic sketches, and narration copy used in this production and served as technical adviser, in consultation with Dr. H. R. Karp, chief, division of neurology, department of medicine, Emory University School of Medicine.

AVAILABLE: Free short-term loan from the National Medical Audiovisual Center (Annex), Station K, Atlanta, Ga. 30324. Purchase from General Services Administration, National Archives and Records Services, Washington, D.C. 20409. Attention: Government Film Sales.

Cholera Today. Part 2. Practical laboratory diagnosis. *Order No. M–1478. Motion picture, 16 mm., color, sound, 19 minutes, 1968. Produced by the National Medical Audiovisual Center in cooperation with the Southeast Asia Treaty Organization Cholera Research Program of the National Institutes of Health.*

AUDIENCE: Physicians and allied scientific personnel in medical schools, laboratories, the armed services, the Peace Corps, and other appropriate organizations; public health authorities of any country where cholera is endemic or where an outbreak is possible. Not suited for the general public.

SUMMARY: Developed to provide essential information on the identification of the etiologic agent of cholera. Rapid identification of cholera is necessary for public health administrators to follow the course of an epidemic and to plan control efforts. Explains practical and simple laboratory techniques for diagnosis, using basic equipment available in most countries. Some of the scenes were photographed at the National Communicable Disease Center, Atlanta, Ga.

This film earned an award in *Industrial Photography's* 11th Annual Film Awards program; a Certificate of Creative Excellence in the 1969 U.S. Industrial Film Festival; and a bronze medal in the 12th International Film and TV Festival of New York.

AVAILABLE: Free short-term loan from the National Medical Audiovisual Center (Annex), Station K, Atlanta, Ga. 30325. Purchase from General Services Administration, National Archives and Records Service, Washington, D.C. 20409, Attention: Government Film Sales.

The National Medical Audiovisual Center has sponsored and produced a series of films to provide the medical viewer with the divergent points of view of experts representing their specialty fields. The series, based on contemporary medical thinking, presents questions for which the logic of medical science alone fails to provide clear, unequivocal answers.

AUDIENCE: For professional medical persons. Cleared for television.

Controversial Aspects of Rheumatoid Arthritis. *Motion picture, 16 mm. (TFR), black and white, sound, 28½ minutes, 1969. Order No. T–1679.*

SUMMARY: Moderator: Mary Betty Stevens, M.D., associate professor of medicine, Johns Hopkins University School of Medicine. Panelists: Three senior medical students from Emory University School of Medicine.

Controversial questions discussed include the diagnostic criteria of rheumatoid arthritis, its differentiation from other syndromes, the various therapeutic regimens advocated, and the prognostic factors affecting such patients.

Current Trends in the Therapy for Narcotic Addiction. *Motion picture, 16 mm. (TFR), black and white, sound, 29 minutes, 1969. Order No. T–1704.*

SUMMARY: Moderator: Frances Gearing, M.D., assistant professor of epidemiology, Columbia University School of Public Health and Administrative Medicine. Panelists: Daniel H. Casriel, M.D., medical psychiatric superintendent, Daytop Village, New York, and Jerome H. Jaffe, M.D., director, drug abuse program, State of Illinois, Department of Mental Health.

Narcotics addiction, as seen by Dr. Casriel, is basically withdrawal behind a chemical as a response to stress—a condition requiring intensive psychotherapy. This method of treatment is used at Daytop Village where patients live in a therapeutic community for approximately 1½ years with "no chemical to hide behind." Dr. Jaffe questions the psychiatric approach and discusses the methadone treatment of addicts in Chicago. He reports that this method allows the addict to return to the community promptly; that 75 percent of those treated are working, and that rate of re-arrest or return use has been very low.

These films are available on free short-term loan from the National Medical Audiovisual Center (Annex), Station K, Atlanta, Ga. 30324. Order films by title and number. Films should be requested at least 2 weeks before the preferred showing date; if possible, two alternate showing dates should be given. For purchase, order films by title and number from General Services Administration, National Archives and Records Service, Washington, D.C. 20209. Attn: Government Film Sales.