

MEASURING THE VALUE OF INFORMATION SYSTEMS

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A successful database or information system arises in response to perceived problems or unanswered questions. Once established however, the continued viability of the system often depends upon successful demonstration of its value. Measuring the value of an information system requires skills distinct from those necessary for its creation. Investigators intent upon measuring the value of an information system must effectively solve a host of methodologic problems. Just as many aspects of database design are generic extending across specific database applications, many common problems exist in measuring the value of an information system.

The purpose of this panel discussion is to improve the quality of investigations designed to measure the value of an information system. The audience is invited to share their experience with that of their colleagues participating on the panel. The discussion will focus on five questions:

1. Does an information system allow the medical community to do anything that would otherwise be impossible without an automated system; what is the greatest value of a patient database?
2. Can an information system save money or time in the patient care process; how can the cost of the data collection and storage be justified and make the system self-supporting?
3. How are observations made from a database validated; what are the limitations of drawing inferences from non-randomized studies and how can they be minimized?
4. How can management information systems improve the practice of patient care and how are these improvements measured?
5. How does an information system impact on interactions between members of the health care team and how is this measured?

Each of the panel members has supervised investigations designed to measure some aspect of the value of a well-established information system. For perspective, a brief description of each system with representative references is included below.

The Duke Databank for Cardiovascular Disease 1-5

The Duke Databank for Cardiovascular Disease

was established in 1969 to improve the care of patients with coronary artery disease. Included in the database are over 8,000 patients with suspected coronary artery disease referred to the Duke University Medical Center for cardiac catheterization. A complete baseline description is collected prospectively (history, physical examination, electrocardiogram, chest x-ray, noninvasive tests, results of cardiac catheterization), as well as descriptions of therapies received. Follow-up of all patients is obtained at regular intervals and is 99% complete. The databank permits the process of patient care to be coupled to long term outcomes despite the chronic nature of the disease.

The databank team includes clinicians, biostatisticians and computer science experts. Investigations have focused on making predictions of long term outcomes from baseline patient descriptors, assessing the accuracy of predictive methods using these descriptors, and improving the methodology used to make predictions and to assess their accuracy. The value of the approach has been assessed by measuring the accuracy of these experience based predictions compared to senior clinicians or when transferred to other populations.

The database has been integrated into the process of patient care. Reports from the patient care process are generated from the database files. Outcome predictions are routinely provided where applicable, closing the feedback loop between the process of patient care and subsequent outcome.

(Dr. Pryor is Assistant Professor of Medicine at the Duke University Medical Center and Co-director of the Duke Databank for Cardiovascular Disease).

COSTAR-MPEU 6-9

There are two information systems at the Massachusetts General Hospital (MGH) which have been extensively used for clinical investigation: The first is a computer stored ambulatory medical record (COSTAR) and the second is a computer based databank developed in collaboration with the MGH medical practice evaluation unit (MPEU) and used on all patients admitted to the MGH medical services intensive care unit. There are

four major differences between these two databanks that illustrate the types of tradeoffs that are often required in developing a computer-stored databank:

1) Depth and detail of coding of clinical information - in COSTAR the primary function of the system is to support ambulatory care in a primary care practice. The coded data are occasionally sparse, and much of the detailed clinical information is often recorded in narrative text. In the MPEU system, there is considerable coding of predefined sets of information, but many areas of medicine which are not of primary interest to the investigator are not recorded at all.

2) Who records the information and how is it recorded? In COSTAR the information is recorded by the primary physician on special coding forms; in the MPEU system the data are transcribed by research nurses onto the coding forms using the standard record as the source document.

3) Timeliness of data - in COSTAR it is important that the data be entered into the computer system immediately, since the information is used in daily patient care. In the MPEU, the data are used for retrospective research, and considerable delays in recording and transcribing can be tolerated.

4) Economic justification - In COSTAR the system must be cost-justified on the basis of providing a more economical and effective medical record system for patient care. The MPEU system is supported from grant funds, and the economic justification is based on the usefulness of the system to facilitate clinical research.

(Dr. Barnett is Professor of Medicine at the Harvard Medical School. He is the director of the Laboratory of Computer Science, Massachusetts General Hospital.)

The HELP System 10-13

The HELP system is a comprehensive computer system used for acquiring medical data and implementing medical logic. It has been developed over the past 15 years at LDS Hospital with the assistance of the faculty of the University of Utah. The HELP system has been designed to meet the clinical, medical decision-making, administrative, teaching and research needs of the LDS Hospital. The HELP system consists of a network of computers tied into a central TANDEM System which serves primarily the inpatient needs of the hospital. A very extensive database is acquired on every patient that includes such information as patient identification, location, drugs prescribed, laboratory data, x-ray interpretations, respiratory therapy information, and other clinical information. For patients in intensive care, a complete record of physiological data as well as drugs and IV fluids given and other procedures are stored and reported from the database. The patient database, coupled with the knowledge base, allows us to use medical decision logic to assist in patient care. The on-line execution of the medical decision logic is a unique feature of the HELP system.

(Dr. Gardner is Professor of Medical Biophysics and Computing at the University of Utah Medical School. He has been involved with the HELP system since its beginning.)

The Regenstrief Medical Records System 14-17

The Regenstrief Institute has been developing the Regenstrief Medical Records System since 1973. The purpose of the system has been to improve medical care by facilitating physicians' assimilation and use of data from the medical record and by assisting the physician in the detection of clinical circumstances that need attention. The computer detects problems, follows physician-written protocols and generates specific reminder messages when protocol criteria are met. A number of studies measuring the effect of these reminders on physician behavior have been performed. All studies of the computer reminders have consistently demonstrated a large and statistically significant effect on physician behavior. Physicians order preventive care such as influenza vaccines, pneumovax vaccination, occult blood testing and mamography screening two to three times more often in eligible patients with reminders than without.

Much of our effort has focused on obtaining clinically relevant data in a timely and consistent fashion. Computerized systems have been developed that serve the clinical laboratory, the pharmacy and the clinic registration and scheduling. For more than six years, clinical laboratory data, prescription records and results from all other important diagnostic studies have been captured in a coded and retrievable form. The initial history has been captured on a coded physician completed form for the past year and one half.

The Regenstrief Medical Record currently carries over 65,000 patients. Of these, 30,000 have been followed for more than 5 years, some for more than 10 years. The total database constitutes more than 20 million individual observations in a highly encoded form and occupies more than 200 million bytes of storage.

In the last few years, we have begun to explore other uses of the data including predictions of hypokalemia in outpatients, biochemical predictors of ventricular arrhythmias, clinical predictors of congestive heart failure on the chest x-ray and the effects of the use of nonsteroidal anti-inflammatory agents on cardiovascular outcomes. Studies of this nature are hazardous because of the potential for bias inherent in using databases to determine outcome predictors. Statistical techniques are required that control for bias, the variable intervals between observations and that effectively use serial observations. Despite these problems we are optimistic that databases such as ours will provide boot straps for increasing medical knowledge, especially about the effects of medications and utility of testing.

(Dr. McDonald is Professor of Medicine at the Indiana University School of Medicine and

Director of Medical Information Science within the Regenstrief Institute.)

TMR (The Medical Record) 18-23

The Medical Record (TMR) is a comprehensive medical information system that had its origin in an effort to replace the paper chart with a computerized record that would satisfy the needs of the practicing physician. A complete list of diagnoses and procedures is maintained, as is a time-oriented record consisting of subjective and physical findings, laboratory data, and therapeutic interventions. Data may be reviewed in problem-oriented, time-oriented, or encounter-oriented formats. Automated histories and data collection protocols are supported to enhance data collection for a specific problem or study. Functions that are necessary to manage a practice, such as appointment scheduling, charge capture, accounts receivable, management reports and utilization statistics have been added as spin-offs of the medical database to justify the cost of computerization. TMR has been installed in fifteen sites ranging in size from a three-man obstetrical practice to a sixty-bed cancer hospital.

(Dr. Stead is Associate Professor of Medicine at the Duke University Medical Center and Co-developer of TMR).

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