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COMPUTER-GENERATED NEONATAL DISCHARGE SUMMARY LETTER

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INTRODUCTION

The neonatal units at the Children's Hospital of Michigan (CHM) in Detroit have admitted between 500 and 1000 sick newborns per year since 1972. From the beginning, an attempt has been made to keep records of the patients and of some of their clinical characteristics in order to learn more from past experiences and to gather reliable statistical data relevant to the population served. In 1972 a procedure was initiated whereby each completed chart was reviewed by a physician working in the unit, pertinent data were recorded on McBee Keysort Cards, and a letter was dictated on the basis of this final chart review. Copies of the letter were then sent to the referring physician as well as to hospital medical records, where they were accepted as the official dictated discharge summary.

In order to obtain some uniformity in the content of the discharge letters, a specific format was developed for the letters. The format contained the beginnings of key sentences along with suggested items of information that needed to be included. As a result of this prescribed format, a minimum standard set of data was always included in the letter to the referring physician or summary report to medical records.

By 1978, retrieval of data using the McBee Keysort Cards was becoming cumbersome because of the large number of cards accumulated. In addition, other limitations of the system were becoming obvious to us. We therefore looked into the capabilities of the university-

based computer time-sharing system, the Michigan Terminal System (MTS), for software that might help with the development of a more extensive and convenient data base. It was believed essential that any new system not require any more time than the old system to input, store or process the data, and to generate the discharge letter report. The following is a description of the computerized data base we have developed to meet these needs.

THE DATA BASE

The software package selected to support the data base is called MICRO. MICRO was developed by the Institute for Labor and Industrial Relations and provides interactive programs designed to define "dictionaries," implement entry of new data, retrieve data in various forms, and carry out simple statistical manipulations.

The dictionary is a set of definitions of stored pieces of data (fields). It contains the name, abbreviation, and narrative description of each field, and thus defines the data to be stored. The maximum value of integers and the precision (e.g., number of decimal points) with which they will be stored is also defined. Categories within fields are also designated and defined as required in a similar manner.

There are seven kinds of fields for the storage of facts about our patients. The data can be recorded as a signed integer (i.e., plus or minus number), as an unsigned integer, or as a field of alphanumeric characters (i.e., words). Each of these three can be further designated to have categories (e.g., 1 = female, 2 = male), thus expanding the kinds of fields to six. In addition to those six choices, the author of the dictionary can designate a field of alphanumeric (narrative) data that merely points to lines in a file outside of the confines of the primary data file. The latter type of field is preferred when the length of the field is anticipated to vary considerably from case to case. Thus, large areas of space need not be set aside for each case just to accommodate the needs of a few. Whenever the data from an external field are called for, the system points to the appropriate place in the external file and automatically prints out the contents.

The data base comprises 104 fields per case, including a maximum of 23 numeric values, nine character fields of 16-40 alphanumeric characters each, 64 categorical fields with 3-30 diagnostic or treatment categories each, and eight fields containing pointers to data stored in external line files containing 0-512 characters of narrative each.

Presently, a form is filled out when the patient is discharged. The form consists of a single sheet printed on both sides and has three sections. First is a section containing character fields (e.g., surname,

name of referring institution), integer fields (e.g., date of birth, head circumference, birth weight), and some categorical fields (e.g., sex, race). The second section contains the beginnings of sentences to be completed, primarily for the entry of free-form narrative sections in the discharge letter. The third section is a series of fields containing historical, diagnostic, and treatment categories.

The form is initiated and partially filled in by clerical staff. It is then completed by physicians involved in the care of the patient. The clerical staff then enters the data into the computer using the interactive data entry program provided by MICRO and the letter is ready to be generated by a series of simple commands.

GENERATION OF THE LETTER

The MICRO data base system can be programmed to deliver reports defined by the user. These programs can be called into action simply by naming them and by providing variable data as necessary to pinpoint which records are required. In the case of our discharge letter, the typical command reads, "LETTER XXXXXX yy," where XXXXXX stands for the patient's medical record number and the yy the initials of the attending physician who will sign the letter. The program automatically provides all the rest of the processing necessary to generate the discharge letter.

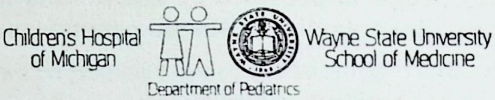
The letter program prints the current date, selects the designated patient record, and merges it with a record in a data base called REFERRING that contains an identical field designating the last name of the referring physician. Next, the program calculates the number of days between the date of birth and the date of admission to give us the AGE-AT-DISCHARGE. This newly created field is merged with the patient's data file also. Finally, the expanded patient data file is merged with a file containing form-letter jargon, commands for punctuation, typewriter carriage control commands, and a designated field from a file containing the signature blanks of our in-house attending physicians.

The rest of the process consists of a series of PRINT commands. The program commands the printer to print each clinical value or category, jargon phrase, signature blank, or narrative-sentence-ending in sequence, formatting and punctuating appropriately. It not only selects the order of items to be printed, but the part of the dictionary to be printed (e.g., the number, the category name, the category description), and signals for the starting and stopping of the printing mechanism.

The jargon file contains stereotyped phrases, such as "BABY (sex) (surname) WAS BORN ON (date-of-birth) AND TRANSFERRED

TO CHILDREN'S HOSPITAL ON (date of admission) BECAUSE OF (chief complaint)." The items in parentheses are values extracted from the individual patient's data base file. Eight of the fields in the patient data file contain appropriate endings for phrases such as, "THE PHYSICAL EXAMINATION REVEALED," or "IN ADDITION, THE INFANT RECEIVED. . . ." These "endings" can contain more than one narrative sentence.

This letter is printed on hospital stationary using a high-quality



October 19, 1981

Dr. Abraham Slaim
11079 Beech Daly
Taylor, Michigan 48180

Re: Baby Boy [redacted] (C.H.M. Record# 770371)

Dear Doctor Slaim:

Baby boy [redacted] was born on 04-07-81 in Riverside Hospital and transferred to Children's Hospital on 04-07-81 because of prematurity and respiratory distress.

Records from the hospital of birth showed the birth weight was 1320 g. and Apgar scores were 4 and 6 at one and five minutes. The baby was born to a 18 year old gravida 1, para 0, after a 33 week gestation. Her pregnancy was described as uncomplicated. Delivery occurred under local anesthesia. Events of the intrapartum period were as follows: excessive bleeding, betamethasone prophylaxis.

At the time of admission to Children's Hospital the baby weighed 1320 g. The head circumference was 27.0 cm. and the length was 39.0 cm. The physical examination revealed a premature infant with severe respiratory distress. The remainder of the physical examination was unremarkable.

X-ray examination of the chest showed hyaline membrane disease. Serial films revealed bilateral pneumothoraces. Echoencephalograms revealed a right caudate nucleus hemorrhage. Pertinent laboratory values obtained during this admission included a peak bilirubin level of 14.9 mg% on 4/10/81.

The baby was treated with gentamicin, methicillin, furosemide, pancuronium, calcium gluconate. The infant was on a mechanical ventilator for 23 days. In addition, the infant received phototherapy, oxygen, surgical repair of the bronchopleural fistulae on 4/15/81.

The infant was discharged on 06-09-81 at 64 days of age on 20 calorie formula, vitamins and iron. At the time of discharge, the weight was 2000 g., length was 45.0 cm. and head circumference was 32.3 cm. The infant's problems at discharge were resolved. The baby will be seen for follow-up by Dr. Slaim. The last hemoglobin and reticulocyte count obtained at Children's were 11.0 g% and 4.5 %.

Diagnoses at discharge were as follows: boy, 33 week gestation, SGA,

FIGURE 11.1a. First page of typical computer-generated neonatal discharge summary letter from the Children's Hospital of Michigan.

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perinatal asphyxia, hyaline membrane disease, bilateral bronchopleural fistulae, bronchopulmonary dysplasia, hyperbilirubinemia, apnea of prematurity and caudate nucleus hemorrhage.

Procedures done during this hospitalization include: echocardiography, umbilical artery catheterization, umbilical venous catheterization, echoencephalography, 3 exchange transfusion(s).

Thank you very much for the referral of this patient.

Sincerely,

Mary P. Bedard, M.D.
Associate Attending, Newborn Nurseries, C.H.M.
Assistant Professor of Pediatrics, Wayne State Univ.

FIGURE 11.1b. Second page of computer-generated neonatal discharge summary letter. This letter also serves as the official discharge summary for the patient's medical record.

typewriter terminal. A sample letter is illustrated in Figure 11.1a,b. The average time for printing a discharge letter is 3 minutes. The average cost per letter is $1.60. The development and extensive use of the system during the first year and one-half of operation cost less than $6000, including purchase cost of three terminals and the high-quality printer. One terminal has a Cathode ray tube (CRT) screen and the other is portable, to be taken home or to some other location if needed. The primary data file containing the first 1500 cases occupies less than 93 disk pages, or less than 93 kilobytes (KB) of memory space.

CONCLUSIONS

The computer-generated neonatal discharge summary letter has been in use at the Children's Hospital of Michigan in Detroit for well over a year. It has proved an efficient and convenient mechanism for getting important information in a timely manner to the physicians who referred our newborn patients to us and who will provide their primary care after discharge. The letter has not been recognized by any of the recipients as an electronically composed communication. Besides having met our data collection, storage, and retrieval needs for compiling statistics, the system has provided the bonus of improved communications with the referring physicians without additional effort on our part.

We are in the process of developing a plan that would define a set of the most common clinical problems likely to occur in these patients, for example, respiratory distress, sepsis, renal failure, growth and nutrition, and acid/base balance. For each problem a list will be developed of specific items in the perinatal data base that would be most relevant to handling it. This list will then be refined to 10 or 25 items selected by the clinical staff as most significant in the evaluation and resolution of each specific problem.

Our system plan includes a video-display terminal at each patient's bedside tied into the larger perinatal data system. These terminals will be programmed so that a three key stroke entry can be used to obtain immediate recall of an information set previously designated for each specific problem. This information would always appear in the same form, with specific items always located in the same screen location.

We anticipate that this structured recall of problem-oriented data will be helpful in supporting clinical care. It would provide immediate recall of relevant information avoiding the delays associated with paging through patient charts or searching for information in other locations. Standardized data presentation formats will reduce the chance of misinterpretation. There is also a staff training aspect to this method. Since the list of items included is a problem-oriented data set to be carefully selected by highly trained medical specialists who will not always be available when a problem develops, it will be helpful in reminding less experienced clinical personnel of all the factors to be considered in the resolution of a specific patient care problem.