Functions Required to Allow TMR to Support the Information Requirements of a Hospital

William W. Stead, M.D. and William E. Hammond, PhD.
Box 2914
Duke University Medical Center
Durham, N.C. 27710

Abstract

The Medical Record (TMR) has been modified to provide the features of a hospital information system that are necessary to support a small hospital. Experience installing TMR in the Kenneth Norris Cancer Research Hospital suggests a system centered around the patient's medical record can meet the service needs of a hospital. Individual departments must surrender some of the autonomy that a task-oriented system would allow, but they each gain access to a chartless record in the process.

Introduction

The Medical Record (TMR) [1,2] is a medical information system that had its origins in an effort to replace the paper chart with a computerized record that would satisfy the needs of the practicing physician [3]. Functions that would aid practice management, such as appointment scheduling, charge capture, accounts receivable, management reports and utilization statistics, were added as spinoffs of the medical database to justify the cost of computerization. By January 1981, TMR was functionally rich enough to allow a large group practice to use it to perform their scheduling, accounting and medical record keeping functions [4].

Although the initial ten TMR sites proved that TMR was flexible enough to support practices in general medicine, the medical subspecialties and the surgical subspecialties, each of these sites had an ambulatory care base. In April 1983, TMR was implemented at the Kenneth Norris Cancer Research Hospital, with the expectation that it would maintain a computerized record and support the information needs of both an ambulatory care clinic and a sixty bed inpatient service.

This paper discusses that experience and contrasts TMR with more traditional approaches to a hospital information system (HIS). Modifications that were required to allow TMR to evolve from its ambulatory care base to provide for the information needs of a hospital are noted. Needs identified during the planning process are separated from those that did not become apparent until the system was in actual use.

Differences Between TMR and HIS

TMR is written in GEMISCH and is operational on Digital Equipment Corporation's family of PDP-11 and VAX computers under the RSX and VMS operating systems. TMR has a modular design and utilizes a facility-controlled data dictionary to define those aspects of a medical information system that vary from site to site.

The TMR record contains demographic and financial data, problems, procedures, subjective and physical findings, studies, and therapies. Nonnumeric data is stored as standard abbreviations or codes. Data is grouped according to its medical meaning. For example, all different ways of looking at the number of red blood cells are stored together regardless of how they were ordered. Important medical summary data is never archived and that data which is archived is kept on-line and interactively accessible. Data is retrievable in problem-oriented, time-oriented and encounter-oriented formats.

Rather than focusing upon the medical meaning of data, hospital information systems are designed to expedite the individual tasks such as admission/discharge, order entry/result reporting, billing and collections which make up health care delivery. The hospital information system database is
organized around the task being performed. For example, a study's results are likely to be linked. Although a study results will not be linked, if a piece of medical data may be obtained in more than one way, the results will not be linked. Although a great deal of data is captured while using a hospital information system, this data will be archived at discharge and is difficult to review by patient over time.

Planning Process

The first step of the planning process for the installation of TMR in the Kenneth Norris Cancer Hospital was to review the functions of a traditional hospital information system and to determine which of them had not been required in ambulatory sites. Most commercial hospital information systems contain functions that are designed to increase communication through large institutions with several hundred beds. Some of these functions, such as bed control and dietary orders, were not included in the initial requirements because it was felt that they could be handled manually for a sixty bed hospital. The following functional enhancements to TMR were identified as necessary for the hospital to open.

TMR was designed to be used real time during the patient visit, taking advantage of interactions between the health care staff and the computer to improve data completeness, accuracy, and the quality of care ([5]). Accordingly, all outpatient activity related to an encounter is entered into TMR before the end of the day, and insurance claims are produced each night. An inpatient service requires a multiple day encounter with production of insurance claims at interim billing or at discharge.

An inpatient system must automatically assign a room charge each day. The room charging program must be able to proportion charges based on time of admission, transfer between rooms with different rates, or discharge before the end of the day. Other charges such as a pharmacy charge for each day on which medicines are dispensed must be captured automatically.

Outpatients move through a clinic so rapidly that it is not necessary to track patient's specific location. For inpatients, a census must be generated and sorted by nursing station for bed control, by name for the information desk, and by physician to optimize rounding.

Experience with TMR had shown that a combination of 47 predefined demographic items and three wild card choices was adequate for ambulatory care sites. An inpatient service requires additional items such as medical/surgical indicator, smoking status, patient condition, allowed activity and method of travel. Initially the study had items were added as requested. However, additional data was requested constantly and required implementation of a generalized database section that allowed the facility to add items at will.

Special purpose demographic reports are required such as a chart front sheet that contains demographic data and allows for case abstracting. Physicians who desire to do their professional billing independent of the hospital can also use this report to initiate the billing process. Inpatient charges must be reported on different insurance forms than outpatient charges. Professional charges must be split from the technical component. Charges are grouped by type instead of being itemized.

In an ambulatory care practice, data is rarely collected on a patient more than once a day, and results can be returned directly to the physician. TMR was designed to keep track of the date a procedure was performed, avoiding the overhead of storing time. An inpatient service requires the addition to the requisition of time the specimen is obtained and patient room number to allow collection of the specimen and routing of the result back to the ward.

TMR was designed to report results to the physician in time-oriented flow sheets to emphasize developing trends. An ambulatory system with an accredited laboratory requires a detailed report that includes data such as the time the specimen was obtained, sex specific normal values and the name and address of the laboratory director.

Ambulatory care utilization statistics need to be reported in a limited number of ways and can be summarized in predefined reports. An inpatient service requires a more elaborate breakdown. For example, seven revenue centers sufficed for outpatient care, but three hundred revenue centers were required by the hospital. Inpatient reporting is best handled by creating a database subdivided by type of patient, place of encounter, provider, revenue center and transaction code and allowing the user to request the specific output that will answer his question.
Installation

The new requirements that had been identified during the planning process were in place when the hospital opened. Within the first few days several additional needs became apparent.

Although TMR had been modified to allow multiple day encounters, the assumption was made that data would be entered real time and that an encounter would be in final form by the time a patient was discharged. In a twenty four hour a day operation, this policy is difficult to enforce when a discharge occurs outside of normal working hours and the personnel needed to update the computer are not available. TMR had to be changed to allow data entry about a hospitalization for up to three days after discharge.

To ease of entry and data review, TMR had been designed to allow entry of all of the diagnoses, charges, studies, therapies and supplies for a day from a single video display. Screen size limited the number of entries to nine diagnoses, nine charges, twenty studies, ten therapies, and six supplies per day. Inpatients regularly exceed these limits. Using over thirty supply items for a patient in a day is not uncommon. TMR was modified to allow unlimited overflow for each of the types of data. It was also necessary to double the amount of data that could be entered into a record before archiving occurred.

TMR allowed studies to be preordered as part of making an appointment. The inpatient system required development of an on-going preorder system. TMR was changed to allow studies to be preordered for any time in the future. At shift change, each ward reviews the preorders for the next shift and activates those orders which are still valid, causing requisitions to print close to the time a specimen should be obtained.

TMR treated multiple results for a test on one day as single results of multiple tests. For example, A.M. and P.M. cortisols were treated as two distinct studies. The same test is performed multiple times on one day in the inpatient environment so often that treating each result as a separate test made flow sheets and graphs meaningless. TMR had to be changed to accept multiple results for a study as multiple results of a single test.

TMR printed all of the results of the studies for an encounter when the last result returned instead of as each result returned. In the outpatient clinic this procedure allows the physician to think about all of the results at once instead of piece meal. In the inpatient setting conditions change so rapidly that it is necessary to print all the results that have been entered during the day, regardless of whether more results are pending.

In an outpatient clinic, a several day's supply of a prescription will be given to a patient at a time and it is correct to bill for the entire amount when the drug is dispensed. If part of the medicine is not used, the patient throws it away. An inpatient pharmacy requires the unit dose system. A supply of the medicines the patient should need are sent to the ward at the beginning of the day, but the patient may be only billed for the medicines that are actually taken. A new display had to be added to TMR that allowed the pharmacist to note the amount of medicine dispensed as the tray was filled. When the tray comes back to the pharmacy, the amount of medicine returned is entered into TMR and the patient is billed for the difference.

Even quite sick outpatients take a limited number of medicines, and it is possible to display them on a single video frame. We found that inpatients take a large enough number of different therapies that it is necessary to use multiple displays and to sort the entries by type of therapy so that all like medicines, antibiotics for example, are grouped together.

Inpatients receive types of therapy that require more detailed prescription information than outpatients. Data such as flow rate had to be added for intravenous medication. Radiation therapy required addition of site and cumulative dose.

Discussion

Despite fifteen years of experience in medical informatics, working closely with both the Duke Hospital Information System and TMR (6), our projection of the changes that would be required to allow TMR to support inpatient care was underestimated. Many unplanned changes have had to be made during the first months of actual operation. Never-the-less the experience suggests that it is possible to have both a chartless record and a hospital information system.

With a task-oriented hospital information system, each service department can have autonomy that is
difficult to provide when data is stored in the medical record. The director of the laboratory service rightly feels that he is responsible for the quality of data reported to the physician. He wants to be able to prevent anyone other than a laboratory technician from validating a result, and he wants to exclude data from the system if it comes from an unknown laboratory. The physician rightly wants all available data in the patient record, and he wants the data displayed in an easily interpretable form such as a graph, regardless of its source. The conflict over who owns the data will be a long term problem.

Six major groups of people use the patient record: administration, business office, laboratory, pharmacy, nurses and physicians. Each group has different needs and will be happy with a consolidated system only after they see the benefits of accessing another group's data. It is important to provide something for each of the groups early in system implementation, but priority must be given first to collection of payments to keep the institution open. Second attention should be given to the service departments. The physicians and nurses who gain the most in the long run must be satisfied last.

Our efforts during planning and installation have therefore addressed the service departments. We are now ready to begin to develop tools that provide the advantage of the computerized medical record to the nurses and physicians. Care plans and rounding fact sheets will be the first step.

References