

MEDIC -- A MEDICAL EXAMPLE OF SNePS

by Diana Webster

1. INTRODUCTION

MEDIC is an interactive medical question-answering system which deals mainly with facts about hemophilia. The facts are stored in a semantic network. The system is designed for information retrieval (involving some inference and logic) rather than as a diagnostic system. That is, one cannot give the system a list of symptoms and then inquire what type of disease is present. However, the user can ask questions about certain symptoms of a particular disease and then surmise that a patient having these symptoms has that particular disease. A sample session with MEDIC will show the type of statements which can be stored and the type of questions which can be asked. In the example below, lines beginning with the * prompt are typed by the user. All other entries are output by MEDIC. Further dialogues with MEDIC are given in Appendix G. The processing times are given in milliseconds.

SYSTEM 1.3 -- AUGUST 28, 1979

MEDIC IS A MEDICAL QUESTION ANSWERING SYSTEM WITH A DATA BASE OF HEMOPHILIA INFORMATION. YOU MAY ASK A QUESTION, I.E.

IS COAGULATION TIME NORMAL IN MODERATE HEMOPHILIA?
OR YOU MAY ADD INFORMATION TO THE SYSTEM, I.E.,

COAGULATION TIME IS NORMAL IN HEMOPHILIA.
TO END THE SESSION, JUST HIT CARRIAGE RETURN OR TYPE
BYE (WITH A SPACE AFTER BYE)
AND HIT THE CARRIAGE RETURN.

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*WHAT SYMPTOMS ARE COMMON IN HEMOPHILIA?

PROCESSING SENTENCE

EPISTAXIS IS COMMON IN HEMOPHILIA .
HEMATURIA IS COMMON IN HEMOPHILIA .
LARGE DISSECTING INTRAMUSCULAR HEMATOMAS ARE COMMON IN HEMOPHILIA .
HEMARTHROSIS IS COMMON IN HEMOPHILIA .

PROCESSING TIME = .60900000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*WHAT SYMPTOMS ARE COMMON IN VON WILLEBRAND'S DISEASE?

PROCESSING SENTENCE

EPISTAXIS IS COMMON IN VON WILLEBRAND'S DISEASE .
MEMORRHAGIA IS COMMON IN VON WILLEBRAND'S DISEASE .
BRUISING IS COMMON IN VON WILLEBRAND'S DISEASE .

PROCESSING TIME = .72580000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*WHAT LAB TESTS ARE NORMAL IN HEMOPHILIA?

PROCESSING SENTENCE

ONE-STAGE PROTHROMBIN TIME TEST IS NORMAL IN HEMOPHILIA .
THROMBIN TIME IS NORMAL IN HEMOPHILIA .
BLEEDING TIME IS NORMAL IN HEMOPHILIA .
PLATELET COUNT IS NORMAL IN HEMOPHILIA .
PROTHROMBIN CONSUMPTION TEST IS NORMAL IN HEMOPHILIA .
COAGULATION FACTOR-RELATED ANTIGEN MAY BE NORMAL IN HEMOPHILIA .

FIBRINOLYSIS IS NORMAL IN HEMOPHILIA .
PROTHROMBIN CONSUMPTION TEST IS NORMAL IN MILD HEMOPHILIA .
CLOTTING TIME OF WHOLE BLOOD MAY BE NORMAL IN MILD HEMOPHILIA .
COAGULATION TIME IS NORMAL IN MILD HEMOPHILIA .
COAGULATION TIME IS NORMAL IN MODERATE HEMOPHILIA .
PTT IS NORMAL IN SUB HEMOPHILIA .

PROCESSING TIME = .5936000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*BLEEDING FROM MUCOUS MEMBRANES IS COMMON IN VON WILLEBRAND'S
DISEASE.

PROCESSING SENTENCE

SENTENCE STORED AS THE FOLLOWING NODE M112
(M112 (SYMPTOM (BLEEDING FROM MUCOUS MEMBRANES)) (FREQUENCY
(COMMON)) (TYPEDIS (M65)))
(M65 (DISTYPE (PLAIN)) (DISEASE (VON WILLEBRAND'S DISEASE)))
(DUMPED)

PROCESSING TIME = .2088000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*WHAT SYMPTOMS ARE COMMON IN VON WILLEBRAND'S DISEASE?

PROCESSING SENTENCE

EPISTAXIS IS COMMON IN VON WILLEBRAND'S DISEASE .
MENORRHAGIA IS COMMON IN VON WILLEBRAND'S DISEASE .
BRUISING IS COMMON IN VON WILLEBRAND'S DISEASE .
BLEEDING FROM MUCOUS MEMBRANES IS COMMON IN VON WILLEBRAND'S
DISEASE .

PROCESSING TIME = .3208000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*HEMORRHAGE INTO FOREARM MUSCLE MAY CAUSE NERVE COMPRESSION IN
* THE ARM IN HEMOPHILIA.

PROCESSING SENTENCE

SENTENCE STORED AS THE FOLLOWING NODE M77
(M77 (PROXCAUSE (HEMORRHAGE INTO FOREARM MUSCLE)) (MODAL (MAY)) (SYMPTOM
(NERVE COMPRESSION IN THE ARM)) (TYPEDIS (M1)))
(M1 (DISTYPE (PLAIN)) (DISEASE (HEMOPHILIA)))
(DUMPED)

PROCESSING TIME = .2216000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*NERVE COMPRESSION IN THE ARM MAY CAUSE LOSS OF USE OF THE HAND
* IN HEMOPHILIA.

PROCESSING SENTENCE

SENTENCE STORED AS THE FOLLOWING NODE M78
(M78 (PROXCAUSE (NERVE COMPRESSION IN THE ARM)) (MODAL (MAY)) (SYMPTOM (LOSS OF USE OF THE HAND)) (TYPEDIS (M1)))
(M1 (DISTYPE (PLAIN)) (DISEASE (HEMOPHILIA)))
(DUMPED)

PROCESSING TIME = .3314000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*NERVE COMPRESSION IN THE ARM MAY CAUSE GANGRENE OF THE FINGERS IN
* HEMOPHILIA.

PROCESSING SENTENCE

SENTENCE STORED AS THE FOLLOWING NODE M79
(M79 (PROXCAUSE (NERVE COMPRESSION IN THE ARM)) (MODAL (MAY)) (SYMPTOM (GANGRENE OF THE FINGERS)) (TYPEDIS (M1)))
(M1 (DISTYPE (PLAIN)) (DISEASE (HEMOPHILIA)))
(DUMPED)

PROCESSING TIME = .3379000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*WHAT MAY CAUSE GANGRENE OF THE FINGERS IN HEMOPHILIA?

PROCESSING SENTENCE

NERVE COMPRESSION IN THE ARM MAY CAUSE GANGRENE OF THE FINGERS IN
HEMOPHILIA .
HEMORRHAGE INTO FOREARM MUSCLE CAUSES GANGRENE OF THE FINGERS IN
HEMOPHILIA .

PROCESSING TIME = .7841000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*WHAT CAUSES LOSS OF USE OF THE HAND IN HEMOPHILIA?

PROCESSING SENTENCE

NERVE COMPRESSION IN THE ARM MAY CAUSE LOSS OF USE OF THE HAND IN
HEMOPHILIA .
HEMORRHAGE INTO FOREARM MUSCLE CAUSES LOSS OF USE OF THE HAND IN
HEMOPHILIA .

PROCESSING TIME = .1941000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*BYE



The data initially entered into the system were selected from data provided by E. R. Gabrieli, M.D. of E.J. Meyer Memorial Hospital. Further data were obtained from books on hemophilia by Lewis, etal. [5], Hilgartner [4], and Biggs [2]. Facts about Von Willebrand's disease, a coagulation disorder, have also been added to the network. The system can accomodate data about any type of disease, provided the data is in the appropriate form, and the lexicon is extended accordingly. All the statements which were parsed (i.e., accepted as grammatically correct) and stored in the SNePS network, HEMONET, are listed in Appendix F. Also in Appendix F are the questions which have so far been parsed along with their answers.

The system consists of the following major components, each of which reflects various choices regarding the allowable data -- its format and representation:

The lexicon, which consists of the allowed words and some of their possible usages.

The semantic (SNePS) network, HEMONET, consisting of all the data structures that represent sentences and deduction rules.

The augmented transition network (ATN) grammar, which defines the allowable structure and treatment for valid statements and questions, and is used to build data representations for statements and natural language answers to questions.

Each of these components will be discussed separately, in detail, later. Of secondary importance is the front-end, which acts as the interface between the user and the rest of the system. This interface is standard, with no innovative human engineering, and will be discussed in Appendix A, The Users' Manual.

The system operates in an ALISP environment using several files of ALISP functions for support. These files are:

MED - Top-level functions which serve as a front-end to the system. Appendix I contains a listing of the code for these functions.

PARSER - functions which utilize the augmented transition network grammar to determine the validity of input sentences and call SNePS functions to manipulate the data network. (See Bates [1].)

SNEPS - functions which construct, find or change parts of semantic network. (See Shapiro [8].)

INFER
MATCH - used to invoke inference rules and trace
MULTI their deduction.

Of course, the usefulness of such systems as PARSER and SNePS weighed heavily in the decision to build the system MEDIC along the lines we will describe.

2. LEXICON

A meaningful natural language sentence consists not merely of words, but of words which fit together in a proper way. So our lexicon is not just a list of words. Each word has an associated list of "features", most of which reflect how that word can be used or even what it means (analogous to standard dictionary entries -- word, grammatical category, definition, etc.). Such features indicate case or categorical restrictions which define or delimit the word. One type of restriction is the superficial grammatic or syntactic one. E.g., words can be nouns, adjectives, etc., or subjects, objects, etc. Thus the grammar would contain rules which require each statement to have a subject and a verb, or each preposition to have an object.

Unfortunately, syntactic grammars tend to accept many syntactically correct but meaningless sentences. As expected,

Venipuncture safe in hemophilia.

Prothrombin consumption test in is.

would both get rejected syntactically. But practically any English sentence can be made nonsensical (though syntactically correct) by changing a word while fixing the syntactic category, as:

-9-

Trauma causes hematuria in hemophilia.

Trauma causes infants in hemophilia.

This last statement is nonsensical (as opposed to merely false) in that the meanings (or semantics) of the words are in conflict.

In order to avoid such sentences, we could use a semantic grammar, introducing deeper case information which reflects the semantics "sufficiently" (We do not try to capture the entire meanings of words.) and making the grammatical rules take these semantic cases into account. (We should point out here that our use of the word "case" is consistent with the currently popular general sense discussed by Bruce [3, p. 336]: "A case is a relation which is 'important' for an event in the context in which it is described." In our situation, a simpler definition is more appealing: The case indicates the role of the word in the sentence.)

In general, a semantic grammar is practical only when the domain of discourse is rather narrow. Since we are tightly restricted here to the realm of hemophilia (and some related diseases), semantic cases are both natural and useful. Some of these cases are disease, laboratory test and laboratory result. An example of the type of restriction imposed by the semantic grammar is that every laboratory result must be associated with a laboratory test. Of course, the semantic approach allows relationships between sentences to be discerned, thus

improving question-answering. The main disadvantage is that semantic grammars tend to be larger than those syntactic gramamrs which accept the same sentences [1].

The grammar adopted in MEDIC uses a blend of syntactic and semantic cases and will be discussed in the formal context of ATNs in Section 4. Our lexicon retains the needed case information via the feature CTGY. As an example, consider the sentence

Prothrombin consumption test is normal in mild hemophilia.

"Prothrombin consumption test" plays the role of a laboratory test, "normal" the role of a laboratory result, "mild" the role of the type of disease and "hemophilia" the role of the disease. This role (case) information is stored in the lexicon (and thereby available to the PARSER functions) in the following form:

(HEMOPHILIA ((CTGY,DISEASE) (NUM,SING) (FTR,INANIM)))
(IS ((CTGY,V) (ROOT,BE) (TENSE,PRES)))
(MILD ((CTGY,DISTYPE)))
(NORMAL ((CTGY,LABRES)))
(PROTHROMBIN/ CONSUMPTION/ TEST ((CTGY,LABTEST) (NUM,SING)))

The CTGY feature allows data to be partitioned into tabular form:

Lab test -----	Lab result -----	Type of disease -----	Input Statement -----
Prothrombin consumption test	normal	mild hemophilia	Prothrombin consumption is normal in mild hemophilia.
PTT	variable	mild hemophilia	PTT is variable in mild hemophilia.
Thrombin time	normal	hemophilia	Thrombin time is normal in hemophilia.

Our syntactic cases are presumed to be familiar. Our semantic cases are shown below with sample words for each case.

Labtest -- PTT, Coagulation time

Labresult -- abnormal, normal

Symptom -- fever, petechiae

Frequency -- common, rare, cyclic

Proxcause -- hematomas, trivial trauma

Proxcond -- bleeding tendency, antibodies against Factor VIII, start of intensive physiotherapy

Disease -- hemophilia, Von Willebrand's disease

Distype -- mild, moderate, severe

Treatment -- analgesic, anticoagulants

Recommendation -- safe, hazardous

Temprel -- in, after

Age -- children, adolescents

There is one group of CTGY's, the idiom related ones, which lie somewhere between the syntactic and semantic cases. These CTGY's arise from the fact that a phrase, rather than just a

single word, is often used to represent a concept. They allow words to be amalgamated into one grammatical unit, due to the overall semantics. For example, several words are used to describe a lab test like "prothrombin consumption test". The corresponding lexical entry would be:

```
(PROTHROMBIN/ CONSUMPTION/ TEST ((CTGY,LABTEST) (NUM,SING)))
```

The category feature of prothrombin consumption test is given as lab test in the lexicon and is in singular (as opposed to plural) form. The slashes (/) allow ALISP to read the phrase "prothrombin consumption test" as a whole instead of as three separate words. Such phrases are called idioms and are treated internally as if they were single words, essentially as noun phrases. So at any point in a sentence where a noun (symptom, lab test, treatment, etc.) is expected, an idiom could occur and will be investigated as a possibility (via the idiom subgrammar to be discussed in Section 4). The lexicon provides the information about whether words are beginnings, middles or ends of idiom phrases. Each completed idiom is also in the lexicon with its appropriate features. The lexical entries for "prothrombin consumption test" and its idiom-components are:

```
(CONSUMPTION ((CTGY,IDIOMMID)))
```

```
(PROTHROMBIN ((CTGY,IDIOMBEG)  
              ((CTGY,IDIOMMID)))
```

```
(PROTHROMBIN/ CONSUMPTION/ TEST ((CTGY,LABTEST) (NUM,SING)))
```

```
(TEST ((CTGY,IDIOMEND)  
        ((CTGY,LABTEST) (NUM,SING) (ROOT,LAB/ TEST)))
```

Another interesting feature which is attached to a word is its ROOT. ROOT is used for handling synonyms. All synonyms will be stored in the SNePS network as one particular word. An example is the phrase "partial thromboplastin time", which is another way of saying "PTT". So, the entry for "partial thromboplastin time" in the lexicon is:

```
(PARTIAL/ THROMBOPLASTIN/ TIME ((CTGY,LABTEST) (NUM,SING)
                                (ROOT,PTT)))
```

ROOT is used for dealing with a word which has several (legal) spellings like "hemophilia" and "haemophilia". Their lexical entries are:

```
(HAEMOPHILIA ((CTGY,DISEASE) (ROOT,HEMOPHILIA)))
(HEMOPHILIA ((CTGY,DISEASE) (NUM,SING) (FTR,INANIM)))
```

ROOT is also used in a more customary way, namely to store the root of a verb. The word "are" has "be" stored as its root. Its lexical entry is:

```
(ARE ((CTGY,V) (ROOT,BE) (TENSE,PRES) (TRANS,T) (INTRANS,T)))
```

Note that if a ROOT is not given for a word, the word itself is assumed to be the ROOT.

Our lexicon (see Appendix E) contains about 400 words, along with their associated features. Of course, it does not contain all the words that might be used in discussing

hemophilia. When a word, say XXX, in the input sentence is not in the lexicon, the message:

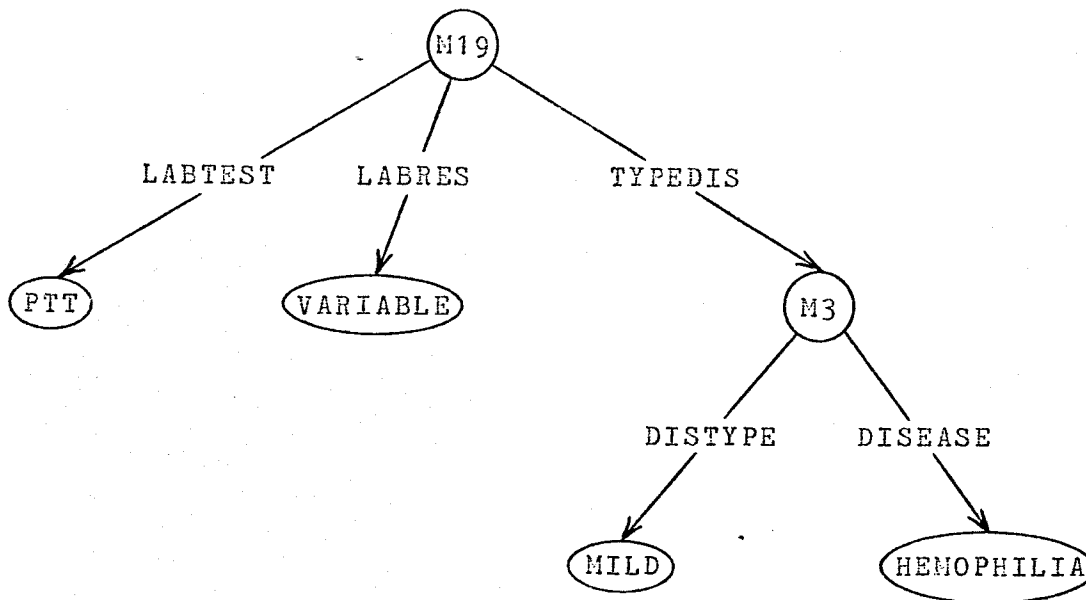
"XXX NOT IN DICTIONARY"

is output. The word along with appropriate features would have to be added before the sentence would be acceptable.

3. SEMANTIC (SNePS) NETWORK

As we indicated in Section 1, each statement in our data base is stored as a semantic network. The network representing a statement is most easily visualized as a directed graph with labeled arcs (called descending arcs in SNePS). (For clarity, we suppress the other types of arcs when possible.) Terminal nodes (called atomic constants) represent individual words in the sentence. Each such node is designated by the word it represents. Nonterminal nodes (called molecular constants) represent word groups, namely phrases and sentences. These nodes are denoted via symbols of the form Mx where x is an integer. The arcs emanating from a molecular node Mx point to the nodes which are its components or constituents. The labels on these arcs specify the role (case) that the indicated constituent plays in the group of words represented by Mx .

As an example, consider the statement "PTT is variable in mild hemophilia." It is represented in our data base by the graph



or by the lists

```
(M19 (LABTEST (PTT)) (LABRES (VARIABLE)) (TYPEDIS (M3)))  
(M3 (DISTYPE (MILD)) (DISEASE (HEMOPHILIA)))
```

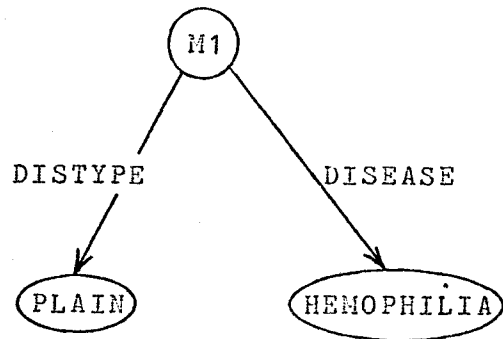
as produced by the SNePSUL DESCRIBE function [8].

We should note that if a sentence is input with an unmodified disease phrase, as in

Petechiae is rare in hemophilia.

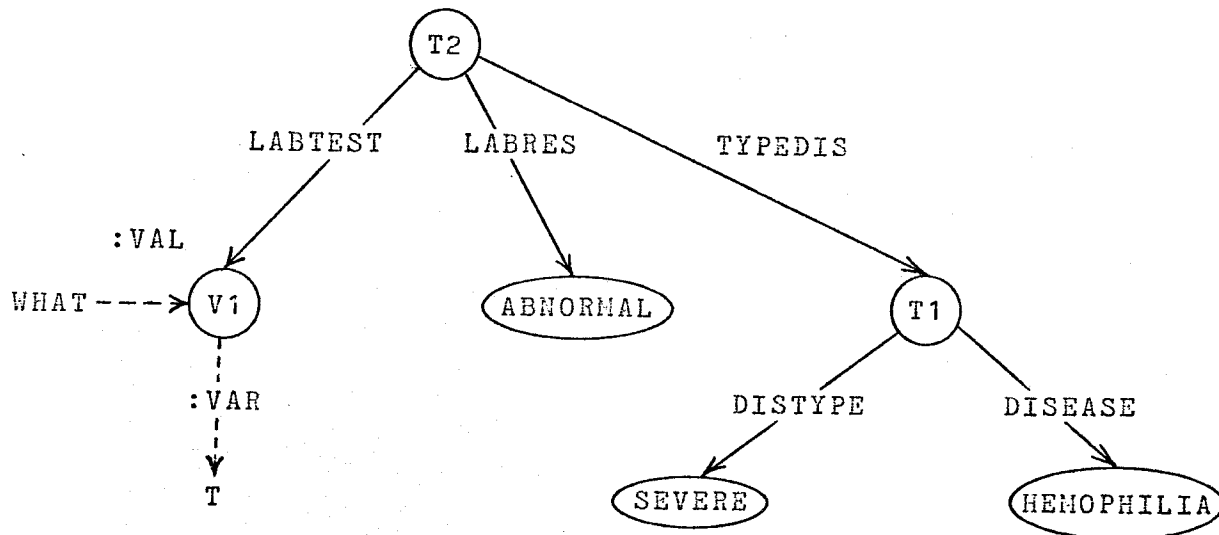
a molecular structure is still built to represent the type of the disease, with the word "plain" assigned as the default DISTYPE. Thus the word "hemophilia" is viewed as a phrase

"plain hemophilia". Graphically, it becomes



"Plain hemophilia" can thus be processed like other types of hemophilia with the same deduction rules and ATN grammar. A plain disease is treated only as a special case when forming the structure (if the disease had no modifier, put "plain" in as the modifier) and in sentence generation (if the modifier is "plain", suppress modification).

The SNePS system is also used to build temporary variable and pattern structures during question-answering. SNePS employs so-called auxiliary arcs to distinguish between constant nodes, as in the example above, and variable nodes, as in the following network built to find answers to "What lab tests are abnormal in severe hemophilia?":



The Tx's denote temporary molecular nodes. :VAL and :VAR are auxiliary arcs which identify "WHAT" as the name of a variable atomic node (See [8] for a more thorough discussion.) In Section 4 we will see how such pattern networks are matched within the data base to answer questions.

Our semantic network also contains deduction rules, which are meta-sentences in the sense that they express relationships between types of statements, rather than expressing medical facts. The SNePSUL version of each rule is presented below followed by its English version and an explanation of how the rule is used in question-answering. Note in advance that these rules use bound variable nodes as in predicate calculus. These nodes are preceded by dollar signs (\$) in quantification and by asterisks (*) for later references.

RULE 1 --

```
(BUILD AVB ($X $Y $Z)
  ANT (BUILD MIN 1 MAX 3
    ARG ((BUILD LABTEST *X LABRES VARIABLE
      TYPEDIS (BUILD DISTYPE *Y DISEASE *Z))
      (BUILD LABTEST *X LABRES PROLONGED
        TYPEDIS (BUILD DISTYPE *Y DISEASE *Z))
      (BUILD LABTEST *X LABRES REDUCED
        TYPEDIS (BUILD DISTYPE *Y DISEASE *Z))))
  CQ (BUILD LABTEST *X LABRES ABNORMAL
    TYPEDIS (BUILD DISTYPE *Y DISEASE *Z)))
```

If a particular laboratory test X has a laboratory result of variable, or a laboratory result of prolonged, or a laboratory result of reduced (in any particular disease), then the laboratory test X has an abnormal laboratory result (in that disease).

This rule would be used for questions like:

What lab tests are abnormal in mild hemophilia?
(i.e., What lab tests have abnormal lab results in mild hemophilia?).

The rule defines what laboratory results fall into the range of abnormality.

RULE 2 --

```
(BUILD AVB ($V $W $X $Y $Z)
  &ANT ((BUILD PROXCAUSE *V SYMPTOM *W
    TYPEDIS (BUILD DISTYPE *Y DISEASE *Z))
    (BUILD PROXCAUSE *W SYMPTOM *X
      TYPEDIS (BUILD DISTYPE *Y DISEASE *Z)))
  CQ (BUILD PROXCAUSE *V SYMPTOM *X
    TYPEDIS (BUILD DISTYPE *Y DISEASE *Z)))
```

is interpreted as

If a condition V causes symptom W (in a particular disease) and if a condition W causes symptom X (in that disease), then the condition V causes symptom X (in that disease). This rule reflects the transitivity of the causal relationship.

This rule would be invoked if a question such as the following were asked:

Does V cause X?

where we know V causes W and W causes X.

An example from the data base is the following. (Part of this example was given in the sample session with MEDIC in the Section 1.) Suppose that the following statements have already been stored in the system.

Hemorrhage into the forearm muscle may cause
nerve compression in the arm in hemophilia.

Nerve compression in the arm may cause loss of
use of the hand in hemophilia.

Nerve compression in the arm may cause gangrene
of the fingers in hemophilia.

Then the responses:

Hemorrhage into the forearm muscle causes
loss of use of the hand in hemophilia.

or

Nerve compression in the arm causes
loss of use of the hand in hemophilia.

will be given in reply to the question:

What may cause loss of use of the hand in hemophilia?

Since we have the above rule, an answer can be determined
by the deduction system. Without the rule, the answer to the
question would be:

"ANSWER NOT FOUND"

RULE 3 --

```
(BUILD AVB ($W $X $Y $Z)
&ANT ((BUILD PROXCAUSE *W SYMPTOM *X
        TYPEDIS (BUILD DISTYPE *Y DISEASE *Z))
      (BUILD PROXCAUSE *W FREQUENCY COMMON
        TYPEDIS (BUILD DISTYPE *Y DISEASE *Z)))
CQ (BUILD SYMPTOM *X FREQUENCY COMMON
    TYPEDIS (BUILD DISTYPE *Y DISEASE *Z)))
```

is interpreted as

If W causes symptom X (in a particular disease) and if
W is common (in that disease), then symptom X is common
(in that disease).

RULE 4 --

```
(BUILD AVB ($W $X $Y $Z)
&AMT ((BUILD PROXCAUSE *W SYMPTOM *X
      TYPEDIS (BUILD DISTYPE *Y DISEASE *Z))
      (BUILD SYMPTOM *X FREQUENCY RARE
      TYPEDIS (BUILD DISTYPE *Y DISEASE *Z)))
CQ (BUILD PROXCAUSE *W FREQUENCY RARE
    TYPEDIS (BUILD DISTYPE *Y DISEASE *Z)))
```

is interpreted as

If W causes symptom X (in a particular disease) and if symptom X is rare (in that disease) then W is rare (in that disease).

4. THE AUGMENTED TRANSITION NETWORK

The ATM in this project parses natural language statements and questions and generates natural language sentences. We chose to describe the grammar used in MEDIC via an ATM because of the well-known ATM attributes: perspicuity, generative power, efficiency of representation and operation, and ability to capture linguistic regularities and generalities [1]. These attributes have stimulated wide (in fact, dominant) usage of ATM grammars in natural language understanding and question-answering systems. Consequently, many systems are now available to support the ATM user -- PARSER and SNePS in the present case. Our primary sources of information about ATNs were a paper by Woods [10] and the excellent summary by Bates [1]. Generation from a network is discussed in two articles by Shapiro [7 and 8].

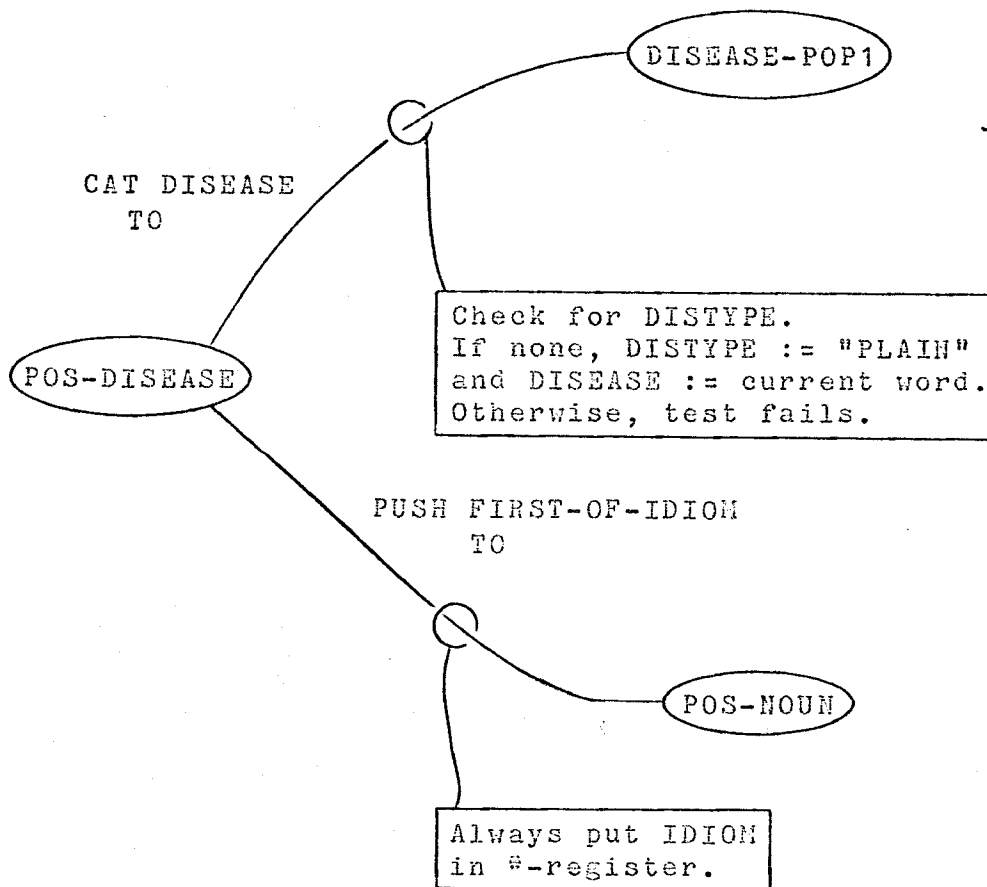
Our ATM can be depicted as a directed multigraph with labeled states and ordered labeled arcs. There is a specified start state, S, and set of possible final states. Moreover, each arc is augmented by a test and set of subsequent actions. Nonterminal PUSH arcs allow recursion, while augmentation allows context-checking and side effects, among other things.

As an example, consider the following two arcs emanating

from one of the nodes in our ATN (There are three other arcs that are not shown here.).

```
(POS-DISEASE
  (CAT DISEASE (NULL (GETR DISTYPE)))
    (SETR DISTYPE 'PLAIN) (SETR DISEASE #)
    (TO DISEASE-POP1))
  (PUSH FIRST-OF-IDION T (SETR IDION #) (JUMP POS-NOUN)))
```

The graphical representation would be



Here, parsing has arrived at a POSSible DISEASE. If the current word has CATEgory DISEASE and the test succeeds, then the upper arc is traversed and the indicated actions are performed.

Otherwise, the network is restarted at the FIRST-OF-IDIOM state and if an IDIOM can be completed, it is saved while the lower arc is traversed, after which execution JUMPS to the POSSible NOUN state (without consuming any more of the input string).

The graphical diagrams of Appendix C will provide a similar picture of the ATN grammar (sans augmentation, as per the usual convention) for MEDIC, while Appendix D shows the actual grammar. Here we will be content with a brief discussion of some of the principles on which the grammar was based.

The overall parsing procedure can be summarized as follows. Each input sentence is "prepared" by deleting all punctuation prior to parsing and by arranging the words in a list. The system then tries to parse the sentence as a question. If successful, a natural language answer (if any) is output. Otherwise, the system tries to parse the sentence as a statement. A successful parse builds a semantic network representation of the information in the statement (In fact, the building proceeds, in a register called FRAME, parallel to (or as part of) the parsing, via the augmented actions.). If this parse fails, the system responds

"ENTRY DOES NOT PARSE".

Since statement parsing can be discussed more easily at this juncture, we will discuss it first. The parsing of a statement is based on the assumption that certain types of words or phrases

will occur in certain locations, relative to each other. Thus sentences are expected to be structured according to various syntactic and semantic principles, as discussed in Section 2. The syntactic principles are those of standard English, e.g.,

- A noun phrase (as subject of a statement) will usually occur at the beginning of a statement and before the verb.
- Prepositional phrases may occur anywhere in a statement.
- Adverbs may occur anywhere in a statement after the subject.
- Predicate adjectives occur after a verb.

The semantic principles derive from our case distinctions, and are much more powerful and restrictive, e.g.,

- If a lab result entry is encountered in a sentence, there must also be a lab test entry in the sentence.
- If the verb "cause" is in the sentence, then a PROXCAUSE entry or PROXCOND entry must occur in the sentence.

For example, these principles allow the following types of statements to be parsed:

- Some lab test has some lab result in some disease.
- Some symptom is some frequency in some disease.
- Some condition causes some symptom in some disease.
- Some treatment has some recommendation in some disease.

One interesting feature of the ATN is the idiom subnetwork

to which we alluded in Section 2. At any point in the parsing where an idiom is allowed, there will be a PUSH arc for the FIRST-OF-IDIOM state (as in the example at the start of this section), which instigates the following procedures:

- Checks to see if the word can be the first word of an idiom.
- If so, then is the second word in the phrase a middle (not first or last) word of an idiom.
- If not, is the second word a last word of an idiom.
- The checking continues until the word being processed is a last word, then idiom-phrase is popped, as a whole, back to previous (just after the PUSH) point in computation.
- Idiom is then checked to see if it is a symptom, lab test or whatever is appropriate at that point.

See the appropriate ATN segments in Appendices C and D for further details.

It is interesting to note that it is possible for a phrase to parse within the idiom subnetwork even though the whole phrase is not in the lexicon, in which case the phrase will not parse in the whole network. For example, the phrase

fatal forearm fingers

will parse within the idiom subnetwork because of the idioms, "fatal hemorrhage", "hemorrhage into the forearm muscle", and "gangrene of the fingers".

However, the phrase "fatal forearm fingers" is nonsensical and not in the lexicon. The example in Appendix I (which illustrates the parsing of a statement with tracing) also shows the parsing of an idiom.

Once a statement has been found to be acceptable, the system searches through the data network to see if it incorporates new information. If the information is new, then a new node representing the statement is added to the network. This node in fact was built up (in list, not SNePS, form) as the parsing was proceeding and is the value of the successful parse. This was accomplished by setting appropriate registers via actions on the arcs of the ATN. For example, if the arc

```
(CAT PROXCAUSE T (SETR CASE (CONCAT 'PROXCASE *))  
  (TO CASE-POP))
```

is traversed as part of a successful parse, the current word (or idiom) is saved as the PROXCAUSE. As an illustration of the final building process, consider the statement

Hematomas may cause fever in hemophilia.

Suppose MEDIC has determined it to be a valid statement, but has not yet built the molecular SNePS structure. In other words, the parse is heading into the FRAME-POP state. At that instant, the register FRAME will contain the list

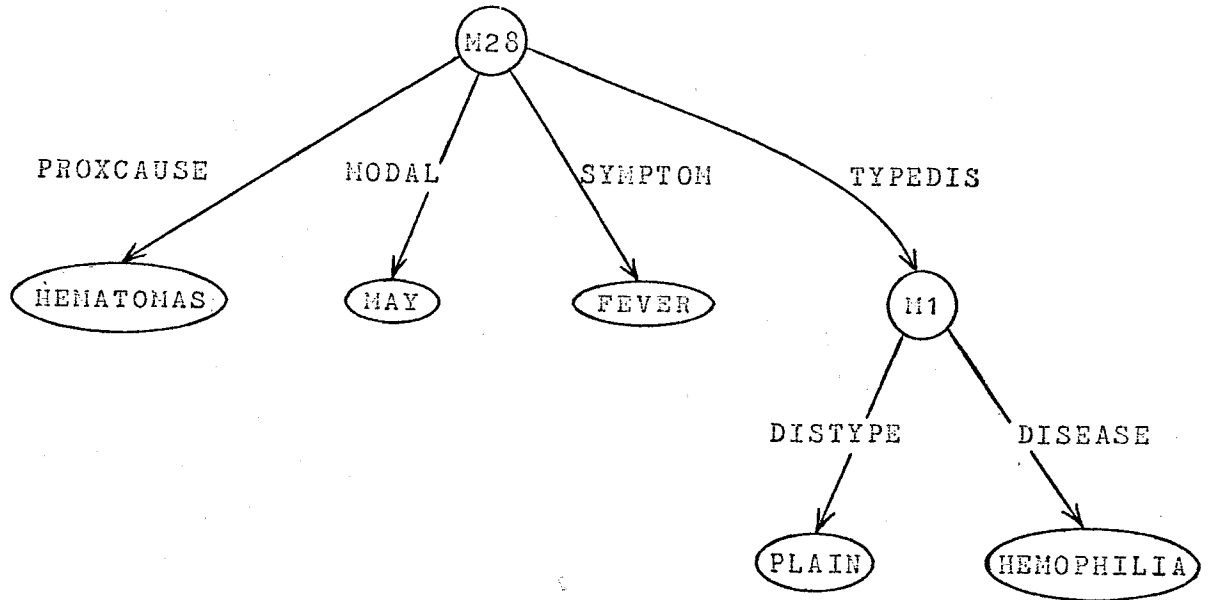
(PROXCAUSE HEMATOMAS MODAL MAY SYMPTOM FEVER TYPEDIS M1)

of each appropriate CTGY followed by the word or node of that CTGY in the statement. FRAME-POP has a single arc emanating from it:

(FRAME-POP

(POP (APPLY FINDORBUILT (GETR FRAME)) T))

Thus the ATN pops (returns) either a newly built structure which looks like the graph



or returns M28 the value of the above structure in the data network.

The parsing of a question is based on principles similar

to those used for parsing statements (as expected, parts of questions are parsed by a sub-network of the arcs also used for statement-parsing). The types of questions MEDIC can parse and answer (if an answer is stored in the network) are:

- True-false questions
This type of question is usually just a permutation of the words of the original input statement (except that the question starts with words like "is", "does", "may" and "have").
- What causes some symptom in some disease?
- What is the effect of some condition in some disease?
- What is the result of some condition in some disease?
- What is the frequency of some symptom in some disease?
- What (which) symptom is some frequency in some disease?
- What (which) condition causes some symptom in some disease?

where the reference to a disease can be omitted.

As a question is parsed, the critical components of the question are saved in a register called QFRAME. When the parsing of the question is completed, the SNePS deduction routines are called to find the answer. For example, let us return to the question

What lab tests are abnormal in severe hemophilia?

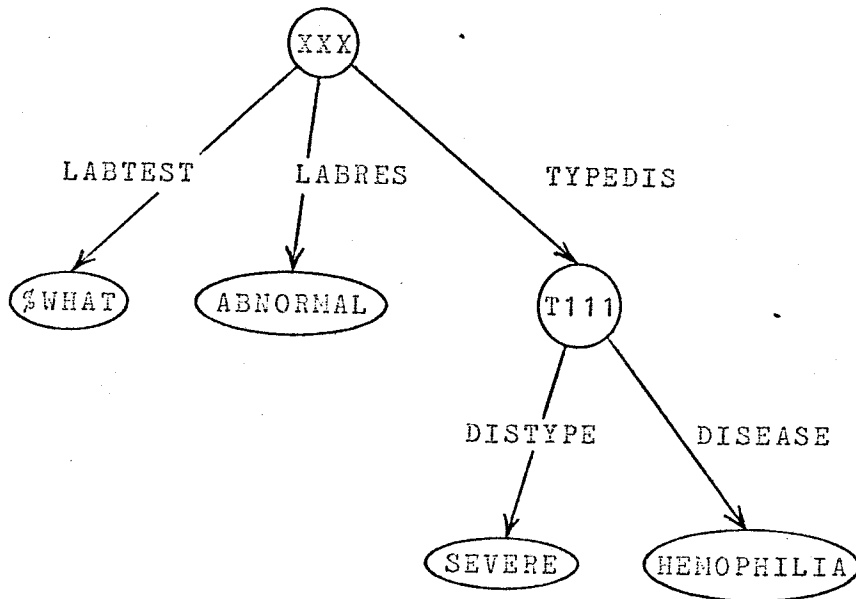
This leads to

(DEDUCE (Contents of QFRAME))

which in turn produces

(DEDUCE LABTEST \$WHAT LABRES ABNORMAL TYPEDIS T111)

\$WHAT is a SNePS variable which will match any appropriate laboratory test with abnormal lab result. The system is told to "FIND" a structure in our data base which looks like



(Cf. Section 3.).

"DEDUCE" also tells the system to activate any deduction rules whose consequents "match" QFRAME's contents. If any rules have such consequents, their antecedents are checked to see if they are in the network. If so, the consequent is instantiated and some type of structure is built. This new structure will be returned as an answer to the question. The system does not stop when finding an answer but returns as many answers as it can find. The answer returned is an assertion node (or

list of nodes, if there is more than one answer) which represents a statement.

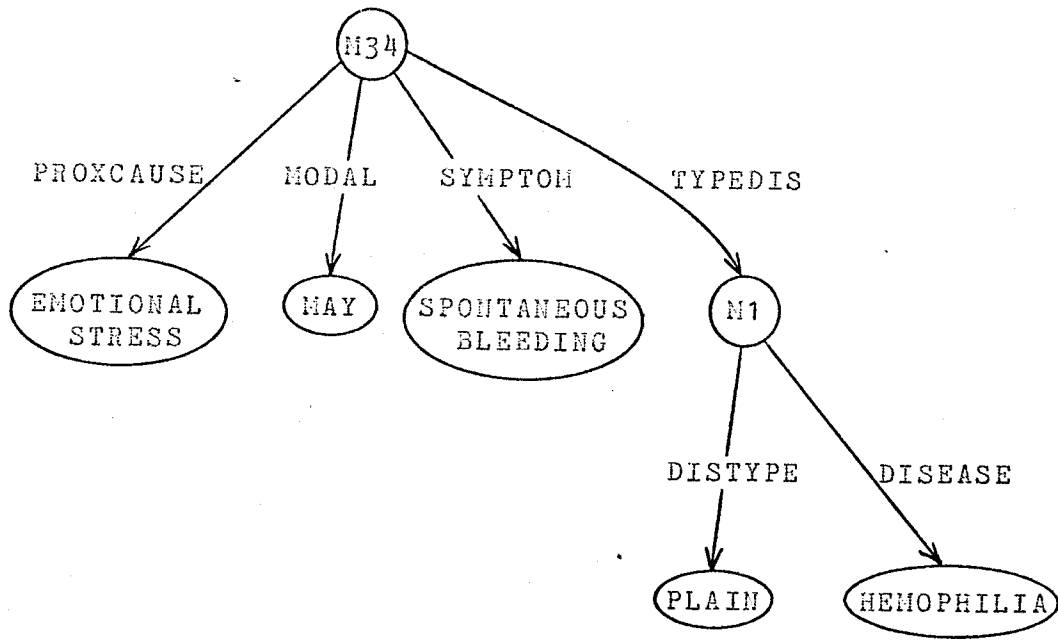
In order to generate natural language answers from these assertion nodes, computation jumps to the generation state (G-START) of the ATH. The arcs emanating from this assertion node are inspected and a string of appropriate words is constructed to form a sentence which represents the answer. Various principles, many analogous to those used in parsing, are used in sentence generation, e.g.,

- Only certain categories can occur as the subject of the sentence, like lab test, treatment, proxcause, or symptom.
- The verb inserted into the sentence depends on the case of the subject. Verbs used are "is", "are", "cause", "causes", "occur", and "occurs".
- If a form of the verb "occur" is used and there is a frequency case emanating from the assertion node, the adverbial form of the word of the frequency arc is used.
- If the type of disease stored is "plain -----", say "plain hemophilia", then the phrase "in hemophilia" is added to the sentence string with "plain" suppressed.

Of course, the statement generated by an assertion node can be quite different from the statement that was entered when the node was created. For example,

Spontaneous bleeding may start in emotional stress
in hemophilia.

would parse to form the structure



But, if M34 is sent to the generation portion of the ATN, the sentence generated would be:

Emotional stress may cause spontaneous bleeding in hemophilia.

5. POSSIBLE EXTENSIONS OF THE SYSTEM

One could introduce a method of comparing diseases since different diseases can be input. Then one could answer questions like:

What are the similarities of hemophilia and
Von Willebrand's disease?

or

What are the differences between hemophilia and
Von Willebrand's disease?

First one would have to add to the ATW so that these questions could be parsed. "Similar" would require a set of deduction rules which would define "similar". The rules might look like the following in English:

If lab test X has lab result Y in hemophilia, and
if lab test X has lab result Y in Von Willebrand's
disease, then hemophilia is similar to Von Willebrand's
disease with respect to the lab result of lab test X.

If condition X causes symptom Y in hemophilia, and
if condition X causes symptom Y in Von Willebrand's
disease, then hemophilia is similar to Von Willebrand's
disease with respect to the effects of condition X.

Further rules in this vein would be needed to define "similar".

"Different" would require a set of rules which define "different". The following might be the English version of such rules:

If labtest X has lab result Y in hemophilia, and if labtest X has lab result Z in Von Willebrand's disease, then hemophilia is different from Von Willebrand's disease with respect to the lab result of lab test X.

If condition X causes symptom Y in hemophilia, and if condition X causes symptom Z in Von Willebrand's disease, then hemophilia is different from Von Willebrand's disease with respect to the effects of condition X.

Further rules of this type would be needed to define "different".

The creation of a medical diagnostic system is actually a separate project, rather than an extension of this project per se. However, there is some noteworthy overlap of the two projects. Some of the ATH could be used for parsing. The same cases of the semantic network could be used with some additional cases added, such as a statistical weighting arc for certain symptoms or laboratory values. The area of lab results would have to be expanded to be allow interpretation of numerical

values as particular results. A chart of statistical weights for certain symptoms in hemophilia is given in Lewis et al. [8]. This chart could be implemented with the above changes plus some ALISP functions which kept running totals for a patient. For each type of disease, we could construct an archetypical patient who exhibits the classic symptoms of the disease. Each given patient would be compared to the archetype to determine if he had the disease.

A working example of a medical diagnostic system is MYCIN [9]. MYCIN is an interactive medical program which has been used to advise physicians requesting advice on appropriate drug therapy for patients with bacterial infections. MYCIN is a production rule system with a knowledge base of 200 rules and data which includes a list of drugs used for bacterial infections and a list of organisms which cause bacterial infection. MYCIN advises the physician by trying to apply a goal rule to a patient. This goal rule is:

If: 1) There is an organism which requires therapy, and
 2) Consideration has been given to the possible
 existence of additional organisms requiring therapy,
 even though they have not actually been recovered
 from any current cultures,

then: do the following:

1) Compile the list of possible therapies which,
 based upon sensitivity data, may be effective
 against the organisms requiring treatment, and

2) Determine the best therapy recommendations
from the compiled list.

otherwise: Indicate that the patient does not require therapy.

If this rule cannot be applied, then the system backs up
and tries to prove something which will yield the goal rule

As the proving proceeds, often data about the patient,
e.g., lab results for a certain lab test, are requested.

The parser now requires words to be spelled correctly,
except for words which actually have more than one correct
spelling like "hemophilia" and "haemophilia" as shown in
Section 2. The problem of handling misspellings could have
been handled by storing the correctly spelled word as the ROOT
of the misspelled word. However, this does not seem to be the
most efficient means because of the amount of storage it would
have consumed. Not all misspellings could have been accomodated.

6. SUMMARY

We have presented an interactive deductive natural language medical question-answering system, based on the very general ATM formalism of PARSER and the SHePS semantic network processing system. Communications take place in the context of the present lexicon which contains approximately 400 words and their delimiting features. The current data base comprises 74 facts about hemophilia and Von Willebrand's disease. Seventy-nine nodes have been constructed in the process of building the data base and comprise a file which is 48 PRUs long. Due to the large data base, an average query takes anywhere from 3 to 8 seconds of CPU time, depending on whether deduction rules are used and how many answers are retrieved.

The NEDIC system is among the first complete natural language deductive question-answering systems using SHePS and can be thought of as being a prototype, experiment or illustration. Consequently, possible extensions or revisions are numerous. Some of these were discussed.

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APPENDIX A
USER'S MANUAL FOR MEDIC

To use MEDIC, sign on the CYBER and enter the following commands:

GET,MEDIC/UN=CSDWEBS
CALL,MEDIC

then wait patiently (at most 2 minutes) until the system is initiated.

A session with MEDIC will begin with:

SYSTEM 1.2 --- MAY 1, 1979

MEDIC IS A MEDICAL QUESTION ANSWERING SYSTEM WITH A DATA BASE OF HEMOPHILIA INFORMATION. YOU MAY ASK A QUESTION, I.E.

IS COAGULATION TIME NORMAL IN MODERATE HEMOPHILIA?

OR YOU MAY ADD INFORMATION TO THE SYSTEM, I.E.,

COAGULATION TIME IS NORMAL IN HEMOPHILIA.

TO END THE SESSION, JUST HIT CARRIAGE RETURN OR TYPE

BYE (WITH A SPACE AFTER BYE)

AND HIT THE CARRIAGE RETURN.

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION

*

The user can now enter a question or statement in natural language form, subject to the restrictions described in Sections 2 and 4. Note that the sentences must contain

no commas, must end with ".", "?" or "!" and must not be compound or complex. The system will read and store data, interpret questions, and generate natural language output if an answer is stored in the data base. After responding (accepting, rejecting, answering), the system will keep requesting more input from the user unless the user enters "BYE". Entering "BYE" will induce the following termination sequence:

```
PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
#BYE
```

```
DID YOU CREATE NEW INFORMATION WHICH SHOULD BE SAVED?
#
```

The user has the option of saving new information that was entered or deduced during the session. Answering "yes" here stores the new data base on HEMONET/UN=CSDWEBS. However, if one calls MEDIC, the old data base will be used. To incorporate the new data base into MEDIC, the ALISP file MEDSYSW used in the procedure MEDIC must be recompiled (See Appendix B.). In any case, the system will respond as follows:

```
GOODBYE
WHEN EXITING, PLEASE DISPOSE ECHO-LISTING
D(ISPOSE), S(AVE AS PERMANENT FILE), L(OCAL), K(ILL)*
```

Then one should type "D" after the # prompt to dispose the listing. Note that the listing will be printed at Central and delivered to the Computer Science department unless the destination code is changed. After coming out of the MEDIC

system, you will be at the KCL level on the Cyber and can then sign off by just saying "BYE".

Several sample dialogues with MEDIC are given in Appendix F.

POSSIBLE PROBLEMS

In order to circumvent a bug in the echo system, the variable PRINEND has been reset to 150. If you decide to do any ALISP computation of your own, (e.g., if you end up in the break package) then you should reset the value of PRINEND to 72.

The system can be used only on weeknights after 7:30 (approximately) when the field length (which should be 110K) is raised. The field length may be increased on weekends by request to the computer operator.

APPENDIX B
HOW TO RECONSTRUCT SYSTEM

It will be necessary to "reconstruct" the MEDIC system in various circumstances (for example, if ALISP or SNEPS/UN=CSDLIB were recompiled or a change in the ATN or data base were desired). Recall (See Appendix A) that the current MEDIC system is activated by calling the procedure MEDIC, which consists of the following control statements:

```
MEDIC.  
ALTER, LN=*, RC=A.  
RFL, 110000.  
ATTACH, ALISP/UN=CSDLIB.  
ALISP, FL, SI=HELPERC/CSDWEBS.
```

The last statement uses the SI parameter to execute the file HELPERC which is just the ALISP statement

```
(LOAD '(MEDSYSW CSDWEBS))
```

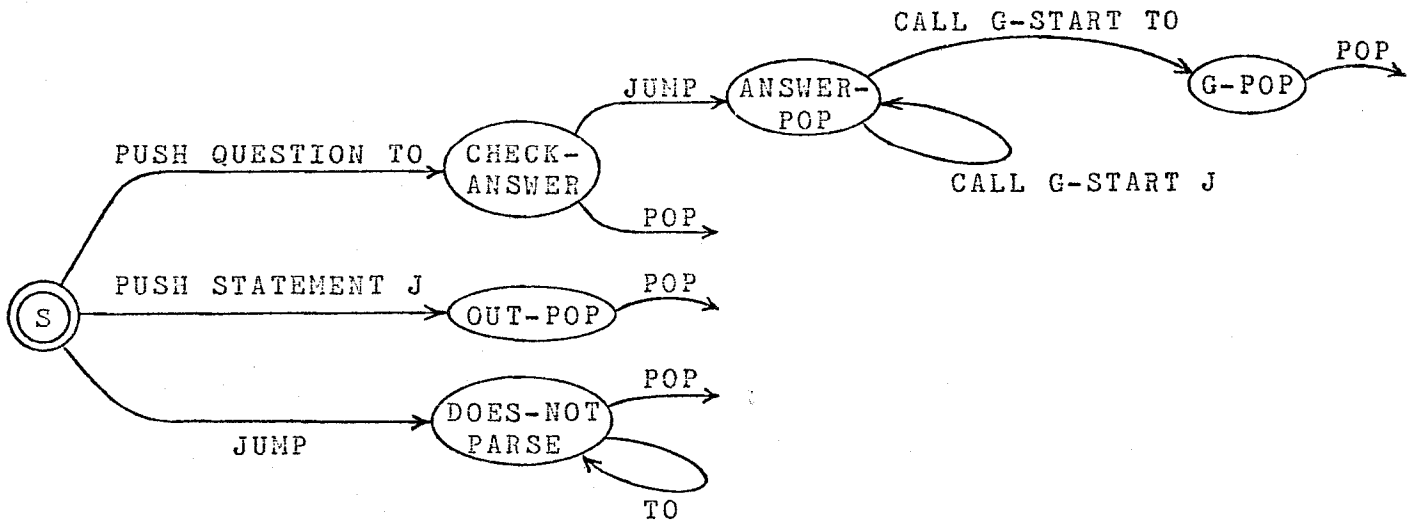
MEDSYSW is a compiled file containing the entire MEDIC system. So reconstructing MEDIC amounts to recompiling MEDSYSW. In order to recompile MEDSYSW, one should enter the ALISP system (when at least 110K is available on the Cyber) and execute the following ALISP code:

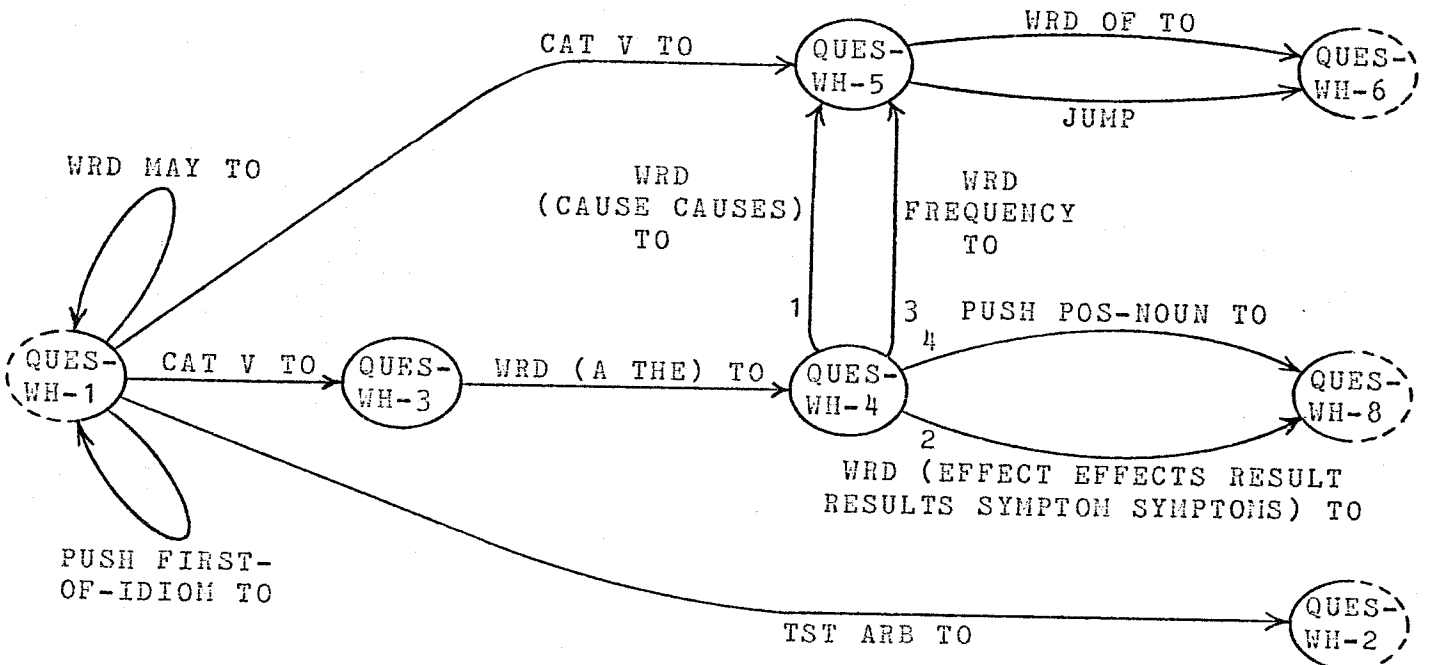
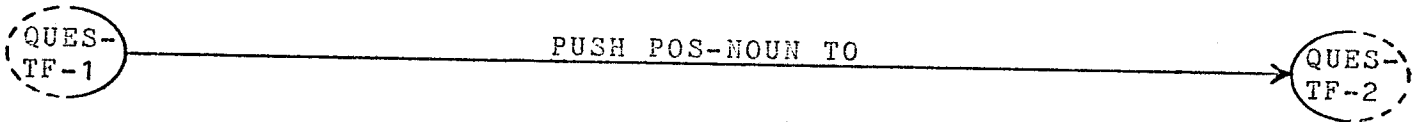
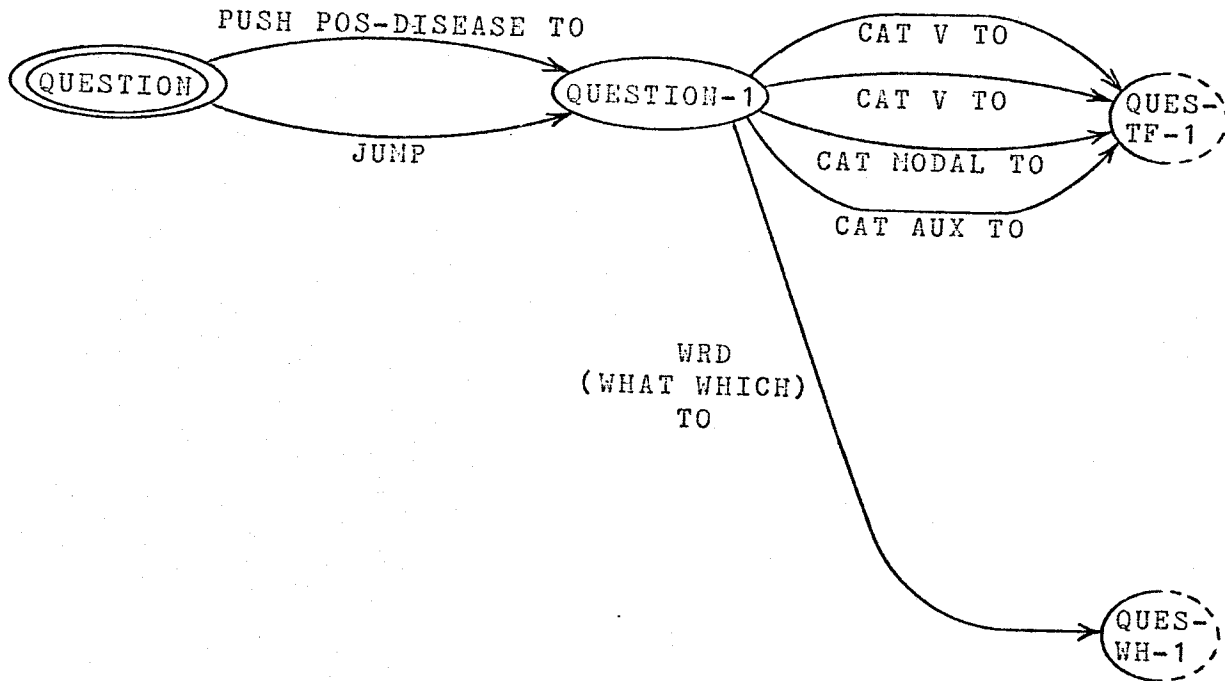
```
(LOAD '(SNEPS CDLIB))  
(ATN-IN '(ATNNET CSDWEBS))  
(LEXIN '(LEXICON CSDWEBS))  
(STATUS '/' 0)  
(INSYS HEMONET)  
(SNEPS T)  
(INTEXT (RULES CSDWEBS))  
(^(PROGN (SAVE 'MEDSYSW) (MEDIC)))
```

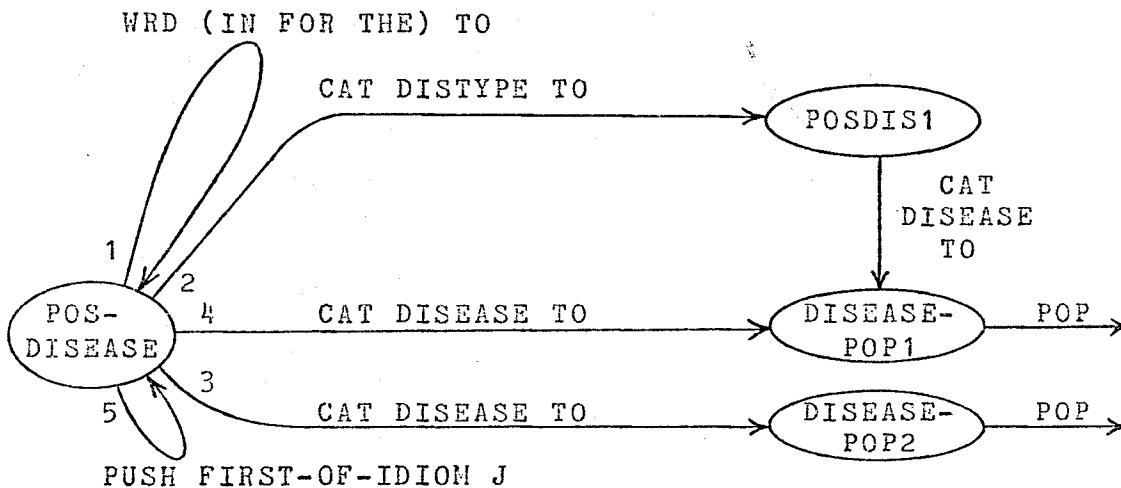
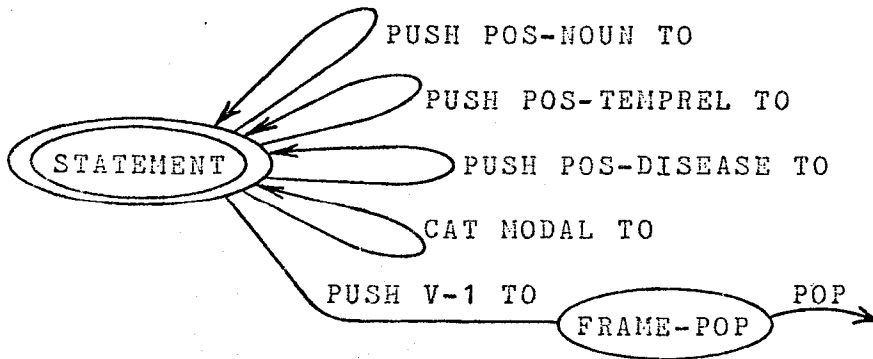
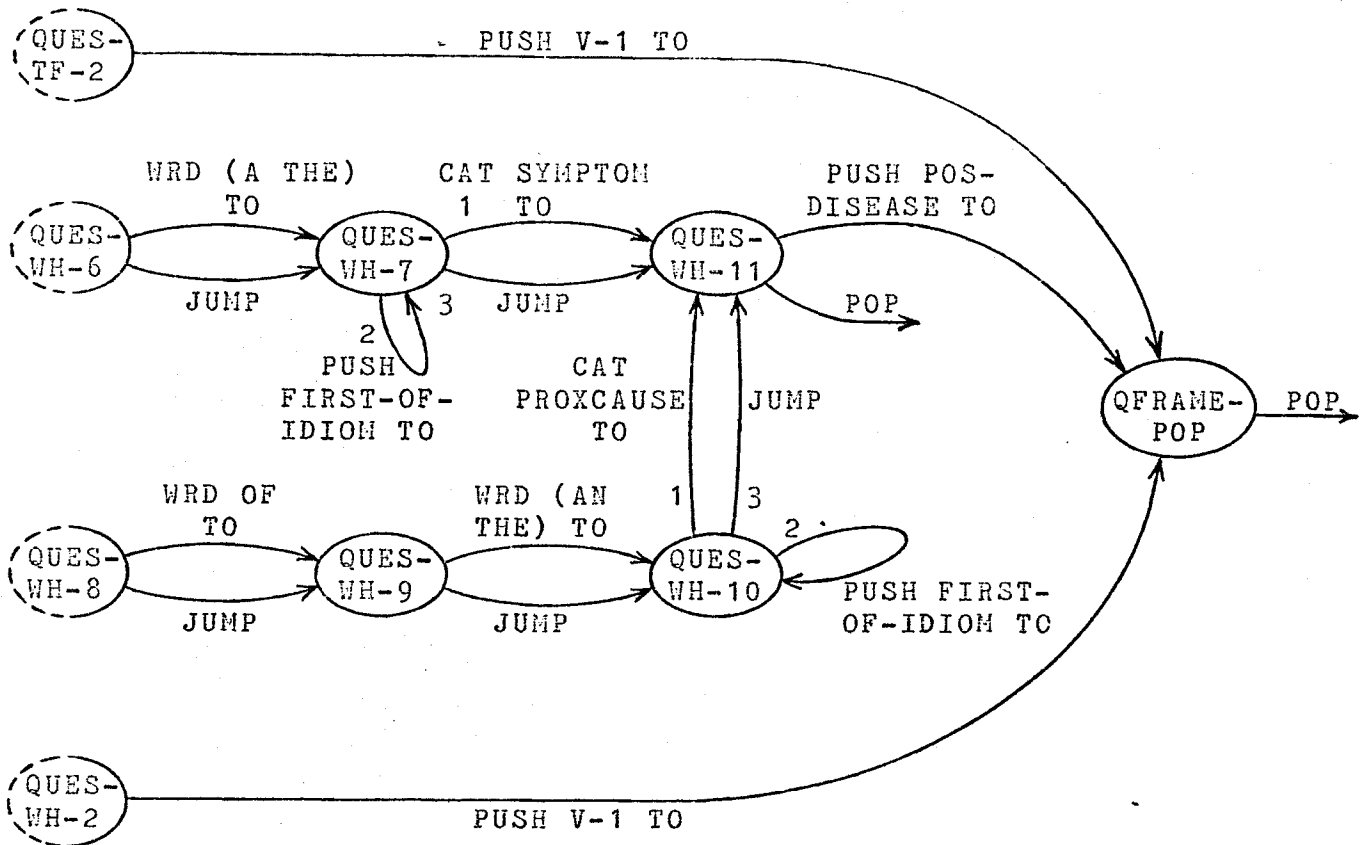
This code will save a new compile file MEDSYSW (approximately 900 PRUs) on the user account on which you are signed. This will require about fifteen minutes on the terminal when Cyber usage is light. Note that the last command above initiates the MEDIC system. Appendix A indicates how to exit from MEDIC.

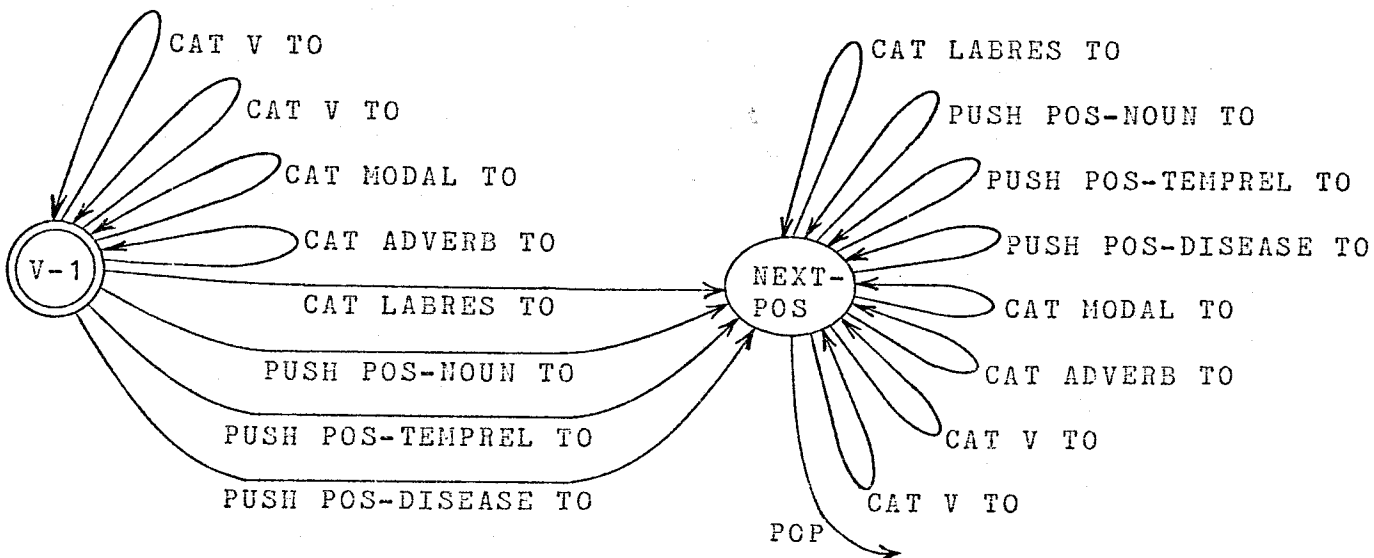
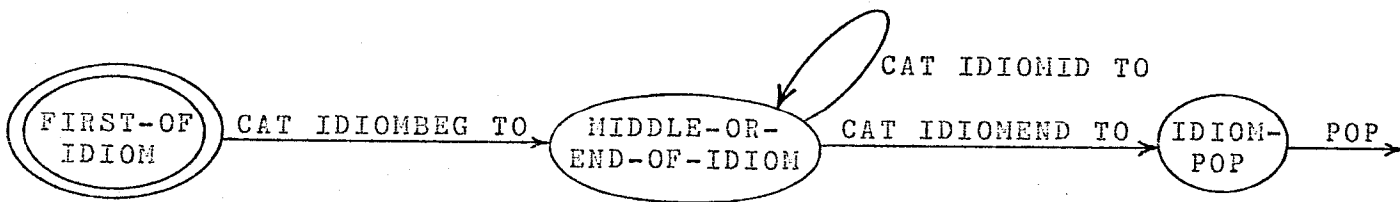
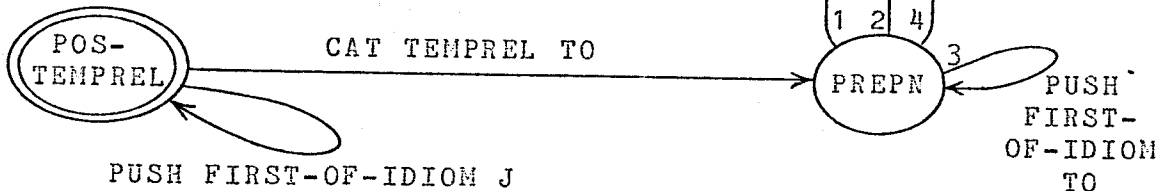
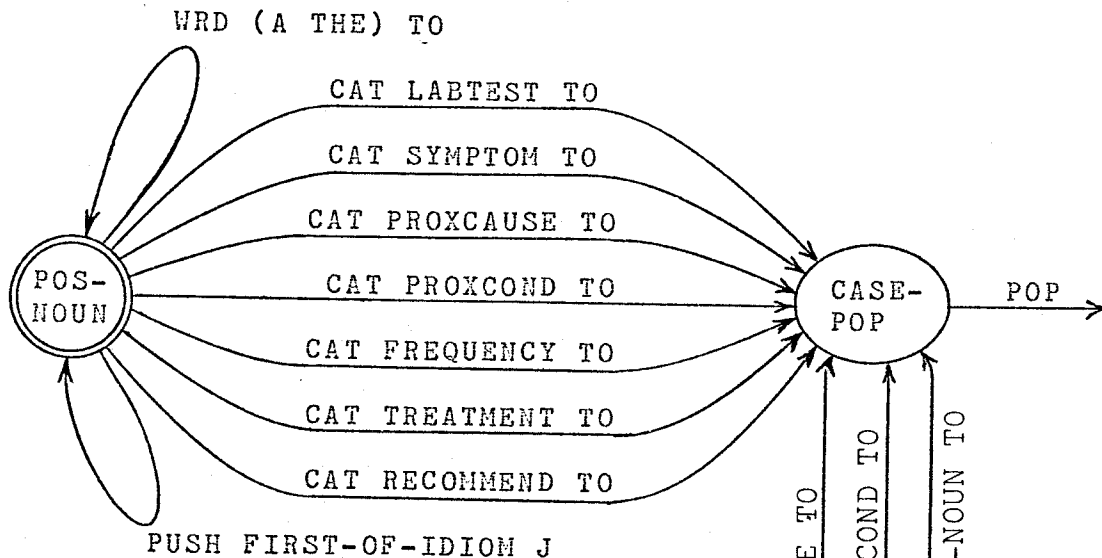
APPENDIX C
ATN STATE DIAGRAM

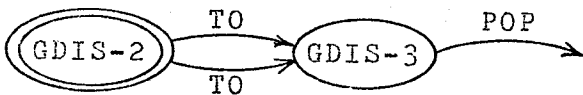
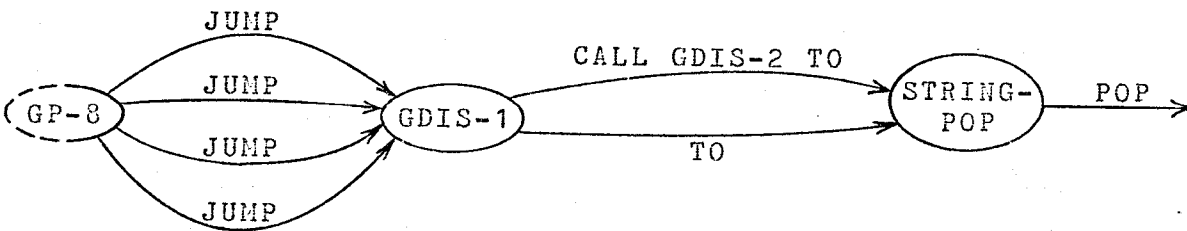
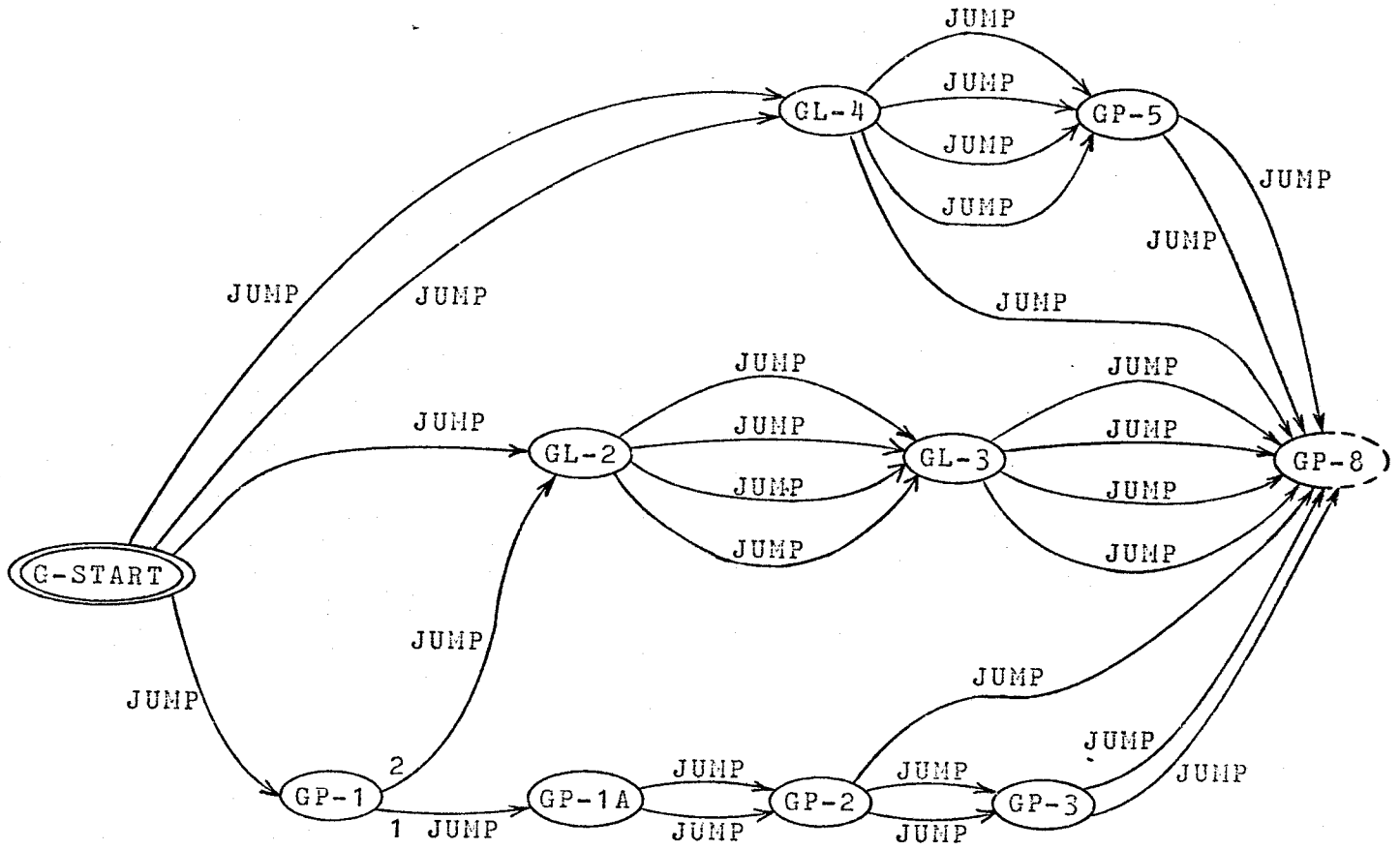
This appendix contains the graphical representation of the ATN. We should note that in general the clockwise (from the top) ordering of the arcs emanating from a node corresponds to their order in the ATN. Occasionally, this order has been changed in the graph to allow easier representation. In such cases, the arcs have been numbered to indicate their actual order in the ATN.











APPENDIX D

AUGMENTED TRANSITION
NETWORK GRAMMAR

; ATNNET file ;

```
(S
  (PUSH QUESTION T (SETR ANSWER (GETR *))
    (JUMP CHECK-ANSWER))
  (PUSH STATEMENT T (SETR OUTNODE *) (TO OUT-POP))
  (JUMP DOES-NOT-PARSE T))

(DOES-NOT-PARSE
  (POP 'NOT T)
  (TO (DOES-NOT-PARSE) T))

(CHECK-ANSWER
  (JUMP ANSWER-POP T)
  (POP 'NO T))

(POS-DISEASE
  (WRD (IN OF FOR) T (TO POS-DISEASE))
  (CAT DISTYPE T (SETR DISTYPE #) (TO POSDIS1))
  (CAT DISEASE (GETR QFLAG 2) (SETR DISEASE #)
    (TO DISEASE-POP2))
  (CAT DISEASE (NULL(GETR DISTYPE))
    (SETR DISTYPE 'PLAIN) (SETR DISEASE #)
    (TO DISEASE-POP1))
  (PUSH FIRST-OF-IDIOM T (SETR IDIOM #) (JUMP POS-DISEASE)))

(POSDIS1
  (CAT DISEASE T (SETR DISEASE #) (TO DISEASE-POP1)))

(DISEASE-POP1
  (POP (FINDORBUILD DISTYPE (^ (GETR DISTYPE)) DISEASE (^ (GETR DISEASE)))
    DISTYPE))

(DISEASE-POP2
  (POP (TBUILD DISTYPE %TYPE DISEASE (^ (GETR DISEASE))) T))

(FIRST-OF-IDIOM
```

(CAT IDIOMBEG T (SETR IDIOM (EXPLODE(GETR #)))
(TO MIDDLE-OR-END-OF-IDIOM))

(MIDDLE-OR-END-OF-IDIOM

(CAT IDIOMMID T
(ADDR IDIOM '/ (EXPLODE (GETR #)))
(TO MIDDLE-OR-END-OF-IDIOM))

(CAT IDIOMEND T
(SETR IDIOM
(PACK (ADDR IDIOM '/ (EXPLODE (GETR #)))))
(TO IDIOM-POP))

(IDIOM-POP (POP IDIOM T))

(STATEMENT

(PUSH POS-NOUN T (ADDR FRAME (GETR #)) (TO STATEMENT))
(PUSH POS-TEMPREL T (ADDR FRAME(GETR #)) (TO STATEMENT))
(PUSH POS-DISEASE T (ADDR FRAME (BUILDQ (TYPEDIS #)))
(TO STATEMENT))

; THE TEST (GETR FRAME) ASSURES THAT MODAL OR VERB CANNOT ;
; OCCUR AS FIRST WORDS OF THE STATEMENT. ;

(CAT MODAL (GETR FRAME) (ADDR FRAME (BUILDQ (MODAL #)))
(TO STATEMENT))

(PUSH V-1 (GETR FRAME)
(ADDR FRAME (GETR #)) (TO FRAME-POP))

(V-1

(CAT V (NULL (EQ (GETF ROOT) 'CAUSE)) (SETR VERB #) (TO V-1))

(CAT V (AND (EQ (GETF ROOT) 'CAUSE)
(OR (MEMB 'PROXCAUSE (GETR FRAME 2))
(MEMB 'PROXCOND (GETR FRAME 2))
(MEMB 'TREATMENT (GETR FRAME 2))
(MEMB 'PROXCAUSE (GETR QFRAME 2))
(MEMB 'PROXCOND (GETR QFRAME 2))
(MEMB 'TREATMENT (GETR QFRAME 2))))

(TO V-1))

(CAT MODAL T (ADDR CASE (BUILDQ (MODAL #))) (TO V-1))

(CAT ADVERB T (TO V-1))

(CAT LABRES (OR (MEMB 'LABTEST (GETR FRAME 2))
(MEMB 'LABTEST (GETR QFRAME 2)))

(ADDR CASE (BUILDQ (LABRES #)))
(TO NEXT-POS))

(PUSH POS-NOUN T (ADDR CASE (GETR #)) (TO NEXT-POS))

(PUSH POS-TEMPREL T (ADDR CASE (GETR #)) (TO NEXT-POS))

(PUSH POS-DISEASE T
(ADDR CASE (BUILDQ (TYPEDIS #)))
(TO NEXT-POS))

(POS-NOUN

(WRD (A THE) T (TO POS-NOUN))

(CAT LABTEST T (SETR CASE (CONCAT 'LABTEST #))
(TO CASE-POP))

(CAT SYMPTOM T (SETR CASE (CONCAT 'SYMPTOM #)) (TO CASE-POP))

(CAT PROXCAUSE T (SETR CASE (CONCAT 'PROXCAUSE *)) (TO CASE-POP))
(CAT PROXCOND T (SETR CASE (CONCAT 'PROXCOND *))
(TO CASE-POP))
(CAT FREQUENCY T (SETR CASE (CONCAT 'FREQUENCY *)) (TO CASE-POP))
(CAT TREATMENT T (SETR CASE (CONCAT 'TREATMENT *))
(TO CASE-POP))
(CAT RECOMMEND T (SETR CASE (CONCAT 'RECOMMEND *))
(TO CASE-POP))
(PUSH FIRST-OF-IDIOM T (SETR IDIOM *) (JUMP POS-NOUN)))

(CASE-POP
(POP CASE T))

(POS-TEMPREL
(CAT TEMPREL T (ADDR CASE (BUILDQ (TEMPREL *))) (TO PREPN))
(PUSH FIRST-OF-IDIOM T (SETR IDIOM *) (JUMP POS-TEMPREL)))

(PREPN
(CAT AGE T (ADDR CASE (BUILDQ (AGE *))) (TO CASE-POP))
(CAT PROXCOND T (ADDR CASE (BUILDQ (PROXCOND *)))
(TO CASE-POP))
(PUSH FIRST-OF-IDIOM T (SETR IDIOM *) (JUMP PREPN))
(PUSH POS-NOUN T (SETR CASE1 *))
(COND ((EQ (CAR (GETR CASE1)) 'PROXCAUSE) (SETR CASE (GETR CASE1)))
(T (ADDR CASE CASE1)))
(TO CASE-POP)))

(NEXT-POS
(CAT LABRES T (ADDR CASE (BUILDQ (LABRES *)))
(TO NEXT-POS))
(PUSH POS-NOUN T (ADDR CASE (GETR *)) (TO NEXT-POS))
(PUSH POS-TEMPREL T (ADDR CASE (GETR *)) (TO NEXT-POS))
(PUSH POS-DISEASE T
(ADDR CASE (BUILDQ (TYPEDIS *)))
(TO NEXT-POS))
(CAT MODAL T (ADDR CASE (BUILDQ (MODAL *)))
(TO NEXT-POS))
(CAT ADVERB T (TO NEXT-POS))
(CAT V (NULL (EQ (GETF ROOT) 'CAUSE)) (SETR VERB *) (TO NEXT-POS))
(CAT V (AND (EQ (GETF ROOT) 'CAUSE)
(OR (GETR PROXCAUSE) (GETR PROXCOND))) (TO NEXT-POS))
(POP CASE T))

(FRAME-POP
(POP (APPLY FINDORBUILD (GETR FRAME)) T))

(OUT-POP
(POP OUTNODE T))

(QUESTION

```
(PUSH POS-DISEASE T
 (SETR SEARCH 'DEDUCE)
 (SETR QFRAME (LIST 'DISTYPE *)) (TO QUESTION-1))
 (JUMP QUESTION-1 T (SETR SEARCH 'DEDUCE)
 (SETR QFLAG T))
```

```
(QUESTION-1
 (CAT V (EQ (GETF ROOT) 'BE) (TO QUES-TF-1))
 (CAT V (EQ (GETF ROOT) 'DO) (TO QUES-TF-1))
 (CAT MODAL T
 (ADDR QFRAME 'MODAL (GETR *)) (TO QUES-TF-1))
 (CAT AUX T (TO QUES-TF-1))
 (WRD (WHAT WHICH) T (TO QUES-WH-1)))
```

```
(QUES-WH-1
 (WRD MAY T (TO QUES-WH-1))
 (CAT V (EQ (GETF ROOT) 'CAUSE)
 (ADDR QFRAME 'PROXCAUSE %CAUSE)
 (TO QUES-WH-5))
 (CAT V (EQ (GETF ROOT) 'BE)
 (TO QUES-WH-3))
 (TST ARB (GET (GETF CTGY) ':CONV)
 (ADDR QFRAME (GETF CTGY) %WHAT)
 (TO QUES-WH-2))
 (PUSH FIRST-OF-IDIOM T (SETR IDIOM *) (JUMP QUES-WH-1)))
```

```
(QUES-WH-2
 (PUSH V-1 T
 (ADDR QFRAME (GETR *)) (TO QFRAME-POP)))
```

```
(QUES-WH-3
 (WRD (A THE) T (TO QUES-WH-4)))
```

```
(QUES-WH-4
 (WRD (CAUSE CAUSES) T
 (ADDR QFRAME 'PROXCAUSE %CAUSE)
 (TO QUES-WH-5))
 (WRD (EFFECT EFFECTS RESULT RESULTS SYMPTOM SYMPTOMS) T
 (ADDR QFRAME 'SYMPTOM %WSYMP)
 (TO QUES-WH-8))
 (WRD FREQUENCY T
 (ADDR QFRAME 'FREQUENCY %FREQ)
 (TO QUES-WH-5))
 (PUSH POS-NOUN T (ADDR QFRAME (GETR *))
 (TO QUES-WH-8)))
```

```
(QUES-WH-5
 (WRD OF T (TO QUES-WH-6))
 (JUMP QUES-WH-6 T))
```

```
(QUES-WH-6
 (WRD (A THE) T (TO QUES-WH-7))
 (JUMP QUES-WH-7 T))
```

```
(QUES-WH-7
  (CAT SYMPTOM T
    (ADDR QFRAME 'SYMPTOM (GETR *))
    (TO QUES-WH-11))
  (PUSH FIRST-OF-IDIOM T
    (SETR IDIOM *) (JUMP QUES-WH-7))
  (JUMP QUES-WH-11 T))
```

```
(QUES-WH-8
  (WRD OF T (TO QUES-WH-9))
  (JUMP QUES-WH-9 T))
```

```
(QUES-WH-9
  (WRD (AN THE) T (TO QUES-WH-10))
  (JUMP QUES-WH-10 T))
```

```
(QUES-WH-10
  (CAT PROXCAUSE T
    (ADDR QFRAME 'PROXCAUSE (GETR *))
    (TO QUES-WH-11))
  (PUSH FIRST-OF-IDIOM T
    (SETR IDIOM *) (JUMP QUES-WH-10))
  (JUMP QUES-WH-11 T))
```

```
(QUES-WH-11
  (PUSH POS-DISEASE T
    (ADDR QFRAME (BUILDQ (TYPEDIS *)))
    (TO QFRAME-POP))
  (POP (OR (STRIP (APPLY (EVAL (GETR SEARCH)) (GETR QFRAME)))
    (IF (EQ (CAR (GETR QFRAME)) 'MODAL)
      (STRIP (APPLY (EVAL (GETR SEARCH)) (CDDR (GETR QFRAME)))))) T))
```

```
(QUES-TF-1
  (PUSH POS-NOUN T (ADDR QFRAME (GETR *)) (TO QUES-TF-2)))
```

```
(QUES-TF-2
  (PUSH V-1 T (ADDR QFRAME (GETR *))
    (TO QFRAME-POP)))
```

```
(QFRAME-POP
  (POP (OR (STRIP (APPLY (EVAL (GETR SEARCH)) (GETR QFRAME)))
    (IF (EQ (CAR (GETR QFRAME)) 'MODAL)
      (STRIP (APPLY (EVAL (GETR SEARCH)) (CDDR (GETR QFRAME)))))) T))
```

```
(ANSWER-POP
  (CALL G-START ANSWER (ATOM (GETR ANSWER)) STRING
    (ADDR ANSWER-STRING (LIST (GETR STRING) '&)) (TO G-POP))
  (CALL G-START ANSWER T STRING
    (ADDR ANSWER-STRING (LIST (GETR STRING) '&))
    (SETR ANSWER (CDR (GETR ANSWER)))
    (JUMP ANSWER-POP)))
```

```
(G-START
  (JUMP GL-2 (SETR STRING (GETA LABTEST)))
  (JUMP GL-2 (SETR STRING (GETA TREATMENT)
    (SETR PLURAL (EQ (LAST (EXPLODE (GETA TREATMENT))) 'S)))
  (JUMP GP-1 T))
```

```
(GL-2
  (JUMP GL-4 (EQ (GETA MODAL) 'MAY)
    (ADDR STRING (GETA MODAL)))
  (JUMP GL-3 (AND (GETA MODAL)(NULL (GETR PLURAL)))
    (ADDR STRING 'IS (GETA MODAL)))
  (JUMP GL-3 (GETA MODAL)
    (ADDR STRING 'ARE (GETA MODAL)))
  (JUMP GL-3 (NULL (GETR PLURAL))
    (ADDR STRING 'IS))
  (JUMP GL-3 (ADDR STRING 'ARE)))
```

```
(GL-3
  (JUMP GP-8 (GETA LABRES)
    (ADDR STRING (GETA LABRES)))
  (JUMP GP-8 (GETA RECOMMEND)
    (ADDR STRING (GETA RECOMMEND)))
  (JUMP GP-8 (GETA FREQUENCY)
    (ADDR STRING (GETF ADJ (GETA FREQUENCY))))
  (JUMP GP-8 (GETA PROXCOND)
    (ADDR STRING 'CAUSED 'BY (GETA PROXCOND))))
```

```
(GL-4
  (JUMP GP-8 (GETA LABRES)
    (ADDR STRING 'BE (GETA LABRES)))
  (JUMP GP-8 (GETA RECOMMEND)
    (ADDR STRING 'BE (GETA RECOMMEND)))
  (JUMP GP-5
    (ADDR STRING 'BE))
  (JUMP GP-5 (AND (GETA SYMPTOM)(NULL (GETR PLURAL)))
    (ADDR STRING 'OCCURS))
  (JUMP GP-5 (GETA SYMPTOM)
    (ADDR STRING 'OCCUR)))
```

```
(GP-1
  (JUMP GP-1A (SETR STRING (GETA PROXCAUSE))
    (SETR PLURAL (EQ (LAST (EXPLODE (GETA PROXCAUSE))) 'S)))
  (JUMP GL-2 (SETR STRING (GETA SYMPTOM))
    (SETR PLURAL (EQ (LAST (EXPLODE (GETA SYMPTOM))) 'S))))
```

```
(GP-1A
  (JUMP GP-2 (GETA PROXCOND)
    (ADDR STRING 'ACCOMPANIED 'BY (GETA PROXCOND)))
  (JUMP GP-2 T))
```

```
(GP-2
  (JUMP GP-8 (EQ (GETA MODAL) 'MAY)
    (ADDR STRING 'MAY 'CAUSE (GETA SYMPTOM)))
  (JUMP GP-3 (ADDR STRING (GETA MODAL)))
  (JUMP GP-3 T))
```

(GP-3
 (JUMP GP-8 (EQ (GETR PLURAL) T)
 (ADDR STRING 'CAUSE) (GETA SYMPTOM))
 (JUMP GP-8 (ADDR STRING 'CAUSES (GETA SYMPTOM))))

(GP-5
 (JUMP GP-8 (GETA FREQUENCY)
 (ADDR STRING (GETF ADV (GETA FREQUENCY))))
 (JUMP GP-8 T))

(GP-8
 (JUMP GDIS-1 (GETA AGE)
 (ADDR STRING (GETA TEMPREL)(GETA AGE)))
 (JUMP GDIS-1 (AND (GETA PROXCOND)(GETA TEMPREL))
 (ADDR STRING (GETA TEMPREL)(GETA PROXCOND)))
 (JUMP GDIS-1 (AND (GETA PROXCAUSE)(GETA TEMPREL))
 (ADDR STRING (GETA TEMPREL)(GETA PROXCAUSE)))
 (JUMP GDIS-1 T))

(GDIS-1
 (CALL GDIS-2 (GETA TYPEDIS) (GETA TYPEDIS) REG
 (ADDR STRING 'IN REG) (TO STRING-POP))
 (TO (STRING-POP) T))

(GDIS-2
 (TO (GDIS-3) (EQ (GETA DISTYPE) 'PLAIN)
 (ADDR REG (GETA DISEASE)))
 (TO (GDIS-3) T (ADDR REG (GETA DISTYPE) (GETA DISEASE))))

(GDIS-3 (POP REG T))

(STRING-POP
 (POP STRING T))

(G-POP
 (POP ANSWER-STRING T))

APPENDIX E

LEXICON

(A ((CTGY,DET)) ((CTGY,IDIOMEND)))
(ABNORMAL ((CTGY,LABRES)))
(ABSENT ((CTGY,FREQUENCY)) ((CTGY,LABRES)))
(ADOLESCENTS ((CTGY,AGE) (NUM,PLUR)))
(AFTER ((CTGY,TEMPREL)))
(AGAINST ((CTGY,IDIOMMID)))
(ANALGESIC ((CTGY,TREATMENT) (NUM,SING) (PLUR,ANALGESICS)))
(ANTIBODIES ((CTGY,IDIOMBEG)))
(ANTIBODIES/ AGAINST/ FACTOR/ VIII ((CTGY,SYMPTOM) (NUM,PLUR))
((CTGY,PROXCOND)))
(ANTICOAGULANTS ((CTGY,TREATMENT) (NUM,PLUR)))
(ANTIGEN ((CTGY,IDIOMEND)))
(ARE ((CTGY,V) (ROOT,BE) (TENSE,PRES) (TRANS,T) (INTRANS,T)))
(ARM ((CTGY,IDIOMEND)))
(ASPIRIN ((CTGY,TREATMENT) (NUM,SING)))
(AT ((CTGY,TEMPREL)))
(ATTITUDE ((CTGY,IDIOMBEG)))
(ATTITUDE/ OF/ INCREASED/ RISK-TAKING ((CTGY,SYMPTOM) (NUM,SING)
(PLUR,ATTITUDES/ OF/ INCREASED/ RISK-TAKING)))
(AUTOIMMUNE ((CTGY,IDIOMBEG)))
(AUTOIMMUNE/ DISEASE ((CTGY,PROXCAUSE)))
(B ((CTGY,IDIOMEND)))
(BE ((CTGY,V) (ROOT,BE))
((CTGY,AUX) (ROOT,BE) (TENSE,PRES) (TRANS,T)))
(BEEN ((CTGY,V) (ROOT,BE) (TENSE,PAST) (PPRT,T))
((CTGY,AUX) (ROOT,BE) (TENSE,PAST)(PPRT,T)))
(BLEED ((CTGY,V) (ROOT,BLEED) (TENSE,PRES) (TRANS,T)))
(BLEEDING ((CTGY,IDIOMBEG))
((CTGY,IDIOMMID))
((CTGY,IDIOMEND)))
(BLEEDING/ FROM/ MOUTH ((CTGY,SYMPTOM) (NUM,SING)))
(BLEEDING/ FROM/ MUCOUS/ MEMBRANES ((CTGY,SYMPTOM) (NUM,SING)))
(BLEEDING/ FROM/ FRENUM/ OF/ UPPER/ LIPS ((CTGY,SYMPTOM) (NUM,SING)))
(BLEEDING/ FROM/ SKIN ((CTGY,SYMPTOM)))
(BLEEDING/ FROM/ THE/ KIDNEY ((CTGY,SYMPTOM) (NUM,SING)))
(BLEEDING/ TENDENCY ((CTGY,PROXCOND) (NUM,SING)))
(BLEEDING/ TIME ((CTGY,LABTEST) (NUM,SING)))
(BLOOD ((CTGY,IDIOMEND)) ((CTGY,IDIOMMID)))
(BRUISING ((CTGY,SYMPTOM)))
(BY ((CTGY,TEMPREL)))
(CALCULI ((CTGY,PROXCAUSE)))
(CAN ((CTGY,MODAL)(TENSE,FUTURE) (ROOT,MAY))
((CTGY,V) (TENSE,PRESENT) (ROOT,CAN)))
(CAUSE ((CTGY,V) (ROOT,CAUSE)))

(CHILDREN ((CTGY,AGE) (NUM,PLUR)))
(CHRISTMAS ((CTGY,IDIOMBEG)))
(CHRISTMAS/ DISEASE ((CTGY,DISEASE)))
(CIRCUMCISION ((CTGY,IDIOMEND)))
(CLOTTING ((CTGY,IDIOMBEG) ((CTGY,IDIOMMID)))
(CLOTTING/ TIME ((CTGY,LABTEST)(NUM,SING)(ROOT,CLOTTING/ TIME/ OF/ WHOLE/ BLOOD)))
(CLOTTING/ TIME/ OF/ WHOLE/ BLOOD ((CTGY,LABTEST) (NUM,SING)))
(COAGULATION ((CTGY,IDIOMBEG)))
(COAGULATION/ FACTOR-RELATED/ ANTIGEN ((CTGY,LABTEST)))
(COAGULATION/ TIME ((CTGY,LABTEST) (NUM,SING)))
(COMMON ((CTGY,FREQUENCY) (ADJ,COMMON) (ADV,FREQUENTLY)))
(COMPRESSION ((CTGY,IDIOMMID)))
(CONDITION ((CTGY,SYMPTOM) (NUM,SING) (ROOT,SYMPTOM)))
(CONDITIONS ((CTGY,SYMPTOM) (NUM,PLUR) (ROOT,SYMPTOM)))
(CONSERVATIVE ((CTGY,IDIOMBEG)))
(CONSERVATIVE/ THERAPY/ OF/ HEMARTHROSIS ((CTGY,TREATMENT) (NUM,SING)))
(CONSUMPTION ((CTGY,IDIOMMID)))
(CONTRAINDICATED ((CTGY,RECOMMEND)))
(COULD ((CTGY,MODAL) (TENSE,PRES) (ROOT,MAY)))
(COUNT ((CTGY,IDIOMEND)))
(CRIPPLING ((CTGY,IDIOMBEG)))
(CRIPPLING/ OF/ JOINTS ((CTGY,SYMPTOM)))
(CRYOPRECIPITATE ((CTGY,IDIOMBEG)))
(CRYOPRECIPITATE/ INFUSION ((CTGY,TREATMENT) (NUM,SING)))
(CUTANEOUS ((CTGY,IDIOMBEG)))
(CUTANEOUS/ ECCHIMOSSES ((CTGY,SYMPTOM) (NUM,PLUR)))
(CYCLIC ((CTGY,FREQUENCY) (ADJ,CYCLIC) (ADV,CYCLICAL)))
(DAYS ((CTGY,IDIOMEND)))
(DECREASE ((CTGY,IDIOMBEG)))
(DECREASE/ OF/ THE/ SEVERITY/ OF/ JOINT/ LESIONS ((CTGY,SYMPTOM)))
(DECREASE/ OF/ THE/ INCIDENCE/ OF/ JOINT/ LESIONS ((CTGY,SYMPTOM)))
(DELAYED ((CTGY,RECOMMEND)))
(DEVELOP ((CTGY,V)))
(DID ((CTGY,V) (ROOT,DO) (TENSE,PAST)))
(DISEASE ((CTGY,IDIOMEND)))
(DISSECTING ((CTGY,IDIOMMID)))
(DO ((CTGY,V) (ROOT,DO) (TENSE,PRES)))
(DOES ((CTGY,V) (ROOT,DO) (TENSE,PRES)))
(DURING ((CTGY,IDIOMMID)))
(ECCHIMOSSES ((CTGY,IDIOMEND)))
(EFFECT ((CTGY,PROXCAUSE) (NUM,SING)))
(EFFECTS ((CTGY,PROXCAUSE) (NUM,PLUR)))
(EMOTIONAL ((CTGY,IDIOMBEG)
((CTGY,IDIOMMID)))
(EMOTIONAL/ STRESS ((CTGY,PROXCAUSE) (NUM,SING)))
(EPISODES ((CTGY,IDIOMBEG)))
(EPISODES/ OF/ HEMARTHROSIS ((CTGY,SYMPTOM) (NUM,PLUR) (ROOT,HEMARTHROSIS)))
(EPISTAXIS ((CTGY,SYMPTOM) (NUM,SING)))
(FACTOR ((CTGY,IDIOMMID) ((CTGY,IDIOMBEG)))
(FACTOR/ VIII-RELATED/ ANTIGEN ((CTGY,SYMPTOM)))
(FACTOR-RELATED ((CTGY,IDIOMMID)))
(FATAL ((CTGY,IDIOMBEG)))
(FATAL/ HEMORRHAGE ((CTGY,SYMPTOM) (NUM,SING)))
(FEVER ((CTGY,SYMPTOM) (NUM,SING)))
(FIBRINOLYSIS ((CTGY,LABTEST)))
(FINGERS ((CTGY,IDIOMEND)))

(FIRST ((CTGY,IDIOMBEG)))
(FIRST/ SYMPTOMS ((CTGY,SYMPTOM) (NUM,PLUR)))
(FIRST/ TRANSFUSION ((CTGY,PROXCOND) (NUM,SING)))
(FOR ((CTGY,TEMPREL))
((CTGY,IDIOMMID)))
(FOREARM ((CTGY,IDIOMMID)))
(FRENUM ((CTGY,IDIOMMID)))
(FREQUENCY ((CTGY,FREQUENCY)))
(FREQUENT ((CTGY,FREQUENCY) (ADJ,FREQUENT) (ADV,FREQUENTLY)))
(FREQUENTLY ((CTGY,FREQUENCY) (ADJ,FREQUENT) (ADV,FREQUENTLY)))
(FROM ((CTGY,IDIOMMID)))
(GANGRENE ((CTGY,IDIOMBEG)))
(GANGRENE/ OF/ THE/ FINGERS ((CTGY,SYMPTOM))
(GASTROINTESTINAL ((CTGY,IDIOMBEG)))
(GASTROINTESTINAL/ BLEEDING ((CTGY,SYMPTOM))
(GI ((CTGY,IDIOMBEG) (ROOT,GASTROINTESTINAL)))
(GLOMERULONEPHRITIS ((CTGY,PROXCAUSE)))
(HAD ((CTGY,PER) (ROOT,HAVE) (TENSE,PAST) (TRANS,T) (UNTENSED,T))
((CTGY,V) (ROOT,HAVE) (TENSE,PAST) (TRANS,T))
((CTGY,AUX) (ROOT,HAVE) (TENSE,PAST)))
(HAEMARTHROSIS ((CTGY,IDIOMEND) (ROOT,HEMARTHROSIS))
((CTGY,PROXCOND) (NUM,SING) (ROOT,HEMARTHROSIS))
((CTGY,SYMPTOM) (NUM,SING) (ROOT,HEMARTHROSIS)))
(HAEMOPHILIA ((CTGY,DISEASE) (ROOT,HEMOPHILIA))
((CTGY,IDIOMBEG)))
(HAEMOPHILIA/ A ((CTGY,DISEASE) (ROOT,HEMOPHILIA)))
(HAEMOPHILIA/ B ((CTGY,DISEASE) (ROOT,CHRISTMAS/ DISEASE)))
(HAEMOPHILIC ((CTGY,DISEASE) (ROOT,HEMOPHILIA)))
(HAND ((CTGY,IDIOMEND)))
(HAS ((CTGY,PER) (ROOT,HAVE) (TENSE,PRES) (TRANS,T))
((CTGY,V) (ROOT,HAVE) (TENSE,PRES) (TRANS,T))
((CTGY,AUX) (ROOT,HAVE) (TENSE,PRES)))
(HAVE ((CTGY,V) (ROOT,HAVE) (TENSE,PRES) (TRANS,T))
((CTGY,AUX) (ROOT,HAVE) (TENSE,PRES)))
(HAZARDOUS ((CTGY,IDIOMEND))
((CTGY,RECOMMEND)))
(HEAL ((CTGY,V)))
(HEALING ((CTGY,IDIOMEND)))
(HEMARTHROSES ((CTGY,IDIOMEND)))
(HEMARTHROSIS ((CTGY,IDIOMEND))
((CTGY,PROXCOND) (NUM,SING))
((CTGY,SYMPTOM) (NUM,SING)))
(HEMATOMAS ((CTGY,IDIOMMID))
((CTGY,IDIOMEND))
((CTGY,PROXCAUSE) (NUM,PLUR)))
(HEMATURIA ((CTGY,SYMPTOM) (NUM,SING)))
(HEMOPHILIA ((CTGY,DISEASE) (NUM,SING) (FTR,INANIM))
((CTGY,N) (NUM,SING) (FTR,INANIM)))
(HEMOPHILIA/ A ((CTGY,DISEASE) (ROOT,HEMOPHILIA)))
(HEMOPHILIA/ B ((CTGY,DISEASE) (ROOT,CHRISTMAS/ DISEASE)))
(HEMOPHILIACS ((CTGY,DISEASE) (ROOT,HEMOPHILIA)))
(HEMORRHAGE ((CTGY,IDIOMEND)) ((CTGY,IDIOMBEG))
((CTGY,SYMPTOM) (NUM,SING)))
(HEMORRHAGE/ INTO/ FOREARM/ MUSCLE ((CTGY,PROXCAUSE) (NUM,SING)))
(HEMORRHAGES ((CTGY,IDIOMEND))
((CTGY,SYMPTOM) (NUM,PLUR)))

(HEPATITIS ((CTGY, SYMPTOM) (NUM, SING)))
(IMMUNIZATION ((CTGY, IDIOMBEG)
((CTGY, IDIOMEND)))
(IMMUNIZATION/ AGAINST/ TETANUS ((CTGY, TREATMENT) (NUM, SING)
(ROOT, TETANUS/ IMMUNIZATION)))
(IMPORTANT ((CTGY, RECOMMEND)))
(IN ((CTGY, TEMPREL)
((CTGY, IDIOMBEG)
((CTGY, IDIOMMID)))
(IN/ PRESENCE/ OF ((CTGY, TEMPREL)))
(INCIDENCE ((CTGY, IDIOMMID)))
(INCREASED ((CTGY, IDIOMMID)))
(INFANT ((CTGY, AGE) (NUM, SING) (PLUR, INFANTS)))
(INFANTS ((CTGY, AGE) (NUM, PLUR)))
(INFECTION ((CTGY, IDIOMEND)))
(INFREQUENT ((CTGY, FREQUENCY)))
(INFUSION ((CTGY, IDIOMEND)))
(INJECTION ((CTGY, IDIOMEND)
((CTGY, TREATMENT) (NUM, SING)))
(INJURIES ((CTGY, IDIOMEND)))
(INTENSIVE ((CTGY, IDIOMMID)))
(INTEREST ((CTGY, V) (ROOT, INTEREST) (TENSE, PRES) (TRANS, T))
((CTGY, N) (NUM, SING) (FTR, INANIM) (PLUR, INTERESTS)))
(INTO ((CTGY, IDIOMMID)))
(INTRA-ARTICULAR ((CTGY, IDIOMBEG)
((CTGY, IDIOMMID)))
(INTRAARTICULAR ((CTGY, IDIOMBEG) (ROOT, INTRA-ARTICULAR)
((CTGY, IDIOMMID) (ROOT, INTRA-ARTICULAR)))
(INTRA-ARTICULAR/ HEMORRHAGE ((CTGY, PROXCAUSE)))
(INTRAMUSCULAR ((CTGY, IDIOMMID)))
(INTRAVENOUS ((CTGY, IDIOMBEG)))
(INTRAVENOUS/ INJECTION ((CTGY, TREATMENT) (NUM, SING)))
(IS ((CTGY, IDENT) (ROOT, BE) (TENSE, PRES))
((CTGY, V) (ROOT, BE) (TENSE, PRES))
((CTGY, AUX) (TENSE, PRES)))
(JOINT ((CTGY, IDIOMBEG)
((CTGY, IDIOMMID)))
(JOINT/ LESIONS ((CTGY, SYMPTOM) (NUM, PLUR)))
(JOINTS ((CTGY, IDIOMEND)))
(KIDNEY ((CTGY, IDIOMEND)))
(LAB ((CTGY, IDIOMBEG)))
(LABORATORY ((CTGY, IDIOMBEG)))
(LABORATORY/ RESULT ((CTGY, LABRES) (ROOT, LAB/ RESULT) (NUM, SING)))
(LAB/ RESULT ((CTGY, LABRES) (NUM, SING)))
(LAB/ TEST ((CTGY, LABTEST) (NUM, SING)))
(LAB/ TESTS ((CTGY, LABTEST) (NUM, PLUR)))
(LABORATORY/ TEST ((CTGY, LABTEST) (NUM, SING) (ROOT, LAB/ TEST)))
(LABORATORY/ TESTS ((CTGY, LABTEST) (NUM, PLUR) (ROOT, LAB/ TEST)))
(LARGE ((CTGY, IDIOMBEG)))
(LARGE/ DISSECTING/ INTRAMUSCULAR/ HEMATOMAS ((CTGY, SYMPTOM) (NUM, PLUR)))
(LESIONS ((CTGY, IDIOMEND)
((CTGY, SYMPTOM) (NUM, PLUR)))
(LEUKOCYTOSIS ((CTGY, SYMPTOM) (NUM, SING)))
(LIFE-THREATENING ((CTGY, IDIOMBEG)))
(LIFE-THREATENING/ HEMORRHAGE ((CTGY, SYMPTOM) (NUM, SING)))
(LIPS ((CTGY, IDIOMEND)))

(LOSS ((CTGY,IDIOMBEG)))
(LOSS/ OF/ USE/ OF/ THE/ HAND ((CTGY,SYMPTOM)))
(LOWER ((CTGY,IDIOMBEG)))
(LOWER/ TRACT/ INFECTION ((CTGY,PROXCAUSE)))
(LUPUS ((CTGY,PROXCAUSE)))
(MAY ((CTGY,MODAL)(TENSE,FUTURE) (ROOT,MAY))
((CTGY,V) (TENSE,FUTURE) (ROOT,MAY)))
(MEMBRANES ((CTGY,IDIOMEND)))
(MENORRHAGIA ((CTGY,SYMPTOM)))
(MIGHT ((CTGY,AUX))
((CTGY,MODAL) (TENSE,PRES) (ROOT,MAY)))
(MILD ((CTGY,DISTYPE)))
(MODERATE ((CTGY,DISTYPE)))
(MOUTH ((CTGY,IDIOMEND)))
(MUCOUS ((CTGY,IDIOMMID)))
(MUSCLE ((CTGY,IDIOMEND)))
(MUST ((CTGY,MODAL) (TENSE,FUTURE) (ROOT,MUST))
((CTGY,AUX)))
(NECESSARY ((CTGY,RECOMMEND)))
(NEEDED ((CTGY,IDIOMBEG))
((CTGY,RECOMMEND) (ROOT,NECESSARY)))
(NEEDED/ FOR/ PAIN ((CTGY,RECOMMEND)))
(NEEDED/ FOR/ TWO/ DAYS ((CTGY,RECOMMEND)))
(NEEDED/ TO/ STOP/ BLEEDING ((CTGY,RECOMMEND)))
(NEONATAL ((CTGY,IDIOMBEG)))
(NEONATAL/ CIRCUMCISION ((CTGY,PROXCAUSE) (NUM,SING)))
(NERVE ((CTGY,IDIOMBEG)))
(NERVE/ COMPRESSION/ IN/ THE/ ARM ((CTGY,PROXCAUSE) (NUM,SING))
((CTGY,SYMPTOM) (NUM,SING)))
(NORMAL ((CTGY,LABRES))
((CTGY,ADJ)))
(NOT ((CTGY,IDIOMBEG)))
(NOT/ HAZARDOUS ((CTGY,RECOMMEND) (ROOT,SAFE)))
(OCCUR ((CTGY,V)))
(OF ((CTGY,IDIOMMID))
((CTGY,IDIOMEND))
((CTGY,TEMPREL)))
(OFTEN ((CTGY,MODAL)))
(ON ((CTGY,TEMPREL)))
(ONE-STAGE ((CTGY,IDIOMBEG)))
(ONE-STAGE/ PROTHROMBIN/ TIME/ TEST ((CTGY,LABTEST) (NUM,SING)))
(ONLY ((CTGY,ADVERB)))
(ORGANS ((CTGY,IDIOMEND)))
(OUT ((CTGY,IDIOMEND)))
(OVER ((CTGY,TEMPREL)))
(PAIN ((CTGY,IDIOMEND)))
(PARENCHYMATOUS ((CTGY,IDIOMMID)))
(PARTIAL/ THROMBOPLASTIN/ TIME ((CTGY,LABTEST) (NUM,SING) (ROOT,PTT)))
(PETECHIAE ((CTGY,SYMPTOM) (NUM,SING) (PLUR,PETECHIAE)))
(PHYSIOTHERAPY ((CTGY,IDIOMEND))
((CTGY,TREATMENT) (NUM,SING)))
(PLASMA ((CTGY,IDIOMBEG)))
(PLASMA/ INFUSION ((CTGY,TREATMENT) (NUM,SING)))
(PLATELET ((CTGY,IDIOMBEG)))
(PLATELET/ COUNT ((CTGY,LABTEST)))
(POSSIBLE ((CTGY,RECOMMEND)))

(PRESENCE ((CTGY,IDIOMMID)))
(PRESENT ((CTGY,LABRES)))
(PREVENTION ((CTGY,IDIOMBEG)))
(PREVENTION/ OF/ INTRA-ARTICULAR/ HEMORRHAGES ((CTGY,TREATMENT) (NUM,SING)))
(PROHIBITED ((CTGY,RECOMMEND) (ROOT,RULED/ OUT)))
(PROLONG ((CTGY,V) (ROOT,PROLONG) (TENSE,PRES) (TRANS,T)))
(PROLONGED ((CTGY,LABRES)))
(PROTHROMBIN ((CTGY,IDIOMBEG))
((CTGY,IDIOMMID)))
(PROTHROMBIN/ CONSUMPTION/ TEST ((CTGY,LABTEST) (NUM,SING)))
(PTT ((CTGY,LABTEST) (NUM,SING) (ROOT,PTT)))
(PYELONEPHRITIS ((CTGY,PROXCAUSE))
((CTGY,PROXCAUSE)))
(RARE ((CTGY,FREQUENCY) (ADJ,RARE) (ADV,RARELY)))
(RARELY ((CTGY,FREQUENCY) (ADJ,RARE) (ADV,RARELY)))
(REDUCED ((CTGY,LABRES)))
(REPEATED ((CTGY,IDIOMBEG)))
(REPEATED/ HEMARTHROSIS ((CTGY,PROXCAUSE)))
(REPEATED/ TRANSFUSION ((CTGY,TREATMENT) (NUM,SING)))
(RESULT ((CTGY,LABRES) (NUM,SING) (ROOT,LAB/ RESULT))
((CTGY,IDIOMEND)))
(RESULTS ((CTGY,SYMPTOM)))
(RISK-TAKING ((CTGY,IDIOMEND)))
(RULED ((CTGY,IDIOMBEG)))
(RULED/ OUT ((CTGY,RECOMMEND)))
(SAFE ((CTGY,RECOMMEND)))
(SEVERE ((CTGY,DISTYPE)))
(SEVERITY ((CTGY,IDIOMMID)))
(SHALL ((CTGY,MODAL)(TENSE,FUTURE))((CTGY,AUX)))
(SHOULD ((CTGY,AUX))
((CTGY,MODAL) (TENSE,PRES) (ROOT,SHALL)))
(SKIN ((CTGY,IDIOMEND)))
(SLOW ((CTGY,FREQUENCY)))
(SPONTANEOUS ((CTGY,ADJ))
((CTGY,IDIOMBEG)))
(SPONTANEOUS/ BLEEDING ((CTGY,SYMPTOM) (NUM,SING)))
(SPONTANEOUS/ BLEEDING/ IN/ PARENCHYMATOUS/ ORGANS ((CTGY,SYMPTOM)))
(SPONTANEOUS/ HEMARTHROSES ((CTGY,SYMPTOM)))
(START ((CTGY,V))
((CTGY,IDIOMBEG)))
(START/ OF/ INTENSIVE/ PHYSIOTHERAPY ((CTGY,PROXCOND) (NUM,SING)))
(STOP ((CTGY,IDIOMBEG)))
(STRESS ((CTGY,IDIOMEND)))
(SUB ((CTGY,DISTYPE)))
(SUBCUTANEOUS ((CTGY,IDIOMBEG)))
(SUBCUTANEOUS/ HEMATOMAS ((CTGY,SYMPTOM) (NUM,SING)))
(SUBHEMOPHILIA ((CTGY,DISEASE)))
(SYMPTOM ((CTGY,SYMPTOM) (NUM,SING)))
(SYMPTOMS ((CTGY,SYMPTOM) (NUM,PLUR))
((CTGY,IDIOMEND)))
(TENDENCY ((CTGY,IDIOMEND)))
(TEST ((CTGY,IDIOMEND))
((CTGY,LABTEST) (NUM,SING) (ROOT,LAB/ TEST)))
(TESTS ((CTGY,IDIOMEND))
((CTGY,LABTEST)))
(TETANUS ((CTGY,IDIOMBEG)))

((CTGY, IDIOMEND)))
(TETANUS/ IMMUNIZATION ((CTGY, TREATMENT) (NUM, SING)))
(THE ((CTGY, IDIOMMID)))
(THEIR ((CTGY, ADJ) (TYPE, POSS)))
(THERAPY ((CTGY, IDIOMMID))
((CTGY, IDIOMEND)))
(THROMBIN ((CTGY, IDIOMBEG)))
(THROMBIN/ TIME ((CTGY, LABTEST) (NUM, SING)))
(TIME ((CTGY, LABRES) (NUM, SING))
((CTGY, IDIOMMID))
((CTGY, IDIOMEND)))
(TO ((CTGY, TEMPREL))
((CTGY, IDIOMMID)))
(TRACT ((CTGY, IDIOMMID)))
(TRANSFUSION ((CTGY, IDIOMBEG))
((CTGY, IDIOMEND))
((CTGY, PROXCOND) (NUM, SING)))
(TRANSFUSION/ THERAPY ((CTGY, PROXCAUSE) (NUM, SING)))
(TRAUMA ((CTGY, IDIOMEND))
((CTGY, PROXCAUSE)))
(TREATMENT ((CTGY, TREATMENT) (NUM, SING)))
(TREATMENTS ((CTGY, TREATMENT) (NUM, PLUR)))
(TRIVIAL ((CTGY, IDIOMBEG)))
(TRIVIAL/ INJURIES ((CTGY, PROXCAUSE) (NUM, PLUR)))
(TRIVIAL/ TRAUMA ((CTGY, PROXCAUSE) (NUM, SING)))
(TWO ((CTGY, IDIOMMID)))
(UNDER ((CTGY, TEMPREL)))
(UPON ((CTGY, TEMPREL)))
(UPPER ((CTGY, IDIOMMID)))
(USE ((CTGY, IDIOMMID)))
(USED ((CTGY, V)))
(USUALLY ((CTGY, ADVERB)))
(VARIABLE ((CTGY, LABRES)))
(VENIPUNCTURE ((CTGY, TREATMENT) (NUM, SING)))
(VIII ((CTGY, IDIOMEND)))
(VIII-RELATED ((CTGY, IDIOMMID)))
(VON ((CTGY, IDIOMBEG)))
(VON/ WILLEBRAND/'S/ DISEASE ((CTGY, DISEASE)))
(VWD ((CTGY, DISEASE) (ROOT, VON/ WILLEBRAND/'S/ DISEASE)))
(WANT ((CTGY, V) (ROOT, WANT) (TENSE, PRES) (TRANS, T)
(S-TRANS, T))
((CTGY, N) (NUM, SING) (FTR, ABSTRACT) (PLUR, WANTS)))
(WAS ((CTGY, IDENT)(ROOT, BE) (TENSE, PAST) (PPRT, T) (TRANS, T)
(INTRANS, T))
((CTGY, AUX)))
(WERE ((CTGY, IDENT) (ROOT, BE) (TENSE, PAST) (PPRT, T) (TRANS, T)
(INTRANS, T))
((CTGY, AUX)))
(WHAT ((CTGY, WH-Q)))
(WHICH ((CTGY, WH-Q)))
(WHOLE ((CTGY, IDIOMMID)) ((CTGY, IDIOMBEG)))
(WHOLE/ BLOOD/ CLOTTING/ TIME ((CTGY, LABTEST) (NUM, SING)
(ROOT, CLOTTING/ TIME/ OF/ WHOLE/ BLOOD)))
(WILL ((CTGY, MODAL)(TENSE, FUTURE))
((CTGY, AUX)))
(WILLEBRAND/'S ((CTGY, IDIOMMID)))

(WITH ((CTGY,TEMPREL)))
(WITHOUT ((CTGY,TEMPREL)))
(WOULD ((CTGY,MODAL) (TENSE,PRES) (ROOT,WILL)))
(WOUND ((CTGY,IDIOMBEG)))
(WOUND/ HEALING ((CTGY,SYMPTOM) (NUM,SING)))

APPENDIX F

DATA INPUT TO SYSTEM

AND

QUESTIONS ASKED

D A T A

1. Petechiae is rare in hemophilia.
2. Prothrombin consumption test is normal in mild hemophilia.
3. Clotting time of whole blood may be normal in mild hemophilia.
4. One-stage prothrombin time test is usually normal in hemophilia.
5. Thrombin time is usually normal in hemophilia.
6. Bleeding time is usually normal in hemophilia.
7. Fatal hemorrhage may occur after neonatal circumcision in severe hemophilia.
8. Coagulation time is prolonged only in severe hemophilia.
9. Coagulation time is normal in moderate hemophilia.
10. Coagulation time is normal in mild hemophilia.
11. Prothrombin consumption test is abnormal in severe hemophilia.
12. Prothrombin consumption test is variable in moderate hemophilia.
13. PTT is prolonged in severe hemophilia.
14. PTT is prolonged in moderate hemophilia.
15. PTT is variable in mild hemophilia.
16. PTT is normal in sub hemophilia.
17. Bleeding tendency in infants causes cutaneous ecchimoses after trivial trauma in severe hemophilia.
18. Subcutaneous hematomas develop in infants after trivial trauma in severe hemophilia.
19. Bleeding from mouth in children is frequent in hemophilia.
20. Bleeding from frenum of upper lips is frequent in children in hemophilia.
21. Spontaneous bleeding may be cyclic in hemophilia.
22. Wound healing is often slow in hemophilia.
23. Hematomas may cause fever in hemophilia.
24. First symptoms develop rarely in adolescents.
25. Hematomas may cause leukocytosis in hemophilia.
26. Transfusion therapy may cause hepatitis in hemophilia.
27. Antibodies against factor VIII may develop upon transfusion in hemophilia.

28. Attitude of increased risk-taking may develop in hemophilia.
29. Spontaneous bleeding may start in emotional stress in hemophilia.
30. Episodes of hemarthrosis are frequent in presence of antibodies against factor VIII.
31. Trivial injuries may cause life-threatening hemorrhage in hemophilia.
32. Epistaxis is common in hemophilia.
33. Hematuria is common in hemophilia.
34. Large dissecting intramuscular hematomas are common in hemophilia.
35. Anticoagulants are ruled out in hemophilia.
36. Intravenous injection is safe in hemophilia.
37. Venipuncture is safe in hemophilia.
38. Immunization against tetanus is important in hemophilia.
39. Tetanus immunization is possible without transfusion in mild hemophilia.
40. Conservative therapy of hemarthrosis is necessary in hemophilia in presence of antibodies against factor VIII.
41. Plasma infusion is needed for two days after start of intensive physiotherapy in hemophilia.
42. Cryoprecipitate is needed for two days after start of intensive physiotherapy in hemophilia.
43. Prevention of intra-articular hemorrhages can cause decrease of the severity of joint lesions in hemophiliacs.
44. Prevention of intra-articular hemorrhages can cause decrease of the incidence of joint lesions in hemophiliacs.
45. Trauma may cause hematuria in hemophilia.
46. PTT is abnormal in mild hemophilia. **
47. Prothrombin consumption test is abnormal in moderate hemophilia. **
48. Coagulation time is abnormal in severe hemophilia. **
49. PTT is abnormal in severe hemophilia. **
50. PTT is abnormal in moderate hemophilia. **
51. Platelet count is normal in hemophilia.
52. Prothrombin consumption test is normal in hemophilia.
53. Coagulation factor-related antigen may be normal in hemophilia.
54. Coagulation factor-related antigen may be reduced in hemophilia.
55. Coagulation factor-related antigen may be abnormal in hemophilia. **
56. Fibrinolysis is normal in hemophilia.
57. PTT is prolonged in hemophilia.
58. PTT is abnormal in hemophilia. **
59. Hemarthrosis is common in hemophilia.
60. Hemarthroses are frequent in presence of antibodies against factor VIII in hemophilia.
61. Hemarthroses are caused by transfusion in hemophilia. **
62. Platelet count is normal in Von Willebrand's disease.
63. Prothrombin consumption test is normal in Von Willebrand's disease.
64. PTT may be normal in Von Willebrand's disease.
65. PTT may be prolonged in Von Willebrand's disease.
66. Coagulation factor-related antigen is reduced in Von Willebrand's disease.
67. Fibrinolysis is normal in Von Willebrand's disease.

68. Bleeding time is normal in Von Willebrand's disease.
69. Epistaxis is common in Von Willebrand's disease.
70. Hemarthrosis is rare in Von Willebrand's disease.
71. Menorrhagia is common in Von Willebrand's disease.
72. Bruising is common in Von Willebrand's disease.
73. PTT is abnormal in Von Willebrand's disease. **
74. Conagulation factor-related antigen is abnormal in Von Willebrand's disease. **

** Statement was not input by user, but was constructed by a deduction rule.

QUESTIONS ASKED

1. Is petechiae rare in hemophilia?
--Petechiae is rare in hemophilia.
2. What symptom is rare in hemophilia?
--Petechiae is rare in hemophilia.
3. What condition is rare in hemophilia?
--Petechiae is rare in hemophilia.
4. Which condition is rare in hemophilia?
--Petechiae is rare in hemophilia.
5. Which symptom is rare in hemophilia?
--Petechiae is rare in hemophilia.
6. Which symptoms are rare in hemophilia?
--Petechiae is rare in hemophilia.
7. Which condtions are rare in hemophilia?
--Petechiae is rare in hemophilia.
8. What conditions are rare in hemophilia?
--Petechiae is rare in hemophilia.
9. What symptoms are rare in hemophilia?
--Petechiae is rare in hemophilia.
10. Does petechiae occur in hemophilia?
--Petechiae is rare in hemophilia.
11. What is the frequency of petechiae in hemophilia?
--Petechiae is rare in hemophilia.
12. Is prothrombin consumption test normal in mild hemophilia?
--Prothrombin consumption test is normal in mild hemophilia.
13. What lab test is normal in mild hemophilia?
--Prothrombin consumption test is normal in mild hemophilia.
--Clotting time of whole blood may be normal in mild hemophilia.
14. Is clotting time of whole blood normal in mild hemophilia?
--Clotting time of whole blood may be normal in mild hemophilia.
15. May clotting time of whole blood be normal in mild hemophilia?
--Clotting time of whole blood may be normal in mild hemophilia.

16. Is one-stage prothrombin time test usually normal in hemophilia?
--One-stage prothrombin time test is normal in hemophilia.
17. Is thrombin time usually normal in hemophilia?
--Thrombin time is normal in hemophilia.
18. Which lab tests are normal in hemophilia?
--Prothrombin consumption test is normal in mild hemophilia.
--Clotting time of whole blood may be normal in mild hemophilia.
--One-stage prothrombin time test is normal in hemophilia.
--Thrombin time is normal in hemophilia.
--Bleeding time is normal in hemophilia.
--Coagulation time is normal in moderate hemophilia.
--Coagulation time is normal in mild hemophilia.
--PTT is normal in sub hemophilia.
--Platelet count is normal in hemophilia.
--Prothrombin consumption test is normal in hemophilia.
--Coagulation factor-related antigen may be normal in hemophilia.
--Fibrinolysis is normal in hemophilia.
19. Is bleeding time usually normal in hemophilia?
--Bleeding time is normal in hemophilia.
20. What lab test is normal in hemophilia?
--Prothrombin consumption test is normal in mild hemophilia.
--Clotting time of whole blood may be normal in mild hemophilia.
--One-stage prothrombin time test is usually normal in hemophilia.
--Thrombin time is usually normal in hemophilia.
--Bleeding time is normal in hemophilia.
--Coagulation time is normal in moderate hemophilia.
--Coagulation time is normal in mild hemophilia.
--PTT is normal in sub hemophilia.
--Platelet count is normal in hemophilia.
--Prothrombin consumption test is normal in hemophilia.
--Coagulation factor-related antigen may be normal in hemophilia.
--Fibrinolysis is normal in hemophilia.
21. May fatal hemorrhage occur after neonatal circumcision in severe hemophilia?
--Fatal hemorrhage may occur after neonatal circumcision in severe hemophilia.
22. Can fatal hemorrhage occur after neonatal circumcision in severe hemophilia?
--Fatal hemorrhage may occur after neonatal circumcision in severe hemophilia.
23. Is coagulation time prolonged only in severe hemophilia?
--Coagulation time is prolonged only in severe hemophilia.
24. Is coagulation time normal in moderate hemophilia?
--Coagulation time is normal in moderate hemophilia.

25. Is coagulation time normal in mild hemophilia?
--Coagulation time is normal in mild hemophilia.
26. Is prothrombin consumption test abnormal in severe hemophilia?
--Prothrombin consumption test is abnormal in severe hemophilia.
27. Is prothrombin consumption test variable in moderate hemophilia?
--Prothrombin consumption test is variable in moderate hemophilia.
28. Is PTT prolonged in severe hemophilia?
--PTT is prolonged in severe hemophilia.
29. Is PTT prolonged in moderate hemophilia?
--PTT is prolonged in moderate hemophilia.
30. Is PTT variable in mild hemophilia?
--PTT is variable in mild hemophilia.
31. Is PTT normal in sub hemophilia?
--PTT is normal in sub hemophilia.
32. What lab test is normal in sub hemophilia?
--PTT is normal in sub hemophilia.
33. Does bleeding tendency in infants cause cutaneous ecchimoses after trivial trauma in severe hemophilia?
--Bleeding tendency in infants causes cutaneous ecchimoses after trivial trauma in severe hemophilia.
34. What symptoms of hemophilia occur in infants?
--Bleeding tendency in infants causes cutaneous ecchimoses after trivial trauma in severe hemophilia.
--Subcutaneous hematomas develop in infants after trivial trauma in severe hemophilia.
35. Do subcutaneous hematomas develop in infants after trivial trauma in severe hemophilia?
--Subcutaneous hematomas develop in infants after trivial trauma in severe hemophilia.
36. What symptoms of severe hemophilia occur in infants?
--Bleeding tendency in infants causes cutaneous ecchimoses after trivial trauma in severe hemophilia.
--Subcutaneous hematomas develop in infants after trivial trauma in severe hemophilia.
37. Is bleeding from mouth in children frequent in hemophilia?
--Bleeding from mouth in children is frequent in hemophilia.
38. What symptoms of hemophilia occur in children?
--Bleeding from mouth in children is frequent in hemophilia.
--Bleeding from frenum of upper lips is frequent in children

in hemophilia.

39. What symptoms are frequent in hemophilia?
--Bleeding from mouth in children is frequent in hemophilia.
--Bleeding from frenum of upper lips is frequent in children in hemophilia.
40. Is bleeding from frenum of upper lips frequent in children in hemophilia?
--Bleeding from frenum of upper lips is frequent in children in hemophilia.
41. What symptoms of hemophilia are frequent in children?
--Bleeding from mouth in children is frequent in hemophilia.
--Bleeding from frenum of upper lips is frequent in children in hemophilia.
42. Is spontaneous bleeding cyclic in hemophilia?
--Spontaneous bleeding may be cyclic in hemophilia.
43. What symptom is cyclic in hemophilia?
--Spontaneous bleeding may be cyclic in hemophilia.
44. Is wound healing often slow in hemophilia?
--Wound healing is slow in hemophilia.
45. May hematomas cause fever in hemophilia?
--Hematomas may cause fever in hemophilia.
46. Can hematomas cause fever in hemophilia?
--Hematomas may cause fever in hemophilia.
47. What is the cause of fever in hemophilia?
--Hematomas may cause fever in hemophilia.
48. What causes fever in hemophilia?
--Hematomas may cause fever in hemophilia.
49. What is the effect of hematomas in hemophilia?
--Hematomas may cause fever in hemophilia.
--Hematomas may cause leukocytosis in hemophilia.
50. Do first symptoms develop rarely in adolescents?
--First symptoms develop rarely in adolescents.
51. May hematomas cause leukocytosis in hemophilia?
--Hematomas may cause leukocytosis in hemophilia.
52. Can hematomas cause leukocytosis in hemophilia?
--Hematomas may cause leukocytosis in hemophilia.
53. What is the cause of leukocytosis in hemophilia?
--Hematomas may cause leukocytosis in hemophilia.
54. What causes leukocytosis in hemophilia?
--Hematomas may cause leukocytosis in hemophilia.

55. What are the symptoms of hematomas in hemophilia?
--Hematomas may cause fever in hemophilia.
--Hematomas may cause leukocytosis in hemophilia.
56. May transfusion therapy cause hepatitis in hemophilia?
--Transfusion therapy may cause hepatitis in hemophilia.
57. May antibodies against factor VIII develop upon transfusion in hemophilia?
--Antibodies against factor VIII may develop upon transfusion in hemophilia.
58. May attitude of increased risk-taking develop in hemophilia?
--Attitude of increased risk-taking may develop in hemophilia.
59. May spontaneous bleeding start in emotional stress in hemophilia?
--Spontaneous bleeding may start in emotional stress in hemophilia.
60. Are episodes of hemarthrosis frequent in presence of antibodies against factor VIII?
--Episodes of hemarthrosis are frequent in presence of antibodies against factor VIII.
61. May trivial injuries cause life-threatening hemorrhage in hemophilia?
--Trivial injuries may cause life-threatening hemorrhage in hemophilia.
62. Is epistaxis common in hemophilia?
--Epistaxis is common in hemophilia.
63. What symptoms are common in hemophilia?
--Epistaxis is common in hemophilia.
--Hematuria is common in hemophilia.
--Large dissecting intramuscular hematomas are common in hemophilia.
--Hemarthrosis is common in hemophilia.
64. Is hematuria common in hemophilia?
--Hematuria is common in hemophilia.
65. Are large dissecting intramuscular hematomas common in hemophilia?
--Large dissecting intramuscular hematomas are common in hemophilia.
66. Are anticoagulants ruled out in hemophilia?
--Anticoagulants are ruled out in hemophilia.
67. Are anticoagulants prohibited in hemophilia?
--Anticoagulants are ruled out in hemophilia.
68. What treatments are prohibited in hemophilia?

- Anticoagulants are ruled out in hemophilia.
- 69. Is intravenous injection safe in hemophilia?
--Intravenous injection is safe in hemophilia.
- 70. What treatment is safe in hemophilia?
--Intravenous injection is safe in hemophilia.
--Venipuncture is safe in hemophilia.
- 71. Is venipuncture safe in hemophilia?
--Venipuncture is safe in hemophilia.
- 72. What treatments are safe in hemophilia?
--Intravenous injection is safe in hemophilia.
--Venipuncture is safe in hemophilia.
- 73. Is immunization against tetanus important in hemophilia?
--Immunization against tetanus is important in hemophilia.
- 74. What treatment is important in hemophilia?
--Immunization against tetanus is important in hemophilia.
- 75. Is tetanus immunization possible without transfusion in mild hemophilia?
--Tetanus immunization is possible without transfusion in mild hemophilia.
- 76. What treatment is possible without transfusion in mild hemophilia?
--Tetanus immunization is possible without transfusion in mild hemophilia.
- 77. Is conservative therapy of hemarthrosis necessary in hemophilia?
--Conservative therapy of hemarthrosis is necessary in hemophilia in presence of antibodies against factor VIII.
- 78. What treatment is necessary in hemophilia?
--Conservative therapy of hemarthrosis is necessary in hemophilia in presence of antibodies against factor VIII.
- 79. Is plasma infusion needed for two days after start of intensive physiotherapy in hemophilia?
--Plasma infusion is needed for two days after start of intensive physiotherapy in hemophilia.
- 80. What treatments are needed for two days after start of intensive physiotherapy in hemophilia?
--Plasma infusion is needed for two days after start of intensive physiotherapy in hemophilia.
--Cryoprecipitate infusion is needed for two days after start of intensive physiotherapy in hemophilia.
- 81. Is cryoprecipitate infusion needed for two days after start of intensive physiotherapy in hemophilia?
--Cryoprecipitate infusion is needed for two days after

start of intensive physiotherapy in hemophilia.

82. What lab test is abnormal in hemophilia?
--Prothrombin consumption test is abnormal in severe hemophilia.
--PTT is abnormal in mild hemophilia.
--Prothrombin consumption test is abnormal in moderate hemophilia.
--Coagulation time is abnormal in severe hemophilia.
--PTT is abnormal in severe hemophilia.
--PTT is abnormal in moderate hemophilia.
--Coagulation factor-related antigen may be abnormal in hemophilia.
--PTT is abnormal in hemophilia.
83. What lab test is abnormal in mild hemophilia?
--PTT is abnormal in mild hemophilia.
84. What lab tests are abnormal in moderate hemophilia?
--Prothrombin consumption test is abnormal in moderate hemophilia.
--PTT is abnormal in moderate hemophilia.
85. What lab tests are abnormal in severe hemophilia?
--Prothrombin consumption test is abnormal in severe hemophilia.
--Coagulation time is abnormal in severe hemophilia.
--PTT is abnormal in severe hemophilia.
86. What symptoms occur in severe hemophilia?
--Fatal hemorrhage may occur after neonatal circumcision in severe hemophilia.
--Bleeding tendency in infants causes cutaneous ecchimoses after trivial trauma in severe hemophilia.
--Subcutaneous hematomas develop in infants after trivial trauma in severe hemophilia.
87. What symptoms occur in hemophilia?
--Petechiae is rare in hemophilia.
--Fatal hemorrhage may occur after neonatal circumcision in severe hemophilia.
--Bleeding tendency in infants causes cutaneous ecchimoses after trivial trauma in severe hemophilia.
--Subcutaneous hematomas develop in infants after trivial trauma in severe hemophilia.
--Bleeding from mouth in children is frequent in hemophilia.
--Bleeding from frenum of upper lips is frequent in children in hemophilia.
--Spontaneous bleeding may be cyclic in hemophilia.
--Wound healing is slow in hemophilia.
--Hematomas may cause fever in hemophilia.
--Hematomas may cause leukocytosis in hemophilia.
--Transfusion therapy may cause hepatitis in hemophilia.
--Antibodies against factor VIII may develop upon transfusion in hemophilia.
--Attitude of increased risk-taking may develop in

- hemophilia.
 - Spontaneous bleeding may start in emotional stress in hemophilia.
 - Trivial injuries may cause life-threatening hemorrhage in hemophilia.
 - Epistaxis is common in hemophilia.
 - Hematuria is common in hemophilia.
 - Large dissecting intramuscular hematomas are common in hemophilia.
 - Trauma may cause hematuria in hemophilia.
 - Hemarthrosis is common in hemophilia.
 - Hemarthroses are frequent in presence of antibodies against factor VIII in hemophilia.
 - Hemarthroses are caused by transfusion in hemophilia.
88. What lab tests are normal in Von Willebrand's disease?
- Platelet count is normal in Von Willebrand's disease.
 - Prothrombin consumption test is normal in Von Willebrand's disease.
 - PTT may be normal in Von Willebrand's disease.
 - Fibrinolysis is normal in Von Willebrand's disease.
 - Bleeding time is normal in Von Willebrand's disease.
89. What lab tests are abnormal in Von Willebrand's disease?
- PTT is abnormal in Von Willebrand's disease.
 - Coagulation factor-related antigen is abnormal in Von Willebrand's disease.
90. What lab tests are prolonged in Von Willebrand's disease?
- PTT may be prolonged in Von Willebrand's disease.
91. What lab tests are reduced in Von Willebrand's disease?
- Coagulation factor-related antigen is reduced in Von Willebrand's disease.
92. What symptoms are common in Von Willebrand's disease?
- Epistaxis is common in Von Willebrand's disease.
 - Menorrhagia is common in Von Willebrand's disease.
 - Bruising is common in Von Willebrand's disease.
93. What symptom is rare in Von Willebrand's disease?
- Hemarthrosis is common in Von Willebrand's disease.

APPENDIX G

DIALOGUE WITH MEDIC

SYSTEM 1.3 -- AUGUST 28, 1979

MEDIC IS A MEDICAL QUESTION ANSWERING SYSTEM WITH A DATA BASE OF HEMOPHILIA INFORMATION. YOU MAY ASK A QUESTION, I.E.

IS COAGULATION TIME NORMAL IN MODERATE HEMOPHILIA?
OR YOU MAY ADD INFORMATION TO THE SYSTEM, I.E.,

COAGULATION TIME IS NORMAL IN HEMOPHILIA.
TO END THE SESSION, JUST HIT CARRIAGE RETURN OR TYPE
BYE (WITH A SPACE AFTER BYE)
AND HIT THE CARRIAGE RETURN.

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*WHAT LAB TESTS ARE ABNORMAL IN HEMOPHILIA?

PROCESSING SENTENCE

PROTHROMBIN CONSUMPTION TEST IS ABNORMAL IN SEVERE HEMOPHILIA .
COAGULATION FACTOR-RELATED ANTIGEN IS ABNORMAL IN HEMOPHILIA .
PTT IS ABNORMAL IN MODERATE HEMOPHILIA .
PTT IS ABNORMAL IN SEVERE HEMOPHILIA .
COAGULATION TIME IS ABNORMAL IN SEVERE HEMOPHILIA .
PTT IS ABNORMAL IN HEMOPHILIA .
PROTHROMBIN CONSUMPTION TEST IS ABNORMAL IN MODERATE HEMOPHILIA .
PTT IS ABNORMAL IN MILD HEMOPHILIA .

PROCESSING TIME = .1439000000000E5

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*WHAT LAB TEST IS ABNORMAL IN VON WILLEBRAND'S DISEASE?

PROCESSING SENTENCE

COAGULATION FACTOR-RELATED ANTIGEN ISBNORMAL IN VON WILLEBRAND'S DISEASE .

PTT IS ABNORMAL IN VON WILLEBRAND'S DISEASE .

T

PROCESSING TIME = .6087000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION

*WHAT TREATMENTS ARE SAFE IN HEMOPHILIA?

PROCESSING SENTENCE

INTRAVENOUS INJECTION IS SAFE IN HEMOPHILIA .

VENIPUNCTURE IS SAFE IN HEMOPHILIA .

PROCESSING TIME = .2390000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION

*WHAT MAY CAUSE HEMATURIA IN HEMOPHILIA?

PROCESSING SENTENCE

TRAUMA MAY CAUSE HEMATURIA IN HEMOPHILIA .

PROCESSING TIME = .1529000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION

*GLOMERULONEPHRITIS MAY CAUSE HEMATURIA IN HEMOPHILIA.

PROCESSING SENTENCE

(GLOMERULONEPHRITIS NOT IN DICTIONARY)

ENTRY DOES NOT PARSE NIL

PROCESSING TIME = .5910000000000E3

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION

*GLOMERULONEPHRITIS MAY CAUSE HEMATURIA IN HEMOPHILIA.

PROCESSING SENTENCE

SENTENCE STORED AS THE FOLLOWING NODE M112

(M112 (PROXCAUSE (GLOMERULONEPHRITIS)) (MODAL (MAY)) (SYMPTOM (HEMATURIA)) (TYPEDIS (M1)))

(M1 (DISTYPE (PLAIN)) (DISEASE (HEMOPHILIA)))

(DUMPED)

PROCESSING TIME = .1554000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*WHAT MAY CAUSE HEMATURIA IN HEMOPHILIA?

PROCESSING SENTENCE

TRAUMA MAY CAUSE HEMATURIA IN HEMOPHILIA .
GLOMERULONEPHRITIS MAY CAUSE HEMATURIA IN HEMOPHILIA .

PROCESSING TIME = .1763000000000E4

PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION
*BYE

APPENDIX H
PARSING WITH TRACE

"ATN PARSER INITIALIZATION"

(TRACE LEVEL= => 7 <=)

(BEGINNING AT STATE => S <=)

*PARSE: *(PROTHROMBIN CONSUMPTION TEST IS NORMAL IN MILD HEMOPHILIA)

(PROTHROMBIN CONSUMPTION TEST IS NORMAL IN MILD HEMOPHILIA)

(ABOUT TO PUSH TO => QUESTION <=)

(REGS AT LEVEL => 1 <=)

(=> NIL <=)

(ABOUT TO PUSH TO => POS-DISEASE <=)

(REGS AT LEVEL => 2 <=)

(=> NIL <=)

(ABOUT TO PUSH TO => FIRST-OF-IDIOM <=)

(REGS AT LEVEL => 3 <=)

(=> NIL <=)

(TRAVERSE WITH => PROTHROMBIN <=)

(ON ARC => (CAT IDIOMBEG T (SETR IDIOM (EXPLODE (GETR #))) (TO MIDDLE-OR-
-END-OF-IDIOM)) <=)

(BUFFER = => (CONSUMPTION TEST IS NORMAL IN MILD HEMOPHILIA) <=)

(TRAVERSE WITH => CONSUMPTION <=)

(ON ARC => (CAT IDIOMMID T (ADDR IDIOM (QUOTE) (EXPLODE (GETR #))) (TO
MIDDLE-OR-END-OF-IDIOM)) <=)

(BUFFER = => (TEST IS NORMAL IN MILD HEMOPHILIA) <=)

(TRAVERSE WITH => TEST <=)

(ON ARC => (CAT IDIOMEND T (SETR IDIOM (PACK (ADDR IDIOM (QUOTE) (EXPL
ODE (GETR *)))))) (TO IDIOM-POP)) <=)

(BUFFER = => (IS NORMAL IN MILD HEMOPHILIA) <=)

(POPPING FROM => IDIOM-POP <=)

(REG: AT LEVEL => 4 <=)

(=> ((IDIOM,PROTHROMBIN CONSUMPTION TEST) (IDIOM P R O T H R O M B I N
C O N S U M P T I O N T E S T) (*,TEST) (*,TEST) (IDIOM P R O T H R O
M B I N C O N S U M P T I O N) (*,CONSUMPTION) (*,CONSUMPTION) (IDIOM
P R O T H R O M B I N) (*,PROTHROMBIN) (*,PROTHROMBIN)) <=)

(RETURNING FORM => PROTHROMBIN CONSUMPTION TEST <=)

(ABOUT TO GO TO STATE => POS-DISEASE <=)

(WITH REGISTERS AT LEVEL => 3 <=)

(=> ((IDIOM,PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN CONSUMPTION TES
T) (*,PROTHROMBIN)) <=)

(BUFFER = => (PROTHROMBIN CONSUMPTION TEST IS NORMAL IN MILD HEMOPHILIA)
<=)

(ABOUT TO PUSH TO => FIRST-OF-IDIOM <=)

(REGS AT LEVEL => 3 <=)

(=> ((IDIOM,PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN CONSUMPTION TES
T) (*,PROTHROMBIN)) <=)

(BUFFER = => (PROTHROMBIN CONSUMPTION TEST IS NORMAL IN MILD HEMOPHILIA)
<=)

(BLOCKED AT => FIRST-OF-IDIOM <=)

(TRYING ALTERNATIVE AT => MIDDLE-OR-END-OF-IDIOM <=)

(BLOCKED AT => MIDDLE-OR-END-OF-IDIOM <=)

(TRYING ALTERNATIVE AT => QUESTION <=)

(JUMP TO => QUESTION-1 <=)

(BLOCKED AT => QUESTION-1 <=)

(TRYING ALTERNATIVE AT => S <=)

(ABOUT TO PUSH TO => STATEMENT <=)

(REGS AT LEVEL => 1 <=)

(=> NIL <=)

(ABOUT TO PUSH TO => POS-NOUN <=)

(REGS AT LEVEL => 2 <=)

(=> NIL <=)

(ABOUT TO PUSH TO => FIRST-OF-IDIOM <=)

(REGS AT LEVEL => 3 <=)

(=> NIL <=)

(TRAVERSE WITH => PROTHROMBIN <=)

(ON ARC => (CAT IDIOMBEG T (SETR IDIOM (EXPLODE (GETR #))) (TO MIDDLE-OR-
-END-OF-IDIOM)) <=)

(BUFFER = => (CONSUMPTION TEST IS NORMAL IN MILD HEMOPHILIA) <=)

(TRAVERSE WITH => CONSUMPTION <=)

(ON ARC => (CAT IDIOMMID T (ADDR IDIOM (QUOTE) (EXPLODE (GETR #))) (TO
MIDDLE-OR-END-OF-IDIOM)) <=)

(BUFFER = => (TEST IS NORMAL IN MILD HEMOPHILIA) <=)

(TRAVERSE WITH => TEST <=)

(ON ARC => (CAT IDIOMEND T (SETR IDIOM (PACK (ADDR IDIOM (QUOTE) (EXPL
ODE (GETR #)))))) (TO IDIOM-POP)) <=)

(BUFFER = => (IS NORMAL IN MILD HEMOPHILIA) <=)

(POPPING FROM => IDIOM-POP <=)

(REG: AT LEVEL => 4 <=)

(=> ((IDIOM,PROTHROMBIN CONSUMPTION TEST) (IDIOM P R O T H R O M B I N
C O N S U M P T I O N T E S T) (*,TEST) (*,TEST) (IDIOM P R O T H R O
M E I N C O N S U M P T I O N) (*,CONSUMPTION) (*,CONSUMPTION) (IDIOM
P R O T H R O M B I N) (*,PROTHROMBIN) (*,PROTHROMBIN)) <=)

(RETURNING FORM => PROTHROMBIN CONSUMPTION TEST <=)

(ABOUT TO GO TO STATE => POS-NOUN <=)

(WITH REGISTERS AT LEVEL => 3 <=)

(=> ((IDION,PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN)) <=)

(BUFFER = => (PROTHROMBIN CONSUMPTION TEST IS NORMAL IN MILD HEMOPHILIA) <=)

(TRAVERSE WITH => PROTHROMBIN CONSUMPTION TEST <=)

(ON ARC => (CAT LABTEST T (SETR CASE (CONCAT (QUOTE LABTEST) *))) (TO CASE-POP)) <=)

(BUFFER = => (IS NORMAL IN MILD HEMOPHILIA) <=)

(POPPING FROM => CASE-POP <=)

(REG: AT LEVEL => 3 <=)

(=> ((CASE LABTEST PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN CONSUMPTION TEST) (IDION,PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN)) <=)

(RETURNING FORM => (LABTEST PROTHROMBIN CONSUMPTION TEST) <=)

(ABOUT TO GO TO STATE => STATEMENT <=)

(WITH REGISTERS AT LEVEL => 2 <=)

(=> ((FRAME LABTEST PROTHROMBIN CONSUMPTION TEST) (* LABTEST PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN)) <=)

(BUFFER = => (IS NORMAL IN MILD HEMOPHILIA) <=)

(ABOUT TO PUSH TO => POS-NOUN <=)

(REGS AT LEVEL => 2 <=)

(=> ((FRAME LABTEST PROTHROMBIN CONSUMPTION TEST) (* LABTEST PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN)) <=)

(BUFFER = => (IS NORMAL IN MILD HEMOPHILIA) <=)

(ABOUT TO PUSH TO => FIRST-OF-IDIOM <=)

(REGS AT LEVEL => 3 <=)

(=> NIL <=)

(BUFFER = => (IS NORMAL IN MILD HEMOPHILIA) <=)

(BLOCKED AT => FIRST-OF-IDIOM <=)

(TRYING ALTERNATIVE AT => STATEMENT <=)

(ABOUT TO PUSH TO => POS-TEMPREL <=)

(REGS AT LEVEL => 2 <=)

(=> ((FRAME LABTEST PROTHROMBIN CONSUMPTION TEST) (* LABTEST PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN)) <=)

(BUFFER = => (IS NORMAL IN MILD HEMOPHILIA) <=)

(ABOUT TO PUSH TO => FIRST-OF-IDION <=)

(REGS AT LEVEL => 3 <=)

(=> NIL <=)

(BUFFER = => (IS NORMAL IN MILD HEMOPHILIA) <=)

(BLOCKED AT => FIRST-OF-IDION <=)

(TRYING ALTERNATIVE AT => STATEMENT <=)

(ABOUT TO PUSH TO => POS-DISEASE <=)

(REGS AT LEVEL => 2 <=)

(=> ((FRAME LABTEST PROTHROMBIN CONSUMPTION TEST) (* LABTEST PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN)) <=)

(BUFFER = => (IS NORMAL IN MILD HEMOPHILIA) <=)

(ABOUT TO PUSH TO => FIRST-OF-IDION <=)

(REGS AT LEVEL => 3 <=)

(=> NIL <=)

(BUFFER = => (IS NORMAL IN MILD HEMOPHILIA) <=)

(BLOCKED AT => FIRST-OF-IDION <=)

(TRYING ALTERNATIVE AT => STATEMENT <=)

(ABOUT TO PUSH TO => V-1 <=)

(REGS AT LEVEL => 2 <=)

(=> ((FRAME LABTEST PROTHROMBIN CONSUMPTION TEST) (* LABTEST PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN)) <=)

(BUFFER = => (IS NORMAL IN MILD HEMOPHILIA) <=)

(TRAVERSE WITH => BE <=)

(ON ARC => (CAT V (NULL (EQ (GETF ROOT) (QUOTE CAUSE))) (SETR VERB *) (T
O V-1)) <=)

(BUFFER = => (NORMAL IN MILD HEMOPHILIA) <=)

(TRAVERSE WITH => NORMAL <=)

(ON ARC => (CAT LABRES (OR (MEMB (QUOTE LABTEST) (GETR FRAME 2)) (MEMB (QUOTE LABTEST) (GETR QFRAME 2))) (ADDR CASE (BUILDQ (LABRES *))) (TO NEX
T-POS)) <=)

(BUFFER = => (IN MILD HEMOPHILIA) <=)

(ABOUT TO PUSH TO => POS-NOUN <=)

(REGS AT LEVEL => 3 <=)

(=> ((CASE LABRES NORMAL) (*,NORMAL) (*,NORMAL) (VERB, BE) (*, BE) (*, IS))
<=)

(BUFFER = => (IN MILD HEMOPHILIA) <=)

(ABOUT TO PUSH TO => FIRST-OF-IDIOM <=)

(REGS AT LEVEL => 4 <=)

(=> NIL <=)

(BUFFER = => (IN MILD HEMOPHILIA) <=)

(TRAVERSE WITH => IN <=)

(ON ARC => (CAT IDIOMBEG T (SETR IDIOM (EXPLODE (GETR *))) (TO MIDDLE-OR
-END-OF-IDIOM)) <=)

(BUFFER = => (MILD HEMOPHILIA) <=)

(BLOCKED AT => MIDDLE-OR-END-OF-IDIOM <=)

(TRYING ALTERNATIVE AT => NEXT-POS <=)

(ABOUT TO PUSH TO => POS-TEMPREL <=)

(REGS AT LEVEL => 3 <=)

(=> ((CASE LABRES NORMAL) (*,NORMAL) (*,NORMAL) (VERB, BE) (*, BE) (*, IS))
<=)

(BUFFER = => (IN MILD HEMOPHILIA) <=)

(TRAVERSE WITH => IN <=)

(ON ARC => (CAT TEMPREL T (ADDR CASE (BUILDQ (TEMPREL *))) (TO PREPN)) <=)

(BUFFER = => (MILD HEMOPHILIA) <=)

(ABOUT TO PUSH TO => FIRST-OF-IDIOM <=)

(REGS AT LEVEL => 4 <=)

(=> ((CASE TEMPREL IN) (*,IN) (*,IN)) <=)

(BUFFER = => (MILD HEMOPHILIA) <=)

(BLOCKED AT => FIRST-OF-IDIOM <=)

(TRYING ALTERNATIVE AT => PREPN <=)

(ABOUT TO PUSH TO => POS-NOUN <=)

(REGS AT LEVEL => 4 <=)

(=> ((CASE TEMPREL IN) (*,IN) (*,IN)) <=)

(BUFFER = => (MILD HEMOPHILIA) <=)

(ABOUT TO PUSH TO => FIRST-OF-IDIOM <=)

(REGS AT LEVEL => 5 <=)

(=> NIL <=)

(BUFFER = => (MILD HEMOPHILIA) <=)

(BLOCKED AT => FIRST-OF-IDIOM <=)

(TRYING ALTERNATIVE AT => POS-TEMPREL <=)

(ABOUT TO PUSH TO => FIRST-OF-IDIOM <=)

(REGS AT LEVEL => 4 <=)

(=> NIL <=)

(BUFFER = => (IN MILD HEMOPHILIA) <=)

(TRAVERSE WITH => IN <=)

(ON ARC => (CAT IDIOMBEG T (SETR IDIOM (EXPLODE (GETR *))) (TO MIDDLE-OR-
-END-OF-IDIOM)) <=)

(BUFFER = => (MILD HEMOPHILIA) <=)

(ELCKED AT => MIDDLE-OR-END-OF-IDIOM <=)

(TRYING ALTERNATIVE AT => NEXT-POS <=)

(ABOUT TO PUSH TO => POS-DISEASE <=)

(REGS AT LEVEL => 3 <=)

(=> ((CASE LABRES NORMAL) (*,NORMAL) (*,NORMAL) (VERB,BE) (*,BE) (*,IS))
<=)

(BUFFER = => (IN MILD HEMOPHILIA) <=)

(TAKING WRD> => (IN OF FOR) <=)

(ON ARC => (WRD (IN OF FOR) T (TO POS-DISEASE)) <=)

(BUFFER = => (MILD HEMOPHILIA) <=)

(TRAVERSE WITH => MILD <=)

(ON ARC => (CAT DISTYPE T (SETR DISTYPE *) (TO POSDIS1)) <=)

(BUFFER = => (HEMOPHILIA) <=)

(TRAVERSE WITH => HEMOPHILIA <=)

(ON ARC => (CAT DISEASE T (SETR DISEASE *) (TO DISEASE-POP1)) <=)

(BUFFER = => NIL <=)

(POPPING FROM => DISEASE-POP1 <=)

(REG: AT LEVEL => 4 <=)

(=> ((DISEASE,HEMOPHILIA) (*,HEMOPHILIA) (*,HEMOPHILIA) (DISTYPE,MILD) (*,
MILD) (*,MILD) (*,IN)) <=)

(RETURNING FORM => ((M3)) <=)

(ABOUT TO GO TO STATE => NEXT-POS <=)

(WITH REGISTERS AT LEVEL => 3 <=)

(=> ((CASE LABRES NORMAL TYPEDIS M3) (*,M3) (*,IN) (CASE LABRES NORMAL)
(*,NORMAL) (*,NORMAL) (VERB,BE) (*,BE) (*,IS)) <=)

(BUFFER = => NIL <=)

(POPPING FROM => NEXT-POS <=)

(REG: AT LEVEL => 3 <=)

(=> ((CASE LABRES NORMAL TYPEDIS M3) (*,M3) (*,IN) (CASE LABRES NORMAL) (*,NORMAL) (*,NORMAL) (VERB, BE) (*,BE) (*,IS)) <=)

(RETURNING FORM => (LABRES NORMAL TYPEDIS M3) <=)

(ABOUT TO GO TO STATE => FRAME-POP <=)

(WITH REGISTERS AT LEVEL => 2 <=)

(=> ((FRAME LABTEST PROTHROMBIN CONSUMPTION TEST LABRES NORMAL TYPEDIS M3) (* LABRES NORMAL TYPEDIS M3) (*,IS) (FRAME LABTEST PROTHROMBIN CONSUMPTION TEST) (* LABTEST PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN)) <=)

(BUFFER = => NIL <=)

(POPPING FROM => FRAME-POP <=)

(REG: AT LEVEL => 2 <=)

(=> ((FRAME LABTEST PROTHROMBIN CONSUMPTION TEST LABRES NORMAL TYPEDIS M3) (* LABRES NORMAL TYPEDIS M3) (*,IS) (FRAME LABTEST PROTHROMBIN CONSUMPTION TEST) (* LABTEST PROTHROMBIN CONSUMPTION TEST) (*,PROTHROMBIN)) <=)

(RETURNING FORM => ((M4)) <=)

(ABOUT TO GO TO STATE => OUT-POP <=)

(WITH REGISTERS AT LEVEL => 1 <=)

(=> ((OUTNODE,M4) (*,M4) (*,PROTHROMBIN)) <=)

(BUFFER = => NIL <=)

VALID PARSE OR STRUCTURE>

M4

TIME(MS.) = .47250000000000E4

"END OF PARSE"

(TIME (MS.) = => .47510000000000E4 <=)

APPENDIX I

NED ALISP FUNCTIONS

```

MED                4 SEPTEMBER 1979  22.45.30

CREATED:           6 APRIL 1979   0.8.28
LAST MODIFIED:     4 SEPTEMBER 1979 22.36.15
CHANGES MADE TO: NEWFILE?

```

```

MEDIC
VALUE
(LAMBDA NIL
  (SETQ SYSIN 0 SYSOUT 0 INUNIT 0 OUTUNIT 0)
  (ECHO-ON)
  (SETQ INFERENCE NIL)
  (INTRO)
  (GETINFO)
  (NEWFILE?)
  (PRIN3      <>          "GOODBYE"          <>
   "WHEN EXITING, PLEASE DISPOSE ECHO-LISTING" <>
  (LISP)
  (EXIT))

```

```

PLIST
NIL

```

```

INTRO
VALUE
(LAMBDA NIL
  (PRIN3      <>
   "-----"
   <>          "                SYSTEM 1.3  --  AUGUST 28, 1979"          <>
   "-----"
   <>
   "MEDIC IS A MEDICAL QUESTION ANSWERING SYSTEM WITH A DATA BASE OF"
   <>          "HEMOPHILIA INFORMATION.  YOU MAY ASK A QUESTION, I.E."
   <>          "        IS COAGULATION TIME NORMAL IN MODERATE HEMOPHILIA?"
   <>          "OR YOU MAY ADD INFORMATION TO THE SYSTEM, I.E.,"          <>

```



```

"      COAGULATION TIME IS NORMAL IN HEMOPHILIA."      <>
"TO END THE SESSION, JUST HIT CARRIAGE RETURN OR TYPE"  <>
"      BYE (WITH A SPACE AFTER BYE)"                  <>
"AND HIT THE CARRIAGE RETURN."                          <>

```

)

```

PLIST
NIL

```

```

      GETINFO
VALUE
(LAMBDA NIL
  (STATUS '? 7)
  (STATUS '/. 7)
  (STATUS '! 7)
  (REPEAT (SENTENCE)
    BEGIN (RUNTIME .0)
      (PRIN3 <> <>
        "PLEASE ASK A QUESTION OR ENTER NEW HEMOPHILIA INFORMATION"
        <> " ")
      (SETQ SENTENCE (GET-SENTENCE))
    UNTIL (NULL (CAR SENTENCE))
      (PROCESS SENTENCE)
      (PRIN3 <> "PROCESSING TIME =" * (RUNTIME))))

```

```

PLIST
NIL

```

```

      GET-SENTENCE
VALUE
(LAMBDA NIL
  (PROC (SS)
    (REPEAT NIL
      BEGIN (STATUS '/' 0)
        (SETQ SS (APPEND SS (READLINE)))
        (STATUS '/' 7)
      UNTIL (MEMBER (LAST SS) '(? /. !))
      UNTIL (EQ (CAR SS) 'BYE)
      UNTIL (NULL SS))
    (RETURN (RDC SS))))

```

```

PLIST
NIL

```

```

      PROCESS
VALUE
(LAMBDA (S1)
  (PRIN3 <> "PROCESSING SENTENCE" <> * (PRINT-IT (APPLY : S1)) <>))

```

```

PLIST

```

NIL

```

PRINT-IT
VALUE
(LAMBDA (L)
  (COND
    ((EQ L 'NO) (PRIN3 "ANSWER NOT FOUND"))
    ((EQ L 'NOT) (PRIN3 "ENTRY DOES NOT PARSE"))
    ((ATOM L) (PRIN3 <> "SENTENCE STORED AS THE FOLLOWING NODE" * L <>)
              (APPLY* DESCRIBE L))
    (T (PRINT-SENTENCES L))))

```

PLIST
NIL

```

PRINT-SENTENCES
VALUE
(LAMBDA (L)
  (REPEAT NIL
    BEGIN (COND ((EQ (CAR L) '&) (PRIN3 "." <>))
                (T (PRIN3 * (CAR L))))
          (SETQ L (CDR L)))
    UNTIL (AND (NULL L) (SETQ L ' )))

```

PLIST
NIL

```

?
VALUE
(LAMBDA NIL '?)

```

PLIST
NIL

```

!
VALUE
(LAMBDA NIL '!)

```

PLIST
NIL

```

/.
VALUE
(LAMBDA NIL '/.)

```

PLIST

NIL

NEWFILE?

VALUE

(LAMBDA NIL

(PRIN3 "DID YOU CREATE NEW INFORMATION WHICH SHOULD BE SAVED?" <>)

(STATUS '/' 7)

(IF (YES? (READ)) (OUTSYS (HEMONET CSDWEBS))))

PLIST

NIL

YES?

VALUE

(LAMBDA (ANS)

(REPEAT NIL

UNTIL (EQ ANS 'YES)

WHILE (NOT (EQ ANS 'NO))

(PRIN3 <> "PLEASE TYPE 'YES' OR 'NO'")

(SETQ ANS (READ))))

PLIST

NIL

APPENDIX J
DUMP OF DATA BASE NETWORK NODES

FILEFNS
SNEPCHK
(SNEPS FILE LOADED)
NIL
NIL

GENIT
NOVAL
(V 17 P 1 M 111 B 1)
NIL

DRELST
NOVAL
(:VAL (SYMPTOM LABTEST LABRES DISEASE TYPEDIS DISTYPE MODAL PROXCAUSE
FREQUENCY TEMPREL AGE RECOMMEND TREATMENT PROXCOND PEVB ANT
CQ &ANT ARG AVB EVB))
NIL

AUXRELST
NOVAL
(:VAL (THRESH MAX MIN EMIN EMAX ETOT :CONV :VAL :VAR :SVAR))
NIL

ARELST
NOVAL
(:VAL (SYMPTOM- LABTEST- LABRES- DISEASE- TYPEDIS- DISTYPE- MODAL-
PROXCAUSE- FREQUENCY- TEMPREL- AGE- RECOMMEND- TREATMENT-
PROXCOND- PEVB- ANT- CQ- &ANT- ARG- AVB- EVB-))
NIL

NODES
NOVAL
(:VAL (M110 M109 M108 M107 M106 M105 M104 V16 V15 V14 V13 M103 M102
M101 M100 M99 M98 M97 V12 V11 V10 V9 V96 M95 M94 M93 M92 M91
M90 V8 V7 V6 V5 W V4 V N89 M88 M87 M86 M85 M84 M83 M82 M81 M80 V3 Z V2
Y V1 X GRANCRENE/ OF/ THE/ FINGERS M79 LOSS/ OF/ USE/ OF / THE
/ HAND M78 HEMORRHAGE/ INTO/ FOREARM/ MUSCLE NERVE/ COMPRESSION/ IN/
THE/ ARM M77 BRUISING M76 HEMORRHAGIA M75 M74 M73 M72 M71 M70
M69 M68 M67 M66 VON/ WILLEBRAND/'S/ DISEASE M65 HEMARTHROSES M64 M63 M62
FIBRINOLYSIS M61 REDUCED M60 COAGULATION/ FACTOR-RELATED
/ ANTIGEN M59 M58 PLATELET/ COUNT M57 TRAUMA M56 DECREASE/ OF/ THE/
INCIDENCE/ OF/ JOINT/ LESIONS M55 PREVENTION/ OF/ INTRA-ARTICULAR
/ HEMORRHAGES DECREASE/ OF/ THE/ SEVERITY/ OF/ JOINT/ LESIONS M54

CRYOPRECIPITATE/ INFUSION M53 PLASMA/ INFUSION NEEDED/ FOR/
TWO/ DAYS AFTER START/ OF/ INTENSIVE/ PHYSIOTHERAPY M51 CONSERVATIVE/
THERAPY/ OF/ HEMARTHROSIS NECESSARY M49 POSSIBLE WITHOUT M46
TETANUS/ IMMUNIZATION IMPORTANT M45 VENIPUNCTURE M44 INTRAVENOUS/
INJECTION SAFE M43 ANTICOAGULANTS RULED/ OUT M42 LARGE/ DISSECTING
/ INTRAMUSCULAR/ HEMATOMAS M41 HEMATURIA M40 EPISTAXIS COMMON M39
TRIVIAL/ INJURIES LIFE-THREATENING/ HEMORRHAGE M38 HEMARTHROSIS
IN/ PRESENCE/ OF M37 FREQ EMOTIONAL/ STRESS M35 ATTITUDE/ OF/ INCREASED/
RISK-TAKING M34 ANTIBODIES/ AGAINST/ FACTOR/ VIII UPON
TRANSFUSION M33 TRANSFUSION/ THERAPY HEPATITIS M32 WSYMP LEUKOCYTOSIS M31
FIRST/ SYMPTOMS RARELY ADOLESCENTS M30 HEMATOMAS FEVER M28
WOUND/ HEALING OFTEN SLOW M27 SPONTANEOUS/ BLEEDING CYCLIC M26 BLEEDING
/ FROM/ FRENUM/ OF/ UPPER/ LIPS M25 TYPE WHAT BLEEDING/
FROM/ MOUTH CHILDREN FREQUENT M24 SUBCUTANEOUS/ HEMATOMAS M23 BLEEDING/
TENDENCY IN INFANTS CUTANEOUS/ ECCHIMOSSES TRIVIAL/ TRAUMA
M22 M21 SUB M20 M19 M18 PTT M17 VARIABLE M16 ABNORMAL M15 M14 M13 MODERATE
M12 COAGULATION/ TIME PROLONGED M11 FATAL/ HEMORRHAGE NEONATAL/
/ CIRCUMCISION M10 SEVERE M9 BLEEDING/ TIME M8 THROMBIN/ TIME M7
ONE-STAGE/ PROTHROMBIN/ TIME/ TEST M6 CLOTTING/ TIME/ OF/
WHOLE/ BLOOD MAY M5 PROTHROMBIN/ CONSUMPTION/ TEST NORMAL M4 MILD M3
PETEHIAE RARE M2 PLAIN HEMOPHILIA M1))
NIL

VARBL

NOVAL

(:VAL (V16 V15 V14 V13 V12 V11 V10 V9 V8 V7 V6 V5 V4 V3 V2 V1))

NIL

M110

NOVAL

(AVE (V16 V15 V14 V13) &ANT (M107 M105) CQ (M109))

NIL

M109

NOVAL

(CQ- (M110) PROXCAUSE (V13) FREQUENCY (RARE) TYPEDIS (M108)

:SVAR (V13 V15 V16))

NIL

M108

NOVAL

(TYPEDIS- (M109) DISTYPE (V15) DISEASE (V16) :SVAR (V15 V16))

NIL

M107

NOVAL

(&ANT- (M110) SYMPTOM (V14) FREQUENCY (RARE) TYPEDIS (M106)

:SVAR (V14 V15 V16))

NIL

M106

NOVAL

(TYPEDIS- (M107) DISTYPE (V15) DISEASE (V16) :SVAR (V15 V16))

NIL

M105

NOVAL
(&ANT- (M110) PROXCAUSE (V13) SYMPTOM (V14) TYPEDIS (M104)
:SVAR (V13 V14 V15 V16))
NIL

M104
NOVAL
(TYPEDIS- (M105) DISTYPE (V15) DISEASE (V16) :SVAR (V15 V16))
NIL

V16
NOVAL
(AVE- (M110) DISEASE- (M108 M106 M104) :VAR (T))
NIL

V15
NOVAL
(AVE- (M110) DISTYPE- (M108 M106 M104) :VAR (T))
NIL

V14
NOVAL
(AVE- (M110) SYMPTOM- (M107 M105) :VAR (T))
NIL

V13
NOVAL
(AVE- (M110) PROXCAUSE- (M109 M105) :VAR (T))
NIL

M103
NOVAL
(AVE (V12 V11 V10 V9) &ANT (M100 M98) CQ (M102))
NIL

M102
NOVAL
(CQ- (M103) SYMPTOM (V10) FREQUENCY (COMMON) TYPEDIS (M101)
:SVAR (V10 V11 V12))
NIL

M101
NOVAL
(TYPEDIS- (M102) DISTYPE (V11) DISEASE (V12) :SVAR (V11 V12))
NIL

M100
NOVAL
(&ANT- (M103) PROXCAUSE (V9) FREQUENCY (COMMON) TYPEDIS (M99)
:SVAR (V9 V11 V12))
NIL

M99
NOVAL
(TYPEDIS- (M100) DISTYPE (V11) DISEASE (V12) :SVAR (V11 V12))
NIL

M98
NOVAL
(&ANT- (M103) PROXCAUSE (V9) SYMPTOM (V10) TYPEDIS (M97)
:SVAR (V9 V10 V11 V12))
NIL

M97
NOVAL
(TYPEDIS- (M98) DISTYPE (V11) DISEASE (V12) :SVAR (V11 V12))
NIL

V12
NOVAL
(AVB- (M103) DISEASE- (M101 M99 M97) :VAR (T))
NIL

V11
NOVAL
(AVE- (M103) DISTYPE- (M101 M99 M97) :VAR (T))
NIL

V10
NOVAL
(AVB- (M103) SYMPTOM- (M102 M98) :VAR (T))
NIL

V9
NOVAL
(AVB- (M103) PROXCAUSE- (M100 M98) :VAR (T))
NIL

M96
NOVAL
(AVB (V8 V7 V6 V5 V4) &ANT (M93 M91) CQ (M95))
NIL

M95
NOVAL
(CQ- (M96) PROXCAUSE (V4) SYMPTOM (V6) TYPEDIS (M94) :SVAR (V4 V6 V7 V8))
NIL

M94
NOVAL
(TYPEDIS- (M95) DISTYPE (V7) DISEASE (V8) :SVAR (V7 V8))
NIL

M93
NOVAL
(&ANT- (M96) PROXCAUSE (V5) SYMPTOM (V6) TYPEDIS (M92)
:SVAR (V5 V6 V7 V8))
NIL

M92
NOVAL
(TYPEDIS- (M93) DISTYPE (V7) DISEASE (V8) :SVAR (V7 V8))
NIL

M91
NOVAL
(SANT- (M96) PROXCAUSE (V4) SYMPTOM (V5) TYPEDIS (M90)
:SVAR (V4 V5 V7 V8))
NIL

M90
NOVAL
(TYPEDIS- (M91) DISTYPE (V7) DISEASE (V8) :SVAR (V7 V8))
NIL

V8
NOVAL
(AVE- (M96) DISEASE- (M94 M92 M90) :VAR (T))
NIL

V7
NOVAL
(AVE- (M96) DISTYPE- (M94 M92 M90) :VAR (T))
NIL

V6
NOVAL
(AVE- (M96) SYMPTOM- (M95 M93) :VAR (T))
NIL

V5
NOVAL
(AVE- (M96) PROXCAUSE- (M93) SYMPTOM- (M91) :VAR (T))
NIL

W
NOVAL
(:VAL (V13))
NIL

V4
NOVAL
(AVE- (M96) PROXCAUSE- (M95 M91) :VAR (T))
NIL

V
NOVAL
(:VAL (V4))
NIL

M89
NOVAL
(AVE (V3 V2 V1) ANT (M86) CQ (M88))
NIL

M88
NOVAL
(CQ- (M89) LABTEST (V1) LABRES (ABNORMAL) TYPEDIS (M87) :SVAR (V1 V2 V3))
NIL

M87
NOVAL
(TYPEDIS- (M88) DISTYPE (V2) DISEASE (V3) :SVAR (V2 V3))
NIL

M86
NOVAL
(ANT- (M89) MAX (3) MIN (1) ARG (M85 M83 M81) :SVAR (V1 V2 V3))
NIL

M85
NOVAL
(ARG- (M86) LABTEST (V1) LABRES (REDUCED) TYPEDIS (M84) :SVAR (V1 V2 V3))
NIL

M84
NOVAL
(TYPEDIS- (M85) DISTYPE (V2) DISEASE (V3) :SVAR (V2 V3))
NIL

M83
NOVAL
(ARG- (M86) LABTEST (V1) LABRES (PROLONGED) TYPEDIS (M82)
:SVAR (V1 V2 V3))
NIL

M82
NOVAL
(TYPEDIS- (M83) DISTYPE (V2) DISEASE (V3) :SVAR (V2 V3))
NIL

M81
NOVAL
(ARG- (M86) LABTEST (V1) LABRES (VARIABLE) TYPEDIS (M80)
:SVAR (V1 V2 V3))
NIL

M80
NOVAL
(TYPEDIS- (M81) DISTYPE (V2) DISEASE (V3) :SVAR (V2 V3))
NIL

V3
NOVAL
(AVE- (M89) DISEASE- (M87 M84 M82 M80) :VAR (T))
NIL

Z
NOVAL
(:VAL (V16))
NIL

V2
NOVAL
(AVE- (M89) DISTYPE- (M87 M84 M82 M80) :VAR (T))
NIL

Y
NOVAL
(:VAL (V15))
NIL

V1
NOVAL
(AVE- (M89) LABTEST- (M88 M85 M83 M81) :VAR (T))
NIL

X
NOVAL
(:VAL (V14))
NIL

GANGRENE/ OF/ THE/ FINGERS
NOVAL
(SYMPTOM- (M79) =DICT (((CTGY, SYMPTOM))))
NIL

M79
NOVAL
(PROXCAUSE (NERVE/ COMPRESSION/ IN/ THE/ ARM) MODAL (MAY) SYMPTOM
(GANGRENE/ OF/ THE/ FINGERS) TYPEDIS (M1))
NIL

LOSS/ OF/ USE/ OF/ THE/ HAND
NOVAL
(SYMPTOM- (M78) =DICT (((CTGY, SYMPTOM))))
NIL

M78
NOVAL
(PROXCAUSE (NERVE/ COMPRESSION/ IN/ THE/ ARM) MODAL (MAY) SYMPTOM
(LOSS/ OF/ USE/ THE/ HAND) TYPEDIS (M1))
NIL

HEMORRHAGE/ INTO/ FOREARM/ MUSCLE
NOVAL
(PROXCAUSE- (M77) =DICT (((CTGY, PROXCAUSE) (NUM, SING))))
NIL

NERVE/ COMPRESSION/ IN/ THE/ ARM
NOVAL
(PROXCAUSE- (M79 M78) SYMPTOM- (M77) =DICT (((CTGY, PROXCAUSE) (NUM, SING))
(CTGY, SYMPTOM) (NUM, SING))))
NIL

M77
NOVAL
(PROXCAUSE (HEMORRHAGE/ INTO/ FOREARM/ MUSCLE) MODAL (MAY) SYMPTOM
(NERVE// COMPRESSION/ IN/ THE/ ARM) TYPEDIS (M1))
NIL

BRUISING
NOVAL

(SYMPTOM- (M76) =DICT (((CTGY, SYMPTOM))))
NIL

M76
NOVAL
(SYMPTOM (BRUISING) FREQUENCY (COMMON) TYPEDIS (M65))
NIL

HEMORRHAGIA
NOVAL
(SYMPTOM- (M75) =DICT (((CTGY, SYMPTOM))))
NIL

M75
NOVAL
(SYMPTOM (MENORRHAGIA) FREQUENCY (COMMON) TYPEDIS (M65))
NIL

M74
NOVAL
(SYMPTOM (HEMARTHROSIS) FREQUENCY (RARE) TYPEDIS (M65))
NIL

M73
NOVAL
(SYMPTOM (EPISTAXIS) FREQUENCY (COMMON) TYPEDIS (M65))
NIL

M72
NOVAL
(LABTEST (BLEEDING/ TIME) LABRES (NORMAL) TYPEDIS (M65))
NIL

M71
NOVAL
(LABTEST (FIBRINOLYSIS) LABRES (NORMAL) TYPEDIS (M65))
NIL

M70
NOVAL
(LABTEST (COAGULATION/ FACTOR-RELATED/ ANTIGEN) LABRES (REDUCED)
TYPEDIS (M65))
NIL

M69
NOVAL
(LABTEST (PTT) MODAL (MAY) LABRES (PROLONGED) TYPEDIS (M65))
NIL

M68
NOVAL
(LABTEST (PTT) MODAL (MAY) LABRES (NORMAL) TYPEDIS (M65))
NIL

M67
NOVAL

(LABTEST (PROTHROMBIN/ CONSUMPTION/ TEST) LABRES (NORMAL) TYPEDIS (M65))
NIL

M66

NOVAL

(LABTEST (PLATELET/ COUNT) LABRES (NORMAL) TYPEDIS (M65))
NIL

VON/ WILLEBRAND/'S/ DISEASE

NOVAL

(DISEASE- (M65) =DICT (((CTGY,DISEASE))))

NIL

M65

NOVAL

(TYPEDIS- (M76 M75 M74 M73 M72 M71 M70 M69 M68 M67 M66) DISTYPE (PLAIN)
DISEASE (VON/ WILLEBRAND/'S/ DISEASE))

NIL

HEMARTHROSES

NOVAL

(SYMPTOM- (M64) =DICT (((CTGY,IDIOMEND)) ((CTGY,SYMPTOM) (NUM,PLUR))))

NIL

M64

NOVAL

(SYMPTOM (HEMARTHROSES) FREQUENCY (FREQUENT) TEMPREL (IN/ PRESENCE/ OF)
PROXCOND (ANTIBODIES/ AGAINST/ FACTOR/ VIII) TYPDIS (M1))

NIL

M63

NOVAL

(SYMPTOM (HEMARTHROSIS) FREQUENCY (COMMON) TYPEDIS (M1))

NIL

M62

NOVAL

(LABTEST (PTT) LABRES (PROLONGED) TYPEDIS (M1))

NIL

FIBRINOLYSIS

NOVAL

(LABTEST- (M71 M61) =DICT (((CTGY,LABTEST))))

NIL

M61

NOVAL

(LABTEST (FIBRINOLYSIS) LABRES (NORMAL) TYPEDIS (M1))

NIL

REDUCED

NOVAL

(LABRES- (M85 M70 M60) =DICT (((CTGY,LABRES))))

NIL

M60

NOVAL
(LABTEST (COAGULATION/ FACTOR-RELATED/ ANTIGEN) MODAL (MAY) LABRES
(REDUCEDD) TYPEDIS (M1))
NIL

COAGULATION/ FACTOR-RELATED/ ANTIGEN
NOVAL
(LABTEST- (M70 M60 M59) =DICT (((CTGY,LABTEST))))
NIL

M59
NOVAL
(LABTEST (COAGULATION/ FACTOR-RELATED/ ANTIGEN) MODAL (MAY) LABRES
(NORMAL) TYPEDIS (M1))
NIL

M58
NOVAL
(LABTEST (PROTHROMBIN/ CONSUMPTION/ TEST) LABRES (NORMAL) TYPEDIS (M1))
NIL

PLATELET/ COUNT
NOVAL
(LABTEST- (M66 M57) =DICT (((CTGY,LABTEST))))
NIL

M57
NOVAL
(LABTEST (PLATELET/ COUNT) LABRES (NORMAL) TYPEDIS (M1))
NIL

TRAUMA
NOVAL
(PROXCAUSE- (M56) =DICT (((CTGY,IDIOMEND)) ((CTGY,PROXCAUSE))))
NIL

M56
NOVAL
(PROXCAUSE (TRAUMA) MODAL (MAY) SYMPTOM (HEMATURIA) TYPEDIS (M1))
NIL

DECREASE/ OF/ THE/ INCIDENCE/ OF/ JOINT/ LESIONS
NOVAL
(SYMPTOM- (M55) =DICT (((CTGY,SYMPTOM))))
NIL

M55
NOVAL
(TREATMENT (PREVENTION/ OF/ INTRA-ARTICULAR/ HEMORRHAGES) MODAL
(MAY) SYMPTOMS (DECREASE/ OF/ THE/ INCIDENCE/ OF/ JOINT/ LESIONS) TYPEDIS (M1))
NIL

PREVENTION/ OF/ INTRA-ARTICULAR/ HEMORRHAGES
NOVAL
(TREATMENT- (M55 M54) =DICT (((CTGY,TREATMENT) (NUM,SING))))
NIL

DECREASE/ OF/ THE/ SEVERITY/ OF/ JOINT/ LESIONS

NOVAL

(SYMPTOM- (M54) =DICT (((CTGY,SYMPTOM))))

NIL

M54

NOVAL

(TREATMENT (PREVENTION/ OF/ INTRA-ARTICULAR/ HEMORRHAGES) MODAL (MAY)
SYMPTOM (DECREASE/ OF/ THE/ SEVERITY/ OF/ JOINT/ LESIONS) TYPEDIS (M1))

NIL

CRYOPRECIPITATE/ INFUSION

NOVAL

(TREATMENT- (M53) =DICT (((CTGY,TREATMENT) (NUM,SING))))

NIL

M53

NOVAL

(TREATMENT (CRYOPRECIPITATE/ INFUSION) RECOMMEND (NEEDED/ FOR/ TWO/ DAYS)
TEMPREL (AFTER) PROXCOND (START/ OF/ INTENSIVE/ PHYSIOTHERAPY) TYPEDIS (M1))

NIL

PLASMA/ INFUSION

NOVAL

(TREATMENT- (M51) =DICT (((CTGY,TREATMENT) (NUM,SING))))

NIL

NEEDED/ FOR/ TWO/ DAYS

NOVAL

(RECOMMEND- (M53 M51) =DICT (((CTGY,RECOMMEND))))

NIL

AFTER

NOVAL

(TEMPREL- (M53 M51) =DICT (((CTGY,TEMPREL))))

NIL

START/ OF/ INTENSIVE/ PHYSIOTHERAPY

NOVAL

(PROXCOND- (M53 M51) =DICT (((CTGY,PROXCOND) (NUM,SING))))

NIL

M51

NOVAL

(TREATMENT (PLASMA/ INFUSION) RECOMMEND (NEEDED/ FOR/ TWO/ DAYS) TEMPREL
(AFTER) PROXCOND (START/ OF/ INTENSIVE/ PHYSIOTHERAPY) TYPEDIS (M1))

NIL

CONSERVATIVE/ THERAPY/ OF/ HEMARTHROSIS

NOVAL

(TREATMENT- (M49) =DICT (((CTGY,TREATMENT) (NUM,SING))))

NIL

NECESSARY

NOVAL

(RECOMMEND- (M49) =DICT (((CTGY,RECOMMEND))))

NIL

M49

NOVAL

(TREATMENT (CONSERVATIVE/ THERAPY/ OF/ HEMARTHROSIS) RECOMMEND
(NECESSARY) TYPEDIS (M1) TEMPREL (IN/ PRESENCE/ OF) PROXCOND (ANTIBODIES/
AGAINST/ FACTOR/ VIII))

NIL

POSSIBLE

NOVAL

(RECOMMEND- (M46) =DICT (((CTGY,RECOMMEND))))

NIL

WITHOUT

NOVAL

(TEMPREL- (M46) =DICT (((CTGY,TEMPREL))))

NIL

M46

NOVAL

(TREATMENT (TETANUS/ IMMUNIZATION) RECOMMEND (POSSIBLE) TEMPREL (WITHOUT)
PROXCOND (TRANSFUSION) TYPEDIS (M3))

NIL

TETANUS/ IMMUNIZATION

NOVAL

(TREATMENT- (M46 M45) =DICT (((CTGY,TREATMENT) (NUM,SING))))

NIL

IMPORTANT

NOVAL

(RECOMMEND- (M45) =DICT (((CTGY,RECOMMEND))))

NIL

M45

NOVAL

(TREATMENT (TETANUS/ IMMUNIZATION) RECOMMEND (IMPORTANT) TYPEDIS (M1))

NIL

VENIPUNCTURE

NOVAL

(TREATMENT- (M44) =DICT (((CTGY,TREATMENT) (NUM,SING))))

NIL

M44

NOVAL

(TREATMENT (VENIPUNCTURE) RECOMMEND (SAFE) TYPEDIS (M1))

NIL

INTRAVENOUS/ INJECTION

NOVAL

(TREATMENT- (M43) =DICT (((CTGY,TREATMENT) (NUM,SING))))

NIL

SAFE

NOVAL
(RECOMMEND- (M44 M43) =DICT (((CTGY,RECOMMEND))))
NIL

M43
NOVAL
(TREATMENT (INTRAVENOUS/ INJECTION) RECOMMEND (SAFE) TYPEDIS (M1))
NIL

ANTICOAGULANTS
NOVAL
(TREATMENT- (M42) =DICT (((CTGY,TREATMENT) (NUM,PLUR))))
NIL

RULED/ OUT
NOVAL
(RECOMMEND- (M42) =DICT (((CTGY,RECOMMEND))))
NIL

M42
NOVAL
(TREATMENT (ANTICOAGULANTS) RECOMMEND (RULED/ OUT) TYPEDIS (M1))
NIL

LARGE/ DISSECTING/ INTRAMUSCULAR/ HEMATOMAS
NOVAL
(SYMPTOM- (M41) =DICT (((CTGY,SYMPTOM) (NUM,PLUR))))
NIL

M41
NOVAL
(SYMPTOM (LARGE/ DISSECTING/ INTRAMUSCULAR/ HEMATOMAS) FREQUENCY (COMMON)
TYPEDIS (M1))
NIL

HEMATURIA
NOVAL
(SYMPTOM- (M56 M40) =DICT (((CTGY,SYMPTOM) (NUM,SING))))
NIL

M40
NOVAL
(SYMPTOM (HEMATURIA) FREQUENCY (COMMON) TYPEDIS (M1))
NIL

EPISTAXIS
NOVAL
(SYMPTOM- (M73 M39) =DICT (((CTGY,SYMPTOM) (NUM,SING))))
NIL

COMMON
NOVAL
(FREQUENCY- (M102 M100 M76 M75 M73 M63 M41 M40 M39) =DICT (((CTGY,FREQUENCY
(ADJ,COMMON) (ADV,FREQUENTLY))))
NIL

M39
NOVAL
(SYMPTOM (EPISTAXIS) FREQUENCY (COMMON) TYPEDIS (M1))
NIL

TRIVIAL/ INJURIES
NOVAL
(PROXCAUSE- (M38) =DICT (((CTGY, PROXCAUSE) (NUM, PLUR))))
NIL

LIFE-THREATENING/ HEMORRHAGE
NOVAL
(SYMPTOM- (M38) =DICT (((CTGY, SYMPTOM) (NUM, SING))))
NIL

M38
NOVAL
(PROXCAUSE (TRIVIAL/ INJURIES) MODAL (MAY) SYMPTOM (LIFE-THREATENING/
HEMORRHAGE) TYPEDIS (M1))
NIL

HEMARTHROSIS
NOVAL
(SYMPTOM- (M74 M63 M37) =DICT (((CTGY, IDIOMEND)) ((CTGY, PROXCOND) (NUM, SING))
((CYGY, SYMPTOM) (NUM, SING))))
NIL

IN/ PRESENCE/ OF
NOVAL
(TEMPREL- (M64 M49 M37) =DICT (((CTGY, TEMPREL))))
NIL

M37
NOVAL
(SYMPTOM (HEMARTHROSIS) FREQUENCY (FREQUENT) TEMPREL (IN/ PRESENCE/ OF)
PROXCOND (ANTIBODIES/ AGAINST/ FACTOR/ VIII))
NIL

FREQ
NOVAL
(:VAL (Q1759))
NIL

EMOTIONAL/ STRESS
NOVAL
(PROXCAUSE- (M35) =DICT (((CTGY, PROXCAUSE) (NUM, SING))))
NIL

M35
NOVAL
(SYMPTOM (SPONTANEOUS/ BLEEDING) MODAL (MAY) PROXCAUSE (EMOTIONAL/ STRESS)
TYPEDIS (M1))
NIL

ATTITUDE/ OF/ INCREASED/ RISK-TAKING
NOVAL

(SYMPTOM- (M34) =DICT (((CTGY,SYMPTOM) (NUM,SING) (PLUR,ATTITUDES/ OF/
INCREASED/ RISK-TAKING))))
NIL

M34
NOVAL
(SYMPTOM (ATTITUDE/ OF/ INCREASED/ RISK-TAKING) MODAL (MAY) TYPEDIS (M1))
NIL

ANTIBODIES/ AGAINST/ FACTOR/ VIII
NOVAL
(PROXCOND- (M64 M49 M37) SYMPTOM- (M33) =DICT (((CTGY,SYMPTOM) (NUM,PLUR))
((CTGY,PROXCOND))))
NIL

UPON
NOVAL
(TEMPREL- (M33) =DICT (((CTGY,TEMPREL))))
NIL

TRANSFUSION
NOVAL
(PROXCOND- (M46 M33) =DICT (((CTGY,IDIOMBEG)) ((CTGY,IDIOMEND))
((CTGY,PROXCOND) (NUM,SING))))
NIL

M33
NOVAL
(SYMPTOM (ANTIBODIES/ AGAINST/ FACTOR/ VIII) MODAL (MAY) TEMPREL (UPON)
PROXCOND (TRANSFUSION) TYPEDIS (M1))
NIL

TRANSFUSION/ THERAPY
NOVAL
(PROXCAUSE- (M32) =DICT (((CTGY,PROXCAUSE) (NUM,SING))))
NIL

HEPATITIS
NOVAL
(SYMPTOM- (M32) =DICT (((CTGY,SYMPTOM) (NUM,SING))))
NIL

M32
NOVAL
(PROXCAUSE (TRANSFUSION/ THERAPY) MODAL (MAY) SYMPTOM (HEPATITIS) TYPEDIS (M1))
NIL

WSYMP
NOVAL
(:VAL (Q1746))
NIL

LEUKOCYTOSIS
NOVAL
(SYMPTOM- (M31) =DICT (((CTGY,SYMPTOM) (NUM,SING))))
NIL

M31
NOVAL
(PROXCAUSE (HEMATOMAS) MODAL (MAY) SYMPTOM (LEUKOCYTOSIS) TYPEDIS (M1))
NIL

FIRST/ SYMPTOMS
NOVAL
(SYMPTOM- (M30) =DICT (((CTGY,SYMPTOM) (NUM,PLUR))))
NIL

RARELY
NOVAL
(FREQUENCY- (M30) =DICT (((CTGY,FREQUENCY) (ADJ,RARE) (ADV,RARELY))))
NIL

ADOLESCENTS
NOVAL
(AGE- (M30) =DICT (((CTGY,AGE) (NUM,PLUR))))
NIL

M30
NOVAL
(SYMPTOM (FIRST/ SYMPTOMS) FREQUENCY (RARELY) TEMPREL (IN) AGE (ADOLESCENTS))
NIL

HEMATOMAS
NOVAL
(PROXCAUSE- (M31 M28) =DICT (((CTGY,IDIOMNID)) ((CTGY,IDIOMEND))
((CTGY,PROXCAUSE) (NUM,PLUR))))
NIL

FEVER
NOVAL
(SYMPTOM- (M28) =DICT (((CTGY,SYMPTOM) (NUM,SING))))
NIL

M28
NOVAL
(PROXCAUSE (HEMATOMAS) MODAL (MAY) SYMPTOM (FEVER) TYPEDIS (M1))
NIL

WOUND/ HEALING
NOVAL
(SYMPTOM- (M27) =DICT (((CTGY,SYMPTOM) (NUM,SING))))
NIL

OFTEN
NOVAL
(MODAL- (M27) =DICT (((CTGY,MODAL))))
NIL

SLOW
NOVAL
(FREQUENCY- (M27) =DICT (((CTGY,FREQUENCY))))
NIL

M27
NOVAL
(SYMPTOM (WOUND/ HEALING) MODAL (OFTEN) FREQUENCY (SLOW) TYPEDIS (M1))
NIL

SPONTANEOUS/ BLEEDING
NOVAL
(SYMPTOM- (M35 M26) =DICT (((CTGY,SYMPTOM) (NUM,SING))))
NIL

CYCLIC
NOVAL
(FREQUENCY- (M26) =DICT (((CTGY,FREQUENCY) (ADJ,CYCLIC) (ADV,CYCLICAL))))
NIL

M26
NOVAL
(SYMPTOM (SPONTANEOUS/ BLEEDING) MODAL (MAY) FREQUENCY (CYCLIC) TYPEDIS (M1))
NIL

BLEEDING/ FROM/ FRENUM/ OF/ UPPER/ LIPS
NOVAL
(SYMPTOM- (M25) =DICT (((CTGY,SYMPTOM) (NUM,SING))))
NIL

M25
NOVAL
(SYMPTOM (BLEEDING/ FROM/ FRENUM/ OF/ UPPER/ LIPS) FREQUENCY (FREQUENT)
TEMPREL (IN) AGE (CHILDREN) TYPEDIS (M1))
NIL

TYPE
NOVAL
(:VAL (Q1747))
NIL

WHAT
NOVAL
(:VAL (Q1734) =DICT (((CTGY,WH-Q))))
NIL

BLEEDING/ FROM/ MOUTH
NOVAL
(SYMPTOM- (M24) =DICT (((CTGY,SYMPTOM) (NUM,SING))))
NIL

CHILDREN
NOVAL
(AGE- (M25 M24) =DICT (((CTGY,AGE) (NUM,PLUR))))
NIL

FREQUENT
NOVAL
(FREQUENCY- (M64 M37 M25 M24) =DICT (((CTGY,FREQUENCY) (ADJ,FREQUENT)
(ADV,FREQUENTLY))))
NIL

M24
NOVAL
(SYMPTOM (BLEEDING/ FROM/ MOUTH) TEMPREL (IN) AGE (CHILDREN) FREQUENCY
(FREQUENT) TYPEDIS (M1))
NIL

SUBCUTANEOUS/ HEMATOMAS
NOVAL
(SYMPTOM- (M23) =DICT (((CTGY, SYMPTOM) (NUM, SING))))
NIL

M23
NOVAL
(SYMPTOM (SUBCUTANEOUS/ HEMATOMAS) TEMPREL (IN) AGE (INFANTS) PROXCAUSE
(TRIVIAL/ TRAUMA) TYPEDIS (M9))
NIL

BLEEDING/ TENDENCY
NOVAL
(PROXCOND- (M22) =DICT (((CTGY, PROXCOND) (NUM, SING))))
NIL

IN
NOVAL
(TEMPREL- (M30 M25 M24 M23 M22) =DICT (((CTGY, TEMPREL)) ((CTGY, IDIOMBEG))
((CTGY, IDIOMMID))))
NIL

INFANTS
NOVAL
(AGE- (M23 M22) =DICT (((CTGY, AGE) (NUM, PLUR))))
NIL

CUTANEOUS/ ECCHIMOSSES
NOVAL
(SYMPTOM- (M22) =DICT (((CTGY, SYMPTOM) (NUM, PLUR))))
NIL

TRIVIAL/ TRAUMA
NOVAL
(PROXCAUSE- (M23 M22) =DICT (((CTGY, PROXCAUSE) (NUM, SING))))
NIL

M22
NOVAL
(PROXCOND (BLEEDING/ TENDENCY) TEMPREL (IN) AGE (INFANTS) SYMPTOM (CUTANEOUS/
ECCHIMOSSES) PROXCAUSE (TRIVIAL/ TRAUMA) TYPEDIS (M9))
NIL

M21
NOVAL
(LABTEST (PTT) LABRES (NORMAL) TYPEDIS (M20))
NIL

SUB
NOVAL

(DISTYPE- (M20) =DICT (((CTGY,DISTYPE))))

NIL

M20

NOVAL

(TYPEDIS- (M21) DISTYPE (SUB) DISEASE (HEMOPHILIA))

NIL

M19

NOVAL

(LABTEST (PTT) LABRES (VARIABLE) TYPEDIS (M3))

NIL

M18

NOVAL

(LABTEST (PTT) LABRES (PROLONGED) TYPEDIS (M12))

NIL

PTT

NOVAL

(LABTEST- (M69 M68 M62 M21 M19 M18 M17) =DICT (((CTGY,LABTEST) (NUM,SING)
(ROOT,PTT))))

NIL

M17

NOVAL

(LABTEST (PTT) LABRES (PROLONGED) TYPEDIS (M9))

NIL

VARIABLE

NOVAL

(LABRES- (M81 M19 M16) =DICT (((CTGY,LABRES))))

NIL

M16

NOVAL

(LABTEST (PROTHROMBIN/ CONSUMPTION/ TEST) LABRES (VARIABLE) TYPEDIS (M12))

NIL

ABNORMAL

NOVAL

(LABRES- (M88 M15) =DICT (((CTGY,LABRES))))

NIL

M15

NOVAL

(LABTEST (PROTHROMBIN/ CONSUMPTION/ TEST) LABRES (ABNORMAL) TYPEDIS (M9))

NIL

M14

NOVAL

(LABTEST (COAGULATION/ TIME) LABRES (NORMAL) TYPEDIS (M3))

NIL

M13

NOVAL

(LABTEST (COAGULATION/ TIME) LABRES (NORMAL) TYPEDIS (M12))
NIL

MODERATE
NOVAL
(DISTYPE- (M12) =DICT (((CTGY,DISTYPE))))
NIL

M12
NOVAL
(TYPEDIS- (M18 M16 M13) DISTYPE (MODERATE) DISEASE (HEMOPHILIA))
NIL

COAGULATION/ TIME
NOVAL
(LABTEST- (M14 M13 M11) =DICT (((CTGY,LABTEST) (NUM,SING))))
NIL

PROLONGED
NOVAL
(LABRES- (M83 M69 M62 M18 M17 M11) =DICT (((CTGY,LABRES))))
NIL

M11
NOVAL
(LABTEST (COAGULATION/ TIME) LABRES (PROLONGED) TYPEDIS (M9))
NIL

FATAL/ HEMORRHAGE
NOVAL
(SYMPTOM- (M10) =DICT (((CTGY,SYMPTOM) (NUM,SING))))
NIL

NEONATAL/ CIRCUNCISION
NOVAL
(PROXCAUSE- (M10) =DICT (((CTGY,PROXCAUSE) (NUM,SING))))
NIL

M10
NOVAL
(SYMPTOM (FATAL/ HEMORRHAGE) MODAL (MAY) PROXCAUSE (NEONATAL/ CIRCUNCISION)
TYPEDIS (M9))
NIL

SEVERE
NOVAL
(DISTYPE- (M9) =DICT (((CTGY,DISTYPE))))
NIL

M9
NOVAL
(TYPEDIS- (M23 M22 M17 M15 M11 M10) DISTYPE (SEVERE) DISEASE (HEMOPHILIA))
NIL

BLEEDING/ TIME
NOVAL

(LABTEST- (M72 M8) =DICT (((CTGY,LABTEST) (NUM,SING))))
NIL

M8

NOVAL

(LABTEST (BLEEDING/ TIME) LABRES (NORMAL) TYPEDIS (M1))
NIL

THROMBIN/ TIME

NOVAL

(LABTEST- (M7) =DICT (((CTGY,LABTEST) (NUM,SING))))
NIL

M7

NOVAL

(LABTEST (THROMBIN/ TIME) LABRES (NORMAL) TYPEDIS (M1))
NIL

ONE-STAGE/ PROTHROMBIN/ TIME/ TEST

NOVAL

(LABTEST- (M6) =DICT (((CTGY,LABTEST) (NUM,SING))))
NIL

M6

NOVAL

(LABTEST (ONE-STAGE/ PROTHROMBIN/ TIME/ TEST) LABRES (NORMAL) TYPEDIS (M1))
NIL

CLOTTING/ TIME/ OF/ WHOLE/ BLOOD

NOVAL

(LABTEST- (M5) =DICT (((CTGY,LABTEST) (NUM,SING))))
NIL

MAY

NOVAL

(MODAL- (M79 M78 M77 M69 M68 M60 M59 M56 M55 M54 M38 M35 M34 M33 M32 M31 M26 M10 M5) =DICT (((CTGY,MODAL) (TENSE,FUTURE) (ROOT, MAY)) ((CTGY,V) (TENSE,FUTURE) (ROOT,MAY))))
NIL

M5

NOVAL

(LABTEST (CLOTTING/ TIME/ OF/ WHOLE/ BLOOD) MODAL (MAY) LABRES (NORMAL) TYPEDIS (M3))
NIL

PROTHROMBIN/ CONSUMPTION/ TEST

NOVAL

(LABTEST- (M67 M58 M16 M15 M4) =DICT (((CTGY,LABTEST) (NUM,SING))))
NIL

NORMAL

NOVAL

(LABRES- (M72 M71 M68 M67 M66 M61 M59 M53 M57 M21 M14 M13 M8 M7 M6 M5 M4) =DICT (((CTGY,LABRES)) ((CTGY,ADJ))))
NIL

M4
NOVAL
(LABTEST (PROTHROMBIN/ CONSUMPTION/ TEST) LABRES (NORMAL) TYPEDIS (M3))
NIL

MILD
NOVAL
(DISTYPE- (M3) =DICT (((CTGY,DISTYPE))))
NIL

M3
NOVAL
(TYPEDIS- (M46 M19 M14 M5 M4) DISTYPE (MILD) DISEASE (HEMOPHILIA))
NIL

PETECHIAE
NOVAL
(SYMPTOM- (M2) =DICT (((CTGY,SYMPTOM) (NUM,SING) (PLUR,PETECHIAE))))
NIL

RARE
NOVAL
(FREQUENCY- (M109 M107 M74 M2) =DICT (((CTGY,FREQUENCY) (ADJ,RARE)
(ADV,RARELY))))
NIL

M2
NOVAL
(SYMPTOM (PETECHIAE) FREQUENCY (RARE) TYPEDIS (M1))
NIL

PLAIN
NOVAL
(DISTYPE- (M65 M1))
NIL

HEMOPHILIA
NOVAL
(DISEASE- (M20 M12 M9 M3 M1) =DICT (((CTGY,DISEASE) (NUM,SING) (FTR,INANIM))
((CTGY,N) (NUM,SING) (FTR,INANIM))))
NIL

M1
NOVAL
(TYPEDIS- (M79 M78 M77 M64 M63 M62 M61 M60 M59 M58 M57 M56 M55 M54 M53 M51
M49 M45 M44 M43 M42 M41 M40 M39 M38 M35 M34 M33 M32 M31
M28 M27 M26 M25 M24 M8 M7 M6 M2) DISTYPE (PLAIN) DISEASE (HEMOPHILIA))
NIL

SYMPTOM
NOVAL
(:CONV SYMPTOM- =DICT (((CTGY,SYMPTOM) (NUM,SING))))
NIL

LABTEST
NOVAL

(:CONV LABTEST-)
NIL

LABRES
NOVAL
(:CONV LABRES-)
NIL

DISEASE
NOVAL
(:CONV DISEASE- =DICT (((CTGY, IDIOMEND))))
NIL

TYPEDIS
NOVAL
(:CONV TYPEDIS-)
NIL

DISTYPE
NOVAL
(:CONV DISTYPE-)
NIL

MODAL
NOVAL
(:CONV MODAL-)
NIL

PROXCAUSE
NOVAL
(:CONV PROXCAUSE-)
NIL

FREQUENCY
NOVAL
(:CONV FREQUENCY- =DICT (((CTGY, FREQUENCY))))
NIL

TEMPREL
NOVAL
(:CONV TEMPREL-)
NIL

AGE
NOVAL
(:CONV AGE-)
NIL

RECOMMEND
NOVAL
(:CONV RECOMMEND-)
NIL

TREATMENT
NOVAL
(:CONV TREATMENT- =DICT (((CTGY, TREATMENT) (NUM, SING))))

NIL

PROXCOND
NOVAL
(:CONV PROXCOND-)
NIL

PEVB
NOVAL
(:CONV PEVB-)
NIL

ANT
NOVAL
(:CONV ANT-)
NIL

CQ
NOVAL
(:CONV CQ-)
NIL

&ANT
NOVAL
(:CONV &ANT-)
NIL

ARG
NOVAL
(:CONV ARG-)
NIL

AVE
NOVAL
(:CONV AVE-)
NIL

EVB
NOVAL
(:CONV EVB-)
NIL

SYMPTOM-
NOVAL
(:CONV SYMPTOM)
NIL

LABTEST-
NOVAL
(:CONV LABTEST)
NIL

LABRES-
NOVAL
(:CONV LABRES)
NIL

DISEASE-
NOVAL
(:CONV DISEASE)
NIL

TYPEDIS-
NOVAL
(:CONV TYPEDIS)
NIL

DISTYPE-
NOVAL
(:CONV DISTYPE)
NIL

MODAL-
NOVAL
(:CONV MODAL)
NIL

PROXCAUSE-
NOVAL
(:CONV PROXCAUSE)
NIL

FREQUENCY-
NOVAL
(:CONV FREQUENCY)
NIL

TEMPREL-
NOVAL
(:CONV TEMPREL)
NIL

AGE-
NOVAL
(:CONV AGE)
NIL

RECOMMEND-
NOVAL
(:CONV RECOMMEND)
NIL

TREATMENT-
NOVAL
(:CONV TREATMENT)
NIL

PROXCOND-
NOVAL
(:CONV PROXCOND)
NIL

PEVE-

NOVAL
(:CONV PEVB)
NIL

ANT-
NOVAL
(:CONV ANT)
NIL

CQ-
NOVAL
(:CONV CQ)
NIL

&ANT-
NOVAL
(:CONV &ANT)
NIL

ARG-
NOVAL
(:CONV ARG)
NIL

AVB-
NOVAL
(:CONV AVB)
NIL

EVB-
NOVAL
(:CONV EVB)
NIL