A STATEWIDE MANAGEMENT INFORMATION SYSTEM FOR THE CONTROL OF SEXUALLY TRANSMITTED DISEASES

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ABSTRACT

The persistent endemicity in the U.S. of infectious syphilis and gonorrhea, together with increasing diagnoses of gonococcal-related pelvic inflammatory disease in women and genital herpes infections, have intensified pressures on state and local VD control programs to measure, analyze, and interpret the distribution and transmission of these and other sexually transmitted diseases. In response, the Division of Venereal Disease Control (DVDC) of the Centers for Disease Control (CDC) is participating in the development of three state-wide, prototype sexually transmitted disease (STD) management information systems. A systems analysis of a typical state-wide STD control program indicated that timely, comprehensive, informational support to public health managers and policy makers should be combined with rapid, direct support of program activities using an on-line, integrated data base, computer system with telecommunications capability. This methodology uses a data base management system, query facility for ad hoc inquiries, custom design philosophies, but utilizes distinct hardware and software implementations.

INTRODUCTION

State-wide Sexually Transmitted Disease control programs must accurately detect, diagnose, and treat a wide range of diseases, many of which are highly infectious, provide primary and secondary prevention activities to control the spread of these diseases, and provide high-quality health care. These control programs must capture and retain extensive archives of sensitive data that pertain to large population segments. In 1982, about 1 million cases of gonorrhea and approximately 33,000 cases of primary/secondary syphilis were reported by health departments in the U.S. to the Centers for Disease Control. Patient histories and data related to the sexual contacts of patients are sustained, so that the on-going functions of the control program can continuously interact with these data. Indeed, few control activities occur without health care personnel first referencing this vital data base. Its upkeep is an enormous task, and huge numbers of data transactions occur within it.

In addition, frequent tabulations and disease surveillance are required by the program to identify disease trends, establish planning goals, evaluate program performance, and provide information for management as needed. Many programs profit from some form of computer-based support. With few exceptions (e.g., the STD clinic-based Opscan-MIMS system in Cincinnati, Ohio), these programs with computer capability rely invariably on off-line batch processing, which mostly yield periodic periodings of STD morbidity or laboratory results. The vast majority of local STD information systems are manual. Thus, the vital STD services of many control programs are served by systems with limited abilities to permit impromptu, unprogrammed queries or access of data from remote locations.

To relieve this restrictive information availability to state-wide control programs and their dispersed workers, the Division of Venereal Disease Control of the Centers for Disease Control, a federal agency, processes summary data submitted by control programs, returns analyses of these summaries to the states and major cities, and publishes nationally a wide variety of STD information. But, these efforts provide a better comprehensive, national focus for STD information than a responsive information system for local control efforts, and, of course, make no contribution to patient-specific information requirements. Mindful of these needs, the DVDC conducted a systems analysis of several typical state-based STD control programs and evaluated various modern computer-based strategies for possible implementation. As a result, the state health departments of Arizona, South Carolina, and Utah have collaborated with the DVDC in the development, within each state, of a STD management information system (MIS). These three transaction-intensive systems incorporate distinct hardware and software strategies, but reflect a common design philosophy. They all utilize on-line computer processing, with data access via telecommunications from remote and immediate sites. Furthermore, each places nearly the entirety of the state's STD data into a secure, integrated data base, organized by a data base management system (DBMS) and supported by an ad hoc query facility, custom software, and statistical utilities.

METHODS

The systems analysis included the following: (1) acquisition of detailed information of existing control programs and their attendant information systems; (2) identification and documentation of input documents, working documents, and data required by control programs; and (3) identification of information needs at every level of program organization, with emphasis on the local
needs of STD clinic managers and state program managers. Needs at each management level were divided into the categories of strategic planning, management control, and operational control.

This analysis was supplemented by an informal survey to identify and describe existing state-owned computer systems and their potential availability to STD control programs, and a survey of modern computer and communication technology and performance.

Although computer technology has been successfully employed in a wide variety of medical patient care applications (and many of these were studied), no large-scale, public health-based, disease control program in the U.S. had implemented a modern MIS of the type contemplated.

**DISCUSSION**

State-based STD control programs in the United States are characterized by a remarkable homogeneity in their function and structure. They share common major objectives, which are (1) to identify and bring to adequate treatment individuals infected with STD; (2) to prevent the devastating sequelae of STD; (3) to provide timely post-treatment followup to patients; and (4) to provide prevention services to insure that persons who are exposed to STD are examined promptly.

Around these objectives, programs are organized by component, which, in turn, cut across different STD. Personnel and financial resource allocations, and activity reporting and accountability generally align with these structural components or subprograms, which are (1) STD surveillance or morbidity; (2) case management; (3) syphilis and gonorrhea screening; (4) information and education; and (5) clinical services. Figure 1 shows this organizational arrangement with regard to syphilis and gonorrhea in more detail, and indicates the intensive management required for cases of gonococcal pelvic inflammatory disease (PID) and penicillin-resistant gonorrhea (PPNG). The managerial function of the organization conforms to this subprogram structure as well.

**FIGURE 3 - TYPICAL ORGANIZATIONAL STRUCTURE OF AN STD CONTROL PROGRAM**

Although a control program varies little in structure from state to state (or large city), its precise composition is tempered somewhat by the varying levels of Federal, state and local participation in the control program. In addition, variations in population distribution and incidence of disease within each state affect the deployment of resources, as well as internal communication requirements. But, importantly, the need to provide data within precise categories for internal and external utilization imposes organizational constraints as well (Figure 2). For example, programs commonly need to cross-reference interview data and morbidity data so that unnecessary field investigations of persons that have already been treated or recently examined for STDs are not initiated. Speed and accurate cross-referencing in this instance are important to the patient, or potential patient, as well as to the economic use of resources. The prevalence of disease is affected as well.

**FIGURE 2 - PHYSICAL VIEW OF THE DATA ESTABLISHMENT OF A TYPICAL STD CONTROL PROGRAM**

**SYSTEMS CONSIDERATIONS**

In general, as the time between data capture and information availability is compressed, cost is increased. Batch processing, while relatively low in cost, induces a time lag too great for comprehensive utilization by control programs in disease intervention efforts. Thus, on-line systems to support STD control are indicated, and should span, via telecommunications, the entire STD control information network (Figure 3).

**FIGURE 3 - DATA INFORMATION FLOW WITHIN THE PHYSICAL COMPONENTS OF THE STD PCs NETWORK**

On-line processing for several users, though, requires greater system complexity. Such systems must sustain a multi-processing, time-sharing environment, in which concurrent communications with remote input/output devices are maintained, and distinct jobs, which may even require access to the same data, are accomplished simultaneously.
Minicomputers now efficiently and reliably perform these tasks and provide acceptable response times to users.

Data base design consideration

The twin concepts of integrated data base and DBMS are central to the MIS philosophy. The integrated data base, in which unique patient identifying data unifies all system data, eliminates the need for separate files, and allows for centralized control of data, of data entry, and of data retrieval. Consolidating the program's data in this fashion accomplishes the following: data can be shared and can serve multiple applications and simultaneous accesses; redundancy of stored data is reduced; data security and integrity are more closely ensured; and data independence, the disassociation of the data from application constraints, is achieved.

The DBMS manages the data and provides methods for creating and maintaining this integrated data base with its required linkages between data items, while allowing the retrieval of data by the use of an "English-like" query language. The need for customized report programs is reduced.

The creation of the data base requires critical decisions regarding how the aggregate of data will be structured and which variables are to be designated as keys through which updating and retrieval will be directed. These decisions affect operating system overhead, file storage requirements, and user response time.

Hardware/software strategies

The major criteria for selection of strategies for these MIS were (1) projected cost-effectiveness; (2) simplicity of use; (3) availability of appropriate hardware within states; (4) performance of system; and (5) portability - the capacity for the developed MIS to be used, with only minor modifications, in other states and cities.

For the Arizona MIS, a system that links the State's major STD clinics in Tucson and Phoenix with the control program's central office in Phoenix, a network DBMS (total) was selected for implementation on a Honeywell Level 6 minicomputer. ANSI standard Fortran 77, a recent version, serves as the programming language.

In Utah, where the Salt Lake City County STD Clinic is linked with the STD control program's central office, a large IBM 370 - compatible computer is used. It is equipped with ADABAS, a network DBMS, which makes use of Natural, its own higher-level programming language. ADABAS, which uses an integrated data dictionary as an intermediary between user and data base, has also been available in a minicomputer version, ADABAS-M.

The MIS for the VD control program in South Carolina links the Richland County STD Clinic in Columbia and the VD control central office in Columbia. It utilizes a PDP-11/34 minicomputer and InterSystems M, a recent version of MUMPS (Massachusetts General Hospital Utility Multi-Programming System). A consolidated hierarchical DBMS, programming language, and computer operating system, MUMPS was developed within the medical community and facilitates data base creation and development of application programs.

Control - MIS interactions

The coordinated interactions between control program and MIS is usually initiated with the introduction of a laboratory test result for an STD, or by the need for a field investigation. Typically, subsequent MIS events may include checks against existing files, updating of existing data, and the introduction of data for new patients and contacts (Figure 4).

SUMMARY

The operations of these three STD MIS, together with those of a similar STD system developed by the Department of Health Services in Los Angeles, California, and a second-generation version of the South Carolina system that has been installed in San Francisco are being monitored carefully. Each of these systems has been implemented in stages, each stage corresponding to the control program component to which it most directly relates. Each system will be evaluated for cost effectiveness; for effectiveness in assisting VD control efforts; for its usefulness in assisting clinical and operational research; for its capacity to assist in the development of new analytic techniques to combat STD; and for its ability to describe the epidemiology of infectious STD.

REFERENCES