DIRECT ENTRY OF PATIENT DATA TO A PORTABLE, BRIEFCASE COMPUTER: INTERFACE WITH OVERVIEW MEDICAL DATA BASE AT THE OFFICE

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Abstract

A "Computerized Notation System" is described, which allows capture of all the physician's or nurse's notes, using a 4 lb portable computer. The system produces all of the written communication required in daily practice, including daily notes, prescriptions, orders, "History and Physicals", and "Discharge Summaries". By "flagging" certain items, it is possible to transmit data from the portable computer to an office computer and "centralized" database. Programs now in development will allow this computer to generate Quality Assurance and research reports, and perform scheduling and billing operations.

INTRODUCTION

At the 1981 and 1982 SCAMC meetings, we described the "Computerized Notation System" (CNS), a system which allows physicians and nurses to input their notes directly to a digital medical database [1-6]. In parallel to this digital medical database, a paper chart is produced, which includes all of the written communications required of the physician or nurse: orders, prescriptions, patient medication summaries, daily notes, discharge summaries, etc. Thus, the use of the pen is entirely replaced by direct keyboard entry. The following components of the system allow data entry and data retrieval to be rapid, economical, and cost-efficient:

1) A complete computer system in each examining room or hospital room (by use of portable personal computers such as the HP-85 or Epson HX-20).

2) An "evolutionary" record in which each "visit" record serves as structure for the next record (avoiding need for re-entry of most of the medical data).

3) User-specification of common demographic, textual, and numeric entries, which appear automatically or at a single key-stroke.

4) A physically separate cassette tape for each patient (allowing storage of 5-25 years of patient information, and allowing the record to be up-dated at both the hospital and clinic).

5) Print-outs of 2 1/4" or 4" width, are generated during "real-time" of the patient interview, to be given to the patient or attached to standard clinic or hospital chart forms.

The CNS has been implemented in a variety of practices, including Nephrology, Neurology, Oncology, Family Practice, and ICU Nursing. Speed of operation (entering and printing) is equal to or greater than pen-entry to the paper chart [3-6]. With the Epson HX-20, the CNS system is highly economical, and easily portable to any location of practice. This computer weighs only 4 lbs., including integral batteries, 2 1/4" impact printer, microcassette drive, screen, and 16 K RAM expansion (yielding 32 K total RAM). Since this computer configuration lists at about $1000, the implementation of the CNS in a primary care practice of 400 patients costs about $3600 ($2000 for two computers, $1000 for 400 microcassette tapes, and $600 for the program). An even lower cost is obtained, if the physician does not wish to have patient histories generated by the computer; an "overview" option allows storage of present clinical information of 50 patients on one tape. Current information on 400 patients may then be held on 8 tapes.

FIGURE 1: EPSON HX-20 WITH 16 K RAM EXTENSION MODIFIED TO HOLD HOSPITAL PATIENT TAPES

A major goal of the CNS development was to produce the paper communications required of the physician or nurse in day-to-day patient care, and to produce these in a legible, organized format. However, the digital medical database produced by the CNS should also be of value in "transactional" aspects of medical practice, such as billing or patient scheduling. It should also, like all complete databases, be of use in answering the research or quality assurance questions related to practice of medicine. This paper describes the modifications to the CNS which allow it to create a "central" database in the physician's office, for performance of QA, Research, Scheduling, and Billing functions (D, R, S, and B functions). These modifications have been implemented on the HX-20 computer.
METHODS

The "visit" record of the CNS contains information of the following types: Demographic, Problem list, Textual entries, Problem numbers of textual entries, Orders (Plans), Numeric list (with normals) and date of visit. A typical daily note printout follows:

PRESENT PROBLEMS

CHRONIC BLOOD DISORDER
CREATININE  1.2
CREAT SLOWLY INCREASING.
FISTULA WORKING, MAY NEED DIALYSIS IN 1-2 YEARS.
BLOOD PRESSURE 160/90
BUN 5.7
CREAT 8
MSP 6.4
WBC 6.4

FIGURE 2 HOSPITAL NOTE PRINTED BY EPSONHX-20

was 2X, this maximum being dictated by the size of the CNS program and the desired maximum visit record size (a 35 K record allows entry of a prolonged "first visit" of a patient).

The QRSB RAM file was designed to allow storage of QRSB data from more than one patient. Data from each patient was filed by patient initials and clinic ID number (patient initials are verified during loading of last "visit" from each patient tape). If only a few items of QRSB data were stored per patient, it was possible to have data from 10 or more patients accumulated in the QRSB file. (In the Epson HX-20, RAM files are not lost when the computer is turned "off").

An "error" message was constructed to indicate when the QRSB file was full. The user was then given 2 options for "unloading" this file: storage on a QRSB tape, or transmission over RS-232 connection, directly to the office computer. If the QRSB tape was used, it was "unloaded" at a later time through the RS-232.

Office computer programs are now in development on the Epson QX-10 (128 K). The basic function of these programs is as follows. The CNS-SB program receives the QRSB data, and separates it by patient and by Q, R, S, B categories. Dates of visits, problem title changes, problem numbers used for text entry, and demographic changes are placed in the "B" file. Textual entries are then compared to "translation" lists for Q, R, S, and B, data, for purpose of standardization and determining non-defined entries. The translation lists include: DRG codes for problem titles, billing amounts for "B" entries, calculated time interval of physician's clinic hours, and QA or research elements of interest for certain studies. The Q, R, S, and B data are then merged with similar data from previous visits, and stored on 5 1/4" floppy discs. The CNS-SB program then calculates the current billing status of the patient (from entries of payments made previously or currently), and produces an up-to-date bill. It also calculates a return appointment consistent with physician's schedule, and prints a return appointment card. An overview of data transfer is shown in Figure 3.

The CNS-SB portion of the CNS program must be "resident" in the computer, along with the data handling functions, to produce timely bills and appointment cards. The CNS-QR portion may be loaded whenever it is desired to review and analyze data for specific QA and Research questions.

RESULTS

In early studies, we demonstrated that the CNS program, in Microsoft(R) Basic on the Epson HX-20, can rapidly review textual entries for flags associated with Q, R, S, and B data. This review does not slow the speed of data entry appreciably. Storage of the QRSB data in the RAM file or QRSB tape, and transmission of this data through the RS-232 interface to the office computer is straightforward, and made especially easy with the compatible QX-10. The design of the "central" office programs (CNS-QR/SB) is also completed, and is now being tested. This program is modelled after scheduling and billing programs now in existence. The research program's design will allow calculation of incidence of observations, trends of numerics, incidence of items, and correlations between any two variables.

CONCLUSIONS AND DISCUSSION

For the CNS-QR/SB programs to be effective, it will be necessary to have a high degree of consistency of entry in each individual practice. The translation lists must be constructed with care. Billing items, DRG-coded problem titles, scheduling language (such as, "RTC"), and QA and Research questions identified. In discussions with individual physicians, it appears that each one feels that he could so define his practice, if inconsistencies are reported to him on a regular basis. The first implementation of the CNS-QR/SB programs will be in a local Nephrology practice, a dialysis unit, and a Family Practice residency. Data will be collected on the number of inconsistencies, and the number of lost charges.
The CNS program represents an "inversion" of the usual data transfer of a digital medical database. In most such systems, the initial functions are transactional processes such as billing and scheduling. Items of clinical medical relevance, such as problem titles, medications, and laboratory values are "added on" to the database. Usually, physician and nurse notes are the last, and most difficult addition to the database. In the CNS, the largest database is constructed first, that of physicians' and nurses' notes. From this information, smaller databases are extracted, by review of textual and verbal entries, in a "pyramid" manner. Intrinsic to the design of the CNS is a judgement that physicians and nurses will not be likely to input all notes to a database, unless freeform text is allowed and facilitated. It remains to be seen whether physicians and nurses will use a computer system which, in an inexpensive manner, allows note entry from any location of practice. It also remains to be seen whether enough consistency of opinion and data entry can be developed, to allow text review to result in accurate Q, R, S, and B functions. With considerable consistency of input, microcomputers such as the HX-20 could even serve as information senders and receivers for hospital information, thus facilitating or replacing mainframe computers in this function.

REFERENCES

3. Ash, S.R., Mertz, S.L., Ulrich, D.K. "Streamlining of Problem-Oriented Notation with a