

SYSTEMS ANALYSIS IN PLANNING AND EVALUATION OF AUTOMATED MULTIPHASIC HEALTH SCREENING PROGRAMS¹

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There is currently a good deal of controversy about the advantages and disadvantages of automated multiphasic health screening (AMHS). This article reviews ways that systems analysis can be used to help health authorities make decisions concerning AMHS programs.

This presentation is concerned with the use of the analytic techniques of systems analysis by health program policy-makers in their planning, operation, and accomplishment evaluation of automated multiphasic health screening programs. As such, the views are those of a manager and planner of health services programs who must decide the program content and allocation of resources for his organization. Criteria for establishing and the sequential steps necessary for developing automated multiphasic health screening programs are discussed from the particular orientation of a national or regional organization whose responsibility is to place automated multiphasic health screening within the context of all other major components of the health care delivery system within its jurisdiction.

The policy-maker's decisions on the advisability and scope of automated multiphasic health screening (AMHS) are not easy. He is confronted with a complex, often conflicting series of interests that can both knowingly and unknowingly influence his program judgments. First of all, he is aware of widely divergent professional opinions on the value and accomplishments of AMHS. This difficulty is compounded by persons with whom he is in contact, who reflect many viewpoints. For example:

- The biomedical engineer who wants to devise and test new instrumentation.
- The industrialist, whether an equipment maker, a laboratory supplier, an architect who plans AMHS facilities, or a data processor who desires to expand and diversify his firm's services.
- Hospitals, medical groups, and private companies that provide or wish to provide AMHS services directly or on a contractual basis.
- Researchers—whether epidemiologists, sociologists, or health planners—who view AMHS as an important new source of data.
- Hospital administrators, physicians, program managers, and technicians who may view AMHS as either a new horizon or perhaps a threat to current modes of operation.
- Consumers, including individual persons, unions, and employers, who want to know the advantages, costs, and personal benefits to them of participating in AMHS.
- Political leaders who are protective of their role in program innovations, such as AMHS, that have political, social, and financial ramifications.

The objective of systems analysis, in its barest simplicity, is to provide a structured approach to rational decision-making. It is the process of applying logic, establishing clear objectives, identifying alternative methods to

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achieve objectives, quantifying and measuring each step in the planning process, evaluating the cost-effectiveness of each alternative, and (for the option selected) measuring the cost-benefit or ultimate program accomplishment in human terms as well as its cost. Systems analysis is not a substitute for the judgment or expertise of the manager, but rather a tool to assist the manager in using his training and experience to make more rational decisions.

Mass Screening, Multiphasic Health Screening, and Automated Multiphasic Health Testing

Fluctuating, overlapping terminology contributes to misunderstandings and confusion in discussing methods to reach large numbers of people whose health or disease status is to be identified. Some of the terms used are: mass screening or mass health examinations, multiphasic health screening, multiphasic health testing, and automated multiphasic health screening or testing.

"Mass screening," as defined by the United States Commission on Chronic Illness in 1957, is "the presumptive identification of unrecognized disease or defect by the application of tests, examinations, or other procedures which can be applied rapidly. Screening tests sort out apparently well persons who probably have a disease from those who probably do not. A screening test is not intended to be diagnostic. Persons with positive or suspicious findings must be referred to their physicians for diagnosis and necessary treatment." (6) A physical examination is usually considered part of this procedure. "Mass health examination" (MHE) is the term used by the Report of the Technical Discussions at the Twenty-Fourth World Health Assembly. An MHE is defined as "the application of various investigative techniques," singly or in combination, "to large numbers of people regardless of whether people are present for examination *en masse* or are examined serially over a period of time." (12)

"Multiphasic screening" is an extension of the mass screening or mass health examination technique, and specifically means administering

more than one test to persons recruited for mass screening or mass health examinations.

"Automated multiphasic health testing" is, in turn, an extension of the multiphasic screening concept in which varying combinations of examinations are automatically performed without physician contact with the individual examined, the results of which are automatically recorded. Thus, the word "automated" can mean the automatic performance of tests (the usual meaning), the automatic recording of results, and the use of automated data processing (computer applications) in the processing and analyzing of test results.

This presentation focuses on automated multiphasic health screening (AMHS), but both the criteria and developmental steps discussed for use by health policy-makers are equally applicable to mass screening and mass health examinations.

Comprehensive summaries on mass screening are presented in the Wilson and Jungner WHO public health paper *Principles and Practice for Screening for Disease* (11), and others on mass health examinations are presented in the Report of the Technical Discussions at the Twenty-Fourth World Health Assembly (12). The former work contains an extensive bibliography. Gelman, among others, has summarized the state-of-the-art of automated multiphasic health testing (8), and has prepared one of the most extensive annotated bibliographies on multiphasic health testing-screening systems (9). The technical aspects of automated multiphasic health testing were recently reviewed at a conference held in Davos, Switzerland (7).

Systems Analysis and Criteria for Establishing AMHS

Enthusiasm for and investments in AMHS programs have exceeded our knowledge of their actual accomplishments and benefits. Cost-effectiveness and cost-benefit analyses of AMHS are quite possible, though difficult, but few studies have been conducted to relate, quantitatively, AMHS objectives and costs to their accomplishments (3, 10). As the American

Public Health Association has stated: "Comprehensive multiphasic screening programs of the type recommended require careful detailed planning and coordination. Time and effort must be spent to survey existing programs; past histories of different programs; existing community needs, services, and resources; the cost, value, and feasibility of various tests; and to sample the attitudes and desires of the target populations and the medical community concerning a screening program. Only after this basic work has been completed can an effective program be tailored to the specific community concerned." (2) Furthermore, the American Medical Association has expressed the opinion that "automated multiphasic screening at this point in time is a promising technique which requires further experimentation and controlled evaluation to fully identify its benefits, limitations, and ultimate potential." (1) No better illustrations of the need for applying the analytic techniques of systems analysis to AMHS could be stated.

Certain essential criteria must be satisfied in deciding whether AMHS is to become established policy and whether AMHS programs are to be developed and maintained in any organizations. This is true in any case, but particularly so when national or regional governments are considering AMHS use on a broad-scale basis. AMHS should be used only when it:

- 1) brings the health care delivery system to a larger segment of the population than would otherwise be the case;
- 2) increases the productivity, economic efficiency, and overall effectiveness of available health manpower and the total health care delivery system;
- 3) permits the provision of more high-quality services at reasonable cost;
- 4) is acceptable to the people served;
- 5) is acceptable to physicians and compatible with the health care system of which it is only one component;
- 6) has a direct relationship with other parts of the health care delivery system to assure use of its findings;
- 7) utilizes procedures that are sufficiently

sensitive and useful to accomplish the purposes for which AMHS was established;

8) has accomplishments in terms of better and more widespread health care that justify its continued financing.

These criteria represent the overall goals of AMHS; and, as such, they describe the context within which decisions must be made concerning the use of AMHS. Systems analysis—with emphasis on the quantification of each step in the planning process—attempts to define these criteria more specifically, describes variables influencing conformance to the criteria, identifies constraints on resources, specifies feasible alternatives and strategies, evaluates alternatives, may assist in selecting the preferable option, and aids in preparing an action plan for implementation and evaluation of the selected program alternatives.

Systems Analysis in AMHS Program Planning and Accomplishment Evaluation

The steps in planning AMHS programs are no different, in concept, than those for any other public health program or component of the health care delivery system. Thus, the application of systems analysis to AMHS planning is only an example of its overall application and value in health planning.

A systematic approach is essential in planning and evaluating AMHS programs, and involves the following major steps:

- 1) *Determine the overall purpose of AMHS.* AMHS can be used for three possible purposes: epidemiologic surveys to ascertain prevalence and incidence of disease for one stated period of time, disease surveillance over time to describe trends in health status, and case-finding for the detection and treatment of disease. Although epidemiologic surveys and disease surveillance are, from a public health viewpoint, meritorious purposes for AMHS, the programs should in most cases include components of disease detection and identification for treatment if political and consumer acceptance is to be achieved.

2) *Quantify the objectives of AMHS.* Prior to program implementation, for example, the following should be established in writing: the number of persons to be reached, the specific target population and geographic area to be served, the anticipated number of persons to be benefited, the anticipated improvements of AMHS over other alternative health service approaches (e.g., the number of additional people served and the extent of increased health protection or improvement), and the projected cost-effectiveness and cost-benefit ratios of AMHS compared with other feasible alternative approaches. Health program managers have, in general, an inborn, highly resistant aversion to the absolutely essential step of quantifying program objectives in program planning and evaluation. No AMHS program, however, should be initiated without this analytical process of defining objectives in numerical terms.

3) *Quantify tests and procedures to be used.* Again, as a preliminary step to AMHS program implementation, tests and procedures to be conducted, as well as their validity, reliability, acceptability, cost, yield, and time required must be defined to the fullest extent possible in numerical terms. The priorities of procedures selected will depend on the relative public health importance in each country or region of conditions for which AMHS is under consideration. This in turn depends on the severity, prevalence, and incidence of the disease or condition, and the population most at risk or the target population selected.

4) *Quantify available and required resources.* The available and needed resources—manpower, facilities, and finances—must be quantitatively defined, not only in terms of resources required for the AMHS program itself, but also of those required by the total health care delivery system to assume the added burden of diagnostic and treatment services resulting from AMHS findings. The manpower resources required for AMHS should include persons to deal with the public, to operate the

equipment, and to organize and manage the program. Likewise, financial resource analysis must include careful estimates of both capital and operational costs. Quantification of required manpower and financial resources should be both short-term and long-term, since AMHS programs are expensive and rarely justified on a short-term basis (12). Analysis of “trade-offs” of manpower and financial resources between AMHS and existing and related programs of lesser productivity (with reallocation to AMHS) is often essential if adequate resources for AMHS are to be identified. AMHS implementation cannot often solely depend upon the provision of new funds.

5) *Appraise qualitatively the public and political acceptability of AMHS.* Informed judgment has an essential role in systems analysis, and the social and political constraints on AMHS in any country require expert judgment based on experience, sensitivity, and perceptive aptitudes.

6) *Establish a quantifiable basis for evaluating accomplishments of AMHS.* Evaluation of AMHS programs involves comparison of the original objectives with program accomplishments (both numerically defined) and cost-effectiveness and cost-benefit analyses. Cost-effectiveness (4, 5) involves comparing costs and performance of different methods used to accomplish similar objectives (e.g., the cost and reliability of identifying a new case of diabetes by two different techniques, or the effect of variations in manpower mix regarding their relative success and cost in carrying out the same or similar procedures). Cost-benefit analyses, which are quite difficult to apply to AMHS and most other health programs, attempt to ascertain the improvements in health status resulting from alternative resource investments. A simple but often forgotten dictum is that the criteria and methods used for accomplishment evaluation must be planned before a program is commenced, and must be combined and integrated with the establishment of program objectives.

SUMMARY

Systems analysis applied to automated multiphasic health screening (AMHS) is the process that attempts to relate, in a sequential and coherent fashion, program planning, program management and control, and program accomplishment evaluation—particularly by using numerical targets so as to measure AMHS inputs (money, manpower, equipment, and facilities) and AMHS outputs (persons served

and accomplishments achieved). It also has an important supportive role in integrating AMHS programs with other complex components of the health care delivery system. The latter application of systems analysis to AMHS has received considerably less emphasis—which explains, in part, the controversy over the usefulness and cost-benefit value of AMHS, particularly in developing countries.

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