Communications with physician-users is a serious problem in clinical laboratory practice today. Its symptoms are cumbersome test request procedures, abuse of stat requests, duplication of test orders, too many phone calls. Most computerized systems ignore these problems. Those that rely on on-line interactive terminals have only exacerbated it. These problems are easily solved by reports printed in the laboratory and delivered on schedule directly to each physician. These reports contain only current information on the patients of direct interest to the addressee, and they satisfy 85% of his need for laboratory information.

A system of this kind has been operating continuously in one hospital, and has recently been installed in a second.

Introduction

Major efforts toward the computerization of clinical laboratories have heretofore been directed toward the internal operations of the laboratory: on-line data acquisition, data conversion, quality control computations, standardization, and the like. All of the 14 laboratory systems that have been offered commercially in the last fourteen years, and most of the research systems developed in academic laboratories have had this emphasis. This uniformity of approach apparently stems from the common error that computers are most useful, or most immediately applicable, to problems of computation. This error is two-fold: first, computers are equally useful in record-keeping, and second, the primary problem of the clinical laboratory is not computation, but communication.

Communication

The principal function of the laboratory as a professional component of an organized system for providing health care is to support the primary physician with competent and useable information derived from laboratory tests. In support, communications is the controlling factor: the physician must communicate his need for laboratory information to the laboratory, and the laboratory must return the information to him when and where he needs it. For full effectiveness, this two-way communication must be extended to include acknowledgments back and forth; it must be controlled from the laboratory, where the active interest is; and it must apply modalities and techniques that optimize the utility of the system to its users -- the primary physician staff of the hospital (or other health organization).

Responsibility

By law and custom, and even more profoundly by the intrinsic nature of the task, the laboratory bears the full responsibility for its clinical service, from the instant the physician formulates a laboratory order until he and his colleagues have exhausted the usefulness of any medical data thereby generated. If anything goes wrong, the laboratory will get the blame; hence the laboratory must demand the full authority over the entire process which goes with full responsibility. This means that laboratory personnel, not ward clerks, must enter the test requests; laboratory personnel, not Central Dispatch messengers, must pick up the specimens; and laboratory personnel must deliver the reports and must enter them into the patient records. Further, the laboratory must select appropriate report formats just as it selects appropriate test procedures. There is no one else with the professional training and experience to carry out these tasks except laboratory personnel.

If this sounds like a radical extension of laboratory's responsibility, it is not; it is merely an objective recognition of the realities of the situation. Anything less will lead -- and has led many times in the past -- to disaster.

It is, also, a warning to computer experts: the laboratory cannot be effectively computerized from the outside; you must take into account the special requirements of the application.

The CURRENT System

This paper describes a system, based on these principles, that has been in operation since 1970 in one laboratory, and has recently been installed in a second. The system differs radically from conventional computer systems: it uses no terminals, while conventional systems rely on them; all input (both test requests and laboratory results) are via manual keyboards; conventional systems require on-line interfaces; the others emphasize "instant" results; the CURRENT system delivers laboratory-printed reports on a predetermined schedule; CURRENT operates in batch-mode; the conventional systems are real-time.
Within our space limitations, we cannot describe every detail of the CURRENT system. We limit our discussion to three features: Scheduled Operations, the Test Request, and the Physician-Oriented Report.

Scheduled Operations

A characteristic of the CURRENT system is the use of scheduled operations. Some 90% of all data processing operations in the laboratory follow a standard pattern which can be economically incorporated into a systematic computer-driven schedule. The remainder, up to 10% of any operation, requires the intervention of experienced and intelligent operators in the system. This principal applies in varying degree throughout the entire data processing system.

In test billing, for example, 8% of charges are for routine tests, another 10% are special tests for which a charge can be assigned, and the remainder is work which, for one reason or another, cannot be billed, such as tests performed for the benefit of the laboratory itself.

Laboratory test ordering is another example. Some 80% of laboratory orders are generated on a fixed schedule to accord with the daily routine of clinical practice. The normal reporting schedule is about 20 hours, giving the physician time to evaluate the results before writing the next order in the circadian cycle. In this context, a system that delivers the report "instantly" is defective: the instant reports will be lost before the physician gets around to using them. When this happens, the physician orders Stat, thus further interfering with the orderly systematic processing of laboratory work. There are, of course, legitimately shorter turn-around times, ranging from a few hours in a metabolic ward to the true emergency, requiring the utmost in speedy response from the entire laboratory. It is counterproductive to design the system entirely around the emergencies.

The Test Request

The beginning of communication with the physician is the test request. In conventional computer systems, this is processed in one of two ways: (1) the hand-written request form is replaced by a machine-readable document, intended to make the laboratory's job easier in entering the request when it reaches the laboratory. In fact it does not do so. The extra effort at the clinical end in preparing the document results in an error rate as high as 2%. When these errors reach the laboratory, they cause more trouble than the previous hand-written documents caused. (2) a far more costly solution is the interactive terminal at the nursing desk or clinical station. The entry is supposedly performed by the physician himself; in fact, it is done by a nurse transcribing the doctor's hand-written orders. There is no economy, no assistance to the user in an unnecessarily burdensome clerical task. In addition, because the terminal is programmed to exclude any entry that is not complete and verifiable by the computer itself at the instant of entry, many requests are rejected; for example, the new admission workup ordered before the admission procedure has been completed. These rejections are unnecessary.

The CURRENT Process

The CURRENT operator calls up a set of test request forms printed specifically for each clinical unit. This ordered set, carrying patient identification data for patients known to be on that unit or previously scheduled to be there, are printed ten to a page. They provide space for checking off routine tests for that unit and allow for entry of special orders. Blank forms are included for the unexpected patient. These forms, in convenient order, provide a checklist of possible work to be ordered so as to minimize last-minute orders. They eliminate up to 80% of the work involved in imprinting charge plates on the conventional forms. They are far easier to use than any terminal device, and far less expensive. They are always available at the unit on schedule; 90% of the work is scheduled, if the system supports it.

At the laboratory end, these source documents, already sorted and pre-identified by page, eliminate 90% of the work in entering the tests requested into the system, and almost 100% of the errors arising in other systems.

Basically, we have created a system of individualized test request forms for each source location in the hospital, available for use when required, and printed only a short while in advance of the scheduled use. No manual system can do as much; nor can any terminal system, because the terminal is essentially a random access device, not a scheduled one.

The Physician-Oriented Report

Conventional systems, both manual and computer-based, take as their final objective the delivery of reports to the patient's medical record. The manual systems can go no further: the clerical task of preparing individual reports for individual physicians overwhelms any manual effort. The Chart Report is of course an essential product, and one that CURRENT produces reliably and economically. But it is not enough.

Conventional systems do in fact include one more step, one that is often forgotten: the doctor calls the laboratory, often several times a day, to get the information he needs. This step is ignored by such systems because it imposes an unnecessary and costly burden on both the doctor and the laboratory, which these systems have not seen how to remove. The daily count of telephone calls is a significant measure of system efficiency. Properly used, it can provide quality control statistics for the computer system operators that are just as important as the means and standard deviations of an enzyme analysis run.
attempt to resolve this problem by providing a computer terminal at each nursing unit to deliver reports to the physician-user. In effect, this substitutes a computer-terminal operation for a telephone call. Since the computer terminal is more expensive and also more difficult to operate, this solution is ineffective. Assuming that the doctor remembers correctly how to operate the terminal, it still takes him two or three minutes to go to the terminal, log in, and call up the information he needs—provided he knows in advance that the information is waiting for him. If it is not ready, the system has wasted his time. And if the information is ready, he waits another two or three minutes for the report to be printed out, or else he copies it by hand from the screen. A doctor seeing 20 patients can easily waste an hour or more a day in this operation. All this is a scandalous waste of a limiting medical resource, and is totally unnecessary.

On any rational analysis, the end product of the laboratory system must be a useful report in the doctor's hands. CURRENT is the only system now available that regularly and systematically delivers personal reports directly to individual doctors.

The CURRENT Doctor's Report provides each physician with his own report, addressed and delivered directly to him, containing all the information required to satisfy his current laboratory information needs. It lists each patient he is concerned with in the hospital or clinic, tells where that patient is, all tests ordered within the 24-hour cycle (and who ordered them), what specimens were collected, what work is in progress, and all the results now available (indicating any significant changes since the last report). All this information is presented in logical sequence and in compact form, using standard readily-recognizable abbreviations where convenient. It is printed with ten or more patients to a page in alphabetic order, allowing even a busy practice to be covered in two or three sheets of paper. The information is up-to-the-minute, reliable, and comprehensible. It is delivered on a schedule specified by its recipient, as frequently as may be required. These reports need not be filed or transcribed because (a) all the information they carry is also recorded in the patients' charts, and (b) the doctor can get a fresh copy at any time on request.

What does all this information cost the doctor? Almost nothing: he merely registers his report schedule and the delivery point, once; and he orders a patient to be included in his report, once; these become standing orders, valid as long as he does not cancel them. He can even order whole groups of patients: all patients admitted on his own service can be automatically included in his report. Subject, of course, to professional courtesy, he can obtain reports on other patients than his own; those he sees in consultation, for example, or the interesting problem patient whom he wishes to follow throughout the hospital stay.

It must be emphasized that this is a report of current information, i.e. laboratory data for the current 24-hour cycle. For longer-term review, the patient's chart, containing the computer-printed laboratory cumulative report, is also available, and for real emergencies, for Stat Reports, you will rely on the speed and convenience of the nearest telephone. These facilities will always be required in medical practice; the Doctor's CURRENT Report provides a convenient, useful, and efficient alternative.