AN AUTOMATED MEDICAL RESOURCE ALLOCATION AND PLANNING SYSTEM (MEDRAPS)
FOR U.S. NAVAL MEDICAL TREATMENT FACILITIES

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The goal of this project was to create a software system for analysis of health services utilization in the U.S. Navy medical system. Products included an integrated database with population, financial and detailed utilization data, and an interactive planning model for use by managers and analysts in the U.S. Navy medical department. The entire system is menu-driven and permits planners to generate a series of user-specified analysis reports through direct interaction with multiple datasets.

Information needed by managers of large and complex hospital systems includes (1) the demands for medical services, (2) the resources available to meet these demands, and (3) performance data to evaluate to what extent patient needs are met and resources efficiently used. Because of technological advances, managers of many health delivery systems can access numerous data bases that provide such information. However, due to the rapid progression of technology and the increasing complexity of the data bases being developed, the manager can become overwhelmed with data possibilities. From a management perspective a key issue is how to standardize and integrate information from multiple data bases so that such information is readily accessible and subject to analysis and interpretation. Further, and perhaps most importantly, this must be done without forcing managers to learn complex computer commands and languages that direct their energies away from performing managerial functions.

In this paper we will: (1) present an overview of major data sources available to managers, using the U.S. naval hospital system as a case study, (2) discuss the rationale for the design of MEDRAPS (Medical Resource Allocation and Planning System), a software system designed as a research and development effort to synthesize and integrate data from multiple sources, and (3) provide a description and sample output for MEDRAPS.

Case Study--Naval Hospital System

The naval hospital system, which is a large complex organization, presents an interesting case study. Numerous individual Navy and Department of Defense agencies maintain records which are needed to operate this expansive system. Separate data files contain hospital medical records, beneficiary information, costs, and resources. These data files tend to be quite large; the Navy Inpatient Data System maintained by the Naval Medical Data Services Center, for example, contains over a million individual patient records. Each record is composed of basic demographic data and extensive diagnoses and discharge data. A similar situation exists for the other data systems available to Navy Medical Department managers such as files containing: (1) active duty mobilization strength data from the Department of Defense Manpower Data Center, (2) dependents of active duty and other beneficiary population strength data from the Defense Eligibility Enrollment Recording System (DEERS), (3) reimbursement to civilian medical providers through the CHAMPUS Program, (4) direct care costs at naval medical facilities through the Uniform Chart of Accounts, and (5) naval medical facility staffing data from the Naval Medical Command, Washington, DC. The coding schemes used for each of these databases are quite complex, requiring constant reference to numerous code manuals which makes data retrieval cumbersome, especially when data are required from more than one of these files.

Rationale for the Design of MEDRAPS

An information system designed to overcome access problems should, at a minimum, have the following characteristics:

- Require little or no technical training--Training needed to access data from the system should be minimal; lengthy or highly technical training programs should not be required of managers. Further, data output should be in a clearly labeled format familiar to hospital managers.
Flexibility of system output—The user should be able to select the level of analysis (e.g., summary data or by individual facility) and other options of interest.

Portability of the system—The system should be written in a widely used computer language and should be executable on computers that are readily available.

The system should be on-line and interactive.--The user should be able to obtain immediate results. Minor errors should be able to be corrected without having to start the session over.

Because of these system specifications, the normal procedure of writing special purpose programs for each specific data request was inappropriate. Our approach was to develop a type of software system referred to as a Decision Support System (DSS).11-10, which is defined as a menu-driven software system that enables managers and planners to directly access and utilize large or multiple datasets. Decision Support Systems focus on specific decision making problems and include a range of output reports so that users can select preformatted reports or specify the content of output data to be produced. The primary advantage of these systems is that no technical training or background is required to operate the system. These systems are usually menu-driven, on-line, and operate interactively. The user can, within specified limits, directly access data, structure reports and select parameters of interest. Further, these systems are usually portable since they are normally written in a common computer language such as FORTRAN or COBOL.

In the process of outlining requirements and reviewing work to date on medical information systems, it became apparent that the Resource Analysis and Planning System developed by Vector Research, Inc. of Ann Arbor, MI and Actuarial Research Corp. of Falls Church, VA, for the Office of the Assistant Secretary of Defense for Health Affairs (OASD(HA)), provided an excellent starting point for developing a more extensive and detailed medical department system. The Resource Analysis and Planning System11 is a software package with the following capabilities: (1) incorporates data such as hospital staffing levels, catchment area population strengths, hospital workload levels, cost factor and CHAMPUS information; (2) aggregates data by branch of service, geographical region or individual medical facility; (3) projects data five years beyond the baseline year and permits the user to modify baseline inputs such as inflation rate, number of physicians, and number of beds to obtain five year projections for different scenarios; and (4) contains an option for projecting bed utilization and occupancy rates during wartime. Although providing a base for a naval medical department information system, the Resource Analysis and Planning System did not provide certain information of interest to Navy program managers and contingency planners. For example, there is no detailed information about the types of illnesses and injuries experienced by beneficiary populations. This detailed hospital disposition data would permit medical department managers to assess the health status of beneficiary groups, to identify or profile health patterns across beneficiary groups and medical facilities, and to study the impact that factors such as military mobilization or increased incidence rates of disease and trauma might have on the health care delivery system.

Description and Sample Output for MEDRAPS

The Medical Resource Allocation and Planning System (MEDRAPS) was designed to provide relevant information to naval medical department managers and planners by utilizing data from a number of different sources: detailed inpatient utilization data from the Naval Medical Data Services Center; population and resource data from the Resource Analysis and Planning System; and cost data from the Uniform Chart of Accounts system.12 The MEDRAPS model has three major components or modules: historical data analysis, beneficiary and utilization projections, and facility resource profile reports. The historical data analysis module permits investigation of inpatient utilization rates and lengths of stay by diagnostic category. Users can select from a variety of parameters to analyze historical data for individual medical treatment facilities and for groups of facilities. The second major component provides the capability to make future projections of the beneficiary population and inpatient utilization for naval medical treatment facilities. In addition, users have the option for reviewing and changing baseline population projections and utilization rates. The third component of the model focuses on facility resources and costs in which the user can select from a menu containing five different facility profile reports. These are (1) medical resource summary, (2) inpatient cost per disposition, (3) inpatient cost per bed day, and (5) projected inpatient costs. After choosing the module of interest the user is presented with a further choice of options. For example, the features contained in module 1—historical data analysis—are summarized in Exhibit 1. Exhibit 2 presents an example menu from which the user can select a report of interest. Exhibit 3 presents an example of a report that compares disposition rates for one hospital with all facilities.

In summary, the MEDRAPS system has three major modules: historical medical data analysis, beneficiary and utilization projections, and facility resource or cost profiles. For each module, the system produces a series of user-specified analysis reports based on a number of large data bases. A major advantage, from the user's perspective, is that the entire system is menu-driven and permits managers, planners and
administrators to interact directly with multiple and large datasets.

References


EXHIBIT 1

Historical Medical Data Analysis - Capabilities of the MEDRAPS System

**Level of analysis - diagnostic categories**

1. Major diagnostic category
2. Disease subcategory
3. ICD-9 three digit diagnosis code
4. Facility summary report

**Dependent variables for analysis**

1. Disposition rate per 1,000 population
2. Occupied bed day rate per 1,000 population
3. Average length of stay

**Beneficiary Category**

1. Navy and Marine Corps active duty personnel
2. Other active duty personnel
3. Dependents of active duty personnel
4. Retired military personnel
5. Dependents of retired and survivors
6. Total - all beneficiaries

**Options for Comparison Facilities**

1. Individual medical treatment facility
2. All other facilities
3. Selected facilities for comparison purposes
4. Total - all facilities

1All diagnostic categories are based on the International Classification of Diseases - Ninth Revision (ICD-9)
Exhibit 2
Sample Terminal Session

MAIN MENU
**********

4. SELECT MODULE YOU WANT TO USE:
   0=STOP
   1=HISTORICAL MEDICAL DATA
   2=Beneficiary and Utilization Projections
   3=Facility Resources and Costs
   ?
   1

HISTORICAL MEDICAL DATA
**********

5. SELECT TYPE OF ANALYSIS REPORT:
   1=Facility Summary Report
   2=Major Diagnostic Category Report
   3=Disease Subcategory Report
   4=3 Digit ICD-9 Code Report
   ?
   1

FACILITY SUMMARY REPORT
**********

6. SELECT DEPENDENT VARIABLE TO BE DISPLAYED IN FACILITY SUMMARY REPORT:
   1=Dispositions
   2=Occupied Bed Days
   3=Population
   4=Disposition Rate Per 1000 Population
   5=Occupied Bed Day Rate Per 1000 Population
   6=Average Length of Stay
   ?
   1
### Exhibit 3

**Disposition Rate by Major Diagnostic Category**

#### Facility: 67 - Hospital A

**Beneficiary Category: 0 - Total**

<table>
<thead>
<tr>
<th>MDC Number</th>
<th>Major Diagnostic Category</th>
<th>Hospital A Rate</th>
<th>Total Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Infectious Diseases</td>
<td>2.9</td>
<td>2.8</td>
</tr>
<tr>
<td>2</td>
<td>Nervous System</td>
<td>16.1**</td>
<td>4.7</td>
</tr>
<tr>
<td>3</td>
<td>Endocrine/Metabolic</td>
<td>2.8**</td>
<td>1.2</td>
</tr>
<tr>
<td>4</td>
<td>Blood Diseases</td>
<td>0.8**</td>
<td>0.5</td>
</tr>
<tr>
<td>5</td>
<td>Mental Disorders</td>
<td>11.0**</td>
<td>6.2</td>
</tr>
<tr>
<td>6</td>
<td>Nervous System</td>
<td>10.9**</td>
<td>3.9</td>
</tr>
<tr>
<td>7</td>
<td>Circulatory System</td>
<td>11.0**</td>
<td>4.7</td>
</tr>
<tr>
<td>8</td>
<td>Respiratory System</td>
<td>8.5**</td>
<td>5.7</td>
</tr>
<tr>
<td>9</td>
<td>Digestive System</td>
<td>12.3**</td>
<td>7.8</td>
</tr>
<tr>
<td>10</td>
<td>Genitourinary System</td>
<td>11.7**</td>
<td>6.8</td>
</tr>
<tr>
<td>11</td>
<td>Pregnancy Problems</td>
<td>8.8</td>
<td>13.4</td>
</tr>
<tr>
<td>12</td>
<td>Skin Diseases</td>
<td>3.0</td>
<td>2.4</td>
</tr>
<tr>
<td>13</td>
<td>Musculo-Skeletal</td>
<td>14.5**</td>
<td>4.8</td>
</tr>
<tr>
<td>14</td>
<td>Congenital Anomalies</td>
<td>3.3**</td>
<td>1.1</td>
</tr>
<tr>
<td>15</td>
<td>Perinatal Conditions</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>16</td>
<td>Ill Defined Problems</td>
<td>6.1**</td>
<td>3.3</td>
</tr>
<tr>
<td>17</td>
<td>Injury/Poisoning</td>
<td>11.2</td>
<td>8.2</td>
</tr>
<tr>
<td>18</td>
<td>Supplementary</td>
<td>15.1</td>
<td>14.8</td>
</tr>
</tbody>
</table>

**Total**  
150.5  
92.4

**One standard deviation from the average rate**