HOSPITAL INFORMATION SYSTEM

DOCTOR'S ORDERS PHASE 2

# 323 - 66

AUTHOR: J. SEGALL
DMHA PHASE II

Demonstration Project for CRT Unit

Proper introduction of "digiscribe" CRT device can be important to the future success of Phase II. The first uses of this device will be on a limited scale (probably not more than 4 units). If the future users of the total system are to be indoctrinated to a positive attitude toward Phase II, a carefully thought out first use should be established. This demonstration project will also provide DMHA personnel with a training ground in systems and programming for the digiscribe.

I. Factors involved in this choice are:

a) Be fairly simple to program
   This is important to minimize the effort on this first use, and to increase the probability of producing a functioning, reliable demonstration.

b) Be useful to personnel
   The system should serve some purpose. It should not be just a toy. A measure of this would be if this system could eliminate existing methods of disseminating information.

II. This system should be useful to as many types of personnel as possible i.e. physicians, nurses, administrative.

III. Be useful on a continuing basis in Phase II

   Any time spent on this project should not be wasted. The choice should be a small part of one of the larger functions of Phase II. For maximum returns the project could also be chosen as an improvement of Phase II systems.

IV. Be operational though 4 displays at DMH

   The initial 4 CRT's will probably be distributed to a) Information Systems, b) Administrator, c) DMH demonstration, 2 units.

V. Show capability of Phase II.

   The system should involve as many features of the Phase II system as possible. a) security check, b) multiple sequences of accessing information, communication, multiple uses of information etc.
Selection of Project:
After agreeing to the conditions for selection,
CSF, DMHA and CDC shown "brainstorm" projects to be
used for this demonstration.

Some beginning suggestion might be:

1. Replace some or all 22 copies of admitting form. People interested in parts of this information would identify themselves, be presented with a chain of displays of their interest, and would see only necessary information. (CRT in admitting and doctors lounge)

2. Doctor Directory
Displays of doctors names, telephone, etc. by name, specialty, or geographic location. Perhaps available to the public (CRT at switchboard, information desk and admitting).

3. Patient In-House Directory
Patient room number available by name or by physician to authorized people. (CRT's at information desk for visitors and doctors lounge)

4. Meeting Schedule
Time, place of meetings as well as names of committee members. Available to doctors primarily by their name. (CRT's in doctors lounge and information desk.)

5. Demand Bill
Cashier to use CRT to obtain financial information (CRT's at DMH cashier and SMH cashier).

6. Hospital Telephone Directory
CRT at SMH and DMH information desk
PHASE II STUDY

The study of systems to be implemented in Phase II is scheduled for six months, beginning June 1965.

The results of this study will yield a priority list and schedule for the implementation. The study will show, for each area, generalized approaches to problems.

Hardware definition for Phase II will be aided by data concerning volumes of data and types determined in this study.

The study will be done in two parts, running in parallel:

1) Administrative Study by department heads under Administration's control.

2) Physicians Study by doctors under Administrations control.

CSF will act as a staff service to these studies. CSF will not have any assigned authority over the people involved in the study.
PART I ADMINISTRATIVE STUDY

The installation of the computer for the processing of medical information at DMH requires the hospital to do a great deal of research into the needs of the hospital and its doctors. The first step in this study has been given the title of "Phase II System Study." This study will look at all areas of the hospital and examine the functions of each area; the relationship of services in each area to the physicians way of thinking; the types of services performed; and the factors affecting their efficient performance. The time allotted for this study is less than six months, and the number of individuals involved will be more than thirty. It is therefore, impossible for anyone person, or anyone small group to take on this task by itself.

It is imperative that the people responsible for each area in the hospital give of their professional knowledge for this study and assume responsibility for completing the study within their area. As Phase II is implemented, the department heads will need to know what the computer can do. The best way to learn this is to be closely involved in the system development from the beginning. The study has the best possible chance for success in the time available if the department heads share in its conduct; by having responsibility for this study, a more thorough job will be done.

The following is a plan of the Phase II System Study. It includes the subjects to be studied, the timetable and an outline of the methods to be used in aiding and controlling the study. Finally, there are some suggestions on the approach to the study that the department heads might want to take.
The timetable for this study is as follows:

<table>
<thead>
<tr>
<th>Event</th>
<th>Begin</th>
<th>End</th>
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<tbody>
<tr>
<td>Final Report</td>
<td>11/29</td>
<td>1/1</td>
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<tr>
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<td>7/12</td>
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</tr>
<tr>
<td>Types of Service</td>
<td>7/12</td>
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</tr>
<tr>
<td>Action Initiation</td>
<td>7/19</td>
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<tr>
<td>Action Confirmation</td>
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<tr>
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</tr>
<tr>
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<td>8/30</td>
<td>10/4</td>
</tr>
<tr>
<td>Review by Administration</td>
<td>10/4</td>
<td>12/6</td>
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<tr>
<td>&amp; Systems Engineering</td>
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</table>

During this period of time it is suggested that all the department heads meet once a week with Administration and the systems people to discuss progress in their areas. Although each area is different, the study approach should be similar in all areas. In addition, the final formats of information for each department should be fairly consistent for computer processing, and for presentation to the physician who must order services.

PRN time with the system engineering people will also be available to all areas.
Within each area, certain aspects of the job have to be studied. These are:

1. Type of service performed: How can all the types of service be related to each other in a hierarchy, from the most general (Physical Therapy) to the most specific (diathermy to the left knee cap)?

2. Action Iniation: What is needed by the department to perform the service? (Pat. name, diagnosis, medical history, etc.)

3. Action Confirmation: How are results of the service, or the performance of the service indicated?

4. Department Control: What is needed to get the most efficient production out of the department. What schedules, personnel skills, space and equipment availability, etc?

5. Doctors Order Form: How does the physician "mentalize" his selection of service from the department?
As a means to an end, the following is a suggested method of approaching the problem within each department.

1. Each department search the literature in their files relative to:
   a. other computer application for information about relating each type of service to the total department.
   b. Personnel utilization studies, standard times for various jobs.
   c. Standard vocabulary for use by physicians in ordering your services.

2. Study your departments services and how they are ordered. Problems or confusion in existing procedures should help point out better ways of relating your services for Phase II.

3. Study your scheduling of personnel, space and equipment, looking for ways to control work flow.

4. Study your needs for supplies. How can these be predicted for good inventory control.
PART II PHYSICIAN'S STUDY

STUDY OF MEDICAL INFORMATION

Doctors will be the prime communicators with the system, therefore, they must
be involved in the development of the information content of the machine and
the format for its display.

In conjunction with the department heads, they must establish guide lines
for the order of information in each department. Independently, they must
develop approaches to categorizing histories, physicals, progress notes, etc.
They must also determine audit controls and how these are to be used with the
system. The program with the doctors could be scheduled as follows:

<table>
<thead>
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<th>Date</th>
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<tr>
<td>Orientation</td>
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PHYSICIANS' ORIENTATION:

1. Goals of the computer project
   a. Total hospital information system
   b. All administrative data; bills, scheduling, control.
   c. Medical information; medical record (histories, physicals, progress notes, surgical reports, etc); medical audit as patient is being treated.
   d. Orders: rapid, direct contact of physician with service area.
   e. Results: quick, easily obtained progress reports. Results available immediately, and in many locations.

2. Problems of using a computer:
   a. Detail required
   b. Standardization required
   c. Preplanning required
   d. Cooperation and empathy required

3. Installation program
   a. Phase I
   b. Phase II study
      I. Determine what is applicable to computers
      II. Gross study of these areas for general approaches
      III. Establish implementation schedules.
   c. Phase II implementation.

4. Phase II study schedule
   a. Areas to be studied
   b. Study of these areas, assigned to small groups of physicians
   c. Special study of audit criteria
   d. Format of order inputs
Areas to be studied:

I. Survey of all items of information transmitted by the doctor to the hospital on behalf of his patients.
   A. Required information:
      1. Laws, Audits, Joint Commission
      2. for diagnosis
   B. To get care
      1. Orders
      2. requests
   C. To evaluate care
      1. results
      2. reports

II. Evaluation of the value of each item to the physician in terms of:
   A. Control of patient's care by physician
   B. Time saved by the physician
   C. Time saved for the patient
   D. Time saved for the hospital personnel

III. Priority and committee assignment for the study of each area.

The study of each area should include a further definition of required information with an objective of breaking the information into small units that can be placed together to form the larger, complete packages of information required for the care of the patient. This information should be classified so that it can then lead to the study of how the doctor will build his complete piece of information from the small units.

Audit controls should be established. Relationships existing between diagnosis and treatments that can pre-determined and looked for within the computer must be listed. In addition, procedures must be formulated for acting on these audit controls, be they required items, or suggested procedures for the ordering physician to follow

(more)
order formation: finally, all this information will have to be set down in the way that a doctor will proceed from his initial desire to say something, to actually getting his request into the computer. there will be several routes that doctors can take to get to the same information, all of these will have to be determined.
The Hospital Information System, Phase II, is a compilation of many individual projects. These projects have some interlocking areas, but are generally independent. Each, therefore, should undergo a separate study.

The progress of these studies will be enhanced if a plan of study for each area is established before the actual studies begin. The following report attempts to outline the information that each study should produce and show some objectives of Phase II.

The reports in this section cover only parts of the total project. They were selected from the vast listing groups according to the Phase II Schedule of Events.

Certain functions covered are tied to the Phase I system. The connections to these accounting functions:

Phase I covered the basic accounting functions relating to the operating of a health production model. The Phase II portion of this report provides for the financial control functions of the hospital's health production.
are not, however, discussed in detail. Some further areas are obvious, and the conclusion ends with some new creative problems rather than those of system engineering.

The functions covered in this report are:

- Doctors Orders
- Administrative Reports
- Medical Audit Application
- Medical Audit Standard Generation
- Results TBD/HP on-line input
- Payroll on-line input
- Previous c配送ng Information
- Demonstration Projects: Addition

The relationship of various functions to the whole system is shown in Fig. 1. The portions covered in this series of reports are indicated by crossed connecting lines. This coding is shown on the key to symbols and lines preceding fig. 1.

The report covering Doctors Orders also discusses some basic requirements of the human-machine interface via the Dicscribe (CCSC'svik device activated by placing a finger at the screen). These concepts, in Part 2 of the Doctors Order report, are referred to or implied in all subsequent reports.
Connections to phase I functions.

All other phase II functions.

Demonstration Product: Admitting.

Previous Admitting Information.

Payroll Online.

TPR/BP On-Line Input.

Medical Audit: Standard Generation.

Medical Audit: Applications.

Administrative Reports.

Doctors Orders.

Functions included in Study Reports shown with coded intes.
Some reports show, in detail, techniques for handling the data collected during the study. This was done for data that appears to be voluminous and complex.

Implementation of the functions covered in this series will take 18 to 24 months. Towards the end of this time, work should begin on study outlines for the next series of functions.

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2 Phase II Schedule of Events, Part 1 Section 5.
DETROIT MACOMB HOSPITAL ASSOCIATION

HOSPITAL INFORMATION SYSTEM

DOCTOR'S ORDERS:
Proposed Techniques for Implementation

Prepared by:

Jack Segall
Managing Director
Community Systems Foundation

June, 1966
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Levels of Information for Various Systems Used by Physicians

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Example of Data Organized for Study
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GENERAL CONCEPTS

One of the first uses of the Phase II System will be the input and processing of doctor's orders. This use will probably be the most frequently used one throughout the future of the system.

Because it will be first, and because it will be used often, the system and procedures developed now will have lasting effect on the success of Phase II.

The problem can be divided into two broad categories

1) How the user sees the system on the CRT. i.e. the format, consistency, and clairvoyancy* of the display.

2) How the necessary information to process orders is organized within the computer.

These two parts, are closely related. The organization internally must satisfy the requirements of displays.

The most important part of this project is the human-machine interface. If this is "successful", the whole project should survive. If the human finds the interface confusing, frustrating or overly complicated, the project will most likely fail.

*The user knows what he wants to do with the system, but he must arrive at this use by selecting from alternatives without really knowing where his choice will lead. He must therefore exercise "clairvoyance" in predicting that the item he selects will indeed get him to where he wants to go.
The organization within the computer, should be subordinate to the needs of the human.

The studies that are to be made of each Phase II function will produce the data needed to define the internal structures. The needs of the human user must be known so that these studies can produce the best information.

The first part of this report will discuss some of the human needs for the ordering system, and will define some terms relating to these systems. The second part will discuss the studies needed to accomplish this project. Third section will detail techniques for managing the large volume of data that will be needed to complete the studies.

Before embarking on any studies the people concerned, particularly the software developers should agree that the techniques used and the end products are desirable and possible to accomplish.
PART I
HUMAN NEEDS

RELATIONSHIPS OF INFORMATION

When writing orders, the users purpose is to select all the components of the desired order and to indicate a final approval of these components as a group. This will be accomplished through a chain of multiple choice displays. To simplify discussion, some definitions relating information in the system are necessary.

1) All the things displayed at one time from which a choice is made will be called a CLASS. (figure 1)

2) The components of a CLASS, the individual lines of choice will be called an ITEM.

3) The sequence of getting from one ITEM to any other ITEM will be called a ROUTE. A ROUTE is made up of a series of classes, where the ITEMS selected determine the route followed. (figure 2,3)

Any order is made up of a group of ITEMS.
(Drug order items are drug name, dose, route, timing).
Each item is selected from a class of similar items, (Class - Headache pills, specifying a route, to aspirin, Bufferin, Anacin etc.) The similarity will be determined by the route selected. The routes can be classified as belonging to similarity based on:

A. Indexing: alphabetic or numeric order as might be found in a dictionary or other reference manual.
ITEMS are grouped into a CLASS of similar items.

RELATIONSHIP BETWEEN ITEMS AND CLASSES

CLASS "A"

Figure 1
Figure 2

SELECTING AN ITEM

RELATIONSHIP OF ROUTES TO ITEMS
The desired item.

Combinations of these possibilities become the route for selecting the desired item.

Class B

Figure 3
B. Frequency: items grouped in order of relative frequency of use. These groups could be all of one type of item, or groups of several types of items (admission orders encompassing lab, x-ray, dietary and patient status orders).

C. Limits: items grouped by defined criteria of possible selection. Audit standards, available doses, etc., would be included in this group.

The user must understand the class of information presented, and must know what new display (class, item or route) will follow his selection.
CREATING THE HABIT

Humans tend to be creatures of habit, that is, they prefer familiar situations that call for a minimum of new decisions. In this system, the quantity of decisions is high. Everytime a class of items is displayed, the user must make a choice. If humans naturally reduce decision making by habit, the system should do likewise.

This would indicate that

1) The same classes of items should be repeated as often as possible.

2) Classes should be similar in structure.

3) Routes should be similar for all kinds of orders.

4) Items should be displayed in standard segments within any class.

5) Often used functions should be accomplished by a standard display.

The problems of conceiving habitual displays is more pronounced at the detailed end of a sequence than at the beginning. The first few sets of classes will be used to choose major objectives in the system, i.e. patient orders, service area involved, patient's name, etc. These broad categories can easily become familiar displays. However, each type of order has a different amount of detail in it, and each presents different problems as this detail is selected. For example;
a drug is specified by its

name
route
doze
timing

while a patient status order is specified by

the function
the status (bed rest)
(complete)

Standardization should be attempted at this detailed level.

The studies of the physicians order system must relate the types and specifications of different orders to classes of like elements. These classes, in turn, must be sequenced into logical, easily predicted routes.

Just organizing in this way, is not enough. The user must not be frustrated by a wider variety of classes than is necessary.

**ORGANIZING THE ORDER**

The process of selecting an order can be divided into various levels where each level is a unique specification for the order. If sufficient levels are used to describe the most detailed order, then less detailed types can be defined using a smaller number of levels.

For example

<table>
<thead>
<tr>
<th>Level 1</th>
<th>A</th>
<th>Patient status</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Medication</td>
<td>Function</td>
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<tr>
<td>Level 2</td>
<td>Drug name</td>
<td>Status</td>
</tr>
<tr>
<td>Level 3</td>
<td>Route</td>
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<tr>
<td>Level 4</td>
<td>Dose</td>
<td></td>
</tr>
<tr>
<td>Level 5</td>
<td>Timing</td>
<td></td>
</tr>
</tbody>
</table>
In general terms, the levels could be called,

1 - Type of Order (service area)
2 - Order
3 to 5 - Specifications

A further level, Level 0, should be added to define
the use of the system, i.e. patient orders. This
will provide for other uses such as

Physical
History
Progress Notes
Patient Results

The use of these levels will aid in defining needs
for each type of order. The unique specifications can
be determined, and then each can be related to the
others. (The drug route may be independant of the drug,
but the dose may depend on the route.) By putting the
levels in the proper sequence, lower order levels
(higher level number) can be limited in scope, making
it easier to choose the correct items.

The specification for the order becomes an ITEM
from the CLASS describing that factor. i.e. one gallon
is the item from the class of DOSE. The levels, then
are classes of information.

Figures 4 shows a general sequence for selecting
a patient, an order, confirmation and continued use
of the system.
route level 5
route R-15

items level 5
item T-15
level 5 item

CLASS
confirmation
or change

C
1 to 5
& P

item "change"

item "OK as"

CLASS
select
next use

item level 1

next use
goes to
selected level.

sequence of selection

---------- related information
Using the level organization, the sequence is a chain of like operations for each level. Selection of each level, in this general case requires

1) selecting a route to obtain information
2) obtaining the information via this route
3) proceeding to the next level

This process is repeated until all levels have an item specified. At this time the confirmation display is presented.

In actual practice, the following modifications could apply.

1) The choice of a route would be left to the computer based on previously selected items. Probability functions would determine 1st displays - if drug ordering by quick list were very frequent. This could be an item on the 1st class (level 0).

2) The choice of an item might be made by the computer; i.e. the administration route for a pill that can only be given orally.

3) The correction of a level at confirmation could bypass all lower levels if these were not affected by the changed item.

The system study will, of course, define each level and its associated routes. An example would be helpful at this time and is shown in Appendix 1. The process of
selecting a drug order (figure 5a) might involve choosing from the following.

Level 0: Selecting patient orders from: patient results, meeting schedule, admission pending, progress notes, etc..

Patient Level: Selecting a route from: hospital alphabetic directory, doctors own patients, nursing unit directory, medical service of diagnosis, consultation requested list etc.. Then selecting the correct patient from the list determined by the route.

Level 1: Selecting a route to choose the type of order from: a hospital service area list, admission order types, preoperative, post-operative, etc.. Then selecting medications from the selection derived by the route chosen.

Level 2: Selecting a route from: alphabetic by trade or generic, quick lists by doctor, diagnosis, therapeutic effect, or medical specialty. The desired drug would appear in the lists of the correctly selected route.

Level 3: This route selection might be done by the computer based on the kind of drug selected. However, the physician might want to choose a drug administration route from selections based on patients age (pediatric), patient condition (comatose), recommended practice, minimum dose routes.

Level 4: By the time the drug and the route are chosen, the variety of doses is probably limited. In essence, the drug name and administration route might define the dose selection route. However, additional choices could be offered such as calculate dose (based on patient age, weight, etc.), common doses, frequency of administration. The proper dose would be displayed and selected.
Level 5: Route options for timing would be similar to other levels, particularly Level 4. So much is already specified that the remaining choices should be limited.

In general, the ability to select a route prior to choosing the desired item can accomplish two things,

1) It can reduce the number of displays needed to pick the item.

2) It can increase clairvoyance by setting limits on what will follow.

All orders have two processes in common, after the detail is selected.

1) The order must be confirmed.
then 2) The user will do something else with the system.

CONFIRMING AN ORDER

The frequency that these two processes will occur suggests that some standardization would help satisfy the "habit" pattern of the system. A means of confirming all types of orders, regardless of their detail, within a single framework is required.

Finding a standard display for confirmation is aided by the "level" organization. A confirmation display that allows review of the entire order and the option of correcting one or more separate specification (levels) can be made.
Figures 5a and b show such a display. Figure 5a shows this display for a drug order, figure 5b is the generalized format showing fixed and variable data. Each level is shown on one selection line of the CRT. On the left are the specifications (ITEM) chosen by the doctor; on the right are his options to change each specification. For levels 2 through 5, the class name of the specification is a variable item displayed for each type of order. The level 1 item (Medication, Patient Status, Laboratory, etc.) determines these class names. In terms previously defined, a class of specifications (Drug name) is shown on the right; the item (castor oil) is shown on the left. If the physician wishes to alter his order, he points to "change......" of the class to be changed. The system would return to the correct sequence for reselecting this class.

For example: If he wishes to change the dose, he touches **CHANGE DOSE** on line 17 right. This returns the system to the selection of doses for castor oil. After selecting the new dose, he will be presented with this same display but the dose left of the line 17 will be changed.
<table>
<thead>
<tr>
<th>LEFT SIDE</th>
<th>MEDICATIONS</th>
<th>CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>0</td>
</tr>
</tbody>
</table>

| RIGHT SIDE | CHANGE | TYPING | OFF.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>0</td>
</tr>
</tbody>
</table>

PAGE 16
If the order is correct, he points to "ORDER OK AS SHOWN" and the order is confirmed.

This same display can be used to review existing orders on a patient. The physician can, using the "change...." selection, modify the order, or reconfirm it for continuing therapy.

This display standardizes the approval and confirmation of a new order or a continuing order. The general pattern remains constant, while variable information tells the user what he has done and what items he can change. In addition, by allowing this one step entry to the class to be changed, use of the system is simplified.

AFTER CONFIRMING AN ORDER

After the physician has confirmed his order he will be finished with the system or he will

a) want to "write" further orders on the same patient

b) want to do (or see) something else on the same patient

c) go to a new patient and
   i) write orders
   ii) do something else

D) use the system for some other purpose (meeting schedule, admissions pending, etc.)
To simplify reaching this next use, and to provide an habitual display, it is suggested that a standard format be presented following confirmation of an order. This format should be able to follow the conclusion of any use of the system. (Appendix I) Such a display is shown in figure 6. Figure 6A shows this display following confirmation of the order in figure 5a. Figure 6B shows the generalized "End of Use" display.

Again, this display is based on the "level" organization. The physician can reenter the system at the most convenient point. Subsequent levels would be selected as in the original sequence. The selection does not go beyond level 3. This is due to the seven selection line maximum of the CRT. However, for most applications, Level 3 would be of such detail that it is doubtful that even it would be repeated without changing level 1 or 2.
<table>
<thead>
<tr>
<th>LEFT SIDE</th>
<th>RIGHT SIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>PREVIOUS USE! WAS FOR:</td>
<td>MEDICATION</td>
</tr>
<tr>
<td>PATIENT ORDER(S):</td>
<td></td>
</tr>
<tr>
<td>STAY WITH</td>
<td></td>
</tr>
<tr>
<td>SAME PATIENT:</td>
<td></td>
</tr>
<tr>
<td>AND</td>
<td></td>
</tr>
<tr>
<td>SAME USE:</td>
<td></td>
</tr>
<tr>
<td>AND</td>
<td></td>
</tr>
<tr>
<td>SAME TYPE OF ORDER:</td>
<td></td>
</tr>
<tr>
<td>AND</td>
<td></td>
</tr>
<tr>
<td>SAME DRUG NAME:</td>
<td></td>
</tr>
<tr>
<td>AND</td>
<td></td>
</tr>
<tr>
<td>NONE OF THE ABOVE:</td>
<td>BEGINNING DISPLAY</td>
</tr>
</tbody>
</table>
### Display Format for Selection

**General Format**

**Capital Letters: Standard Display Words**

**Small Letters: Source of Variable Display Words**

<table>
<thead>
<tr>
<th>LEFT SIDE</th>
<th>RIGHT SIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>1 2 3 4 5 6 7 8 9</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>level 0 class</td>
<td>level 1 item</td>
</tr>
<tr>
<td>FOR YOUR NEXT FUNCTION</td>
<td>GO TO NEW PATIENT &amp; USE</td>
</tr>
<tr>
<td>STAY WITH</td>
<td></td>
</tr>
<tr>
<td>SAME PATIENT</td>
<td>GO TO NEW ITEM</td>
</tr>
<tr>
<td>AND</td>
<td></td>
</tr>
<tr>
<td>SAME USE</td>
<td>GO TO NEW ITEM</td>
</tr>
<tr>
<td>AND</td>
<td></td>
</tr>
<tr>
<td>SAME Ileiev112 ciliaxisi</td>
<td>GO TO NEW ITEM</td>
</tr>
<tr>
<td>AND</td>
<td></td>
</tr>
<tr>
<td>SAME Ileiev113 ciliaxisi</td>
<td>GO TO NEW ITEM</td>
</tr>
<tr>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 6b**

---

**Page 21**
SUMMARY:

The magnitude and variety of information contained in the doctors order system requires some common guides lines to make this system reasonably workable. In addition, the variety should be presented to the CRT user in common formats to reduce decision making and frustration with the system.

A classification system based on levels of information for a given order seems best. The levels would be chosen by various routes, depending on the user needs.

Frequent displays would follow a fixed format for all types of orders. Two suggested displays are Order Confirmation and End of Use. Each of these will occur at least once for each order specified.
PART II
SYSTEM STUDIES
DOCTORS ORDER INFORMATION FLOW

Bring the dream of Phase II into reality will require a great deal of learning about hospital functions. To complete the doctors order project, studies must be conducted of almost everything that happens. The direction that the studies must take should lead to knowledge that will allow programming of the system for use as suggested in the previous discussion. The studies, therefore, should be designed to examine various levels and routes of physician ordering. In addition, the output of a physician order, the communication with the service area must be known.

Figure 7 shows what happens now to information during an order cycle. The information flows between the doctor and the hospital following input. The hospital has little control of input, generally allowing the physician to use his own writing and his own language. For present systems, the hospital is represented by people at its interface. These people will first translate the physicians request into usable formats for the hospital i.e. filling out a requisition, adding
the patient identifying data and certain medical facts from the record. (figure 8). This restructured information is subjected to interpretation by the people performing the service. Schedules, inventories, equipment etc. must be determined through this interpretation. In addition, the kind of report to be issued is sometimes dependant on the order format. (figure 9) Finally the service is performed. Because the originator of the request is generally not present when this is done, some indication must be made to him of performance (or failure to perform). Verifying performance can be the output (lab test) or a note (drug given as ordered). This step must be included to complete the cycle. (figure 10)

When the computer is added to the system, the same steps exist in the cycle, but the relationships change between the doctor and the hospital, and between the translator and performer of service. Figure 11 shows how the machine affects the cycle. The doctor-hospital interface moves toward the input side. The hospital, now, is represented by the machine, and through the machine has some control over the doctor's "writing and language". The people do not come into the system until the interpretation of the order. The machine will be able to do some of this function, presumably
data input
interpretation

what follows

who
when
schedule

what is needed

equipment
inventory

perform service

figure 9

Interpretation and Perform Process

reports
buy goods
more service
Figure 10

VERIFICATION PROCESS
Figure 11
Improving performance (scheduling, inventory control, etc.). The machine also takes over part of the verification phase. This is principally as a communicator to the doctor, but the machine could evaluate the performance and make recommendations, including automatic input for subsequent orders.

Because the hospital (represented by the machine) has control of input, certain information about this function must be learnt. (Figure 12) The machine must know what to ask of the user to successfully translate and interpret the order for the performer.

Studies made of orders in the hospital will have to answer all questions in each part of this cycle, for all types of orders and for all levels of information in those orders. In addition, the studies will have to examine how people think about this information at the cycle points where man and machine interface.

What to Study?

The studies undertaken will be viewed as individual elements of the whole chain of ordering. The types of studies and some recommendations for carrying them out follow.

Figure 13 shows the general questions that the studies must answer. Although shown in a serial pattern, properly designed data collection could obtain, at one time, infor-
STUDY QUESTIONS TO BE ANSWERED

what can a physician order?

what specifies each order to service area?

how is order related to other orders?

what is the frequency of orders?

what verifies performance?

what follows performance?

what like functions can others order?

levels for each type of order?

who specifies what?

routes of selection

list real orders in desired patterns
mation for several of the questions.

Figure 14 shows the needed information and suggested sources for this information. The numbers in the matrix refer to the order in which each source should be investigated to answer each question.

WHAT IS AN ORDER?

The first order of business will be to define "What is an order?". Anything that the doctor writes on the order sheet now is an order. These range from specific drug requests to such things as "refer to social service". But are there other "orders" that do not appear here? Does the doctor suggest procedures in other parts of the record, or verbally to nursing personnel? Do other people create information that is classifiable as an order?

This study should give a complete list of types of orders issued by physicians and others. It is important that this be done, as this information will become the scope of orders handled through the system.

For each type of order found, its component specifications must be known.

1) What factors define the order for the performer to carry it out?

2) What is the relationship between these? Which specification is dependant (most often) on others?

3) Who must determine the specification? (the physician, the service area, etc.)
<table>
<thead>
<tr>
<th>ROUTES</th>
<th>IS LIST OF ALL POSSIBLE ITEMS COMPLETED?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What are orders grouped in classes?</td>
<td></td>
</tr>
<tr>
<td>2. What limits are on orders?</td>
<td></td>
</tr>
<tr>
<td>3. What are the frequencies of orders?</td>
<td></td>
</tr>
<tr>
<td>4. What relationships exist between orders?</td>
<td></td>
</tr>
<tr>
<td>5. What type of order specifications per order?</td>
<td></td>
</tr>
<tr>
<td>6. What else is needed to perform service?</td>
<td></td>
</tr>
</tbody>
</table>

(LEVEL 1 to 5)

FOR EACH TYPE OF ORDER

<table>
<thead>
<tr>
<th>OTHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What specifies the independence of literature-handbooks?</td>
</tr>
<tr>
<td>2. What determines sample nursing station?</td>
</tr>
<tr>
<td>3. What note is needed?</td>
</tr>
</tbody>
</table>

BY 1. A PHYSICIAN

INFORMATION SOURCES

- Known menu, rec. for service
- Service personnel talk with service area's
- Sample reports on service
- Literature-handbooks of service
- Cardex, work sheets
- Sample nursing station
- Observation

INFORMATION NEEDED
The results of this study will establish the levels for each type of order.

INPUT OF ORDERS

The next series of studies relate to the man-machine interfaces. For input, the routes of selection have to be determined

1) How are the classes of each type of order thought of by the doctors?

2) What is the frequency of use (quick lists)?

3) What relationships exist between orders? And diagnosis?

For output, frequencies and relationships of like orders must be known. Should all aspirin orders be grouped at the pharmacy, or all drugs for one patient?

By this time, fairly complete lists of orders and their specifications should have been developed. These lists should be expanded to include all orders and all specifications, with each associated by the routes of selection determined previously.

Coupled to this information should be specifications for additional information about the patient, needed to perform the service (i.e. diagnosis for X-rays).

VERIFYING SERVICE

The complete order cycle includes verifying that the service has or has not been performed. The method of verification for each type of order must be found. Initially, some of these may be too complex for this
functions application. If this is so, then some simpler method will have to be devised as an interim. (The complex verifications will come under the heading of Results later in the Phase II development.)

**SOURCES OF INFORMATION**

Many of these studies can be accomplished with one data collection effort. For instance, while looking for types of orders from service areas, the detailed lists of orders and their class structure could be obtained. When checking out selection routes, many different service areas could be discussed with physicians at one sitting.

The suggested sources of information could be utilized as follows.

**SERVICE AREAS KNOWN MENU:** This would be any lists of services rendered. In some instances these lists will not be specific enough for use in the study, but they can serve as a guide. Where many individual services are grouped on the menu, the grouping may be a key to a class of items to be used in routing.

**SAMPLE MEDICAL RECORDS**

Doctor order sheets will, of course, show most of what can be ordered. They will also hint at the sequence of ordering (if there is a standard for this) and perhaps show related orders. Each type of order should be checked
for the sequence of its specifications (levels).

A comparison of doctors orders with nurses notes will show some verification needs and also some things done for the patient without a physicians specific order (either standard hospital policies or implied orders).

SAMPLE REQUISITIONS IN CURRENT SYSTEM

The requisition is now the means of communicating with the service area. Studies of this will show what the performer needs to know about the order, and what changes are made from the physicians specifications (Translation Phase).

In addition, all orders as determined from the menus and medical records that require inter-department communication should appear on requisitions.

OBSERVING DAILY ACTIVITY ON THE NURSING UNITS will reveal those "orders" that remain within the nursing unit service area. These may not appear on requisitions or on order sheets.

LITERATURE, SPECIFICALLY MEDICAL HANDBOOKS AND REFERENCE INDEXES. These documents will probably be arranged in sequences and indexed in ways that make it easy for the user to find what he wants. The methods used will aid in grouping orders and selecting the best routes.
SAMPLING REPORTS ON SERVICE will show what information is given on verification. This source will probably have to be supplemented with a search and review of "reports" of incomplete services, as the existing reports maybe geared to completed service.

TALKING WITH THE PEOPLE involved will provide feedback about the whole system. The people will be able to fill in any missing information, and help evaluate the proposed organization before too much programming effort is put into wrong systems.
SUMMARY

The specific words needed to process orders will be determined by reviewing present papers containing these words. The patterns to be established for use on the CRT will come, in part from present patterns, and from the thinking of people who will use the information.

The data to be collected will cover a wide variety of organization, and for many types of orders, will be complex. The information must pass through several stages during its useful life. The stages will be the same in the new and old systems, although the computer will do much of the work.
PART III
HOW TO ORGANIZE THE DATA

Regardless of the sources of information used, the data gathered will have to be organized so that it has meaning for the programmers.

The data organization will, as stated earlier, depend on the end product. Therefore techniques for data collection should be based on the class-item-route-level concepts. The following are suggested procedures for handling this problem. The procedures are designed to handle the complex data collection problems (pharmacy orders). Simplification can, and should, be used for less complex problems such as Laboratory or X-ray. Appendix 2 is an example of real data processed through the steps described.

Step 1 (figure 15)
Determine all categories of orders. The names used for these will become level items. A category may be defined as occurring in

1. A given service area only
2. A group performed by a specific person.
3. A group at a specific time during the patients stay
**STEP 1**

- **Categorize orders**

  - **Service area groups**
    - **Area 1**
    - **Area 2**
    - **Area 3**
    - **Area 5**

  - **Performer groups**
    - **Performer 1**
    - **Performer 2**
    - **Performer 3**

  - **Specific time groups**
    - **Time 1**
    - **Time 2**
    - **Time 3**

  - **List orders**

  - **Step 4**

  - **To step 2**

  - **To step 7**

**Figure 15**
categories 2 and 3 will be groups of orders from different service area. Each order in these groups should also appear somewhere in one of the category 1 areas. As categories 2 and 3 are determined, the orders that make them up should be listed for later use. In effect, category 1 names will define types of orders, and it is this group that will be used in the following sequence of data handling.

Step 2 (figure 16)

For each Type of Order found in Step 1, determine the unique specifications that will define an order of that type. These specifications will be the variables needed to modify the key element of the order. The names given to these variables will become the level class names 2 through 5 (including the key element). See Appendix 1 for suggested class names. Definition of these variables will be determined by the needs of the person who must perform the service. Enough variables must be supplied to completely define what must be done for the patient.

Step 3 (figure 17)

The variables will be unique, in that each should define a separate characteristic of the order. However, the range of characteristics in any variable will depend on what has already been defined about the order. (If a drug in the form of a capsule is selected, then all doses relating to liquid medications are eliminated from the
STEP 2

determine specifications for each area

area A

spec A
spec B
spec C
spec D
spec E

go to next area

to step 3

figure 16
STEP #3

determine interdependence of specifications

spec A  spec B
     |     |
     v     v
spec C  spec E
     |     |
     v     v
spec D

level 1  level 2  level 3  level 4  level 5

to step 4

figure 17
range of doses that can be selected.) The interdependency of each level must be determined. In essence this means determining which specification is generally selected before others. This should lead to a chain of selection where the ranges in each successive lower level are reduced as more is specified about the order. At this point in the study, the interdependency will be determined by intuition and observation of the normal order of writing specifications on the doctors order sheets. Later, in Step 6, a quantitative analysis will be possible.

Step 4 (figure 18)

A list in detail of every possible order specification must be obtained. This will be the words and numbers to be displayed as items in classes 2 through 5. While this is being done, the frequency of occurrence for each specification should be obtained. This can be done by putting information about real orders onto punched cards in the following format:

Code for Type of Order Number Specification Number

Where the Code for Type of Order is an arbitrary number assigned to each type of order determined for Step 2.
LIST
SPECIFICATIONS

obtain complete order

assign order number

assign area code: type of order

from step 1

from step 3
determine level No. for specification

list on card

are there more specs for order?

YES

take next specification

NO

take next complete order

step 4 card

to step 5

type of order code

level number specification

order number

order number counter
This will allow later separation of the data into gross categories for analysis so that drug specification will not be processed with those of Laboratory, etc..

**Order Number** is an arbitrary code assigned to each complete order used. These complete orders, obtained from requisitions, charts or department menus will contain all specifications. As one punched card is made for each specification (level), this order number will allow each specification to be related together for interdependence analysis.

The **Level Number** will identify the class of the specification, and will permit analysis of each class separately.

Finally the **Specification** is the actual alphanumeric symbols used in transmitting the order from its originator to its performer. Each order should have a card for each level of specification. **Item Number** will be added to these cards in Step 6, and is defined in Step 5.

**Step 5 (figure 19)**

For each level, sort items in order of frequency of use, and then assign a serial number to each specification,
beginning with the most frequently used one. This number, prefixed by the level number of the specification will identify the specification.

This process can be done by sorting the punched cards created in Step 4. Sorting into groups by Type of Order by Level Number by Specification, alphabetic or numeric will produce a list, for each type of order, for each of its specification levels, a line for everytime each specification was used. This list should be edited to eliminate duplicate meanings in specification, sorted differently because of spelling or actual terminology used. A count of the number of occurrences for each specification will then give the relative frequency of occurrence. The list produced should be checked against department menus if it was not obtained from them. This will assure that samples taken from requisitions and charts do indeed contain all possible orders.

Another punched card should be made up, one for each unique specification. This card should contain

| Code for Type of Order | Level Number | Item Number | Specifications | Number of Occurrences |

where the code for Type of Order, Level Number and Specification are the same as defined in Step 4. The Item Number
is assigned to each specification in order of its frequency of occurrence. The combination of codes for type of order plus level number plus item number uniquely identify the specification. The Number of Occurrences is the frequency with which this specification appeared. If the list of specifications is long, the item number could be determined by sorting the cards on number of occurrences before actually assigning the item numbers.

**SUMMARY OF STEPS 1 THROUGH 5**

At this point a list has been created of all possible terminology used in writing orders. Theoretically combinations of these words will produce all possible orders a patient can be given, with these orders containing all necessary specifications. Each word or phrase has also been assigned an identifying number. This number will aid in organizing the data in the next steps. These remaining steps will interrelate these items in useable classes and routes for the CRT displays. These routes will be based on indexing, frequency and limit definitions. The assignment of items to displays will involve combinations of these routes.
Step 6 (figure 20)

For each type of order, select an item in the highest level. List all items in the next lowest level that are valid if this high level item were selected. Repeat this process for all items at this highest level, then repeat it again for the next level as related to the third level:

level 1 list level 2 items applicable
level 2 " level 3 " "
level 3 " level 4 " "
level 4 " level 5 " "

These lists will show the limits on subsequent displays when any item is selected.

The lists can be created by using the cards created in Step 4 with the Item Number added.

A. Select a level number and an item from this level.
B. List the order numbers in which this item appears.
C. Take all cards for the next lowest level, and find the items that have the same order numbers.
D. List each unique specification (edit listing from C to remove duplication) as relating to the item selected for A. This can be done using the numbers assigned to items in Step 5.

This process should be repeated for each item in each level. The resulting lists will show how specifications
STEP 6

SELECT AN AREA

SELECT HIGHEST LEVEL

SELECT AN ITEM

SORT CARD FOR THIS ITEM

RECORD ORDER NO.

MATCH TO ITEMS ON NEXT LOW LEVEL

ONE CARD PER UNIQUE SPEC MATCHED

ADD TO UNIQUE SPECS IN LOWER LEVEL FOR ITEM IN HIGH LEVEL

TO STEP 7

6A

IS THIS LAST LOW LEVEL?

YES

NO

CARDS FOR NEXT LEVEL

6

IS THIS LAST ITEM AT THIS LEVEL?

NO

SELECT NEXT ITEM

A

YES

IS THIS LAST LEVEL IN THIS AREA?

NO

SELECT NEXT LEVEL

B

YES

IS THIS LAST AREA?

NO

SELECT NEXT AREA

C

YES

TO STEP 7

-52-
are limited by previously selected variables. In addition, if the lists are in numerical order by item number, they will be in frequency of use order as well.

At this point, the interdependency established in Step 3 can be checked. Using this Step 6 sorting technique, the levels used in Steps A and C can be reversed. The interdependency will be correct if the list produced in D shorter for the original levels used in A and C than when they are reversed.

Step 6A

For further limitation, limits can be placed on all lower levels dependent on the highest level item selected. The procedure is similar to Step 6, except that before going to a new item, a match on order number is made for all levels of that order. This list may, however, not provide enough variety in the lower levels if the original sample is too small. However, for certain kinds of orders that are limited in scope, this extra step could be worthwhile.

Step 7 (figure 21)

For all items at any level, create lists of like items as determined by the routes wanted for selection; These routes will be based on
STEP 7

select a level

select a route

list items for route at selected level

list lower level associated items

organize into serial display formats

to step 8

figure 21

LIST LOWER LEVEL ASSOCIATED ITEMS FOR EACH ROUTE

from step 6

cards per matched unique specification
1. Indexing: arranged alphabetically or numerically

2. Quick Lists: Selected items arranged in frequency of use order.

3. Limits: Items grouped by defined criteria (i.e. admission orders)

Listing by routes should begin with the highest level. When a group of like items are determined, the applicable lower level items can be determined from listings obtained in Step 6. Duplications can be eliminated to arrive at the minimum number of lower level specification needed to complete orders for each route at each level. Routes should include those categories of orders found in Step 1 but not used up until now (categories 2 and 3). Certain frequency routes of personal preference (doctors individual quick lists) could be determined after the system is running by programming a count of each doctors orders. Or this could be collected during this study by adding a doctor code to the card used in Step 4.

Step 8 (figure 22)

Listing all displays for programming can be accomplished by listing the components of each display by specification number and showing what display or program prior to a display is produced if that item is selected. Non-speci-
fication items (i.e. names of various route of selection) can be numbered in the same manner as specifications.

This can be done by taking each route as defined in Step 7, and arranging the first level items into displays groups. If the first level contains less than one display of items, (about 14) it will be pregrouded. If it contains more than one display of items, then a split will have to be done. This split will in effect define further routes for selection.

When a display is formatted, the decks of cards produced in Step 6 associated with each item in the display will be the components of subsequent displays.

Certain listings for displays may be quite long. Many of the items might be logically of one group, but infrequently used. In this case thought should be given to using a variable input. Instead of having the actual item displayed, an item called "keyboard entry" would call up a display of a form to be filled in using the keyboard. This variable input might be useful for verification done by selected people within the service area. These people, skilled in typing, could handle numerical results faster through variable input than through selecting the correct value from a series of
STEP 8

A
select a level

select a route

list all items

form groups of less than 14 items

YES

are there more than 14 items?

find subsequent display items

assign title and number to this display

select an item from this display

list items for this display (see suggested format)

SEE TEXT

B

does item lead to a program or new display?

disp.

program

note program name

was this last item of this display?

NO

YES

from step 6

cards from step 6

CREATE FORMATS FOR ALL DISPLAYS

figure 22
displays. In any case, variable input used by non-typists should be limited.

In addition, a variable input provision might be allowed where there is uncertainty of the completeness of items known, or where these items are subject to rapid change; i.e. new drugs. Special procedures could be used when a variable inputs was made to allow human review of the data prior to any machine handling for translation or interpretation in preparation for performance of the service.

**SUMMARY**

Collection of the data is accomplished using punched cards (or other computer input). The computer is used for sorting and organizing the large volume of data. The end results, lists of items in each display, with connecting links shown should provide the programmers with enough information to know where they are going. When the study is begun, these procedure should be examined in detail to assure that all necessary information is gathered, and to define the programs necessary to handle this data.
APPENDIX I

Levels for Doctors' Orders and Other Uses of the System by Doctors

The use of levels for all types of orders is illustrated with some examples:

CAPITAL LETTERS are the level's class name.

Small levels are the items within each class.

The use of "END OF USE" display in fig. 6b can be illustrated for other functions by using the appropriate class names and items.
<table>
<thead>
<tr>
<th>Level</th>
<th>Drug Name</th>
<th>Type of Exam</th>
<th>Lab Area</th>
<th>Type of Order</th>
<th>Patient Orders</th>
<th>Laboratory</th>
<th>Medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 5</td>
<td>Level 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>--------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 3 Status</td>
<td>Level 2 Function</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visitors</td>
<td>Laboratory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bathroom</td>
<td>Patient Orders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bed Rest</td>
<td>System Use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Order</td>
<td>System Use</td>
</tr>
<tr>
<td>Patient Status</td>
<td>System Use</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Exam</th>
<th>Lab Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>Lab Area</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Body Area</th>
<th>Lab Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitals</td>
<td>Blood Pressure</td>
</tr>
<tr>
<td>Temperature</td>
<td>Pulse</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Admission</th>
<th>Last Test</th>
</tr>
</thead>
</table>

| Appendix 1 | Page 2 |

EXAMPLE OF DATA HANDLING

APPENDIX 2

Assume that the list of orders shown represents all the possible orders in a hospital. An example of the output of each step of the data organizing procedure is shown.

The extent of data handling from this short list will illustrate the need for using the computer to process this data.

The purpose of this example is to show that the proposed data handling techniques will produce the desired output; i.e. step 8.
<table>
<thead>
<tr>
<th>ORDER NO.</th>
<th>SPECIFICATION</th>
<th>TYPE OF ORDER CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bed Rest</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Vital signs t.i.d.</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Routine Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>4B</td>
<td>BUN stat</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Blood sugar - stat</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Serum amylase - stat</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Serum calcium - stat</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>SGOT</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>Chest x-ray</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>Abdomen, flat plate</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>N. P. O. - except for oral meda ordered</td>
<td>5</td>
</tr>
<tr>
<td>12</td>
<td>Demerol, 50mg., Im. q4hrs. p.r.n.</td>
<td>6</td>
</tr>
<tr>
<td>13</td>
<td>Thopen 1/150gr., Im. q4hrs. p.r.n.</td>
<td>6</td>
</tr>
<tr>
<td>14</td>
<td>Maalex tablets, i p.o. q4hrs.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Darvon 10mg. tab b.i.d. p.c. (q12hrs)</td>
<td>6</td>
</tr>
<tr>
<td>16</td>
<td>Librium 10mg. 1q b.i.d. p.r.n. for nausea</td>
<td>6</td>
</tr>
<tr>
<td>17</td>
<td>5% D/Normal saline 1000cc</td>
<td>7</td>
</tr>
<tr>
<td>18</td>
<td>then 5% D/W 1000cc + 1 amp. M. V. I. for today</td>
<td>7</td>
</tr>
<tr>
<td>19</td>
<td>Secobarbital 50mg., Im. HS p.r.n. for sleep</td>
<td>6</td>
</tr>
<tr>
<td>20</td>
<td>EKG</td>
<td>8</td>
</tr>
<tr>
<td>21</td>
<td>FBS</td>
<td>3</td>
</tr>
<tr>
<td>22</td>
<td>Bilirubin</td>
<td>3</td>
</tr>
<tr>
<td>23</td>
<td>Alkaline phosphatase</td>
<td>3</td>
</tr>
<tr>
<td>24</td>
<td>IV - 5% D/W 500cc. + 20mg. Kil today</td>
<td>7</td>
</tr>
</tbody>
</table>
ORDER NO. | SPECIFICATIONS | TYPE OF ORDER CODE
--- | --- | ---
25 | Cancel librium (phone order) | 6
26 | Bedside commode p.r.n. | 9
27 | ASA gr X Supp q4hr p.r.n. for temp. over 102 | 
28 | Clear liquid diet in small amounts no fat | 5
29 | Dulcolax Supp. 1 in a.m. | 6
30 | 5% D/W 1000cc + MVI, 1 amp. | 7
31 | Then 5% D/normal saline 500 cc. IV | 7
32 | Repeat CBC | 3
33 | Serum NaK | 3
34 | Milk Mag. zi | 6
35 | Bathroom privileges | 9
36 | Discontinue vital signs | 1
37 | Urinalysis (now) (phone order) | 3
38 | Demerol 75mg. stat* | 6
39 | G.B. series tomorrow* | 4
40 | Routine lab* | 3
41 | FBS stat* | 3
42 | Serum amylase stat* | 3
43 | SGOT * | 3
44 | Liquid low fat diet* | 5
45 | Seconal gr less q eve* | 6
46 | Bathroom privileges * | 9
47 | *Cancel above orders | 
48 | IV today 5% D/W 1000cc + 1 amp. MVI | 7
<table>
<thead>
<tr>
<th>ORDER NO.</th>
<th>SPECIFICATIONS</th>
<th>TYPE OF ORDER CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td>Tricofuron vag. supp. 1 b.i.d.</td>
<td>6</td>
</tr>
<tr>
<td>50</td>
<td>Daily B.P.</td>
<td>1</td>
</tr>
<tr>
<td>51</td>
<td>G.B. series, Monday</td>
<td>4</td>
</tr>
<tr>
<td>52</td>
<td>Upper G.I., Tuesday</td>
<td>4</td>
</tr>
<tr>
<td>53</td>
<td>Repeat G.B. per x-ray department</td>
<td>4</td>
</tr>
<tr>
<td>44</td>
<td>Compazine 5mg t.i.d.</td>
<td>6</td>
</tr>
<tr>
<td>55</td>
<td>Soft drinks</td>
<td>5</td>
</tr>
<tr>
<td>56</td>
<td>Repeat serum bilirubin</td>
<td>3</td>
</tr>
<tr>
<td>57</td>
<td>Consult and surgery Dr. Eldredge</td>
<td>10</td>
</tr>
<tr>
<td>58</td>
<td>May wash hair</td>
<td>9</td>
</tr>
<tr>
<td>59</td>
<td>Seconal 1 ss oral q eve.</td>
<td>6</td>
</tr>
<tr>
<td>60</td>
<td>Repeat CBC in a.m.</td>
<td>3</td>
</tr>
<tr>
<td>61</td>
<td>Give one unit whole blood tomorrow a.m.</td>
<td>3</td>
</tr>
<tr>
<td>62</td>
<td>Hold 1000cc. W. blood for OR Monday</td>
<td>3</td>
</tr>
<tr>
<td>63</td>
<td>Hb tomorrow p.m. after blood</td>
<td>3</td>
</tr>
<tr>
<td>64</td>
<td>Surg. prep abdomen - nipples to pubic</td>
<td>2</td>
</tr>
<tr>
<td>65</td>
<td>Enema in p.m., soap</td>
<td>2</td>
</tr>
<tr>
<td>66</td>
<td>Seconal gr. 1 ss 6:00 a.m.</td>
<td>6</td>
</tr>
<tr>
<td>67</td>
<td>On call to OR at 11:00 a.m.</td>
<td>2</td>
</tr>
<tr>
<td>68</td>
<td>NPO after 3:00 a.m.</td>
<td>5</td>
</tr>
<tr>
<td>69</td>
<td>Demerol 50 mg 10:00 a.m.</td>
<td>6</td>
</tr>
<tr>
<td>70</td>
<td>Vistaril 25 mg 10:00 a.m.</td>
<td>6</td>
</tr>
<tr>
<td>71</td>
<td>Atropine 0.4 mg. 10:00 a.m.</td>
<td>6</td>
</tr>
<tr>
<td>72</td>
<td>2 units blood for OR (phone order)</td>
<td>3</td>
</tr>
<tr>
<td>ORDER NO.</td>
<td>SPECIFICATIONS</td>
<td>TYPE OF ORDER CODE</td>
</tr>
<tr>
<td>----------</td>
<td>---------------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>73</td>
<td>NPO</td>
<td>5</td>
</tr>
<tr>
<td>74</td>
<td>Up at bedside tonight</td>
<td>9</td>
</tr>
<tr>
<td>75</td>
<td>Dextrose 5%/0.2 NS 1000cc today with 1 amp MVI</td>
<td>7</td>
</tr>
<tr>
<td>76</td>
<td>Demerol 50mg. q4hrs p.r.n. for pain</td>
<td>6</td>
</tr>
<tr>
<td>77</td>
<td>Phenergan 25mg. q4hr p.r.n. for pain</td>
<td>6</td>
</tr>
<tr>
<td>78</td>
<td>Secomal gr. 1/2 qhs p.r.n.</td>
<td>6</td>
</tr>
<tr>
<td>79</td>
<td>Void by catheter q3hrs p.r.n.</td>
<td>2</td>
</tr>
<tr>
<td>80</td>
<td>Compazine 10mg q8hr p.r.n. for vomiting or nausea</td>
<td>6</td>
</tr>
<tr>
<td>81</td>
<td>Full fluids</td>
<td>5</td>
</tr>
<tr>
<td>82</td>
<td>Up</td>
<td>9</td>
</tr>
<tr>
<td>83</td>
<td>Tigan 1 amp for nausea</td>
<td>6</td>
</tr>
<tr>
<td>84</td>
<td>Dr. Eldredge to discharge</td>
<td>10</td>
</tr>
<tr>
<td>85</td>
<td>Discontinue IV after today</td>
<td>7</td>
</tr>
<tr>
<td>86</td>
<td>Up and about</td>
<td>9</td>
</tr>
<tr>
<td>87</td>
<td>Dulcolax supp tonight p.r.n</td>
<td>6</td>
</tr>
<tr>
<td>88</td>
<td>Low fat diet</td>
<td>5</td>
</tr>
<tr>
<td>89</td>
<td>Fleets enema</td>
<td>2</td>
</tr>
<tr>
<td>90</td>
<td>Weigh patient</td>
<td>1</td>
</tr>
<tr>
<td>91</td>
<td>Repeat urinalysis cath. specimen</td>
<td>3</td>
</tr>
<tr>
<td>92</td>
<td>Decholin tab 1 every a.m.</td>
<td>6</td>
</tr>
<tr>
<td>93</td>
<td>Aquinal zi today</td>
<td>6</td>
</tr>
<tr>
<td>94</td>
<td>Benylin expectorant 2 tsp q.i.d. p.r.n.</td>
<td>6</td>
</tr>
<tr>
<td>95</td>
<td>Regular low fat diet</td>
<td>5</td>
</tr>
<tr>
<td>96</td>
<td>Renew demerol 50mg. q4hr p.r.n. for pain</td>
<td>6</td>
</tr>
<tr>
<td>ORDER NO.</td>
<td>SPECIFICATION</td>
<td>ORDER CODE</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>97</td>
<td>Fleet's enema today if no result with sppp.</td>
<td>2</td>
</tr>
<tr>
<td>93</td>
<td>Remove drain in a.m.</td>
<td>2</td>
</tr>
<tr>
<td>99</td>
<td>Fleet's enema tonight prn</td>
<td>2</td>
</tr>
<tr>
<td>100</td>
<td>Increase decholin to b.i.d. p.o.</td>
<td>6</td>
</tr>
<tr>
<td>101</td>
<td>Agusc zi hs</td>
<td>6</td>
</tr>
<tr>
<td>102</td>
<td>Combiotic 1gr. stat</td>
<td>6</td>
</tr>
<tr>
<td>103</td>
<td>Sparine 25mg., Im stat</td>
<td>6</td>
</tr>
<tr>
<td>104</td>
<td>Increase decholin to i p.o. t.i.d.</td>
<td>6</td>
</tr>
<tr>
<td>105</td>
<td>Remove sutures</td>
<td>2</td>
</tr>
<tr>
<td>106</td>
<td>Low fat diet</td>
<td>5</td>
</tr>
<tr>
<td>107</td>
<td>Home in a.m.</td>
<td>2</td>
</tr>
</tbody>
</table>
Step 1. Categories of Orders

A. Service Area

* 1. Nursing
  2. Laboratory
  3. X-Ray
  4. Dietary
  5. Pharmacy
  6. Solutions
  7. EKG
  8. Patient Status

B. Performed by a Specific Person

  1. Nursing
  2. Patient

C. Grouped by Time

  1. Admission
  2. Surgical Prep
  3. Post-Op
  4. For Pain
  5. For Nausea
  6. For Sleep

A further choice, applicable to all orders is

New Order
Renew Order
Discontinue

This selection is part of level 0

* Numbers (1 to 10) are Type of Order Code.
List of Categories B and C Orders

B1 Nursing

Vital Signs
Bedsign Commode
Bathroom Privileges
Enema
NPO
Void By Catheter
Weigh Pt.
Remove Drain
Home

B2 Patient

Bed Rest
Bedside Commode
Bathroom Privileges
Wash Hair
Up and About
Home

C1 Admitting

Bed Rest
Vital Signs TID
Routine Lab
BUN
Blood Sugar
Serum Amylase
Serum Calcium
SGOT
EKG
X-ray - Chest
   - Abdomen - flat plate

NPO except oral medication ordered
Demerol 50 mg  Im q 4hr prn
Thopos 1/50mg  1 gr q 4hr prn
Maalox  Tablets ii p.o. q 4hr
Darvon 10 mg tab bid p.o. q 12 hrs
Librium 10 mg lg  1m. bid prn for nausea

Seconobarbital 50 mg  Im. hr prn for Sleep
5% d/Normal Saline 1000 cc.
then 5% d/w 1000 cc + 1 amp mvi for today.
C2 Surgical Prep

Surgical Prep. nipples to abdomen
Enema in pm
Second gr. 1
Seconal gr. 1 cc 6 a.m.
NPO after 3 a.m.
Demerol 50 mg. 10 a.m.
Vistaril 25 mg. 10 a.m.

Atropine 0.4 mg. 10 a.m.
On call to OR at 11 a.m.
2 units blood for OR.

C3 Post Op Orders

NPO
Up at bedside tonight
Dextrose 5% 10.2 mg. 1000 cc.
today 6 lamp. mi then bid.
Demerol 50 mg. q 4 hr. prn for pain.
Phenergan 25 mg. q 4 hr. prn for pain
Seconal gr. 1/2 qhs prn
Void by catheter q 8 hrs prn.
Compazine 10 mg. q 8 hrs. prn for nausea or vomiting.

C4 For Pain

Demerol 50 mg. q 4 hr prn
Phenergan 25 mg. q 4 hr. prn

C5 For Nausea

Librium 10 mg. 1 g Im bid prn
Compazine 10 mg. q 8 hr. prn
Tigan 1 amp.

C6 For Sleep

Secobarbital 50 mg. Im hs prn
Seconal gr. 1/2 qhs prn
Step 2. Unique Specifications For Each Type of Order of Category

1. Nursing Observation
   Spec A - What to Observe
   Spec B - When to Observe

2. Nursing Procedures
   Spec A - What to Do
   Spec B - Part of Body/Supplies to Use
   Spec C - Limitations/Quantity
   Spec D - When

3. Laboratory
   Spec A - Type of Lab
   Spec B - Test
   Spec C - Specimen
   Spec D - When

4. X-Ray
   Spec A - Part of Body
   Spec B - Type of X-ray
   Spec C - When

5. Dietary
   Spec A - Kind of Diet
   Spec B - Quantity
   Spec C - Begin When

6. Pharmacy
   Spec A - Drug Name
   Spec B - Dose
   Spec C - Route
   Spec D - When

7. Solutions
   Spec A - Type of Solution
   Spec B - Quantity
   Spec C - Plus Additive
   Spec D - When
8. **EKG**
   Spec A- Type
   Spec B- When

9. **Patient Status**
   Spec A- Concerning What
   Spec B- Qualification
   Spec C- When

10. **Consults**
    Spec A- By Whom
    Spec B- For What
For the sake of brevity--

Steps 3 through 8 will be shown for only one type of order and, for a limited selection of items.

Pharmacy orders will be used.
Step 3. Interpretation of Specifications

Area 6 - Pharmacy

Using sequence most often used by physicians.

A count of 10 orders shows:

- In 10 of 10 Name is 1st
- In 8 of 10 Dose is 2nd
- In 6 of 8 Route is 3rd
- In 10 of 10 Time is 4th
- In 2 of 10 Route is unspecified, presumed "automatically" determined by name.

Therefore, Spec A- is level 2 (Name)
Spec B- is level 3 (Dose)
Spec C- is level 4 (Route)
Spec D- is level 5 (Timing)

Level 1 would be Pharmacy
<table>
<thead>
<tr>
<th>Type of order code</th>
<th>Order Number</th>
<th>Level Number</th>
<th>Specification</th>
<th>Item Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>12</td>
<td>2</td>
<td>Demerol</td>
<td>1</td>
</tr>
<tr>
<td>&quot;</td>
<td>33</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot;</td>
<td>61</td>
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</tr>
<tr>
<td>6</td>
<td>Librium liq.</td>
<td>2</td>
</tr>
<tr>
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<td>ASA</td>
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</tr>
<tr>
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</tr>
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</tr>
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</tr>
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</tr>
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</tr>
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</tr>
<tr>
<td>14</td>
<td>Maalox</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>Milk of magnesia</td>
<td>1</td>
</tr>
<tr>
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<td>Phenergan</td>
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<tr>
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</tr>
<tr>
<td>19</td>
<td>Thopue</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>Tigan</td>
<td>1</td>
</tr>
<tr>
<td>21</td>
<td>Tricofuron</td>
<td>1</td>
</tr>
<tr>
<td>22</td>
<td>Vistaril</td>
<td>1</td>
</tr>
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</tr>
<tr>
<td>-------------</td>
<td>------------------</td>
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</tr>
<tr>
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</tr>
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</tr>
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<td>i</td>
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</tr>
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<td>i</td>
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</tr>
<tr>
<td>9</td>
<td>Tables II</td>
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<tr>
<td>10</td>
<td>Cancel</td>
<td>1</td>
</tr>
<tr>
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</tr>
<tr>
<td>13</td>
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<td>1</td>
</tr>
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<td>14</td>
<td>0.4mg.</td>
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</tr>
<tr>
<td>15</td>
<td>1 amp.</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>2 tsp.</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>1 gram</td>
<td></td>
</tr>
</tbody>
</table>
**Type of Order** - 6  
**Level Number** - 4

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N/S</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Im.</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>p. o.</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Supp.</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Vag, Supp.</td>
<td>1</td>
</tr>
<tr>
<td>Item Number</td>
<td>Specification</td>
<td>Occurrence</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------</td>
<td>------------</td>
</tr>
<tr>
<td>1</td>
<td>q4hrs p.r.n.</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Stat.</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>10:00 a.m.</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>q4hrs</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>q eve</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>b.i.d.</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>t.i.d.</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>b.i.d. q12hrs</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>b.i.d. p.r.n.</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>hs p.r.n.</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>In a.m.</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Daily p.r.n.</td>
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</tr>
<tr>
<td>13</td>
<td>6:00 a.m.</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>q8hrs p.r.n.</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>Tonight</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>Every a.m.</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>Today</td>
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</tr>
<tr>
<td>18</td>
<td>q.i.d.</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>hs</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>q hs p.r.n.</td>
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### Type of Order Code - 6 (Pharmacy)

<table>
<thead>
<tr>
<th>Level 2</th>
<th>Level 3 (Dose)</th>
<th>Level 4 (Route)</th>
<th>Level 5 (Timing)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demerol</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>12</td>
<td>50mg.</td>
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<tr>
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<td>75mg.</td>
<td>12</td>
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<td>1</td>
<td>n/s</td>
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<td>96</td>
<td>50mg.</td>
<td>1</td>
<td>n/s</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>45</td>
<td>gr. 1ss</td>
<td>2</td>
</tr>
<tr>
<td>55</td>
<td>gr. 1ss</td>
<td>2</td>
<td>p.o.</td>
</tr>
<tr>
<td>66</td>
<td>gr. 1ss</td>
<td>2</td>
<td>n/s</td>
</tr>
<tr>
<td>78</td>
<td>gr. 1ss</td>
<td>2</td>
<td>n/s</td>
</tr>
<tr>
<td><strong>Decholin</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>92</td>
<td>i</td>
<td>3</td>
</tr>
<tr>
<td>100</td>
<td>n/s</td>
<td>7</td>
<td>p.o.</td>
</tr>
<tr>
<td>104</td>
<td>i</td>
<td>3</td>
<td>p.o.</td>
</tr>
<tr>
<td><strong>Compazine</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>54</td>
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<td>80</td>
<td>10mg.</td>
<td>6</td>
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</tr>
<tr>
<td>5</td>
<td>29</td>
<td>i</td>
<td>3</td>
</tr>
<tr>
<td>37</td>
<td>n/s</td>
<td>7</td>
<td>Supp</td>
</tr>
<tr>
<td><strong>Librium</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>16</td>
<td>10mg.</td>
<td>6</td>
</tr>
<tr>
<td>25</td>
<td>Cancel</td>
<td>10</td>
<td>n/s</td>
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</table>
I. Selection of level 2, item 1 limits
   - Level 3 to items 1, 12
   - Level 4 to items 1, 2
   - Level 5 to items 1, 2, 3, 4

II. Selection of level 2, item 2 limits
   - Level 3 to item 2
   - Level 4 to items 1, 3
   - Level 5 to items 5, 13, 20

III. Selection of level 2, item 3 limits
   - Level 3 to items 3, 7
   - Level 4 to items 1, 3
   - Level 5 to items 6, 7, 16

IV. Selection of level 2, item 4 limits
   - Level 3 to items 6, 3
   - Level 4 to item 1
   - Level 5 to items 7, 14

V. Selection of level 2, item 5 limits
   - Level 3 to items 3, 7
   - Level 4 to item 4
   - Level 5 to items 11, 15

VI. Selection of level 2, item 6 limits
   - Level 3 to items 6, 10
   - Level 4 to items 1, 2
   - Level 5 to items 9, 21
Step 7. Lists of Items by Different Routes of Selection

Type of Order Code 6 (Pharmacy)

Route 1 - Alphabetic

<table>
<thead>
<tr>
<th>Spec</th>
<th>No.</th>
<th>Spec</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquinal</td>
<td>9</td>
<td>Compazine</td>
<td>4</td>
</tr>
<tr>
<td>Aceube</td>
<td>10</td>
<td>Combriatic</td>
<td>12</td>
</tr>
<tr>
<td>ASA</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atropine</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benylin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expectorant</td>
<td>11</td>
<td>Visitoril</td>
<td>22</td>
</tr>
</tbody>
</table>

Route 2 - Frequency

<table>
<thead>
<tr>
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<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demerol</td>
<td>1</td>
</tr>
<tr>
<td>Seconal</td>
<td>2</td>
</tr>
<tr>
<td>Decholin</td>
<td>3</td>
</tr>
<tr>
<td>Compazine</td>
<td>4</td>
</tr>
<tr>
<td>Ducolax</td>
<td>5</td>
</tr>
<tr>
<td>Librium</td>
<td>6</td>
</tr>
</tbody>
</table>

For Route 2, associated level 3 items are (from Step 6a) 1, 2, 3, 6, 7, 12.
Level 4 items are: 1, 2, 3, 4.
Level 5 items are: 1, 2, 3, 4, 5, 6, 7, 11, 13, 14, 15, 16, 20.

This kind of listing would be made for all level 2 items in each route.
### Step 3. Listing of Each Display

#### A. Display title: Drug by Frequency

**Display No. 1**

<table>
<thead>
<tr>
<th>Level-Item Nos.</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - 1</td>
<td>Demerol</td>
</tr>
<tr>
<td>2 - 2</td>
<td>Seconal</td>
</tr>
<tr>
<td>2 - 3</td>
<td>Decholin</td>
</tr>
<tr>
<td>2 - 4</td>
<td>Compazine</td>
</tr>
<tr>
<td>2 - 5</td>
<td>Ducolax</td>
</tr>
<tr>
<td>2 - 6</td>
<td>Librium</td>
</tr>
</tbody>
</table>

#### B. Display title: Doses for Demerol

**Display No. 2**

<table>
<thead>
<tr>
<th>Level-Item Nos.</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - 1</td>
<td>50 mg</td>
</tr>
<tr>
<td>3 - 12</td>
<td>75 mg</td>
</tr>
</tbody>
</table>

#### C. Display title: Routes for Demerol

**Display No. 3**

<table>
<thead>
<tr>
<th>Level-Item Nos.</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 - 1</td>
<td>No specification</td>
</tr>
<tr>
<td>4 - 2</td>
<td>Im</td>
</tr>
</tbody>
</table>

#### D. Display title: Timing for Demerol

**Display No. 4**

<table>
<thead>
<tr>
<th>Level-Item Nos.</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 - 1</td>
<td>q 4 hr prn</td>
</tr>
<tr>
<td>5 - 2</td>
<td>Stat</td>
</tr>
<tr>
<td>5 - 3</td>
<td>10 am</td>
</tr>
<tr>
<td>5 - 4</td>
<td>q 4 hr</td>
</tr>
</tbody>
</table>

#### E. Display title: Order Confirmation

**Display No. 10**

See figure 6b, page 21
DETROIT-MACOMB HOSPITALS ASSOCIATION

HOSPITAL INFORMATION SYSTEMS

MANAGEMENT REPORTING

PROPOSED TECHNIQUES FOR IMPLEMENTATION

Prepared by:

Jack Segall, Managing Director
Community Systems Foundation
July 1966
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Appendix 1. Data Collection Technique. 21
LIST OF ILLUSTRATIONS

Figure 1. Creating a Management Report. 5
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What is Management Information?

When something happens in the hospital it creates a bit of information. A meal served, someone reporting for work, or a bill paid usually is recorded in some fashion. The management of the hospital uses information about these events as a measure of what is happening. These measures aid in making decisions.

The decision-making information is not always in the form in which it was created. The data about a single bill being paid may not be too useful; a sum of all bills paid might have more meaning. This management information is in report form, where a report is the result of various operations applied to data from individual events. Such reports range from the annual financial statement to "is Susie Jones on duty today?"

The effectiveness of a report depends on the events that are recorded and the manipulation of this information.

The reports used by management fall into two broad categories.

1) Reports that are known to be needed, and become routine functions within the organization, and

2) Reports that become necessary for a particular reason and are
   a) one-time reports, or
   b) added to the routine reporting functions.
The CRT can be used to display reports to management. The methods for obtaining a report on the CRT will, like the reports themselves, have to fall in two categories.

1) A routine report is displayed by indicating the name of the report. The formula for the report would be programmed.

2) A series of formula decisions would be displayed and the report described would be produced. The user should have an option to include this "program" as a standard report to be used again.

The handling of management information should allow for both kinds of reports. In addition, the reporting function should fit into the display criteria established for Doctors Orders. In many respects a request by management for a report is similar to a request by a doctor for an order. Both end products are a formula of several independent parts. The various parts are related to each other in that selecting one part excludes others from consideration (a request for a report of meals served would exclude data about laboratory procedures).

Both functions require a human to interface with the system. The problems which this presents exist for doctors and managers.
Part I of Doctors Orders: Proposed Techniques for Implementation is, a priori, a part of this report. The examples related to physicians orders must be translated to the management function, but the philosophy remains the same.

To fit the needs of management information to the criteria for interface, the following must be determined:

1) What specification items define a report.
2) What common classes describe these items.
3) What level or interdependency is associated with these classes.

To do this the process of creating a report should be examined.
Creating a Management Report

A manager who is responsible for a function must make some measurements of that function to do his job effectively. When the measurement consists of counting some output of the function, a "report" is usually desired. The process of creating a report is shown in Figure 1.

The first problem is to define measures of the function that will have meaning. Is it, for example, worthwhile to know how many meals are served daily?

Once the first measures are shown, the manager must look at his system to see if data representing these measures is available. Is there a count of meals now? Can one be obtained? If the data cannot be made available, the decision of what to measure must be altered.

When the data exists, the manager must establish a time frame for the report. The function being measured occurs over a period of time. The serving of meals is a daily activity, but each meal can be construed as occurring over a few hours. The time frame is composed of two parts; the span of data time included in the report, and the period from the end of this time to the production of the report. A report of one month's activity may not have much meaning if it is produced six months late.

The next process is often not performed by the manager, although it is implied in his report request. What manipulations must be done to the data to produce the measures needed? These might be adding up occurrence of the function (counting trays used), subtracting used items from an inventory, or comparing data by ratios, percents or differences. A formula for manipulating the data must be obtained.
When the report is handed to the manager he may make further calculations and comparisons. The extent of these depends on how well the report was defined in the beginning. A good reporting system should minimize calculations by the decision maker.

The answers from the formula must now be presented to the manager. A format for this has to be decided. Numerical data can be arranged in rows, columns or combinations of these. Representations of this data can be made graphically. In addition, similar information from previous time periods might be included for comparison.

The report now is complete and, when given to the manager allows him to measure the function as originally planned. However, the process of reporting has not finished.

After the manager has used the report, something must be done with it and the data it represents. Does the manager keep the whole report for later use, or does he need only parts of the report? Does the new data have to be kept? If a meal count is made, and daily figures for each meal, the day's total and weekly and monthly totals are also on the report, should all this be kept?

What is kept must satisfy the needs for information on future reports (e.g. - comparisons at given points with past time periods) and the needs of other reports in the total system.
Organizing Reports for the Digiscribe

Each part of a complete report cycle can be called a Level within the system.

As with doctors orders, each Level must be specified to complete the procedure, and each Level covers a separate specification. In actual use, it would not be necessary to specify all levels for all reports. Reports that are known can be specified once, and then by selecting the first level specification, the remaining Levels would be remembered by the computer, and the report generated.²

Level names for management functions could be:

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 0</td>
<td>Report name (personnel, financial, work level, etc.)</td>
</tr>
<tr>
<td>Level 1</td>
<td>Data needs.</td>
</tr>
<tr>
<td>Level 2</td>
<td>Time period.</td>
</tr>
<tr>
<td>Level 3</td>
<td>Calculations.</td>
</tr>
<tr>
<td>Level 4</td>
<td>Format.</td>
</tr>
<tr>
<td>Level 5</td>
<td>Remember requirement.</td>
</tr>
</tbody>
</table>

The final sequence of Levels will result from the study of reports. This study will show how the specifications depend on each other.³

As with doctors orders, each level represents a class of items. These items will have to be determined for implementation of this function.⁴

2. Ibid - Page 12.
4. Ibid - Page 5.
Study Needs

The application of management reports to the computer, will require learning several things about the current process.

1) What reports are now produced?
2) What calculations are used?
3) What data is needed?

From this information, the system can be:

1) Programmed to produce routine reports.
2) Modified to accept data that is not already present.
3) Programmed with a set of instruction to allow any type of report to be generated.

Step I - Find Management Reports

All managers should delve into their files for reports that:

1) Their subordinates submit to them.
2) They create and use within their department.

They should also think about reports they would like to have, but cannot obtain with the present, manual system.

These reports would include regular ones as well as special one-time-only reports. This latter group may be hard to determine. During a certain time period all requests for information that require using any existing data or creating some new facts should be noted. These requests will simulate what a manager might ask the computer, and will help define the needs of the report generating sequences on the CRT.
Reports tested in this search should encompass everything from annual reports to the "scratch sheet" reports used to count events as they occur.

Step II - Tracing the Flow of Information

The reports collected should be organized so that the flow of data from a scratch sheet can be followed to its appearance on an annual report. As the data moves, it will be operated on to combine it, make percents out of it, or compare it. It will move from one type of report to another. These movements and manipulation should be noted.

The reports, tied together by data flow, show the complete reporting system. Figure 2 illustrates this process. Before attempting to duplicate this on the computer it should be examined for usefulness.

Reports that managers use should be reviewed. If the manager makes calculations using the data in the report, then changing the report to include those should be considered. If a report is not used, but serves as a "work sheet" for other reports it might be dropped from the computer system. (The computer "work sheets" will be the programs preceding display of the report).

After changes have been made, the flow of information documented in Step I should be modified. This system, separated into regular and special reports will be the goal of the computerized reporting system.
Step III - Data Needs

At the "scratch sheet" end of the information flow are various types of raw data. A listing of this data, including how and where it is obtained should be made. These will be necessary inputs into the computer.

In addition, all report should be reviewed for other pieces of data. Such things as bed capacity, work week hours, etc., may be used in reports, but not shown on scratch sheets.

Non-numeric data such as day of week or nursing station number should also be listed.

All data described should be categorized. It should fall into:

1) Variable or raw data.

2) Semi constant data (monthly census calculated for each month, then used as a constant for per-diem facts).

3) Constant data (bed capacity, day of the week, etc.).

The lists of data should be compared with data available in the computer system. Data that is not in the system, or cannot be put into the system will have to be removed from the data list. Reports that use this unavailable information will have to be eliminated or modified for application to the computer.

The system picture obtained in Steps I and II should be corrected again. The reports remaining will be those that can be produced by the computer. The reports modified or eliminated should be remembered for future
application as data becomes available in the system.

The next steps must establish a formula for each report, and the formula components to be displayed and used to create any new reports.

The components fall into four categories:

1) Time periods.
2) Calculations.
3) Formats.
4) Retained information.
5) Data lists.

The data list has already been established in previous steps.

As each component is studied, it should be organized into display sequences in the same manner as Doctor's Orders. These displays will become the manager's sequence for generating new reports.

Step IV - Time Periods

Reporting periods can probably be listed without much study, i.e. daily, weekly, monthly, pay periods, end of month, end of year, etc. All reports should be checked to make sure that a time period is listed for them. The computer capability might be utilized by adding new time periods of shorter duration, e.g. admissions in last hour. The time period should be set to allow enough time for measurable changes to occur. It should be short enough to allow management to take action soon enough. It should also be related to other time periods for data that is being compared.

The time needed to produce a report following accumulation of the data is not too important. The computer can report a few hours after the end of a reporting period. However, the other extreme is relevant. How
long after a reporting period must the report be available? Should the January monthly report, in full, be available in December? This question concerns retaining information and will be discussed later.

Time periods listed will become the items displayed at Level 3 of the management reporting system.

Step V - Calculations

The report documentation completed in Step III will show the flow of data from one report to another and from one place to another and on the same report. Each movement involves a direct, unaltered transfer, or a calculation using the data during this transfer. Each calculation should be listed.

Similar calculations can be grouped and described by a formula. The formula may include reference to time periods, e.g. monthly total of.

The description of a calculation should include instructions for rounding answers to the needed significant digits.

The formulae should be organized for use as Level 4 items in the display sequences.

The calculation data and timing needs for each report can be assembled. This formula will describe the programming required to produce routine reports.
Step VI - Format

The report functions only when it is displayed to the user. The shape of information displayed can affect the ease of use of the report.

The flexibility of the CRT to show only relevant material, and allow quick expansion of any one piece of information requires that the format of each report be studied. The present paper system often includes more detail on a report than is needed at one time. The computerized system should avoid this by displaying only relevant data.

The format descriptions can make use of names assigned to data, time periods and calculations. The word "monthly" in a report title can serve to define all time periods for calculations. "Monthly meals" defines the data to be used, and "monthly meals per patient day" tells what calculation to perform and what constants to use.

The formats can be described in three parts:

1) Report titles.
2) Report totals.
3) Report details.

Report titles can be designed so that they are unique and will generate the report without further specification.

Report totals are the "largest" totals associated with the report. Some totals will remain the same. Regardless of format, a monthly meal count could be shown by days of the week, any type of meal, or by nursing unit.
The total of the meals would be the same.

The report details can be changed as in the meals example above. These options could be included as modifiers of the report title.

This pattern is similar to selecting a route in the doctors order scheme. The data used is the same, but the manipulation of it varies.

Standard formats should be created, perhaps as formulae with data names assigned to coordinates on the CRT page. This will facilitate a user designing a format by selecting alternatives on the CRT.

A format selection might involve heading columns (months of the year) and then identifying rows (type of meal – breakfast, lunch and dinner). The report "monthly meals per patient day" would be displayed in the proper slots.

Step VII – Retaining information

Because reports are made up at several points in a hierarchy of data handling, a decision must be made about what to retain in memory.

The extremes are keeping all raw data, and calculating reports from the beginning each time or keeping only the highest reporting level of detail. In between are choices such as keeping several levels of the same information, and merely displaying reports instead of calculating them.

The criteria for keeping information involves the storage space available, the computer time used for calculations, the frequency of demand for any report and the acceptable lag time between demand and display if off-line storage (magnetic tape reels) have to be put on the system.
Some measurement of the need to retain information can be obtained from reports. Obviously, enough detail must be available to produce routine reports. In addition one-time reports will show what sort of detail might be asked of the system. If certain information has not been used for these reports, and is not needed to produce routine reports, then it might not need to be stored. The frequency of use of existing reports, measured by counting trips in and out of files, will determine how often information is likely to be used.

Step VIII - Displays

All the knowledge about reports should now be organized into levels and display sequences. This process should be done in the same manner as Doctors Orders.

Then, the routine reports should be "programmed" using the sequenced variables. These reports uniquely identified by title can be preprogrammed to be displayed upon selection of the title.

The list of titles should be organized into displays to make it easy for the manager to obtain his report.

The procedures used in Doctors Orders, Part III, Step VIII can be used.
Study Implementation

The implementation of this study requires the description of a lot of facts contained on many reports. The reports themselves should not be difficult to find. However, the chaining of the data through these reports may become complex.

As an aid to gathering this data, a form can be devised. This form should provide most of the information needed for all steps in this procedure.

An example of a form is shown in Figure 3. A series of these forms have been completed for the reporting of the meals shown in Figure 2.

(Appendix 1).

At the top is a general description of the report examined:

1) Report name - The common name used to describe the report.

2) Used by - The manager(s) who use information on this report for decision making.

3) Report (form) number - A further identification of the format of this report.

4) Used for - The reason(s) report is created. These should be more than "needed by supervisor."

5) Reporting period from to - The period of events covered by the report.

6) Issued days afterwards - The present accepted time lag between the end of a period and the issuing of the report.
The column headings are:

1) **Fact no.** - An arbitrary number assigned to each entry on the report.

2) **Coordinates**

   **Row name**

   **Column name** - most report formats can lie described in this way. These positions will help classify:

   a) Data names.

   b) Formats for producing reports.

Source of information for this report:

1) **Report - row/column names** - Report or other source from which the report being described is made. Each fact on the report is associated with its source described by the name and number of a report and the proper coordinates. This data will trace information through the system.

2) **Calculations on data from source** - What is done to data identified in the preceding column to put it in correct form for the report being described?

3) **Use of this fact is** - Short description of what managers do with each fact on a report. Is it compared to past reports or other facts on this report? Is it used for further calculations? Also include, where possible, an estimate of the use of this fact after it is filed. How often might it be recalled?
The information gathered on these forms will provide item names for format descriptions, new data, calculations and retention requirements.

Through careful analysis, a complete management reporting system can be built from this information.

The form itself will describe each report destined for the computer system. This description can serve as a guide to the programmers.
The reports shown in Figure 2, are representative of a reporting system. Although fictitious, they show the type of information and interrelationships that can exist.

The reports concerned with meals are described on the form shown in Figure 3.

Analysis of these descriptions show:

1) The meal count and meals-daily reports are not really decision-making items. These could probably be eliminated from this hypothetical system.

2) The annual report duplicates data in the monthly reports. Only the annual totals are new.

The system might be redesigned to have only three reports:

1) Annual total meals and meals per patient day.

2) Monthly total meals and meals per patient day.

3) Meals per patient day, by day of the week for each meal and all meals.

Data needs are:

1) Number of each type of meal served each day.

2) The day of the week.

3) The month.

4) The census each day.
Calculation needs are:

1) Sum on all columns in a row.
2) Division of one coordinate on a report by a "variable constant" calculated elsewhere.
3) Sum of items at fixed coordinates from a series of identical reports.
4) Sum of all rows in a column.

Retention requirements seem to be:

1) Cumulated meals by days of the week.
2) Monthly totals.
3) Annual totals.
<table>
<thead>
<tr>
<th>Month</th>
<th>Forecast</th>
<th>Precede to</th>
<th>Compared with other Meals/Meal to Dec.</th>
<th>Sum of all Months Meals/Meal to Dec.</th>
<th>Monthly Meals - January</th>
<th>Total Meals - January</th>
<th>Meals/Meal to Dec.</th>
<th>Total Meals - Annual Report</th>
<th>Meals/Meal to Dec.</th>
<th>Total Meals - Annual Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forecast</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precede</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compared</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Report Name:** Meals - Annual Report

**Replacement Period:** From Jan. 1 To Dec. 30

**Issued:** 30 Days After Preparation

**Prepared by:** Administrator

**Used for:** Calculations on this report, row/column names, data from source, calculations on this report, source of information for this report.
<table>
<thead>
<tr>
<th>Source</th>
<th>Day of the Week</th>
<th>Comparisons</th>
<th>Periodically over a weekly cycles</th>
<th>Data on Annual Report</th>
<th>Daily Planning</th>
</tr>
</thead>
</table>

**Use of this fact is:**

- Sum of all Reports of Mondays.
- Sum of all Reports of Mondays.
- Sum of all Days of Week.
- Divide a by b.
- Sum Census for all Mondays = b
- Divide a by b

**Monthly Report (Form) Number:** 2

**Reporting Period:** From 1st to Last Day of Month

<table>
<thead>
<tr>
<th>Report Name: Meals - Monthly</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Row/Column Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon. Meals Daily - Breakfast/Monday</td>
<td>Mon. Meals Daily - Lunch/Monday</td>
</tr>
<tr>
<td>Mon. Meals Daily - Dinner/Monday</td>
<td>Mon. Meals Monthly Total/Total</td>
</tr>
<tr>
<td>Mon. Breakfast/Per Pt. Day</td>
<td>Mon. Breakfast/Per Pt. Day</td>
</tr>
</tbody>
</table>

**In Form Information About this Report**

- Month of the Year
- Meals Daily - Breakfast
- Meals Daily - Lunch
- Meals Daily - Dinner
- Meals Monthly Breakfast/Monday
- Meals Monthly Lunch/Monday
- Meals Monthly Dinner/Monday
- Meals Monthly Total/Total
- Per Pt. Day
- Adult + Ped. /Total
- Census Monthly Pt. Day
- Census Monthly Total/Total
- Census Daily
- Census Monthly Total/Monday
### Table 6: Daily Meal Count

<table>
<thead>
<tr>
<th>Block</th>
<th>Period</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lunch</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Breakfast</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>Lunch</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>Breakfast</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>Lunch</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>Breakfast</td>
<td>None</td>
</tr>
</tbody>
</table>

**Source of Information forTHIS REPORT**

- Report (Form) Number: 3
- Report Name: Meals - Daily
- Dept: Unknown
- Same Day: 6:00 a.m. - 7:00 p.m. Daily: Issued

**Fact: Coordinates**

- Row name: Column name
- Report: For/Column names
- Calculations on this page

**Additional Notes:**

- Reporting Period: From 6:00 a.m. to 7:00 p.m. Daily: Issued
- Days Afterwards: Same day

---

**Referred to in:**

- Figure 6
DETOXX-HOOPE HOSPITALS ASSOCIATION

HOSPITAL INFORMATION SYSTEMS

MEDICAL AUDIT
1) Applications
2) Standard Generation

Prepared by...
Dec 8, 1989
Reviewing by: Ron Snodin. San
August 1989
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Control</td>
<td>0-1</td>
</tr>
<tr>
<td>Use of the Computer</td>
<td>0-2</td>
</tr>
<tr>
<td>Part I: Medical Audit: Applications</td>
<td>1-4</td>
</tr>
<tr>
<td>After-the-Fact Audit</td>
<td>1-4</td>
</tr>
<tr>
<td>Before-the-Fact Audit</td>
<td>1-7</td>
</tr>
<tr>
<td>What the Computer Does</td>
<td>1-7</td>
</tr>
<tr>
<td>Study Needs</td>
<td>1-9</td>
</tr>
<tr>
<td>What standards exist now?</td>
<td>1-9</td>
</tr>
<tr>
<td>Categorize standards and relate to data in medical record</td>
<td>1-11</td>
</tr>
<tr>
<td>Determine what is to be done when any standard is violated</td>
<td>1-12</td>
</tr>
<tr>
<td>Summary of study findings</td>
<td>1-13</td>
</tr>
<tr>
<td>Data Handling</td>
<td>1-15</td>
</tr>
<tr>
<td>Part II: Medical Audit: Standard Generation</td>
<td>2-20</td>
</tr>
<tr>
<td>Need for new standards</td>
<td>2-20</td>
</tr>
<tr>
<td>Study Needs</td>
<td>2-21</td>
</tr>
<tr>
<td>What medical events need standards?</td>
<td>2-21</td>
</tr>
<tr>
<td>What are the significant factors</td>
<td>2-22</td>
</tr>
<tr>
<td>In a standard?</td>
<td>2-22</td>
</tr>
<tr>
<td>What factors are needed for a workable standard?</td>
<td>2-23</td>
</tr>
<tr>
<td>Data Handling</td>
<td>3-15</td>
</tr>
<tr>
<td>Figure</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>1-1</td>
<td>After the First Audit</td>
</tr>
<tr>
<td>1-2</td>
<td>Before the First Audit</td>
</tr>
<tr>
<td>1-3</td>
<td>Study Mode - General Audit Applications</td>
</tr>
<tr>
<td>1-4</td>
<td>Bank Examination Stages</td>
</tr>
<tr>
<td>2-3</td>
<td>Creation Cycle of New Standards</td>
</tr>
</tbody>
</table>
generally placed in the patient's chart by the attending physician and are effective only if observed by people caring for the patient. The regulations, or hospital policies are promulgated and followed by everyone.

The medical audit functions as the evaluation of the quality of medical care as reflected in medical records and is a highly motivated and developed form of continuing education.

Use of the Computer

Replacing the paper medical record and the associated paper communications media with the Phase I V computer system offers a great potential for improving this technique of medical quality control.

The speed of the computer can reduce or eliminate the time lag now present in "after the fact" audit. The one of a kind device for both recording and requesting medical events can decrease the probability that a regulation or patient caution will be seen. In addition, regulations can be enforced before they are violated, because the communication needed to violate them passes through the same machinery that will apply quality control measures.

The ability of the computer to handle and analyze large quantities of data will aid in developing better quality control systems.

The computer, in effect, can improve patient care by improving on the present method of measuring care quality, as well. The computer cannot determine the true quality of care; this will always remain a human judgment. For the computer programmer knows the rules and before the physician when those rules indicate or warn are false or unreasonable standards. The physician must then justify neglecting the medical rules.

6-2

Poece, M. The Medical Audit, Hospital Progress. Vol. 46 No. 1 p. 105-108 Jan. 65
Quality control is a method of ensuring quality, a method of measuring, using methods of altering the production process to affect quality levels, and creating lists of key points the process can't fail to interrupt will monitor these quality levels.

Quality control in a hospital is performed, in part, by a medical audit committee. The committee establishes standards that are to be measures of quality of care.

These standards are derived from current medical knowledge, and are changed and improved as new information is learned. The reviewing devices used are the medical records. These documents are prepared to represent, with reasonable accuracy, the medical care given to the patient. The standards are applied to information contained in these records and the amount of giving medical care is determined within the standards by medical or physicians. As new standards are developed or the ones violated, the physicians are informed. They are then expected to specific future care with corrective action. Much of this review of care has been given to a particular care. The policy contains "who are the facts." Annual reports are included in the file as an essential part of it. Some other medical review is used to check the medical accuracy and to give corrective action and information. Some medical review and accuracy are an essential part of medical record. The medical record can be provided and monitored for additional control. The tables given are

The Phase IV function, called Medical Audit, is twofold:

d) Assign data to form individual patient case should be examined.

2) More physicians were a comparable medical event is about to

These two functions our directly related. The first must be accomplished before the second begins. Because the Medical Audit function in Phase IV should consider these two problems as separate. The latter function requires learning what standards are currently available and applying these to the daily practice

of medicine within the hospital. The analysis of data for determining new, standards for a critical process requiring knowledge of data available in the system, with indications that presently used standards are insufficient, and learning some analytical techniques.

Therefore, the Medical Audit function is composed of two parts, and will be

described with two separate section outlines.

1) Medical Audit: Evaluation

The use of medical standards in the daily practice of medicine with the maximum and the minimum as the median for each disease. The patients and recovering needs and an average of critical patient information.

2) Medical Audit: Standard Development

The creation of standards for consideration as applicable to medical practice being the computer and hospitalization on a device of critical events of data needed by the patient. Statistical and diagnostic comparisons of selected from

medical information by the use of a Diplomate.

The study area for these two functions are described in the following two

sections.
that the electronic medical record contains the same information as the paper record, most if not all medical work functions can be performed during the electronic processing of this information. The patient chart functions that are guide lines for selecting charts for review by a physician can be done by the computer. As events the following, the patient chart functions can occur. This will allow whose period previously, control or checks of the events before it occurs. The study to accomplish this function will

   a) Determine what events occur.

   b) Determine how and where they occur in the medical record.

   c) Determine how do data where any standard is violated.

The approach used to study these factors will have to be based on the present auditing systems.

A representation of the "after the fact" audit system is shown in Figure 1. This audit concerns accidents that are:

   a) Likely to occur, it is used to select charts for review by physician.

   b) These are used during patient care evaluation the quality of care in a potential chart.

After the Incident

An "after the incident" audit system includes summarizing accidents in the Medical Error Lab. These reports initiate an information system, which allows for a "patient review" in the office. The system may also be used for more specific review by the physician.
These instructions shall be given by

1) The diet, exercise and other habit modification practices.
2) The objective was to reach 15% body fat and weight.
3) The program included the use of weight lifting and cardiovascular.
4) The diet was to be low in fat and caloric content.
5) The diet and exercise plan was to be followed for six weeks.
6) The program included the use of habit modification techniques.

This last group has the least amount of weight.

The decision about the same plan or not planned must be answered. In doing this, the weight exercises are needed and not in the program. Either the

allowing certain type of the health condition, you have to slender the weight group and by the

model, second class, etc.

The weight loss is determined by the result of the planning, one to be

considered by surgery or diet and the result will accede a group and by the

model's second class, etc.

The process for determination of the result of the planning, one to be

considered by surgery or diet and the result will accede a group and by the

model's second class, etc.
To this, we can add the condition that the conditions are specific conditions, and be seen by our understanding. Therefore, as more and more concepts are added, there will be more and more potential differences. A simple "n" if the conditions are met may not be enough. However, if conditions are not met, then the result will vary. The main thing is to make it appear much like the "after the fact" rule.

The following will not be dealt with the "after the fact" rule, but before the fact. The physicians who examine these cases will still exercise judgment. We can do this under a particular case and an argument.

A case may be made of the general situation. For each situation, ascertain a standard, a general choice must be required. If A and B occur, in the presence of conditions C, then the case for a general decision.

If there is a case under the standard violated to stop this all over the patient until compensation is obtained.

In the absence of the standard, the standard standards. These should be followed. They can be made by methods.

1. Identification of the clinical record situation
2. Medical, physical methods
3. Diagnostic methods
4. Laboratory analysis
5. Algorithms, computerized systems of hospital care

The list of standards can be final "n" rules
6. Absolute standards: a way that are applied on a whole manner then
by physicians knowledgeable

A) explanation and understanding of the standard

The object of this system is to prevent or protect the patient. The
standard order must be followed because a mistake could cause,
not must be followed in conjunction with the standard order, the standard without harm.
Failure to follow the standard will cause harm to patients and affect
the effectiveness of this function. By conforming the new

The order is special to the patient and applied to a drug will affect
the usefulness and this system.

Assume a standard says that drug X should can be used when the patient has high
blood pressure.

Should all high blood pressure patients have all their drug orders be use now
and ordered during ascending ordering, if so should an order for drug X initiate a

review of that patient's blood pressure.

These decisions could be the outcome of such order and the order
of this consequences. One order should be to examine the doctor to the patient
and chose the special use order if the patient's blood pressure will be used. Each
one of the patient's ordering consideration drug. In any way conditions have to be
adequate and one drug dose uses of a patient reason will be reduced.

The order in the standard order will be confused in the clinical record
such the order in the drug order has priority to the other record of the order.

Under conditions the physician may prescribe drug X based on the order.

Therefore,
Each part of the guidance should be associated with something in the record. Communication may be in the form of the forms Y section during the time of hour. Communication with other faculties or departments may only take place according to office rules. These divisions provide an orderly and acceptable means of making the work to accent the results related to play functions.

Guidance of the number will all center on an extension of the audible function.

During this piece of the story, the number of the number of audience per person will need to be calculated accurately. This information will aid in the program in establishing a setting and time.

Emergency work has to be done when any standard is violated.

The succession of medical crisis "life" requires that control functions shall be "live." Presenting method of testing control will not give the patient being treated any additional protection. Its control is not secured following succession, thus requiring the need for immediate action.

1) Be alert to see, each control exercised later, after the "next" has taken place.
2) Be always on your "next" until control can be exercised.

Neither of these is gone. Operating in between will be several situations for example a very low, through the discussion and then each sudden can be understood and added with it, etc.

Cassell's support to simplify,

1) It may be very easy to determine the number in their own work and the following subject...
b) Control by-passing of the standard by allowing it, but record the fact of a bypass and notify an auditor.

c) Do not allow a bypass without written physician's consent.

d) Written bypasses can be written under any circumstances.

If there are the choices, the selection of which one to apply to a given standard must consider the validity of the rule, the condition of the particular standard, and the effect on care of the patient.

A further decision should be made upon applying each of standard one, two, and comparison. These form my rule define a standard. A measure of the value of any standard would be the value of exposure to reception of the standard.

A perfect standard would have a percent of exposure equal to the percent of patients having the correct diagnosis in their favor, but not harmed by bypassing the standard.

Summary of Standards

All things regarding medical practice for patient safety should be reviewed.

These cases have general components (single units blood transfusions) to specific reactions for a patient (single to unit of life). This standard should be followed through all the questions raised above each another. This will double as question of criteria for the standard. These criteria could be related to those contained in the medical records. The results found in all data not in this review will have to be verified for equivalency to the medical system. Finally, several procedures that can be applied to the above will be the necessary safety orders and associated with each patient. The following would be wide to record the use of standards and previous results of such medical improvement.
DATA HANDLING

The goal of data collection is to create a template for applying a standard. This formula may have many elements in it, with each element dependent on preceding elements.

Every standard use requires 1) something to happen before the standard is applied, and 2) something to follow the application of the standard.

The standard itself is described by 3) the presence or absence of some medical event, and 4) the location and name of facts in a medical record that can indicate this.

Collection of standard information should include all four parts. The collection should separate the parts for analysis in some logical fashion.

To begin the collection, a simple form can be used. Figure 1 shows one such form.

The Standard is: a single successive statement about the standard: do not give penicillin - allergy, or No surgery if hgb less than 10.

Applied When: used for any time in the patient's care to make it necessary to review care in respect to the standard.

ie - admission causes admission lab work to be reviewed.

- order for penicillin could cause review of allergy.

Factors used to determine that data and information in the template indicated was the patient was cared for in full respect to the standard:

ie - lab results before or after a transfusion, or diagnosis of infection, or presence of reversion to time.

If the regular template collection does not show the proper evidence collected to apply
with a standard, this would be a critical failure in the application of
These sheets should be used for our work standards. They should be
recorded in a separate column for each item in each column. The column will
include the following: US standard, the number of each standard, and the
number of each standard that the record is made for. The number 1 is used. In the US standard
column, each sheet should be identified by the name of the last standard to be applied.

This recording should continue until the standard is completed, with all four
columns completed. Then the record should be with the "facts used..." column used until the end of the operation. The present record function or
inventory of foreign cells and equipment is the "US standard selected" column.

The following is a table of the different standards of these cells.

<table>
<thead>
<tr>
<th>US Standard</th>
<th>Number of Standard</th>
<th>Number of Standard Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The table above shows the different standards and the number of standards
for each cell. The table also includes the number of standards selected for
each cell. This information will be used to help determine the
number of standards used in the operation. The


produce an output, only those records containing judgments by a physician. These judgments, together with weights, provide appropriate the goals of this system.

The next step is to construct tables with facts available in the system.

From the "Fact used" right column, a list of all needs should be made. If this list is long, the fact names could be on metal index cards, together with the number of the standard in which they appear. A sorted list of facts could be made by a computer. The sort, along correctly or using a batch list technique could then be edited to eliminate duplicate lists. Editing should also group synonymous together. A final sorting by the number of the fact might be made. This would group facts concerning various types of colors, vital signs, diagnosis, points in time, etc.

Each of these facts should now be marked for easy classification.

Each fact should be compared with data available in the medical record. If it is not available, the standard associated with it cannot be fully applied.

These unavailable facts and their associated standards should be reviewed for priority of adding them to the system.

The next step is to organize each module's elements. All the facts associated with each standard should be shown. Then the facts should be listed with all the standards that they apply to.

Some frequency of occurrence data should be obtained for each fact. Much of this can be found in existing statistics. Charts of types of services, diagnostic and operations indexes, etc., should indicate this data.
The number of elements and of the procedure where each use is minimized.

These formulas show that each use is presented in the table below.

Before finalizing the procedure, a few facts in each case and details are
obtained. These facts can be used to determine the number of standard can be also a
magnified. Moreover, these facts can be used to determine the number of standard. They can be used in conjunction with other

table and the number of standard. The

To determine the number of standard, the

The

number of standard.
PRELIMINARY FINDINGS

Swimming provides cardiovascular benefits similar to other types of aerobic exercise. Additionally, swimming may be more enjoyable for some individuals, which can lead to increased adherence to a fitness regimen. Further studies are needed to confirm these findings and determine the long-term effects of swimming on cardiovascular health.

Medicine is constantly changing, and new treatments and advancements in healthcare are emerging. Continued education and professional development are essential for healthcare providers to stay current with the latest research and best practices. This includes staying informed about new medications, treatments, and guidelines. Regular training and workshops can help ensure that healthcare professionals are well-prepared to provide the highest quality of care to their patients.

The field of medicine continues to evolve as new research and technologies emerge. The inclusion of new discovered treatments and advancements in healthcare is crucial to driving progress. It is important for healthcare providers to stay informed and continue learning to provide the best care possible. As knowledge and understanding expand, so too do the possibilities for improving health outcomes.

The medical field is rapidly advancing, with new discoveries and developments on the horizon. It is essential for healthcare providers to stay informed and to continue learning. This includes staying up-to-date with the latest research and practicing evidence-based medicine. This ensures that patients receive the most effective and safe care.

In summary, the benefits of swimming include cardiovascular improvements and potential enjoyment. As medicine evolves, healthcare professionals must stay informed and continue their education to provide the best care possible. The field of medicine is constantly changing, and healthcare providers play a crucial role in advancing the quality of care that patients receive.
The evaluation of the entire functional system Phase II broadens the information on the system's control through its interaction. It should be possible to obtain all the information required in a controlled and structured environment.

In this phase of the evaluation, the interaction and control parameters must be considered. The evaluation must be structured to allow the physician or economist to assess the implications of the data collected from the various sources of information.

The evaluation must be structured to provide meaningful results, which can be easily interpreted.

What are the objectives of the phase?

1. The evaluation of the system to determine the parameters required that exist in the environment.

2. To be used to improve the standard.

3. To be used as the end to make a judgment about the system.

4. To control a standard, each decision must be sensitive to the environment by the standard and its capabilities.

The evaluation must be structured to be clear and structured, with the parameters required for the environment. Each parameter should be considered and the role of each parameter should be determined. The evaluation must be structured to allow for a clear and structured presentation of the data collected from the various sources of information. The evaluation must be structured to provide meaningful results, which can be easily interpreted.
There appears to be some data of the other:

This data could be used by the medical profession looking for specific kinds of information. It is 1014 of the kind of a similar patient. The

applicant's data could indicate a high source of "standard" and test in

so-called physiological terms.

Is the Physician's Data for a Normal Subject?

A significant portion of the data on one of the tests is still not known and the factors may

not be understood fully, although the trend implementation and importance

of the evaluation by the physician is the clinician's evaluation.

The study of medical and biological selection of situations during the medical

test could give the physician the results he could be used to the service vision of the

patient. In checking on various factors, however, they still need to be highly

evaluated, since there are still many items possibly have to be considered.

In many cases, it would be difficult to evaluate these situations to the patient and the

remote medical data would not be given immediately. It would be determined and will

result in the physician's examination in this part of Phase II.
DATA HANDLING

The requirements for this study do not involve any new data handling problems.

The analysis used in administrative reporting can be used for medical data reports.

This is contained completely in Part I of Medical Audits can be
an essential part of this function. The creation of ESR displays to allow testing
and simulation can be accomplished by assigning the elements of equations to levels
and proceeding within the patterns adapted in previous sections.

Such levels might be

- Medical fact in the record
- Constructions used to connect these facts...
- IF (a and b without c etc)
- Post
- Controls to be applied when standard is violated.

The implementation need for this section that will be the most difficult involves
the physicians. Almost everything that must be done requires doctors to exercise
professional judgment. The physician will have to be indoctrinated in the purpose
of this system, and will have to revise his thinking about auditing.
DETROIT-MACOMB HOSPITALS ASSOCIATION

HOSPITAL INFORMATION SYSTEM

RESULTS - VITAL SIGN RECORDING
PROPOSED TECHNIQUES FOR
IMPLEMENTATION

Prepared By...

Jack Segall
Managing Director
Community Systems Foundation
August, 1966
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RESULTS TPR/BP

One of the most common entries in a medical record are observations of patient vital signs: temperature, pulse, respiration and blood pressure.

These observations are part of the normal daily care of all patients, made at least once per day. When the patient's condition affects one or more vital signs, observations are made at more frequent intervals. This data is generally recorded in a graphical format that allows interpretation of absolute values and relative change in value over time.

These observations are not difficult to obtain, and are often done by persons who are not nurses.

The patient's condition generally dictates how frequently the observations are made, how soon after an observation the data should be available, and how long a time period of observing should be reviewed at one time.

During surgery, the anesthetist might record vital signs every minute, and would like to see this data immediately. After surgery is complete, the data may have little future use. The recording, however, does become part of the surgical notes about the patient.

A patient on a nursing unit may undergo vital sign observations, a few times a day. These may only be of interest if a variance from normal (or expected) values is found. The review of this data by the physician may take place long after the observation was made. The measurements may have meaning only if the trends recorded over several days are reviewed. This data also becomes part of the permanent medical record.

The phase II system can function in several ways to help vital sign recording.
a) Through direct, on-line, input the observation can be put into the patient's record immediately.

b) Through a doctor's order, the observer can be reminded to take a reading at the correct intervals.

c) The latest recording can be checked against previous levels and changes brought to the attention of the proper personnel.

d) Anticipating orders for specified changes or values of vital signs can be carried out when these values occur.

e) A permanent record of this part of the patient's care can be made.

The studies required to implement these functions are

1) Methods of inputting data
   a) Routine observations
   b) Special observations

2) Methods of displaying data
   a) Absolute values
   b) Relative values

3) Special Requirements for
   a) "Make observation" reminders
   b) Attention to changed or abnormal values.

STUDY NEEDS

Methods of Inputting

The type of data involved is primarily numeric. Pulse and respiration are a count of these functions per minute, temperature is in degrees and tenths of degrees and blood pressure is in millimeters of mercury and has two measurements per observation. Occasionally a quality description is added to pulse and respiration. Words such as "irregular" or "labored" may be used.
Input techniques must provide for both the numeric and descriptive data. There could be, however, a justification for considering these problems separately.

a) Input methods for numeric data only

b) Input methods for combined numeric and descriptive data.

The justification depends on the frequency of occurrence of each type of data.

A study of this occurrence should be done.

A survey of vital sign records in charts can be made. A simple count of observations with and without quality descriptions will give the frequencies. Certain quality descriptions may appear in other areas of the chart such as nurses notes. These should be surveyed as well. During this study, a list of words used for descriptions can be obtained. This list will be useful when the input is being programmed.

This study will show a need for both types of inputs, if a large volume of patients receive strictly numeric input, while the lesser number require descriptive. Presumably, the patients requiring descriptive data will be sicker and have more frequent observations. The actual number of observations in both groups may be about the same.

The purpose of the phase II system should be to simplify the recording of vital signs, to save nursing personnel time and to make the data easily available when needed.

The input system should consider first the strictly numeric input. As numeric data is part of a descriptive input, a modification rather than an entirely new system should probably suffice.

The present methods of inputting numeric data for nursing unit patients are fairly
simple. The observer travels from patient to patient with the necessary measuring instruments and a log book for recording the data.

When the observer has completed all measurements, the log book is returned to the nurses station. Someone transfers the data from the log book to the graphical record in each patient's chart. The person making this entry may or may not be skilled to initiate action for a patient whose vital signs indicate a need for this. The transfer of data, if done by a clerk, may be reviewed by a nurse looking for such changes. When a significant change is noted, the nurse may return to the patient and re-observe the same data as a check of its accuracy before taking action. It is at this point that quality comments are usually added. The computer could eliminate several steps in this procedure. The observer should be able to record vital signs from the bedside directly into the chart. Immediately following this operation, a skilled person could query the records for significant changes. Only those patients with such changes would be presented, eliminating the checking time of normal records. If the skilled person performed the initial observation, immediate feedback of significant changes could be made.

Consider first the input necessary for an unskilled observer. The data is numeric, and its reliability is a function of the observer's skill in using measuring instruments and in using the input device.

Much of the input problems will be directed by the type of hardware used for this function. Devices other than the Digiscribe can be used, and probably should be.

Hardware Consideration Needs

A simple input device for numeric data is the touchtone telephone. This instrument should be considered for this function. It could be connected to one computer by two routes.
a) Use the telephone at the patient's bedside and dial up the computer.

b) Put a line from the computer into each patient room. A single line, with jacks in many rooms would suffice. Only one room would be connected at a time as the observer made rounds. The observer would take a plug-in telephone along.

A more complex device could be used. This would be a series of vital sign monitoring units with a digital pulse output. Such devices are available and could be connected to the computer through telephone lines. The procedures needed to use such a device will be governed by the electronics of its components.

A Digiscribe could also be moved from room to room if special wiring were installed. This could be programmed to display both numeric and qualitative data for selection by the observer. However, as the observer will generally not be skilled enough for quality comments, and as the wiring will be expensive, this method seems the least likely. The Digiscribe at the nursing station could be used in conjunction with a log book, duplicating the present system, but this defeats the goal of saving personnel time.

Certain basic requirements are needed for telephone and monitor inputs.

a) Connect to computer

b) Identify type of data to be inputted

c) Identify patient

d) Identify each vital sign prior to transmitting the value

e) Identify the observer

f) Note date and time of observation

A sequence of events for this is shown in figure 2. The following are questions to be answered about each element.

a) Connect to the Computer

In this done by dialing, or is the phone simply plugged into
SAMPLE SEQUENCE FOR DIALING OF VITAL SIGNS INPUT USING A TOUCH-TONE TELEPHONE UNIT

wait for dial tone

dial CPU's No.

wait for answer tone

dial use code vital sign input code

dial pat. ident. find correct patient's record.

nurse measures vital sign

dial sign code T, P, B, H or L codes: see text.

repeat for all vital signs

dial value of sign put into patient's record.

employee number

dial observ or No.
a special jack?

The hardware requirements and the benefit of some positive sign of connection might favour dialing. The dial tone, a ring, and an answer tone would indicate connection.

b) **Identify type of data to be inputted**

The computer should know what to expect. The detail contained in this identification can range from "medical data" to "vital signs of numeric character on a patient." The extent will depend on how many other things the computer might expect to pass through the connection made.

c) **Identify patient**

The need for this is obvious, but there are several ways it can be done:

a) Patients number

b) Patients name

c) Unit and bed number

d) Combination of these.

This choice will depend on how the computer file is established and how long it takes to input this data. It should take the minimum time, yet be reliable enough so that the wrong record does not get selected.

d) **Identify each vital sign prior to transmitting the data**

This is needed for two purposes

a) it will tell the computer the units of measure and their format

b) not all vital signs need be measured each time, nor should the observer be held to a specific order of inputting them.

This identification can be simple if the previous indication of use (c) to the computer has made it expect vital signs. The telephone dial is such that the following codes could be used
without conflict.*

T for temperature (8 on the dial)
P for pulse (7 on the dial)
B for respiration (breathing) (2 on the dial)
H for systolic (High) (4 on the dial)
L for Diastolic (Low) (5 on the dial)

* Using a special jack in each room, the observer could use a twelve button telephone, where one extra button indicates a code and the other that data is being transmitted. Use of this system could simplify this coding by replacing the telephone company letters with T, P, R, S, D at any point on the dial.

e) Identify the Observer

This should be done and recorded at least until a skilled observer has checked the significant results. If employee time is being recorded on-line, the observers number could be used here. If a special telephone is used, a card reader could be attached for this purpose.

f) Note date and time of observation

This function could be done within the computer.

If a telephone input device is selected rather than on-line monitoring, then each vital sign must be keyed in. This raises additional questions.

Temperature Input:

a) Should the input include a character for the decimal point?
b) Should the measuring point be included (oral, rectal, axillary), or ignored?
c) Should the value be normalized for a single route prior to display?
d) Should special provision be made for reading in hundredths of degrees?
Pulse

a) Should location of pulse be included?

b) Should a simple (one digit code) of quality be included? (uneven, hard to find etc.)*

Respiration

a) Should patients state of consciousness be noted (awake, asleep, etc.)?

b) Should simple quality description be included? (heavy, light, etc.)*

* More detailed quality descriptions will be discussed later in this section.

Blood Pressure

a) Should two separate entries be made or one consisting of two figures?

b) Should the location of the cuff on the patient be indicated?

Input needs differ for routine and special observations. Special observations done during surgery are used immediately. These might not be put into the computer until after they have served their purpose. This input could be a special display on a CRT done when the surgical notes are being created. A more complex system could be devised to translate the output of monitoring equipment, sophisticated enough for use in surgery, into a form acceptable for display on the Digiscribe at a later time.

Methods of displaying Data

Information about vital signs will have to be displayed on the Digiscribe. This data is best presented as a graph. However, the Digiscribe is not designed to produce normal graphs.

The Digiscribe can present characters in predetermined locations on the screen. A graph could be simulated by dots, dashes or other symbols in approximately the correct points. Figure 3 illustrates this.
DIGISCRIBE: uses symbols in character spaces

CONTINUOUS. plots continuous line at any point
The software required to produce such a graph is complex. Some other methods of display might be as useful and easier to program.

The display technique used should present the data in the most useful form for the doctor to study.

Some questions about how a physician uses this data might help choose a technique.

1) Is the physician interested in normal values specifically, or would "normal" be enough information to display.

2) Is a change of value significant and is the size of the change rather than the actual values most important?

3) Is each vital sign considered separately, or are combinations significant?

4) Is the value more meaningful if some calculation or other interpretation is first performed?

5) Should data be presented only when asked for, or at other specific times?

6) Is a trend prediction more significant than actual values?

7) Is this very essential data about patients?

The answers to these questions, from physicians, will indicate several "best" ways of displaying data. One or more ways could be chosen. Some of these methods could be

1) Simulated graph, of one or more vital sign. Each sign could be represented by a letter - ie T, P, R etc. The time axis on the graph could be variable, allowing the user to see a long or short term display.

2) Columns of actual values for each vital sign. A column could show the date and time of the observation. If a ratio or further calculation is necessary, this could also be shown.
3) A variation of the column display could offset values that were different from normal. The distance of offset need not relate to the actual value, but would call attention to the change.

4) A display of non-normal values, with any descriptive remarks could be done. Other observations might be shown as "normal".

A sample display is shown in figure 4.

The first two lines of selection offer the user a choice of vital signs to be displayed. The last line asks "vital sign use finished? - yes". The user can review all vital signs by selecting from the top lines. When he is finished, he points to "yes" and the system would return to a post use display similar to End of Use Display of Doctors Orders.¹

The vital sign selected and the patients name are shown next. Below this would be the actual data. Figure - 4 shows a pulse display and includes offset columns for significant data and comments where these were indicated.

This displayed would be reached through a chain such as

²Level 0 - results
Level 1 - vital signs
Level 2 - would be this display

The first observation shown could be the most recent. Observations would be shown until the CRT was filled. Selecting the same vital again on line 7 right would page the system further into the past. The date and time scale would vary with the number of observations made.

¹ Doctors Orders, proposed techniques/or implementation pages 18 to 21.
² IBID page 62
Selection on line 7 left at the patient's name could bring the same vital sign on another patient. A list of patients would be displayed, one selected, and then the vital sign display would come back with the new patients data. This would allow the physician to quickly review vital signs on all patients at one sitting. The study questions (7) asked earlier might indicate this as a function need.

Regardless of the display techniques used, certain information should be obtained about each vital sign.

1) Normal values: These could be fixed normals, or could vary with other patient criteria i.e., age, weight, etc. The normal values will be useful if flagging of abnormal data is to be done.

2) Significant changes: What size of variation indicates something abnormal? This value may vary over the range of data. These changes will help if an offsetting display or a simulated graph is to be used.

3) What comments related to quality can be used? These should have been collected for input. For display, they can be used to call attention to problems if the numerical data is insufficient to do this on its own, i.e. a pulse in the normal range but with the comment of "weak."

Special requirements for

   a) "Make observation" reminders.
   b) Attention to changed or abnormal values.

Vital sign observations are made at regular intervals according to hospital policy. A physician may increase the frequency of observation by writing an order. Regardless of what determines the frequency for any patient, the Phase II system can keep track of when observations are made and issue reminders to nursing personnel.
The time intervals used now should be studied to determine the usual patterns. These can be described in several ways, i.e. once per shift, every hour, or 2 p.m. These descriptions will be similar to the displays for this kind of order presented to doctors.

In applying this order, some further information is needed.

a) How much leeway is allowed before or after the specified time?
b) Is the time period fixed until changed by another order?
c) Is the time interval dependent on the vital signs?

The hospital policies for regular observation should be examined. There might be a benefit if the policy is varied according to the observation. A major change noted on a regular measurement could trigger a series of closely spaced observations. The criteria for this would combine limits above or below normal with the "reminder to observe" function.

The reminder function can be automated if proper monitoring equipment is used at specified times, the computer would dial up the monitor and take a reading.

A study of the need for this kind of system could be made. The frequency of recording in intensive care or the recovery room would be balanced against the cost of such a system.

In addition to reminding personnel to make observations, the computer can take action when it receives certain results. This function was mentioned earlier and of course, falls into the function of Medical Audits.

But for this report, the following questions should be considered.

a) When should a significant vital sign be displayed?
   i) As soon as a responsible person checks into the system, or
   ii) only when asked for.

b) Should standard orders be associated with vital sign changes?
DATA HANDLING

This particular function does not require extensive data collection. The descriptive words associated with vital signs can be obtained from charts or text books.

The most difficult part of this project will be getting the physicians to set up the various limits for each vital sign, determining what calculations to apply (if any), and deciding on displays. The display techniques will require thought by physicians. The final patterns may not evolve until some interim displays have been used.
DETROIT-MACOMB HOSPITALS ASSOCIATION

HOSPITAL INFORMATION SYSTEM

PAYROLL ON-LINE --

Proposed Techniques for Implementation

Prepared by

Jack Segall, Managing Director
Community Systems Foundation
September 1966
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Payroll: On-Line

Payroll on-line means employees checking in and out of their work shifts directly into the computer. This system will replace the time cards, time checks and keypunching presently used.

The advantages of this system are the elimination of work and costs associated with time cards, distribution of check in points to more closely match working unit, recording of job start and finish times during a work shift, and personnel locator.

The system's success will require a working system 24 hours a day and a hard ware scheme that is reasonable in cost. The payroll system, almost more than any other, is dependent on a careful selection of hardware.

Cost of Hardware

The extensive cost of hardware is due to the nature of employee check-outs.

A study was performed at DMH to determine when employees are checking in and out. All time cards for a 14 day period were studied. The times recorded by the time clocks were obtained for both in and out punches. These times were averaged to obtain the expected number of time clock uses in one minute for 11 minutes in a day. The following results were obtained for DMH employees.

Peak uses of time clocks occurred around 7:15 am, 3:00 pm, 3:30 pm, 4:00 pm, 4:30 pm, 5:00 pm, 7:30 pm, and 11:30 pm. All these times showed more than 7 uses per minute for at least one minute.

The distribution of uses per minute before and after these specific times varies greatly between those checking in and out.
Checking in occurs at a fairly steady rate for long periods of time before shift change. The greatest number of check-ins occurred between 6:15 am and 7:15 am. Figure 1 shows this pattern. It is relatively flat, dropping off after 7:15. Also shown on this figure is the check-out of the night shift at 7:15 am. Outstanding is the tremendous peaking from 0.1 per min. at 7:14 to 5.2 per min at 7:15. This is typical of all check-outs, as shown in figure 2 for 3, 3:30, 4 and 5 pm shift ends. Employees are queuing at the clock. If payroll is to be on-line using touch tone telephone or a similar device, enough equipment has to be provided to take care of these demands.

If the hospital assumes that employees should be able to check out in the same amount of time as now, then hardware quantity will be related to the uses per minute. Hardware costs are mostly in the "black boxes" called interfaces. These cost approximately $100 to $150 per month, and one is needed for each input line to the computer. Each interface can, however, connect to many telephones within the hospital. The interface is in fact, a telephone that can be dialed by someone at any other telephone. The problem is to provide enough interfaces so that all the people who check out in any one minute will not receive a busy signal. The telephone company estimates that each interface will be busy for 6 seconds per check-out. The maximum per line per minute, then, would be 10. In practice, this would be less because callers would not make their call at the exact end of a six second interval: before the end, they receive a busy signal and must redial; after the end, they connect but unbusy time has passed. Probably 4 or 5 people could connect in one minute.

Using the data in figure 2, at 4:00 pm, almost 52 people check out in one minute. Adding 2/3 of this for South Macomb, gives approximately 50 people. At 5 per line per minute, the hardware costs would be $1000 to $1500 per month for interfaces. The addition of card readers to telephones in the
CHECK IN/OUTS FROM 6:20 TO 7:20 AM

Figure 1

Uses per minute

0 5 10 15 20 25 30 35 40 45 50 55 60 6:20 6:25 6:30 6:35 6:40 6:45 6:50
CHECK-OUTS PER MINUTE AT PEAK TIMES

TIME IN MINUTES
Plus or minus two minutes from check-out time
hospital might add $200 to this figure.

Problem 1 - solution goal
A reduction in hardware cost could easily come about if the check-out peaks are reduced.
* A plastic card with the employees number would be used to identify the employee in a special card dialing telephone.

What Constitutes Working Time
The study of time card punching previously discussed showed that there may be differences of opinion about working hours. Certainly they are not the exact times shown on the time card.

Most employees check in earlier than their shift start time. They are not, however, paid for this time.

Most employees leave their work post prior to shift ending time and they are paid for this time. They leave to travel to their locker and time-clock.

Presumably, the employee should produce for 8 hours, and the paid time should be recorded only when he starts work, and should cease when useful work does.

The best time recording system would make it impossible to check in or out at other than these ideal times.

The payroll-on-line system approaches this ideal if check in/out occurs only at the work station. The employee would be required to arrive at this point by the official start time, and not leave until after the end of useful work at this place.

Problem 2 - solution goal
Determine when productive work begins and ends, and force check in and out to be close to these times.
Selection of Hardware

The success of this function will depend on the hardware selected. The devices used by personnel to check in and out must satisfy several criteria.

1) Cost must be reasonable. The cost for this function can be minimized if the same hardware is used for other functions. (The vital sign recording function could use some of these same devices.)

2) The device must be self-explanatory and simple to use. Hospital personnel range from the highly educated to semi-illiterates, all of whom have to use the system.

3) The device must provide a confirmation that the check in/out has been recorded. All employees now visually verify the punch on their time card. This feature should be retained.

Problem 3 Solution Goal

Select hardware useful for other function that is easily understood and that can confirm a recording of data in the computer.

Knowing Who is Working

Part of the present time card system is a review of all cards at the end of the pay period by the department head. This review is primarily to make note of absenteeism, vacations, holidays, etc. The review "fills in the blanks" on the time not recorded according to predetermined schedules. The data on these cards could be used for other purposes. The work hours at any function could be compared with the need for workers: How much staff is needed on nursing unit 3 given the type of patient presently there?

An on-line payroll can accomplish both types of data use, if proper outputs are used.
Problem 4 Solution Goal

Report worked hours in relation to the job being done; report workers not check-in according to predetermined times.

Study Needs

The check-out peak should be reduced if hardware costs are to be reasonable. Anyone who has watched employees checking out knows why the peaks occur. Under present employee control, the worker will end his productive day before the official check-out time. Then he may proceed to the locker room, prepare to go home and finally arrive at the time clock. Regardless of when he arrives, he will not punch his card unless the clock shows that his official check out time has passed. A limited survey at this hospital showed employees waiting several minutes at the clock. Add this time to the clean-up and preparation for departure time and much productive work is lost. In fact, the clean-up and departure elements are probably not rushed because the employee has learned from experience that he has to wait at the time clock anyway.

A probable solution to this peaking problem concerns establishing the beginning and ending of production. This information can in turn be used for establishing better production controls. Thus problem 1 and 2 can be solved with a single study. A typical employee day might look like that shown in figure 3. The punch in occurs before reporting to the work station, the punch out occurs afterwards. Control of time between "in" and actual work is missing, and time is probably wasted prior to punching "out."

The peaking problem concerns "out" uses, so consider this end first. A punch-out time has to be arranged so that personnel do not queue waiting for a clock to tick over to the proper minute. There are two ways of doing this.

1) Have enough clocks so that the time differences between them will
TYPICAL WORK DAY FUNCTIONS

ARRIVAL
- arrive at hospital
- punch IN
- go to locker
- prepare for work

PRODUCTION
- report to work station
- prepare "tools" for the day
- go to lunch
- return from lunch
- finish work
- put away "tools"

DEPARTURE
- go to locker
- punch OUT
distribute the beginning of any punching queue.

2) Distribute the punch out time so not everyone is waiting for the
clock to hit the same minute.

The first solution is easy to fit into this function. If one or more check in
devices are located at each work area, the personnel will be governed by many
different clocks.

The punch out times could be distributed by varying the shift times plus or
minus five or ten minutes, or by having the punch out occur at some time other
than the actual end of the shift.

Suppose that a standard "put away" time could be determined for each job. If
punch out occurred before this function, this would distribute the times.

In housekeeping, for example, each maid restocks her cart at the housekeeping
storage area at the end of the day. Her production on the nursing station ends
before she does this. If the maid on each station was given a set number of
minutes to do this restocking, she could, in clear conscious, check herself out
on the nursing station these few minutes earlier. If she hurries through re-
stocking and preparing for departure, she might actually leave a few minutes
sooner, but the productive time on her unit would be fixed. Similarly, she
would not check in until she reached her work station. She would have to arrive
at the hospital and finish in the locker prior to her reporting time. If "make
ready" time is required away from the unit, this could be allowed as delay in
checking-in.

The study for this function should

1) Determine what is a productive day.

2) What time is spent in "make ready" and "put away."

3) Can shifts of workers without "put away" functions be varied to
eliminate the peaks?
Answers to these questions should solve the peak problem, and should control productive time.

**Selection of Hardware**

At the time this function is being studied, the market will contain many devices capable of recording time on-line.

All of these devices should be considered with the following points in mind.

1) How many devices are needed to satisfy the requirement for the previous study - i.e. distribution by work areas.

2) How simple is the device
   a) Does it require use of unfamiliar techniques.
   b) Does it rely entirely on a card or key being carried or available to the employee?

3) Does it require special wiring.

4) What interface boxes does it need?

5) Does it provide a feedback of some sort when a punch has been recorded.

6) Can its location (work station) be identified by the computer.

7) Is it fast enough to handle the queue at each location.

8) Does it have other uses?

Checking in and out, at 6 seconds per use occupies only 40 minutes per day for 400 employees. Total minutes available are 1440 times the number of interfaces.

As an example, the touch tone telephone, with a card reader attached can be evaluated as follows:

1) The number of telephones in the hospital will always exceed the requirements. A card reader can be attached to any telephone for a few dollars per month.
2) Everyone has used a telephone, although not necessarily the touch tone. Inserting the card is the same as inserting the present time card. Some dialing of codes to indicate "in" or "out" and perhaps the station location would have to be learned. The employee could dial in his number by the keys if his card was not available.

3) No special wiring is needed.

4) Interfaces are available at about $100 to $150 per month. The number needed will depend on the peak demands.

5) A feedback can be provided by an audio signal generated by the computer.

6) The location of the telephone could be known to the computer by having the user dial the extension's number, or building this code into the automatic dialer.

7) The speed is reasonably fast if each phone has a small queue to handle.

8) The telephone can function as a normal conversation instrument. The associated interface hardware can be used for vital sign inputs and patient menu selection.

Who is Working

The department head will want to know who is on duty each day. The sooner this is known, the better the manager can adjust staffing to satisfy needs. The computer can serve in several ways.

1) It can merely report who is in.

2) It can compare who is in with a previously inputted list of who should be in. Then a list of absent employees could be generated.

3) The work staff in can be compared to some measure of work needed and over or under staffed areas can be reported.

In any case, enough information about who is working should be provided to satisfy payroll needs. Sometimes before a payday, vacation, sick days and holidays will have to be credited to each employee's account.
DATA COLLECTION

There are two basic parts to the study needs.

1) Elimination of peak uses through redefinition of check in and out times.

2) Needs of supervisors for information about manpower use related to needs.

Data for the first study can be obtained from time cards and job descriptions.

The study of time clock use already done could be used. It might, however, be better to repeat this study at the time this function is being implemented. This will give more current data.

The handling of data is relatively simple. Time cards should be sorted into work areas: Each nursing unit, patient area housekeepers, accounting office, etc.

Then the recorded times of in and out punches for each group are counted. Done for a single pay period, this will give an average use per day of time clocks. The sum of all groups for each minute of the day will show the total system needs.

The highest peaks should be examined in detail. The working units or jobs that make up each peak should be listed with their contributions to the peak.

Those jobs which contribute most to the peak should be examined to find a means of distributing uses away from the peak.

   a) Is there a put-away operation that can be separated from production, given a standard completion time, and be performed always after check out?

   b) Can the shift time be changed to make checkout or in occur at a non-peak minute?

These studies will require detailed descriptions of the work performed. Such a study is a normal function of a systems engineer and does need to be detailed in this report.
The data needed to help supervisors use the on-line payroll for manpower scheduling and utilization can come from many sources. Some of these reports should have been determined during the studies of the Administrative Reporting Function. Others will result from staffing studies in individual departments. These studies are fairly standard for systems engineers, and similarly, do not need to be detailed.

The current payroll systems will have to be examined. The coding and input system used must mesh with the data needed for payroll. Much of these needs will depend on the hardware selected, but a listing of all payroll needs should be made, and studied with the hardware requirements in mind.

The flow of employee master file information should be made. Attention should be on who has the authority to make changes. Wherever possible, paper records should be eliminated. The employee, however, should have his file protected from change without his authority. Presumably, a security system to accomplish this will be in effect for other Phase II functions and can be used here.
DETROIT-MACOMB HOSPITALS ASSOCIATION

HOSPITAL INFORMATION SYSTEMS

PREVIOUS ADMISSION DATA

TECHNIQUES FOR IMPLEMENTATION

Prepared by:
Community Systems Foundation
Jack Segall, Managing Director
September 1966
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One advantage of electronic storage of information is the ability to retrieve selected data quickly and remotely from the storage area. Detroit Memorial Hospital has, in the past, cared for many patients on more than one occasion. This high readmission rate would indicate a need and a benefit from an information retrieval system that would allow a patient's previous records to be quickly obtained. This record, in three major parts, has many uses.

1) Admitting information: The data identifying the patient would only have to be updated, rather than recreated each time. In fact, much admitting data concerns the head of the household and would remain the same for all family members.

2) Financial information: a review of the payment record for any members of the same family would be useful in establishing deposit requirements and in-house collections.

3) Medical data: The availability of previous medical summaries would lighten the history taking burden, and make available family-wide medical histories when indicated.

The key to providing this information is a means of identifying the patient and/or his family. The hospital function that would first use this system would be the admitting office. An identification scheme will have to be found that

1) An admitting clerk can obtain the necessary information for identification from a preadmitting form or the patient.

2) Will identify the patient if the name changes, or spelling varies, or family structure changes.

3) Reduces to a minimum the probability of two patients having the same identification.

4) Does not take up a great amount of computer storage facilities.
5) Takes less time to use than recreating a new admission record. This identifying scheme should not be confused with the needs of legally identifying an individual in the computer. The identification of a record on a previously admitted patient is not as strict as the legal requirements. This past record scheme will produce information that can be verified by a human before it is used. It does not allow anything to happen to the patient in terms of patient care. Its sole function is to eliminate work by admitting and by medical records personnel.

**STUDY NEEDS**

To accomplish these objectives, the identification scheme has to involve information about each patient that is

1) Unique to each patient and family.

2) Is applicable to patients of all ages (newborn to octogenarian), all nationalities (foreigners, i.e. Canadians).

3) That can be easily remembered by the patient or member of his family.

4) That is short, or can be condensed to reduce storage space.

5) That does not change as long as the individual exists.

The chances of devising a system that perfectly satisfies all of these requirements is small. Certain criteria will have to be sacrificed for others. Even under the present system, with several hundred characters of information per patient on file, duplications are found, or old records are unidentifiable. Any system chosen must be selected with a known probability of duplication and of non-identification. The duplication can be minimized by human scrutiny of the several records, and the non-identification by human questioning and manipulation of data.*

* A patient, Smythe, who insists that is the spelling, might be put through identification with several spellings, anticipating an error on the past records.
A study pattern should be established for testing various identification schemes. This pattern should include

a) defining identification information
b) predicting its effectiveness
c) testing prediction using past records
d) deciding if scheme meets standards
   i) probability of duplication
   ii) storage space
e) testing patient's ability to recall data
f) selecting best scheme.

Data Needs

a) Define identification information
   i) Look at information obtained on admitting forms.
   ii) Classify each bit according to
       1) ability of the patient to recall the information
       2) its susceptibility to change (study a series of admission
          forms of patients with frequent readmissions.
       3) its apparent uniqueness.
   iii) Look at published studies of identification schemes for clues to
        usefulness of data.
   iv) Establish preliminary identification formulae for trial runs.

b) Predict its effectiveness

   Select a sample of admission records. Take each element of each identification formula, and list what would be used for all sample patients to complete that element.

   The duplications that occur in each element will indicate the effectiveness of the element as a unique identifier.
The cumulation of duplication probabilities for all elements in a formula will give the effectiveness of each scheme.

Select the best schemes (most effective) and select a further sample of patients with several readmissions. For each of these patients, determine the frequency of change of information used as elements of these best schemes. The most desirable formulae will use elements that have a low frequency of change.

At this point, the size of the identifier for each patient should be considered. The shortest formula should be used. This will minimize storage requirements and processing time.

A further test should be made of the patient's ability to recall the necessary identifying data. The admitting office can conduct this study by asking patients for this data and recording their ability to recall it.

**Testing Effectiveness with past records**

The formulae that survive these tests are ready for a final check before selecting the proper scheme.

A fairly large sample of previous admissions should be filled in each formula pattern. The data in these files should be examined for duplication, and uniqueness.

The admitting data from Phase I records can probably be used. This data is already in machine readable form. The computer should be used to extract the formula elements, and then to analyze the files created for each formula.

If these files cover an adequate time period, new admissions can be processed through each scheme. This will show how effective each formula is in processing time, containing data known to the patient and in reducing non-identifications.
Putting the Formula to Work

When the final formula has been selected, it must be set up on CRT displays, and the file must be created for previously admitted patients.

The primary use of this function will be in the admitting office. Therefore, the displays should become part of the admitting function.

The clerk in the admitting office will probably use a CRT with a keyboard attachment. She will input admitting information by filling in blanks on a format displayed on the CRT. The format could be arranged so that the data elements used in this function are the first to appear. This could be done by having her select "Previous Admission" from a series of choices of interest to admitting.

These choices, and their organization would be the result of a study of the admitting function.

When all the elements were filled in, the computer would search for a previous record. When it found one, the complete admitting information would be displayed. The display could be divided into four parts:

a) Patient identifier (probably most of the data used to find the previous record.)

b) Financial data.

c) Medical data (some of this would be new for each admission.)

d) Hospital data (Room Number, Intern and Resident assignments, etc.)

The clerk would verify all data with the patient, correcting only what has changed.

Separation of admitting data into these categories would allow increased utilization of the file.
a) Financial data could be related to family units. This would give a better record of payments than the individual patient record.

b) Medical data could relate to the individual or the family, based on the diagnoses.

c) Hospital data would be new for each admission, and most likely determined by the computer. But previous rooms could be recorded, and given to the patient if they desired. In addition, preferred foods and personal comfort items could be remembered and reviewed with the patient.

Use of this function requires that previous admissions be on file in the computer. There are several ways that this can be accomplished.

a) All existing records can be inputted in a single, large effort.

b) New admissions from some point in time can be retained for future reference.

The choice will depend on the cost of each system, the time period required to build up the file and the probable use of the file or readmission rate.

A study should be made of these factors.

a) How many patients are involved?

b) What proportion of patients (or families) have readmissions?

c) What is the usual time between readmissions?

d) What information exists in machine readable form?

From this data it will be possible to estimate the volume of work for a single effort file creation and the length of time to create a file with new patients.

The major cost of a single effort will be in "keypunching" the original data. The cost of a new patient file is in continuing the need for manual file look-ups.
until the computer file contains most of the old records. Costs associated
with unavailable family credit data should also be included.

The final choice may be a combination, using data collected from Phase I
accounting records for the initial file. In fact, the files created during
the large sample testing might serve as the initial file.
DETROIT-MACOMB HOSPITALS ASSOCIATION

HOSPITAL INFORMATION SYSTEM

DEMONSTRATION PROJECT

Prepared by:
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September 1966
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Demonstration Project for CRT Unit

Proper introduction of "digiscribe" CRT device can be important to the future success of Phase II. The first uses of this device will be on a limited scale (probably not more than 4 units). If the future users of the total system are to be indoctrinated to a positive attitude toward Phase II, a carefully thought out first use should be established. This demonstration project will also provide DMHA personnel with a training ground in systems and programming for the digiscribe.

Factors involved in this choice are:

I. a) Be fairly simple to program

   This is important to minimize the effort on this first use, and to increase the probability of producing a functioning, reliable demonstration.

   b) Be useful to personnel

   The system should serve some purpose. It should not be just a toy. A measure of this would be if this system could eliminate existing methods of disseminating information.

II. This system should be useful to as many types of personnel as possible i.e. physicians, nurses, administrative.

III. Be useful on a continuing basis in Phase II

   Any time spent on this project should not be wasted. The choice should be a small part of one of the larger functions of Phase II. For maximum returns the project could also be chosen as an improvement of Phase I systems.

IV. Be operational though 4 displays at DMHA
The initial 4 CRT's will probably be distributed to a) Information Systems, b) Administrator, c) DMH demonstration, 2 units.

V. Show capability of Phase II.
The system should involve as many features of the Phase II system as possible. a) security check, b) multiple sequences of accessing information, communication, multiple uses of information, etc.

The Best Choice

Admitting Information

Input of information now on the Admitting form would be done through the keyboard of the Digiscribe. The form outline would be displayed and the typists would add the correct data (editing errors as she goes). Hard copy would be produced by a connected typewriter using specially designed continuous forms.

Users of this information could query a Digiscribe. Each user will obtain information about patients through selecting categories that interest them. (e.g. The chaplain will want patients whose religion coincides with his.)

Patient information given to a user can be limited to what he needs. (e.g. Billing Clerk might not be given the race or religion of the patient.) This would be based on the identity of the user.

This project satisfies the criteria for selecting a demonstration project.

I. a) Information is known, users needs are known.
   b) Users now screen many admission forms looking for their special categories. Admitting personnel spend extra time retyping admissions for corrections. Editing on the Digiscribe is quicker.

II. Many types of personnel will have need of the information: Doctors - where are my patients?, Clerks - who are private pay?, Chaplain,
Executives - who are VIP's in house?, etc.

III. Phase II will always need a function to allow input of patient information.

IV. Most of the information users could go to one or two locations to get their data. This would require more effort than having papers delivered to them, but a digiscribe in admitting and the doctors lounge area would be "on the way" to and from the cafeteria. This should not inconvenience people too much.

V. Most capabilities of Phase II will be used. User identification will determine who can see what. Many different routes will be available to access patient data, and variable input will be used.

Methods of obtaining hard copy of admission data, and the routes for selecting patients via the Digiscribe would be determined during the study of this function.

**STUDY NEEDS**

The objectives of this function are twofold

1. To use the digiscribe as the Phase I admission data input device.
2. To learn as much as possible about using this hardware for Phase II functions.

Each study will be discussed separately.

**THE Admitting FUNCTION**

First, the needs of admitting and those who use the admitting sheets should be reviewed.

The input of data occurs in Admitting. The sequence of data input is, at present, controlled by a form. This form does not ask for data in the best sequence, because of compromises needed to fit all the blanks into a single piece of paper.
The admitting clerk, filling in blanks on a form displayed on the CRT, can be shown the blanks in a logical order, and blanks that are not needed for a particular patient can be skipped. (e.g. insurance information if patient is private pay.)

During the demonstration project, hard copy admitting records will still be needed. In fact, some of these will be used after all medical record information is computerized. (e.g. patient identifying band.)

The admitting clerk should not have to retype information for these records. Rather, the computer should reformat and type out the data on properly designed hard copy forms. The number of hard copies needed will be reduced by this system.

At the present time, 30 copies of the admitting sheet (22 full and 8 top line only) are made. These are used by 38 functions within the hospital. The demonstration project may be able to eliminate many of these copies and allow the users to obtain their needed information from the computer.

To accomplish this, each user should be asked

1) What he looks for on an admitting form
2) What action he takes when specific data is found
3) When this process has to be done, relative to admission
4) Why is all of this necessary?

The answers to question 1, should yield a list of items through which the user can select admissions of interest. For example, the resident might be interested in patients assigned to him; the priest in Catholic patients only.

In addition, this question will give information about how much admitting data the user needs. Does the priest need the admitting diagnosis, or does the resident need financial data?

The action a user takes may indicate some shortcuts the computer could perform. The action taken will also help define what data about the patient is needed by each user.

The time element between admission and the need for data may help define some different outputs. If data is not needed immediately, but perhaps once a day, the user may be in a better position to get information via the CRT because he will have to leave his office to do this.

Finally, as with all studies, the function must serve a purpose. If, in fact, the user does not need admitting data from the admitting office, then that user should be eliminated from the system.

There are approximately 40 pieces of information on an admitting form. Of these, about 20 could be the data used to select an admission.

ie. patient name
Doctor
Insurance Co.
Service

Each user will be interested in one or more of these "key" items. These will have to be organized into selection displays for the user. Perhaps, these displays might differ for each user. Certainly some data will be made "off limits" for certain users. The design of this system should mesh with Phase I information needs, and should be expandable to the full potential in Phase II. This will require knowledge of these future needs.
The Learning Function

The effort devoted to this demonstration project will be justified by the learning for the future development of Phase II. System's Analysts and programmers should be able to try some of the techniques required to complete this system.

Before this learning can take place, the techniques to be used must be known. The Study Outlines for Phase II contain ideas, specifications and suggestions about hardware and software needs for Phase II.

These should be carefully reviewed and categorized according to their applicability to Phase II. Those ideas at the top of the list, the most desirable, should be included somehow in the development of this demonstration project.

It is for this reason that the demonstration project appears at the end of this series of Study Outlines. It is hoped that the reader will, as he reads the study outlines, evaluate the ideas about Phase II needs, and will then be in a better position to carry out the demonstration project.

The process of categorizing these needs should be two-pronged. First, the desirability of a particular operation should be considered. Then, the real-life problems of being able to perform the operation should be considered. Many ideas that are desirable can only be realized after a great expenditure of time and money. This cost will have to be balanced against loss to the system if the operation is not performed.

This will not be an easy task. It will require judging complex problems without really knowing what they will require. The decisions made at this time will have a long lasting effect on the Phase II system. Functions that are
considered impractical and are eliminated at this stage may be difficult to 
reinstitute later. The desire for a successful and useful Hospital Information 
System should supersede all other influences to these decisions.