The Behavioral Medicine Data Retrieval and Analysis Program
at West Virginia University Medical Center

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This paper describes a computerized information retrieval system developed in
the Department of Behavioral Medicine and Psychiatry
at West Virginia University Medical Center.
The Behavioral Medicine Data Retrieval and Analysis Program is a comprehensive
system which retrieves and analyzes demographic and clinical
information concerning ambulatory care patients.
The computer program is the first attempt in
our setting to monitor such data. The program
presents data on individuals grouped by diagnosis.
The system is currently accessed by a user query containing a five digit
diagnostic code corresponding to whatever
diagnostic category (ies) the user is interested
in retrieving. The user may select an exhaustive
query, using all possible diagnoses, or a
specific diagnostic query. In addition, information
may also be retrieved in summary form
across all diagnostic categories. The present
program is efficient enough to allow data retrieval
in a relatively short period of time.
The system is being enhanced so that it will be
an interactive system to aid the instructional
program. The Behavioral Medicine Data Retrieval
and Analysis Program is being used in teaching,
administration and research.

Patient care activity in a busy medical
center requires that a large amount of information
be obtained. Over time this patient related
information becomes enormous, and it is difficult
to retrieve this data when it is processed manually.
Computerized retrieval of such information
holds the promise of maximizing the efficiency of
record keeping and enhancing its clinical usefulness.

In the Behavioral Medicine Ambulatory Care
Clinic at West Virginia University Medical Center,
we thoroughly assess a patient's status and
provide sound treatments for the problems identified.
But with no systematic method of data
retrieval, it would be next to impossible to
develop, over time, a reliable database from which
to improve our diagnoses and treatment interventions.
As a result, efforts to develop a computerized
data retrieval system were begun in 1975.

Before the development of this system, it was difficult to answer even the most simple
queries about the patients served by our clinic,
e.g. ages of patient, places of residence, frequency of particular diagnoses. In particular,
it was important for the residency training program that specific information about our clinic
patients be available to plan teaching programs and to assist in monitoring the patient care
activities of our residents. As in many other settings, research in the clinical population was
also difficult since clinical information was often missing or alternately the files contained
illegible entries that made the data useless. We
were particularly interested in the potential of
this system assisting us in the development of
localized norms for the psychological tests used
in our clinical setting. The basic purpose for
developing a computerized system was and is to
ensure that the clinical and demographic data for
each patient was and is recorded systematically
and to ensure that this data could and can be
retrieved readily. The Behavioral Medicine Data
Retrieval and Analysis Program (BMDRAP) was thus
designed to be a comprehensive data retrieval
system, with applications in administration,
teaching and research.

The goal of the system was and is to be able
to retrieve the demographic, psychological and
diagnostic features of the patient population.
The demographic data was routinely recorded in the
record of the patient and it was easy to have the
clinician code this information at the time of
the initial interview. Since the program was
developed for a medical clinic, grouping individual
patients by diagnosis was the most clinically use-
ful method of classifying the data. Such an organ-
ization of the patient files would enable us to
compare diagnostic groups on all relevant variables.
The diagnosis would be a 5 digit code from the
diagnostic and statistical manual of mental
disorders (DSM-II)\textsuperscript{3}. This diagnosis would be
coded by the clinician, and it represents the
joint opinions of the resident responsible for
the initial interview and the attending faculty.
Since it was and is important to assess the
patient's psychological status, a standard battery of
tests was included in the initial workup. This
test battery would establish a standard class of data
for each patient identified within the database,
and would quantify aspects of the patient's
personality, past history and current
stresses.\textsuperscript{4} Thus, for each new patient, a standard
amount of data would be coded. To insure the
accuracy of the data, a pre-processing/edit pro-
gram was also developed to check every field
within a patient record for errors before becom-
ing a part of the permanent patient database.
This assured us that the data would be accurate.

The development of the BMDRAP system has per-
mitted us to utilize this data efficiently.

al though not as sophisticated or comprehensive
as some other systems, the system meets our
needs in areas of administration teaching and
research. It enables us to examine the charac-
teristics of patients utilizing our clinic. We
have access to information about the patients
which enables us to gear our teaching program
specifically to the types of problems encoun-
tered. We have also begun to develop local norms
for the psychological tests utilized which should
further refine our diagnostic endeavors in the
future.

FEATURES OF THE BMDRAP SYSTEM

There was some consideration given to using
existent "canned" programs to process the data,
e.g. SAS 76. However, such pre-existent pro-
grams would not have been as easily utilized or
understood by our staff, and it was important
that the output be formatted to be easily read
by the clinicians. Furthermore, an efficient
method for automatically grouping the patients by
diagnosis and searching the patient database for
specific groups necessitated the development of
the present system. Finally, in a clinical
setting, the patient data is often incomplete.
It was thus necessary to have a program that
would not discard such a class of patient records
solely on the basis of a missing field value of
data. The BMDRAP system automatically handles
missing data and keeps the calculations, means
and standard deviations accurate.

Presently the database is being expanded to
include outcome data on the types of treatment
offered and the effectiveness of such inter-
ventions. In addition, individual staff members
may retrieve information about the specific
patients they have personally treated. Such a
use of the system enables us to provide a record
for residents of the patient load which they
treated and therefore summarizes the extent of
the resident's experience with various types of
patients.

The system is being enhanced so that users
can interact directly with the patient database.
This improvement will allow the staff to query
the system as to whether a patient has been seen
in the past, the nature of the problem, and the
outcome of the treatment. Interactive capability
will also enable the staff to use the database
in such a way as to assist more directly in
diagnosis. This enhancement will enable the
system to be utilized as a computerized aid to
instruction (CAI). Such an application is in
line with growing emphasis on such use of com-
puters in medicine (Reference note 1).

THE SYSTEM DESIGN

Presently the system is accessed by entering
specific user queries which tell the system
which diagnostic group(s) the user is interested
in retrieving. The query is currently by means
of a 5 digit code from DSM-II. For example, if
the user is interested in the group "Depressive
Neurosis", the numbers 30040 30040 1 would
be entered in the program. The number 30040 is
the index value, and 1 is the increment. A more ex-
haustive search of the category "Neurosis" would
be made by using the index value 30000 300900 10.
Such a query would retrieve all of the diagnostic
groups within the category "Neurosis", searching
the category by increments of 10. The user may
also choose to have the system select all patient
groups regardless of diagnosis by using the index
value 99999 by an increment of 1. A more detailed
explanation of system access is described in
Appendix A.

Presently the BMDRAP system permits data re-
trieval over a relatively short period of time,
the actual process time depending on its position
in the job queue. Such waits will be eliminated
when an interactive capability is established.
But for our present purposes this is a reasonable
turnabout time, terminal to printer, for informa-
tion retrieval.

The general description of the system is
best presented below in outline form. A flow-
chart is provided in Appendix B which schemati-
cally presents the system.

I. General Description of the System. Begin

PSYCH and:

A. Create the diagnostic message data
structure (dictionary, tree, using mul-
tiple linked lists).

B. Open the index values file, CONTROL.
Whenever the end of CONTROL is reached,
branch to the WRAPUP routine after
closing the file.

C. Get three values from the index file
(IND1, IND2, INCR), in order to query
the system.

D. Enter the INDEX PASS loop; DO the
following from INDEX=IND1 to INDEX=
IND2 by increments of INCR; when IND2
is reached return for possibly another
query at C.

0. Call PRINT_DIAG;
1. Open the patient data file, INPUT.
Whenever the end of INPUT is reached
branch to the OUTPUT routine.
2. Initialize the demographic and psycho-
metric variables for a given INDEX
value.
3. Enter the OUT LOOP:
  a. Get a patient data record CARD
     from INPUT and check for missing
     data fields by using the FCHECK

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subroutine in the GETBUF System Procedure. If such a field occurs, replace it with a 0 so that a 0 will be added to the N frequency count.

b. If the DSM II Diagnosis corresponds to the INDEX value and the ALL-DIAGNOSES FLAG, a switch, is turned OFF, then the program
   (i) sets the gatekeeper flags to FLAG2=ON and FLAG1=OFF;
   (ii) searches the diagnostic message data structure for the appropriate message description and saves the reference to the appropriate ENTRY cell by the pointer (variable) SAVE.
   (iii) transforms the demographic and psychometric variables encoded as characters to numeric code to facilitate their use in processing.
   (iv) accumulates patient record values for the demographic and psychometric variables associated with the given INDEX value (as initialized above).
   (v) end of b.

c. Go back and repeat steps a. and b.

4. End of 3.

5. Close the patient data file, INPUT.

6. If the gatekeeper flag FLAG2=ON, then the program (a.) resets the gatekeeper flag FLAG2=OFF.

If the ALL-DIAGNOSES FLAG is ON: then

F. Print out demographic and psychometric information across all DSM II Diagnostic Categories; and,

G. Tabulate the frequency counts across all diagnostic categories.

Otherwise,

b. Refer to the pointer reference SAVE, which stores the message heading corresponding to the total number of responders for a given DSM II Diagnostic Category in COUNT.

c. Print out tabulations and interpretation.

d. Print out the diagnostic group information referenced by SAVE.

e. Print out the demographic and psychometric information for a given DSM II Diagnosis in tabular form with means, standard deviations, and frequency counts.


8. Return to D. to get the next value of INDEX between INDI1 and INDI2.

EXAMPLE OF OUTPUT

The example provided in Figures 1-3 is the output generated by a query for the diagnostic group with a DSMII index value of 30040. In the interest of saving space, the brief instructional paragraph which assists the user in interpreting the output is not reproduced. The format of output is such that it enables easy comparison of patient flow from year to year and month to month. The "demographic data" section prints out the information coded at intake. Means, standard deviations, and ranges are used on all numerical data. Otherwise, frequency counts are utilized. The "psychometric data" section presents the data obtained by means of the psychological test battery described previously. This section is particularly useful since it presents the mean profile for the MMPI and Minnesota-Briggs History Record.

CONCLUSIONS

The Behavioral Medicine Data Retrieval and Analysis Program was developed for the specific needs of our clinic. The program facilitates easy comparison of different diagnostic groups on a number of important clinical and demographic dimensions. With this system, we are developing local normative data on our diagnostic psychological tests. In turn, WRAP has aided us in the diagnosis of new patients. It has enabled us to improve our teaching program for residents since we now can address the disorders that occur most frequently in our setting. In addition, the residents are able to retrieve in meaningful form a record of the type of patients they have treated during their training period. The Behavioral Medicine Data Retrieval and Analysis Program is the nucleus of further efforts to monitor patient care in the Ambulatory Care Clinic. The development of an interactive capability for the system will enhance the utilization of the system in the future. In addition, there are plans to develop a natural query language with the interactive capability.
**Figure 1.** Page 1 of sample output for diagnostic group depressive neurosis.
<table>
<thead>
<tr>
<th>SEX</th>
<th>FREQUENCY COUNT</th>
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<td>MALE</td>
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<td>FEMALE</td>
<td>112</td>
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<tr>
<td>OTHER SERVICE WVHC</td>
<td>46</td>
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<tr>
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<tr>
<td>STATE HOSPITAL</td>
<td>0</td>
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<td>EMERGENCY ROOM</td>
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<td>OTHER</td>
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<td>STA 82</td>
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<tr>
<td>MEAN EDUCATION</td>
<td>11.02</td>
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<td>STD DEV=</td>
<td>3.14</td>
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<tr>
<td>RANGE=</td>
<td>3.00 - 20.00</td>
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<td>CRAFTSMAN AND KINDRED</td>
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<tr>
<td>SALESMAN</td>
<td>6</td>
</tr>
<tr>
<td>CLERICAL AND KINDRED</td>
<td>8</td>
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<tr>
<td>MANAGERS PROFESSIONAL AND TECH</td>
<td>15</td>
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<td>PROFESSIONAL</td>
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<td>STUDENT</td>
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<td>FULLTIME</td>
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<tr>
<td>PART TIME</td>
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<tr>
<td>NOT EMPLOYED</td>
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<td>VOLUNTARILY IDLE</td>
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<td>RETIRED</td>
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<table>
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<td>MEAN NUMBER OF CHILDREN</td>
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<table>
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<tr>
<td>MEAN NUMBER IN CURRENT RESIDENCE</td>
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<tr>
<td>RANGE=</td>
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<table>
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<tr>
<td>MEAN FREQUENCY</td>
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<tr>
<td>INPATIENT</td>
<td>22</td>
</tr>
<tr>
<td>OUTPATIENT</td>
<td>28</td>
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<tr>
<td>BOTH INPAT &amp; OPD</td>
<td>13</td>
</tr>
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<table>
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<th>HOSPITALIZED AT INTAKE</th>
<th>FREQUENCY COUNT</th>
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<tr>
<td>YES</td>
<td>10</td>
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<tr>
<td>NO</td>
<td>140</td>
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<table>
<thead>
<tr>
<th>NUMBER OF VISITS ESTIMATED BY THERAPIST</th>
<th>FREQUENCY COUNT</th>
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<tr>
<td>MEAN NUMBER OF VISITS ESTIMATED</td>
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<td>STD DEV=</td>
<td>5.22</td>
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<tr>
<td>RANGE=</td>
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<table>
<thead>
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<th>THERAPIST</th>
<th>FREQUENCY COUNT</th>
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<td>MD</td>
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<td>MS</td>
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</tr>
<tr>
<td>PSYCHOLOGY GRADUATE STUDENT</td>
<td>16</td>
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<tr>
<td>COUNSELING &amp; GUIDANCE STUDENT</td>
<td>0</td>
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<tr>
<td>MS STUDENT</td>
<td>11</td>
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<tr>
<td>PSYCHOLOGY INTERN</td>
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<td>FAMILY PRACTICE RESIDENT</td>
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<td>PSYCHIATRY APSIDENT</td>
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<td>FACULTY PSYCHIATRY</td>
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<td>MEDICINE RESIDENT</td>
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<tr>
<td>FACULTY MEDICINE</td>
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Figure 2. Page 2 of sample output for diagnostic group depressive neurosis.
**Psychometric Data**

<table>
<thead>
<tr>
<th>TYPE OF SCALES</th>
<th>FREQUENCY COUNT</th>
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<tr>
<td>NSC</td>
<td>72</td>
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<tr>
<td>NSW</td>
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<td>MINI-MULT</td>
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**MINI-MULT PROFILE**

<table>
<thead>
<tr>
<th>SCALES</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<tbody>
<tr>
<td>NNI</td>
<td>4.37</td>
<td>6.46</td>
<td>11.68</td>
<td>66.07</td>
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<td>69.92</td>
<td>68.26</td>
<td>69.71</td>
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<tr>
<td>DOI</td>
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<td>9.00</td>
<td>5.91</td>
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<td>12.98</td>
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<td>13.43</td>
<td>12.99</td>
<td>13.93</td>
</tr>
</tbody>
</table>

**MINNESOTA-BRIGGS HISTORY RECORD**

- **Family Security**
- **Conflict with Parents**
- **Health Awareness**
- **Introduction**
- **School Job Failure**
- **Social Misfit**
- **Depression/Addictions**

<table>
<thead>
<tr>
<th>SCALES</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>0</th>
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<tbody>
<tr>
<td>NSC</td>
<td>57.00</td>
<td>37.00</td>
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<td>64.00</td>
<td>74.00</td>
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<td>68.00</td>
<td>69.00</td>
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<tr>
<td>DOI</td>
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<td>10.86</td>
<td>13.77</td>
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</table>

**Life Changes Checklist**

- **Death of Spouse**
- **Divorce**
- **Separation**
- **Jail Term**
- **Death of Family Member**
- **Personal Injury**
- **Marriage**
- **Marital Separation**
- **Retirement**
- **Change in Health of Family Member**
- **Pregnancy**
- **Mortgage Violation**
- **Change in Financial State**
- **Death of Close Friend**
- **Change in Time at Work**
- **Change in # of Arguments with Spouse**
- **Change in Spending with Spouse**
- **Mortgage Over $100,000**
- **Foreclosure on Mortgage Loan**
- **Change in Responsibilities at Work**
- **Average Life Changes Score= 174.14**

**Range:** 0.00 - 728.00

Figure 3. Page 3 of sample output for diagnostic group depressive neurosis.
Reference Notes


References


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Appendix A

BRIEF EXPLANATION OF THE SYSTEM ACCESS

The Behavioral Medicine Data Retrieval and Analysis Program is a comprehensive adult outpatient evaluation procedure. The program itself, PSYCH, resides in straightforward fashion as a member of the program library, implemented by a partitioned dataset, and can easily be used by including the following job control statements:

```plaintext
//Go
EXEC PGM=PSYCH
//STEPLIB DD DSN=MC7432F5.SEIME,DISP=SHR,UNIT=2314,VOL=SER=SEIME1
```

A specific user query is entered into the system, along with the main program PSYCH, by simply picking out a desired set of indices, corresponding to those in the professional manual, INDL, IND2, incremented by INCR. The indices are then included as data items in the CONTROL file at the end of the job as follows:

```plaintext
//CONTROL DD *
30000 30090 10
30040 30040 1
99999 99999 1
```

If it is desired that the evaluation run across all diagnostic categories, and not just particular ones, then the special items 99999 99999 1 should be included, as well as any other particular ones.

The messages, used in creating the message data structure, is also stored on the SEIME1 disk volume, and is stored under the following description:

```plaintext
//SYSIN DD DSN=MC7432F5.PSYCH.MESSAGES,
// VOL=SER=SEIME1,UNIT=2314,DISP=SHR
```

The actual patient data, used in computing the statistical results of the evaluation, is also stored on the SEIME1 disk volume, and is stored under the following description:

```plaintext
//INPUT DD DSN=MC7432F5.BEHMED.PSYCHOPD.DATA,
// VOL=SER=SEIME1,UNIT=2314,DISP=SHR
```

created as a cataloged dataset.
Appendix B

PART I

(disk)

(SEIME1

Begin PSYCH

Initialize PLACES, SEXES, REFERRAL-SOURCES, OCCUPATIONS, EMPLOY-STATUSES, MAR-STATUSES, PSYC-TREATS, HOSPITALIZED, THERAPISTS

Create Message Data Structure

PSYCH. MESSAGES (messages data set)

SEIME1

(DATA ROUTINE

CONTROL (card file)

IND1 = 99999

ALL DIAGNOSES—FLAG—ON

INDEX = IND2

INDEX = IND2 + INCR

CALL PRINT—DIAG

* Optimization specification to PL/I compiler. Used to improve performance.
PART II

Begin PRINT-DIAG

**D.1**
OPEN data file INPUT

**D.2**
Initialize demographic and psychometric variables to 0.

**D.3**

**OUT-LOOP:**
GETBUF System Procedure where FORM AND SYSSBF are efficiently overlaid, i.e. share storage via LOC

**D.3.a**

**READ FILE (INPUT) SET (PTR)**

**CALL FCHECK**

**FCHECK**

**D.3.b**

**DSM-II Diag = INDEX**

**T**

**F**

**T**

**F**

**3.b.i**

**FLAG2 = ON**

**SEARCH Message Data Structure And SAVE ENTRY**

**3.b.ii**

Transform Variables from Character to Numeric

**COUNT associated with a DX Category**

**3.b.iii**

Accumulate (particular) Patient Record Values

**3.b.iv**

**ALL-DIAGNOSES = OFF**

**FLAG1 = OFF**

On end file INPUT branch to OUTPUT routine, D.5.

***

PREPROCESS EDIT

DATA

FILE

SEME1

**Using locate mode via PTR. of the BUFFERED SEQUENTIAL INPUT file to improve throughput and give faster execution due to less data movement between work areas and buffers.

*** This routine is run against the data before any processing begins.
PART III

OUTPUT:

CLOSE data file INPUT

Begin I/O Section

D.6

FLAG2=ON

F

RETURN

T

6.a

FLAG2=OFF

6.b

Print Headings

T

ALL—DIAGNOSES—FLAG=ON

F

6.c

Print Descriptions and Interpretation Rules

6.d

Print SAVE—Diagnostic Group

6.e

Print Monthly Intake Tables, Tab. Demo. and Psycho. Info., Means, S.D.'s, Frequencies, and Life Changes for a Particular DX Category

RETURN

135
PART IV

CLOSE index file
CONTROL

E.

WRAPUP: END PSYCH