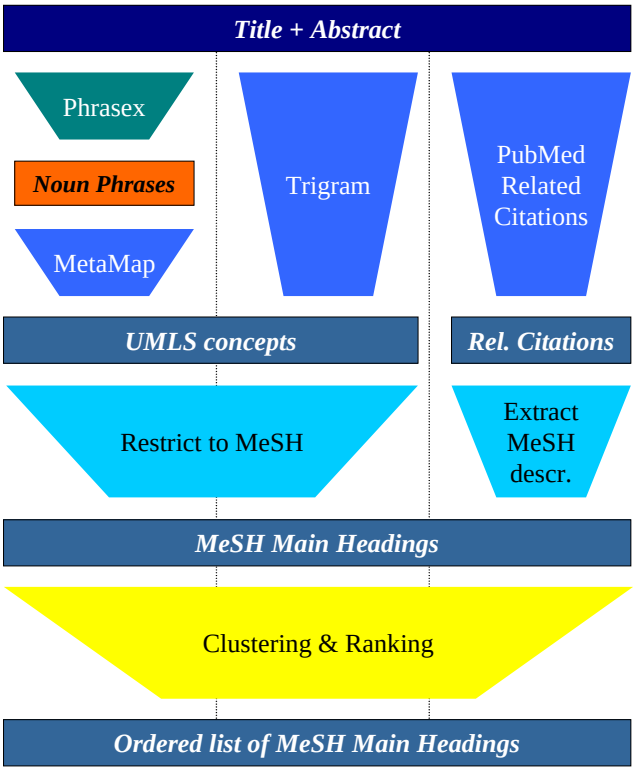
Medical Text Indexer (MTI)



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1. Introduction

This document will provide detailed information on the behind the scenes processing that takes place in the Medical Text Indexer (MTI). As the diagram below shows, there is a lot going on.

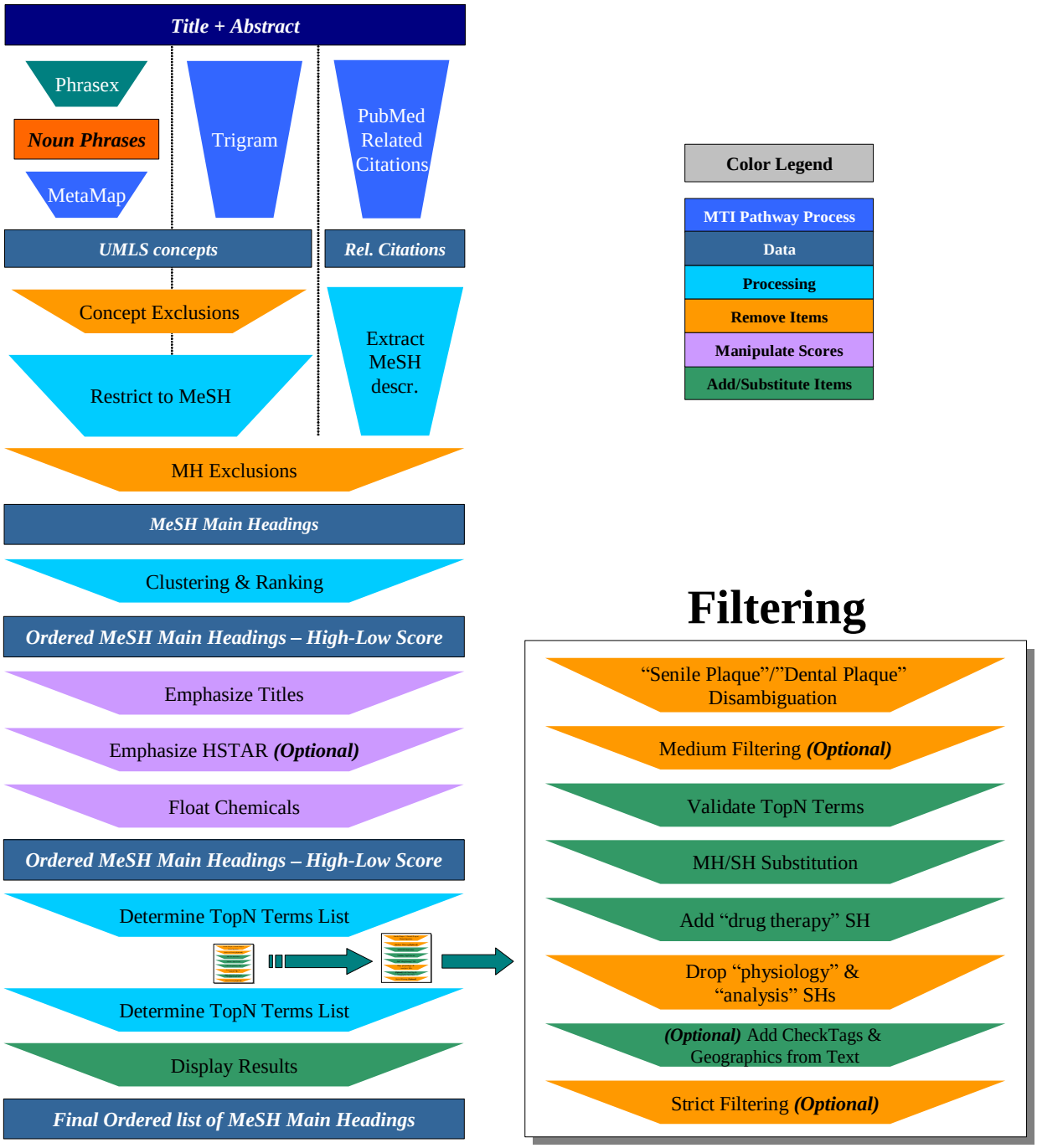

Figure 1: Detailed Medical Text Indexer Process Flow Diagram

2. Exclusions

The following terms are excluded or substituted for even before we get to the Clustering phase of processing in the MTI system.

There is a new option "***noCheckRC***" which allows the user to turn off the checking of **ALL** of these Exclusions from the PubMed Related Citations. This was based on the premise that if a PubMed Related Citation recommended the term, it probably should be there. If the "***noCheckRC***" option is included, only the MetaMap terms are processed through the Exclusions checking.

Regardless of pathway (MetaMap or PubMed) the following MeSH terms are removed:

- TEST
- Comparative Study
- Case Report
- Disease
- [Publication Type]

If the pathway is MetaMap, the following MeSH term is removed:

- Role is excluded

If the pathway is MetaMap ONLY, the following MeSH term replacements are done:

- Men is replaced by CheckTag Male and CheckTag Human
- Women is replaced by CheckTag Female and CheckTag Human
- Patients is replaced by CheckTag Human

If the ***remMHs*** option is set:

- Remove MeSH Headings found in the MH Exclusion list (***Appendix-G***) regardless of path with the following caveat:
    - If the matching MeSH Heading is marked as a "**Special**" term in the MH Exclusion list (see ***Appendix-G***) then we have to verify if it came from the Title in the citation. If the MeSH Heading was triggered by a **perfect matching term** in the citation's Title field, we will **not exclude** the MeSH Heading. This caveat is only applied to MeSH Headings that have come from MetaMap since that is the only path that provides Title/Abstract location information.

3. Clustering and Ranking

The MeSH® headings produced by all of the Indexing Initiative (II) methods are clustered and then formed into a single, final list of recommended indexing terms. This document discusses the steps involved in this clustering and ranking process. A high level view of the steps involved in the processing is as follows:

1. Load and summarize individual path results calculating the term weights (see the section entitled "*Calculating Term Weights*"),
2. Clustering of the results – determining which of the results are related (see the section entitled "*Clustering*"), and finally
3. Ranking the results – using the information obtained in 1 and 2 to compute the rank of each item (see the section entitled "*Ranking*").

Each of these steps will be reviewed in detail over the following sections of this document. But first we provide the reader with some background on where the underlying data used in the processing comes from in the next two sections.

3.1. Overview of Clustering and Ranking (from BoSC99 report)

The task here is to provide a weighting of the confidence or strength of belief in the assignment, and rank the suggested headings appropriately. There are a number of factors that can be recognized as playing a role in that confidence. The method of finding the heading (the path), how much confidence is available in how the method found the heading (the goodness of the match), the location in the text of the nominal phrase that led to that suggestion (the location), and the semantic consistency of the suggested heading with the other suggested headings (the corroborating evidence).

Assigning a weight to the overall method of finding the heading (the *PathWeight*) allows one to discount a method appropriate to strengths. For example, a certain path might not be very specific, but have some sensitivity in suggesting headings that would otherwise not occur. When headings found by other paths offer corroborative evidence for a heading suggested by this method, the additional confidence gained might be helpful.

The goodness of the match, i.e., how much confidence to place in a given heading, depends on the method used to find the heading. The possibilities are:

- A phrase identified in text is an exact match to a MeSH term. Equivalently, it might have been a match to a UMLS® term that was a synonym of a MeSH term.
- Of lesser significance is an exact match to a UMLS term that is then be mapped to a MeSH heading using the Restrict to MeSH method.
- Another possibility is that the phrase is an inexact, or approximate, match to a UMLS term, which is either a synonym of a MeSH heading or mapped to MeSH.

Thus, each time a MeSH heading is suggested, a weighting can be given to that suggestion. This is accomplished using both a *MapScore* and a *NavScore*. The MapScore reflects the confidence in the mapping to a UMLS term, the NavScore the confidence in navigating from a UMLS term to a MeSH Heading.

With regard to the importance of location, the main consideration was whether or not the phrase leading to a heading suggestion was mentioned in the title. All other things being equal, indexers know that things mentioned in the title of the article are probably more important than other concepts mentioned in the article. Similarly, if the heading was suggested by a phrase occurring in the title, it should be given more weight. The additional weight is added as a constant in the formula.
Semantic consistency can be thought of as corroborative evidence for the goodness of a suggestion. It is identified by relationships that a suggested heading has with other suggested headings. These relationships might be either the occurrence in the same hierarchy (as parents or siblings), or as known co-occurring headings in MEDLINE. This latter evidence needs to be weighted according to a normalized frequency of this co-occurrence. The normalized frequency times a constant becomes the COT weight. The former evidence is the REL weight, and is a simple constant.

The overall RankScore can be altered by changing any of the constants (COT, REL, and PathWeight) or by changing the method by which the weight is calculated (NavScore and MapScore). Altering these values allows a number of experiments to be performed to evaluate the robustness of the weighting scheme, and to establish reasonable values for the constants.

3.2. UMLS® Metathesaurus® Files

There are two main UMLS Metathesaurus files used by the clustering and ranking functions, the MRREL and MRCOC files. The following definitions come directly from the UMLS Metathesaurus documentation. The MRCOC file is used to create the normalized frequency database table that the Indexing Initiative uses.

3.2.1. Related Concepts (File = MRREL)

There is one row in this table for each relationship between Metathesaurus concepts known to the Metathesaurus, with the following exceptions found in other files: co-occurrences found in MRCOC; Locator information in MRLO; and Associated Expressions found in MRATX.

Note that for asymmetrical relationships there is one row for each direction of the relationship. Note also the direction of REL - the relationship that the SECOND concept (with Concept Unique Identifier CUI2) HAS TO the FIRST concept (with Concept Unique Identifier CUI1).

RELs may be derived from a source vocabulary's explicit hierarchy (see also MRCXT), derived from other relationships in a source vocabulary, created from information about

allowed qualifiers in a source vocabulary, found in Metathesaurus QA of lexical and semantic matches, or added by Metathesaurus editors.

Where relationships are asymmetrical, there are separate RELS for each direction of the relationship, e.g., one entry for "Atrial Fibrillation" as a child of "Arrhythmia" and another entry for "Arrhythmia" as a parent of "Atrial Fibrillation".

Valid Values for REL:

RB	has a broader relationship
RN	has a narrower relationship
RO	has relationship other than synonymous, narrower, or broader
RL	the relationship is similar or "alike". Some concepts linked by the RL relationship may be determined to be synonyms in future editions of the Metathesaurus. In the current edition of the Metathesaurus, most RL relationships link MeSH supplementary concepts, which have not yet been edited in the new MeSH concept-oriented system. In future editions of the Metathesaurus, this Relation will also be used for "quasisynonyms", such as "Hypertension" and "High Blood Pressure", which are sometimes used synonymously, but have distinct meanings in some circumstances. When RL is used for quasisynonyms, the RELA (Relationship Attribute) will further identify the "quasisynonymous" Relationship.
PAR	has parent relationship in a Metathesaurus source vocabulary
CHD	has child relationship in a Metathesaurus source vocabulary
SIB	has sibling relationship in a Metathesaurus source vocabulary.
AQ	is an allowed qualifier for the first concept in a Metathesaurus source vocabulary.

3.2.2. Co-occurring Concepts (File = MRCOC)

There are two rows in this table for each pair of concepts that co-occur in each information source represented one for each direction of the relationship. (Note that the COA data may be different for each direction of the relationship). Many Metathesaurus concepts have no entries in this file. Due to the very large number of co-occurrence relationships, they are distributed in a separate file.

Co-occurrences are concepts that occur together in the same "entries" in some information source. The relationships represented here are obtained from machine-manipulation of the information source. Co-occurrence relationships may exist between similar concepts (e.g., "Atrial Fibrillation" and "Arrhythmia") or between very different concepts that nevertheless have some important connection in the field of biomedicine (e.g., "Atrial Fibrillation" and "Digoxin"), or between a primary concept and a qualifier e.g., "Lithotripsy" and "instrumentation". A co-occurrence relationship can exist between two concepts that have no other apparent relationship, although the frequency of such co-occurrences will be small.

In the current Metathesaurus, there are three sources of co-occurrence data: MEDLINE, AI/RHEUM, and CCPSS. From MEDLINE, co-occurrence data was computed for concepts that were designated as principal or main points in the same journal article i.e., the co-occurrence counts do not include articles in which either or both of the concepts were present and indexed in MEDLINE but not designated as main points. (A concept is considered to be a main point if the * is attached to the main heading or any of its subheadings.)

3.3. Creating the Normalized Frequency Scores for the Co-Occurring Concepts

This section of the document discusses how we create the co-occurring concepts normalized frequency database used in the Indexing Initiative's Medical Text Indexer (MTI). These steps are done once at the beginning of each year with the final released version of the UMLS Metathesaurus, specifically the MRCOC table.

3.3.1. Overview

The following steps calculate the normalized frequency score for the co-occurring concepts:

1. Summarize all of the records we have by combining identical pairings of CUI1 and CUI2 frequency counts,
2. Determine an overall total of frequency counts for each CUI1 we have, and
3. Finally, divide the frequency counts for each of the records (now summarized) by the total number of frequency counts for the CUI1 that the record is associated with.

3.3.2. Detailed Explanation and Example

1. We pull all records from the MRCOC file except ones containing "|LQ|" in the Type of Co-Occurrence (COT) field. The "LQ" (MeSH topical qualifier) records are only relevant if we want to augment our SubHeading recommendations. We only keep fields 1, 2, and 5 -- CUI1, CUI2, and COF (Frequency of Co-Occurrence) respectively in a bar separated list.

   We end up with a file containing lines similar to the sample below:

```
C0000039|C0000300|2
C0000039|C0001006|1
C0000039|C0001128|1
C0000039|C0001392|1
C0000039|C0001480|1
C0000039|C0001480|1
…
```

2. We than summarize this list by CUI1 by summing the COF for each CUI1 and CUI2 combination and providing a total frequency count for each CUI1 and CUI2 pairing. In the example in #1 above, we would combine the last two rows because the CUI1 and CUI2 pairings are identical. We end up with a file containing lines similar to the sample below:

```
C0000039|C0000300|2
C0000039|C0001006|1
C0000039|C0001128|1
C0000039|C0001392|1
C0000039|C0001480|2
…
```

3. We create a temporary file containing a single line for each unique CUI1 concept. This line contains the total frequency count for that particular CUI1. We end up with a file containing lines similar to the sample below:

```
C0000039|1190
…
```

4. We now combine the two files from #2 and #3. We want to end up with a file containing all of the records of #2 above and the total frequency count from #3 above appended to the end of the line. We end up with a file containing lines similar to the sample below:

```
C0000039|C0000300|2|1190
C0000039|C0001006|1|1190
C0000039|C0001128|1|1190
C0000039|C0001392|1|1190
C0000039|C0001480|2|1190
…
```

5. We now calculate the normalization of the frequency counts for each of the records by dividing the individual record's frequency count (field 3) by the CUI1's total frequency count (field 4). We end up with a file containing lines similar to the sample below:

```
C0000039|C0000300|0.001681
C0000039|C0001006|0.000840
C0000039|C0001128|0.000840
C0000039|C0001392|0.000840
C0000039|C0001480|0.001681
…
```

3.4. Calculating TermWeight

The TermWeight for each MeSH Heading is the summation of all entries for a MH from each of the various paths used (MetaMap after Restrict to MeSH (MMI) and PubMed Related Citations (RC)). The TermWeight for each MH regardless of path is calculated using the following formula where *i* represents the single occurrence of the suggestion of one MeSH heading:

$$TermWeight = TW = \sum_{i=1}^{n} (PathWeight_i * MapScore_i * NavScore_i)$$

Equation 1 - TermWeight Formula

Assigning a weight to the overall method of finding the heading (*PathWeight*) allows one to discount a method appropriate to strengths. The *MapScore* reflects the confidence in the mapping to an UMLS term by a specific method, the *NavScore* is the confidence in navigating from an UMLS term to a MeSH heading.

3.4.1. Tunable and System Parameters

The following table depicts the parameters used in calculating the TermWeight along with their default values:

Abbreviation	Full Name	Tunable by User	Default Value
MMI	MetaMap Indexing Path Weight (*PathWeight*)	X	7
RC	Related Citations Path Weight (*PathWeight*)	X	2
I	Direct Match Navigational String – MMI (*NavScore*)	X	1.00
A	ATX (Associated Expression) Navigational String – MMI (*NavScore*)	X	1.00
G/P	Parent/Broader Navigational String – MMI (*NavScore*)	X	0.90
G/C	Child/Narrower Navigational String – MMI (*NavScore*)	X	0.75
G/S	Sibling Navigational String – MMI (*NavScore*)	X	0.70
O	Other Related Navigational String – MMI (*NavScore*)	X	0.50
IM	MeSH Major Topic Navigational String – RC (*NavScore*)	X	1.00
NIM	MeSH Heading Navigational String – RC (*NavScore*)	X	0.80
Best possible score for items returned by the MMI path (*MapScore*)		-	1,000
Best possible score for items returned by the RC path (*MapScore*)		-	255
Best possible score for items returned by the Trigram path (*MapScore*)		-	1,000

3.4.2. Steps Followed in Calculating the TermWeight

The following steps are done for each MeSH Heading:

1. The weight from the item is provided by each of the individual paths along with the navigational string information. The following example shows items returned for the concept "Blood Flow Velocity" via both the MMI and RC pathways. The individual MapScores are highlighted in **blue** and the individual navigation strings are highlighted in **tan**.

```
❶ MMI: 97479605|C0005798|118|G/P|Blood Flow Velocity|MH||TI|
❷ MMI: 97479605|C0005798|118|O|Blood Flow Velocity|MH||TI|
❸ RC: 97479605|C0005798|28.1847|NIM|Blood Flow Velocity|MH|3|
❹ RC: 97479605|C0005798|26.4019|NIM|Blood Flow Velocity|MH|8|
❺ RC: 97479605|C0005798|26.0665|NIM|Blood Flow Velocity|MH|10|
```

   In the first line we have an item coming from the MMI pathway with a MapScore of 118 out of a possible 1,000 perfect score and having a navigational string of G/P (Parent/Broader).

   In the third line we have an item coming from the RC pathway with a MapScore of 28.1847 out of a possible 255 perfect score and having a navigational string of NIM (MeSH Heading).

2. The items are loaded into the program systematically, so we will always load all of the MMI terms before loading all of the RC terms. To calculate the PathWeight to be used in the calculations for each item, we divide the individual path weight by the path-scoring factor. The path-scoring factor is used to equalize all of the different scoring methods. If the path is MMI or Trigram, we use 1,000 and for RC, we use 255.

```
MMI PathWeight = 7/1000 = 0.0070
RC PathWeight = 2/255 = 0.0078
```

3. We can than calculate the individual item weights via (PathWeight * MapScore * NavScore) where NavScore depends on the navigation string (see table above):

```
❶ MMI: (118 * 0.0070) * 0.90 (G/P) = 0.7434
❷ MMI: (118 * 0.0070) * 0.50 (O) = 0.4130
❸ RC: (28.1847 * 0.0078) * 0.80 (NIM) = 0.1769
❹ RC: (26.4019 * 0.0078) * 0.80 (NIM) = 0.1657
❺ RC: (26.0665 * 0.0078) * 0.80 (NIM) = 0.1635
```

4. Now we sum all of these individual item weights together to get our final TermWeight.

   0.7434❶ + 0.4130❷ + 0.1769❸ + 0.1657❹ + 0.1635❺ = 1.6625

   For our example "Blood Flow Velocity", we have a final TermWeight of 1.6625 and the five (5) different path entries have been summarized into a single term in our list containing the concept name, CUI, score (which is zero at this point), and the TermWeight that we just calculated.

   Blood Flow Velocity|C0005798|0|1.6625

5. The summarized list for all processed and summarized items will look similar to the following:

```
mt_table[0]:  DNA-Binding Proteins|C0012940|0|1.0150
mt_table[1]:  Transcription Factors|C0040648|0|1.0150
mt_table[2]:  SEF1 protein|C0212321|0|1.0150
mt_table[3]:  Blood Circulation Time|C0919393|0|1.1564
mt_table[4]:  Radionuclide Imaging|C0034606|0|1.1564
mt_table[5]:  Blood Flow Velocity|C0005798|0|1.6625
mt_table[6]:  Neurology|C0027855|0|0.4025
. . .
mt_table[84]:  Confusion|C0009676|0|0.1651
mt_table[85]:  Glasgow Coma Scale|C0017594|0|0.3287
mt_table[86]:  Predictive Value of Tests|C0032944|0|0.1651
mt_table[87]:  Regional Blood Flow|C0034965|0|0.1651
mt_table[88]:  Regression Analysis|C0034980|0|0.1651
```

3.5. Clustering

In the clustering phase, we are going to go through every item in our summarized and term weighted list looking for what other items in the list either co-occur with the item or are related via the MeSH tree structure to the item. In an attempt to make the process faster, we are going to compute the clustering in both directions as we progress through the items list. This means we only have to make a single pass through the list. The table below depicts how we progress through the item list computing from the item we are currently working on forward to the end of the item list. This works because the co-occurring and MeSH tree

relationship lists should always be symmetrical (e.g., if we have an entry A|B we also have an entry B|A) as defined by the UMLS Metathesaurus (see section entitled "UMLS Metathesaurus Files").

	0	1	2	. . .	86	87	88
0							
1	*						
2	*	*					
. . .	*	*	*				
86	*	*	*	*			
87	*	*	*	*	*		
88	*	*	*	*	*	*	

Figure 2: Picture of how we traverse the item list for clustering

The results of the clustering process are compartmented into co-occurring terms (cot) and MeSH tree relationship terms. The MeSH tree relationships are again compartmented into PAR/CHD/SIB (treerel) and then RN/RB/RO (othrel) (see section entitled "Related Concepts (File = MRREL)" for definitions).

3.5.1. Overview of Steps for Clustering

- For every item (i) in our summarized and term weighted list we do the following:
  1. For every item remaining (k) in our list ahead of i (e.g., i + 1 to n), we do the following:
     1) Retrieve the CUIs for item[i] and item[k]
     2) See if we have a co-occurring match of the item[i] and item[k] CUIs. If we do,
        i. Add an entry into item[i]'s cot list containing item[k]'s concept name, normalized frequency, and TermWeight.
        ii. Verify that we have the symmetrical co-occurring match of the item[k] and item[i] CUIs and add an entry into item[k]'s cot list containing item[i]'s concept name, normalized frequency, and TermWeight. Note: We might not have a match since we have removed some of the really low normalized frequency count items.
     3) See if we have a MeSH tree relationship match of the item[*i*] and item[*k*] CUIs. If we do, then for each match we have (**Note:** *there can be multiple MeSH tree relationship results*) do the following:
        i. Retrieve the relationship information from the match result and then:
        ii. If the relationship is Parent, Child, or Sibling (PAR/CHD/SIB) then:
            1. Add an entry into item[*i*]'s treerel list containing item[*k*]'s concept name, normalized frequency, and TermWeight.
            2. Add the symmetrical entry by adding an entry into item[*k*]'s treerel list containing item[*i*]'s concept name, normalized frequency, and TermWeight.

iii. If the relationship is Broader, Narrower, or Other (RN/RB/RO) then:

1. Add an entry into item[*i*]'s othrel list containing item[*k*]'s concept name, normalized frequency, and TermWeight.
2. Add the symmetrical entry by adding an entry into item[*k*]'s othrel list containing item[*i*]'s concept name, normalized frequency, and TermWeight.

3.5.2. Example of Clustering

In this example, we continue using our example concept "Blood Flow Velocity". Here we are showing the effects of the clustering on our concept. We have tied each of the example steps below to the steps described in the overview above by adding notations at the beginning of each line (e.g., (2.i) means step 2.i as described in the overview section). The first entry in the example below (mt_table[3] …) which is highlighted and annotated provides us with a good look at all of the aspects of the clustering process. "Blood Circulation Time"

1) We have an item that does not co-occur with and doesn't relate to in "Radionuclide Imaging",
2) We have an item that does co-occur with in "Blood Flow Velocity",
3) The "Blood Flow Velocity" item is not symmetrical since the inverse pairing was removed from the co-occurring table due to it's small normalized frequency count ("NOT FOUND"),
4) The "Blood Flow Velocity" item is related via the MeSH tree structure as a relationship other than synonymous, narrower, or broader (RO),
5) The "Blood Flow Velocity" item is related via the MeSH tree structure as a sibling (SIB),
6) Finally, the "Blood Flow Velocity" item shows how we are handling both directions in the single pass of clustering. The symmetrical entry for the "Blood Flow Velocity" item is automatically added here and doesn't need to be reviewed when we get to it later on.

```
(i) mt_table[3]: Blood Circulation Time
   (k) mt_table[4]: Radionuclide Imaging      <----\
      (2) No Co-Occurring Terms Found         <---------- (1)
      (3) No MeSH Tree Related Terms Found    <----/

   (k) mt_table[5]: Blood Flow Velocity
      (2.i) Co-Occurring Normalized Frequency: 0.0556  <------- (2)
      (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: NOT FOUND  <----- (3)
      (3.i) MeSH Tree Relationship: RO    <----------------- (4)
      (3.i) MeSH Tree Relationship: SIB   <----------------- (5)
                . . .
(i) mt_table[5]: Blood Flow Velocity
   (k) mt_table[6]: Neurology
      (2) No Co-Occurring Terms Found
      (3) No MeSH Tree Related Terms Found
                . . .
   (k) mt_table[10]: Infant, Newborn
```

```
   (2.i) Co-Occurring Normalized Frequency: 0.0014
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0007
   (3) No MeSH Tree Related Terms Found
            . . .
(k) mt_table[19]: Tomography, Emission-Computed
   (2.i) Co-Occurring Normalized Frequency: 0.0007
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: NOT FOUND
   (3) No MeSH Tree Related Terms Found
            . . .
(k) mt_table[29]: Brain
   (2.i) Co-Occurring Normalized Frequency: 0.0072
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: NOT FOUND
   (3) No MeSH Tree Related Terms Found
            . . .
(k) mt_table[33]: Homeostasis
   (2.i) Co-Occurring Normalized Frequency: 0.0012
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0007
   (3) No MeSH Tree Related Terms Found
            . . .
(k) mt_table[35]: Craniocerebral Trauma
   (2.i) Co-Occurring Normalized Frequency: 0.0010
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0006
   (3) No MeSH Tree Related Terms Found
            . . .
(k) mt_table[40]: Blood Vessels
   (2.i) Co-Occurring Normalized Frequency: 0.0067
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0048
   (3) No MeSH Tree Related Terms Found

(k) mt_table[41]: Vascular Diseases
   (2.i) Co-Occurring Normalized Frequency: 0.0012
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0009
   (3) No MeSH Tree Related Terms Found
            . . .
(k) mt_table[46]: Cerebrovascular Circulation
   (2.i) Co-Occurring Normalized Frequency: 0.0244
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0046
   (3) No MeSH Tree Related Terms Found

(k) mt_table[47]: Gestational Age
   (2.i) Co-Occurring Normalized Frequency: 0.0005
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0005
   (3) No MeSH Tree Related Terms Found

(k) mt_table[48]: Infant, Premature
   (2.i) Co-Occurring Normalized Frequency: 0.0017
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0005
   (3) No MeSH Tree Related Terms Found
            . . .
(k) mt_table[50]: Brain Ischemia
   (2.i) Co-Occurring Normalized Frequency: 0.0012
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: NOT FOUND
   (3) No MeSH Tree Related Terms Found
            . . .
(k) mt_table[52]: Intracranial Pressure
   (2.i) Co-Occurring Normalized Frequency: 0.0012
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0014
   (3) No MeSH Tree Related Terms Found

(k) mt_table[53]: Oxygen
   (2.i) Co-Occurring Normalized Frequency: 0.0043
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0005
   (3) No MeSH Tree Related Terms Found
            . . .
(k) mt_table[55]: Heart Rate
   (2.i) Co-Occurring Normalized Frequency: 0.0017
   (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: NOT FOUND
   (3.i) MeSH Tree Relationship: SIB
            . . .
(k) mt_table[61]: Umbilical Arteries
   (2.i) Co-Occurring Normalized Frequency: 0.0112
```

```
      (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0163
      (3) No MeSH Tree Related Terms Found

   (k) mt_table[62]: Xenon Radioisotopes
      (2.i) Co-Occurring Normalized Frequency: 0.0005
      (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0041
      (3) No MeSH Tree Related Terms Found
               . . .
   (k) mt_table[64]: Cerebrospinal Fluid Pressure
      (2.i) Co-Occurring Normalized Frequency: 0.0005
      (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0027
      (3) No MeSH Tree Related Terms Found
               . . .
   (k) mt_table[70]: Tomography, X-Ray Computed
      (2.i) Co-Occurring Normalized Frequency: 0.0007
      (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: NOT FOUND
      (3) No MeSH Tree Related Terms Found

   (k) mt_table[71]: Blood Pressure
      (2.i) Co-Occurring Normalized Frequency: 0.0184
      (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0017
      (3.i) MeSH Tree Relationship: SIB
               . . .
   (k) mt_table[74]: Aging
      (2.i) Co-Occurring Normalized Frequency: 0.0031
      (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: NOT FOUND
      (3) No MeSH Tree Related Terms Found
               . . .
   (k) mt_table[77]: Echoencephalography
      (2.i) Co-Occurring Normalized Frequency: 0.0024
      (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0061
      (3) No MeSH Tree Related Terms Found

   (k) mt_table[78]: Linear Models
      (2.i) Co-Occurring Normalized Frequency: 0.0005
      (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0018
      (3) No MeSH Tree Related Terms Found
               . . .
   (k) mt_table[87]: Regional Blood Flow
      (2.i) Co-Occurring Normalized Frequency: 0.0014
      (2.ii) Co-Occurring Symmetrical Match Normalized Frequency: 0.0058
      (3.i) MeSH Tree Relationship: SIB

   (k) mt_table[88]: Regression Analysis
      (2) No Co-Occurring Terms Found
      (3) No MeSH Tree Related Terms Found
```

After all of the clustering process has completed – the following list contains the co-occurrence and relationship information we have accumulated for our example. This information consists of concept name, normalized frequency, and TermWeight for each item clustered together with our term.

```
mt_table[5]: Blood Flow Velocity|C0005798|0|1.6625
      cot[0]: Infant, Newborn  normfreq: 0.0014  termweight: 0.9240
      cot[1]: Tomography, Emission-Computed  normfreq: 0.0007  termweight: 0.4136
      cot[2]: Brain  normfreq: 0.0072  termweight: 1.1118
      cot[3]: Homeostasis  normfreq: 0.0012  termweight: 0.4327
      cot[4]: Craniocerebral Trauma  normfreq: 0.0010  termweight: 0.2316
      cot[5]: Blood Vessels  normfreq: 0.0067  termweight: 0.0105
      cot[6]: Vascular Diseases  normfreq: 0.0012  termweight: 0.0105
      cot[7]: Cerebrovascular Circulation  normfreq: 0.0244  termweight: 2.1469
      cot[8]: Gestational Age  normfreq: 0.0005  termweight: 0.3901
      cot[9]: Infant, Premature  normfreq: 0.0017  termweight: 0.4203
      cot[10]: Brain Ischemia  normfreq: 0.0012  termweight: 0.8588
      cot[11]: Intracranial Pressure  normfreq: 0.0012  termweight: 0.5694
      cot[12]: Oxygen  normfreq: 0.0043  termweight: 0.3911
      cot[13]: Heart Rate  normfreq: 0.0017  termweight: 0.1768
      cot[14]: Umbilical Arteries  normfreq: 0.0112  termweight: 0.1768
      cot[15]: Xenon Radioisotopes  normfreq: 0.0005  termweight: 0.3425
      cot[16]: Cerebrospinal Fluid Pressure  normfreq: 0.0005  termweight: 0.2144
```

```
cot[17]: Tomography, X-Ray Computed  normfreq: 0.0007  termweight: 0.3767
cot[18]: Blood Pressure  normfreq: 0.0184  termweight: 0.1659
cot[19]: Aging  normfreq: 0.0031  termweight: 0.1657
cot[20]: Echoencephalography  normfreq: 0.0024  termweight: 0.1657
cot[21]: Linear Models  normfreq: 0.0005  termweight: 0.1657
cot[22]: Regional Blood Flow  normfreq: 0.0014  termweight: 0.1651

treerel[0]: Blood Circulation Time  rel: SIB  termweight: 1.1564
treerel[1]: Heart Rate  rel: SIB  termweight: 0.1768
treerel[2]: Blood Pressure  rel: SIB  termweight: 0.1659
treerel[3]: Regional Blood Flow  rel: SIB  termweight: 0.1651

othrel[0]: Blood Circulation Time  rel: RO  termweight: 1.1564
```

3.6. Calculating the RankScore

This is the final stage were we go through all of the information saved from the previous steps and calculate a final RankScore for each item based on the TermWeight, the normalized frequency count, and user specified constants for COT, REL, Title, and PathWeight. The formula for the RankScore is as follows:

$$RankScore = TW * \left[F * \left[1 + \sum_{j=1}^{n} (COT_j * TW_j) + \sum_{k=1}^{n} (REL * TW_k) \right] \right]$$

Equation 2 - RankScore Formula

The following table depicts the user-defined parameters we use in calculating the RankScore along with their default values:

Abbreviation	Description	Tunable by User	Default Value
COT	Factor for Co-Occurring Terms	X	10,000
REL	Factor for Tree Relationship	X	100
TW	TermWeight	-	-
F	Path Factor: If the item comes from MetaMap or Trigrams AND also from PubMed Related Citations F = 2 otherwise F = 1	-	-

3.6.1. Summary of Steps for Calculating the RankScore

1. Set score = 1,
2. Compute scores for the co-occurring terms,
3. Add scores for the PAR/CHD/SIB MeSH tree related terms,
4. Add scores for the RN/RB/RO MeSH tree related terms,
5. Set up and factor in the Path Factor for the item based on what paths recommended the item, and
6. Finally, factor in the TermWeight for the item into the score.

3.6.2. Example of Calculating the RankScore

1. Set score = 1
2. For each of the co-occurring terms (cot) items we found in clustering, do the following:

   score = score + (**term's normalized frequency count** * COT * **term's term weight**)

```
cot[0]: Infant, Newborn  normfreq: 0.0014  termweight: 0.9240
  score = 1.0000 + (0.0014 * 10000 * 0.9240) == 14.2594
cot[1]: Tomography, Emission-Computed  normfreq: 0.0007  termweight: 0.4136
  score = 14.2594 + (0.0007 * 10000 * 0.4136) == 17.2287
cot[2]: Brain  normfreq: 0.0072  termweight: 1.1118
  score = 17.2287 + (0.0072 * 10000 * 1.1118) == 97.0027
cot[3]: Homeostasis  normfreq: 0.0012  termweight: 0.4327
  score = 97.0027 + (0.0012 * 10000 * 0.4327) == 102.1775
cot[4]: Craniocerebral Trauma  normfreq: 0.0010  termweight: 0.2316
  score 775 = 102.1775 + (0.0010 * 10000 * 0.2316) == 104.3940
cot[5]: Blood Vessels  normfreq: 0.0067  termweight: 0.0105
  score = 104.3940 + (0.0067 * 10000 * 0.0105) == 105.0971
cot[6]: Vascular Diseases  normfreq: 0.0012  termweight: 0.0105
  score = 105.0971 + (0.0012 * 10000 * 0.0105) == 105.2227
cot[7]: Cerebrovascular Circulation  normfreq: 0.0244  termweight: 2.1469
  score = 105.2227 + (0.0244 * 10000 * 2.1469) == 628.9811
cot[8]: Gestational Age  normfreq: 0.0005  termweight: 0.3901
  score = 628.9811 + (0.0005 * 10000 * 0.3901) == 630.8457
cot[9]: Infant, Premature  normfreq: 0.0017  termweight: 0.4203
  score = 630.8457 + (0.0017 * 10000 * 0.4203) == 637.8818
cot[10]: Brain Ischemia  normfreq: 0.0012  termweight: 0.8588
  score = 637.8818 + (0.0012 * 10000 * 0.8588) == 648.1532
cot[11]: Intracranial Pressure  normfreq: 0.0012  termweight: 0.5694
  score = 648.1532 + (0.0012 * 10000 * 0.5694) == 654.9635
cot[12]: Oxygen  normfreq: 0.0043  termweight: 0.3911
  score = 654.9635 + (0.0043 * 10000 * 0.3911) == 671.8002
cot[13]: Heart Rate  normfreq: 0.0017  termweight: 0.1768
  score = 671.8002 + (0.0017 * 10000 * 0.1768) == 674.7606
cot[14]: Umbilical Arteries  normfreq: 0.0112  termweight: 0.1768
  score = 674.7606 + (0.0112 * 10000 * 0.1768) == 694.6397
cot[15]: Xenon Radioisotopes  normfreq: 0.0005  termweight: 0.3425
  score = 694.6397 + (0.0005 * 10000 * 0.3425) == 696.2769
cot[16]: Cerebrospinal Fluid Pressure  normfreq: 0.0005  termweight: 0.2144
  score = 696.2769 + (0.0005 * 10000 * 0.2144) == 697.3019
cot[17]: Tomography, X-Ray Computed  normfreq: 0.0007  termweight: 0.3767
  score = 697.3019 + (0.0007 * 10000 * 0.3767) == 700.0068
cot[18]: Blood Pressure  normfreq: 0.0184  termweight: 0.1659
  score = 700.0068 + (0.0184 * 10000 * 0.1659) == 730.5548
cot[19]: Aging  normfreq: 0.0031  termweight: 0.1657
  score = 730.5548 + (0.0031 * 10000 * 0.1657) == 735.7051
cot[20]: Echoencephalography  normfreq: 0.0024  termweight: 0.1657
  score = 735.7051 + (0.0024 * 10000 * 0.1657) == 739.6677
cot[21]: Linear Models  normfreq: 0.0005  termweight: 0.1657
  score = 739.6677 + (0.0005 * 10000 * 0.1657) == 740.4596
cot[22]: Regional Blood Flow  normfreq: 0.0014  termweight: 0.1651
  score = 740.4596 + (0.0014 * 10000 * 0.1651) == 742.8291
```

The score at the end of processing the co-occurring terms is 742.8291.

3. For each of the PAR/CHD/SIB MeSH tree related terms (treerel) items we found in clustering, do the following:

   score = score + (**term's term weight** * REL)

```
treerel[0]: Blood Circulation Time  rel: SIB  termweight: 1.1564
  score = 742.8291 + (1.1564 * 100) == 858.4691
treerel[1]: Heart Rate  rel: SIB  termweight: 0.1768
  score = 858.4691 + (0.1768 * 100) == 876.1536
treerel[2]: Blood Pressure  rel: SIB  termweight: 0.1659
  score = 876.1536 + (0.1659 * 100) == 892.7405
treerel[3]: Regional Blood Flow  rel: SIB  termweight: 0.1651
  score = 892.7405 + (0.1651 * 100) == 909.2529
```

The score at the end of processing the PAR/CHD/SIB MeSH tree related terms is 909.2529.

4. For each of the RN/RB/RO MeSH tree related terms (othrel) items we found in clustering, do the following:

   score = score + (**term's term weight** * REL)

```
othrel[0]: Blood Circulation Time  rel: RO  termweight: 1.1564
  score = 909.2529 + (1.1564 * 100) == 1024.8929
```

The score at the end of processing the RN/RB/RO MeSH tree related terms is 1024.8929.

5. Set up the Path Factor for this item based on what paths recommended the item. If MetaMap or Trigram recommended the item AND the item was recommended by PubMed Related Citations, Path Factor equals two, otherwise it equals 1. MetaMap and PubMed Related Citations both recommended our example "Blood Flow Velocity" so the Path Factor is equal to two.

   score = score * Path Factor (F)

```
score = 1024.8929 * 2 == 2049.7858
```

The score at the end of processing the Path Factor is 2049.7858.

6. Factor in the item's TermWeight for the final RankScore.

   score = score * Item's TermWeight

```
mt_table[5]:  Blood Flow Velocity|C0005798|0|1.6625
score = 2049.7858 * 1.6625 == 3407.7688
```

The final RankScore at the end of processing is **3407.7688**. This number than gets truncated (not rounded) to **3407**.

The final summarized, clustered, and rank scored (not ordered by score at this point) will look similar to the following:

```
mt_table[0]:  DNA-Binding Proteins|C0012940|1478|1.0150
mt_table[1]:  Transcription Factors|C0040648|1707|1.0150
mt_table[2]:  SEF1 protein|C0212321|207|1.0150
mt_table[3]:  Blood Circulation Time|C0919393|2411|1.1564
mt_table[4]:  Radionuclide Imaging|C0034606|260|1.1564
mt_table[5]:  Blood Flow Velocity|C0005798|3407|1.6625
mt_table[6]:  Neurology|C0027855|89|0.4025
. . .
mt_table[84]:  Confusion|C0009676|55|0.1651
mt_table[85]:  Glasgow Coma Scale|C0017594|246|0.3287
mt_table[86]:  Predictive Value of Tests|C0032944|32|0.1651
mt_table[87]:  Regional Blood Flow|C0034965|118|0.1651
mt_table[88]:  Regression Analysis|C0034980|22|0.1651
```

4. Emphasize Titles

- Uses MeSH Terms list
- Done for all MeSH Terms in the list

MeSH terms that are identified to be from the Title section of the processed text have their score boosted via the following formula:

score = current score + (current_score * 2)

5. Emphasize HSTAR (Optional)

- Uses MeSH Terms list
- Done for all MeSH Terms in the list
- Only done when user specifically requests this type of score boosting.

MeSH terms that are identified to be from one of the following MeSH tree hierarchies:

- N01 – N05
  Population Characteristics [N01], Health Care Facilities, Manpower, and Services [N02], Health Care Economics and Organizations [N03], Health Services Administration [N04], Health Care Quality, Access, and Evaluation [N05]
- G02 – G03 *Health Occupations [G02], Environment and Public Health [G03]*
- L01 *Information Science [L01]*

have their score boosted via the following formula:

score = current score + (current_score * HSTAR_FACTOR)

Where HSTAR_FACTOR is the multiplier specified by the user. We are currently using 20 with limited success.

6. Float Chemicals

- Uses MeSH Terms list
- Done for all MeSH Terms in the list

Make all chemical (NM) terms score greater than the highest scoring MeSH Heading Mapped to via Restrict to MeSH. If term is NM, then run the term through Restrict to MeSH and receive a list of MeSH Headings that it is Mapped to (HM). We then find the highest scoring HM that is associated with this NM term and set the NM term's score to the highest score plus one.

The following example illustrates how chemicals (NMs) are "floated" up in the MeSH Term list:

Example:

Given the following list after Clustering (list shows MeSH term and associated initial score):

1. Pyrones|26688
2. tipranavir|22812
3. Biological Availability|21954
4. Antacids|20988
5. Pyridines|17301
6. HIV Protease Inhibitors|3077
7. Food|8376
8. Food-Drug Interactions|2379
9. Magnesium Hydroxide|1735
10. Fasting|1598
11. Aluminum Hydroxide|1273
12. Protease Inhibitors|3756
13. Administration, Oral|1048
14. Area Under Curve|1000
15. Indinavir|737
16. Dietary Fats|594
17. Capsules|573
18. Acetamides|510
19. Eating|407
20. Piperidines|381
21. Intestinal Absorption|359
22. Tablets|355
23. Fats|349
24. Tetrazoles|288
25. Pharmacokinetics|273
26. Butyrophenones|272
27. Cross-Over Studies|244
28. Drug Interactions|234
29. Anti-Infective Agents|217
30. Ketoprofen|209
31. Magnesium|193
32. Biphenyl Compounds|184
33. Voluntary Workers|537
34. Chromatography, High Pressure Liquid|162
35. Antiviral Agents|159
36. Analysis of Variance|151
37. Analgesics, Non-Narcotic|149
38. Half-Life|139
39. Histamine H1 Antagonists|128
40. Tromethamine|117
41. Antihypertensive Agents|117
42. Gastric Acidity Determination|116
43. Absorption|112
44. Drug Administration Schedule|109
45. aluminum magnesium hydroxide|102
46. Sedatives, Nonbarbiturate|102

#2 tipranavir with initial score of 22,812:

Restrict to MeSH provides the following list of Headings Mapped to (HM):

- Pyridines with a score of 17,301
- Pyrones with a score of 26,688

Final score for tipranavir becomes 26,689 (score of highest scoring Term (Pyrones|26,688) plus one.

#45 aluminum magnesium hydroxide with initial score of 102:

Restrict to MeSH provides the following list of Headings Mapped to (HM):

- Aluminum Hydroxide with a score of 1,273
- Drug Combinations which is not in the list
- Magnesium Hydroxide with a score of 1,735

Final score for aluminum magnesium hydroxide becomes 1,736 (score of highest scoring Term (Magnesium Hydroxide|1,735) plus one.

7. Determine TopN Terms List

- Uses freshly sorted MeSH Terms list
- Done for TopN MeSH Terms in the list only

We want to find the TopN MeSH Heading (MH) terms in our sorted by score list ignoring CheckTags (CT) and SubHeadings (SH) terms in the list. We are going to ignore the CTs and SHs because they are handled separately.

Example:

The user requests TopN to be 25.

1. If we find a CT at positions 7 and 15 in the first 25 terms, we increment TopN for each occurrence (two in this case) to make it 27.
2. If we than find a SH at position 26 in the list, we increment TopN by one which gives us 28.
3. So, the TopN that we will use for the remainder of processing is actually 28 because we want to ignore the CTs at position 7 and 15 and ignore the SH at position 26.

8. Senile Plaque/Dental Plaque Disambiguation

- Uses MeSH Treecodes to disambiguate terms.
- Done for all MeSH Terms in the list

MetaMap currently cannot distinguish between the MeSH terms "Senile Plaque" and "Dental Plaque" when it encounters the term "plaque" during processing. This is known as an ambiguity. This filtering step uses the MeSH treecodes of all the other terms (from all pathways) to help determine the context of the remainder of the text being processed. We check to see if there is any contextual evidence that we should pick Dental Plaque over Senile Plaque by reviewing the treecodes for the entire list of MeSH terms. If we find any term within A14.254 (*Dentition*), C07.465 (*Mouth Disease*), or C07.793 (*Tooth Diseases*) – except for C07.793.208.377 (*Dental Plaque*) we choose Dental Plaque and remove any terms related to Senile Plaque. Otherwise, we remove all terms associated with Dental Plaque. **Note:** We except C07.793.208.377 because it is the treecode for Dental Plaque – the MeSH term we are performing the search for and we don't want to bias our review of the contextual data by counting it.

9. Medium Filtering (Optional)

- Uses MeSH Terms list
- Done for TopN MeSH Terms in the list only.
- Only done when user specifically requests this type of term evaluation and processing.

Medium Filtering involves considering the specificity in hierarchies, retaining and removing Terms in the TopN based on their MeSH tree codes. The retaining and removing are done based on several Exceptions (see ***Appendix-A***) and Heuristics (see ***Appendix-B***) which are processed in the following hierarchical order for the TopN terms in the list:

1. Calculate word counts for each term – to be used in the strcheck Exception.
2. Check Exemptions found in Heuristic #1 a-e, g, and then f.
3. Determine Exceptions 0, A-G.
4. Remove Terms based on Heuristic #2, #3a, #3b, #4, #5, #6, #7, #8, #9, #10 in order of Heuristic number.

10. Validate TopN Terms

- Uses MeSH Terms list
- Done for TopN MeSH Terms in the list, which survived the Medium Filtering removal process and the MH/SH Substitution process only.

For each TopN MeSH Term which is a MH or CT the following tests are ran in order with their corresponding additions of CheckTags and SubHeadings taking place when appropriate.

if CUI = C0042542 (Vero Cells), then add MH+ of Cercopithecus aethiops.

if CUI = C0085080 (Chinese hamster ovary cell), then add CT of Hamster AND Animal.

if CUI is in Adolescence list, then add CT of Adolescence AND CT of Human.

if CUI is in Aged list, then add CT of Aged AND CT of Human.

if CUI is in Animal list, then add CT of Animal.

if CUI is in Cattle list, then add CT of Cattle AND CT of Animal.

if CUI is in Cat list, then add CT of Cat AND CT of Animal.

if CUI is in Dog list, then add CT of Dog AND CT of Animal.

if CUI is in Female list, then add CT of Female.

if CUI is in Human list, then add CT of Human.

if CUI is in Newborn list, then add CT of Infant, Newborn AND CT of Human.

if CUI is in Male list, then add CT of Male.

if CUI is in Pregnant list, then add CT of Pregnancy AND if Female hasn't already been added, add Female.

if CUI is in Mice list and recommendation is from MetaMap, then add CT of Mice AND Animal.

if CUI is in Rats list and recommendation is from MetaMap, then add CT of Rats AND Animal.

if CUI is in Sheep list and recommendation is from MetaMap, then add MH+ of Sheep AND CT of Animal.

if CUI is in Swine list and recommendation is from MetaMap, then add MH+ of Swine AND CT of Animal.

if CUI is in United States list and recommendation is from MetaMap, then add MH+ of United States.

if Male CT not used AND this concept has a tree code found in the Male tree list, add CT of Male.

if Mice CT not used AND recommendation is from MetaMap, AND this concept has a tree code found in the Mice tree list, add CT of Mice AND add CT of Animal.

if Rat CT not used AND recommendation is from MetaMap, AND this concept has a tree code found in the Rat tree list, add CT of Rat AND add CT of Animal.

if Female CT not used AND this concept has a tree code found in the Female tree list, add CT of Female.

if Pregnancy CT not used AND this concept has a tree code found in the Pregnancy tree list, add CT of Pregnancy AND add CT of Female.

if Infant, Newborn CT not used AND this concept has a tree code found in the Newborn tree list, add CT of Infant, Newborn AND add CT of Human.

if Animal CT not used AND this concept has a tree code found in the Animal tree list, add CT of Animal.

if Aged CT not used AND this concept has a tree code found in the Aged tree list, add CT of Aged AND add CT of Human.

if Human CT not used AND this concept has a tree code found in the Human tree list, add CT of Human.

if Hamster CT not used AND recommendation is from MetaMap, AND this concept has a tree code found in the Hamster tree list, add CT of Hamster AND add CT of Animal.

if United States MH+ not used AND this concept has a tree code found in the United States tree list, add MH+ of United States.

if the concept's tree code is in "G05" (Genetic Processes) , "G13" (Genetic Phenomena),
"G14" (Genetic Structures), "G01.273.343" (Genetics), "H01.158.273.343" (Genetics),
"N02.421.308" (Genetic Services), add SH "genetics".

else if the concept's tree code is in "K01.316" (Ethics), "K01.752.256" (Ethics),
"N05.350" (Ethics), add SH "ethics".

else if the concept's tree code is in "G04.610" (Immunity), "D24.611.125" (Antigens),
"D24.611.216" (Antibodies), add SH "immunology".

else if the concept's tree code is in "G03.850.310" (Disease Transmission), add SH "transmission".

else if the concept's tree code is in "G12.091.690.140" (Biotransformation), add SH "pharmacokinetics".

else if the concept's tree code is in "G04.185.515.880" (Viral Physiology), add SH "virology".

else if the concept's tree code is in "E01.370.350.700" (Radiography), add SH "radiography".

else if the concept's tree code is in "E01.370.384.730" (Radionuclide Imaging), add SH "radionuclide imaging".

else if the concept's tree code is in "E01.370.350.850" (Ultrasonography), add SH "ultrasonography".

else if the concept's tree code is in "E02.810" (Radiotherapy) AND NOT in "E02.810.530" (Radiosurgery) AND NOT in "E02.810.814" (Whole-Body Irradiation), add SH "radiotherapy".

else if the concept's tree code is in "E02.831" (Rehabilitation), add SH "rehabilitation".

else if the concept's tree code is in "E04.936" (Transplantation) AND NOT
in "E04.936.494" (Replantation), add SH "transplantation".

else if the concept's tree code is in "E04" AND NOT in E01 (Diagnosis), add SH "surgery".

else if the concept's tree code is in "N03.219" (Economics) add SH "economics".

11. MH/SH Substitution

- Uses MeSH Terms list
- Done for TopN MeSH Terms in the list, which survived the Medium Filtering removal process only.

If a Term is a MeSH Heading (MH) and there is a corresponding SubHeading (SH), only show the SubHeading Term.

1. First we look for a direct match in the TopN MH Terms of a SubHeading anywhere else in the list. If we find a match, we are done looking and the substitution takes place. e.g., MH of “Pharmacokinetics” becomes SH of “pharmacokinetics”.
2. If we don’t find a direct match above, we go through the supplemental MH/SH Lookup list (***Appendix-F***). If we find a match from the lookup list, the substitution takes place.

12. Add "drug therapy" SH

- ❖ Uses MeSH Terms list
- ❖ Done for TopN MeSH Terms in the list, which survived the Medium Filtering removal process and the MH/SH Substitution process only.

When therapy (SH) has been recommended AND either: the concept's tree code is in E02.319 (*Drug Therapy*), except E02.319.703 (*Premedication*) OR a term has been exempted on account of Heuristic #1f - add SH of "drug therapy".

13. Drop "physiology" & "analysis" SHs

- ❖ Uses MeSH Terms list
- ❖ Done for TopN MeSH Terms in the list, which survived the Medium Filtering removal process and the MH/SH Substitution process only.

- Remove physiology (SH) unless some term in topN is in Categories G04 or in G06-G11.
- Remove analysis (SH) unless some term in topN is in Categories D01-D25 OR in E05.196 (*Investigative Techniques*) OR in H01.181.278 (*Chemistry, Clinical*).

14. Add CheckTags from Text (Optional)

- ❖ Uses the Title and Abstract fields from the actual text of the citation.
- ❖ Done for all CheckTag substitutions found in the CheckTag Lookup list (***Appendix-D***).

If a Term in the lookup list is found in the text of either the Title or the Abstract, we verify that the CheckTag has not already been added as a result and if it hasn't, we add it. Care is taken to make sure that CheckTags in the lookup table map to actual words in the text and are not part of other words.

15. Add Geographics from Text (Optional)

- ❖ Uses the Title and Abstract fields from the actual text of the citation.
- ❖ Done for all Geographic substitutions found in the Geographics Lookup list (***Appendix-E***).

If a Geographic Term (City/Town names) in the lookup list is found in the text of either the Title or the Abstract, we verify that the Geographic has not already been added as a result and if it hasn't, we add it. Care is taken to make sure that Geographic's in the lookup table map to actual words in the text and are not part of other words.

16. Strict Filtering (Optional)

- Uses MeSH Terms list
- Done for TopN MeSH Terms in the list only.
- Only done when user specifically requests this type of term evaluation and processing.

Strict Filtering involves removing any item on the list not specifically recommended by both the MetaMap and PubMed Related Citations paths.

17. Display Results

- Uses MeSH Terms list
- Done for TopN MeSH Terms in the list that have survived the Medium Filtering removal process and the MH/SH Substitution process only.

In the display results section of the program, we still have the potential of adding new terms based on items found in the entire MeSH Term list (see step 3 below). For all but Step #3 below, we only use the TopN MeSH Terms. The list below details the ordering of how we print out the final results of the MTI.

1. For each of the TopN Terms in the list that are "***oktoprint***" (not removed due to the filtering or substitution) and are either MH, HM, or NM – we print out the result. We also apply options like ***showET*** (replacing MH with ET – see description below) and ***starMHTI*** (star MHs that come title) at this stage.
2. Print the separator "------"
3. For Terms below TopN (TopN + 1 – end of list), we check to see if there might be any "Special Terms". Where "Special Terms" are terms deemed "special" by the program and include MHs that are out of the scope of our normal recommendation scoring by virtue of being scored lower than TopN. They must have a tree code that falls within one of the following trees: "Z01" [except Z01.433 (*Cities*) and Z01.586 (*Historical Geographic Locations*)], "E05.318.760.500" (*Epidemiologic Studies*), "G03.850.520.450.500" (*Epidemiologic Studies*), and "N05.715.360.775.175" (*Epidemiologic Studies*). These terms are printed using a "MH-S" denotation.
4. Print out Other Terms – which are derived through the validation rules. These terms are printed using a "MH+" denotation (***see 11. "Validate TopN Terms" for full explanation of MH+ terms***).
5. Print out CheckTags found in the TopN and then any added through the validation process.
6. Print out SubHeadings found in TopN AND have a score > 200 and any added through the validation process.

17.1. showHMs Display Option

This option simply tells us to display "HM" instead of "MH" for MeSH Headings that have been identified as "Heading Mapped to" for another MeSH Heading (usually a chemical) in our list. We use this option for one of our regular processing jobs to tag HM terms so they are not displayed.

17.2. limitTitleOnly Display Option

This option is used to limit the number of recommendations the MTI system provides when a citation only has a Title field and no Abstract field. The default is 15 instead of the normal default of 25 recommendations.

17.3. limitPTs Display Option

This option is used to limit the number of recommendations the MTI system provides when a citation has been identified as coming from particular Publication Types like "Review" or "Editorial" (***see Appendix-H for complete list***). If there is one or more "PT -" fields in a citation that we are processing, at least one of them appears in our special Publication Type list, and the user has specified the "limitPTs" display option, we limit the number of recommendations provided based on each special Publication Type.

17.4. showETs Display Option

This option determines whether we display an Entry Term (ET) for a given MeSH Heading (MH). This only works with MetaMap-provided terms since MetaMap marks when a term is found in the Title or Abstract and provides us with information detailing what triggered the term and where the trigger was located. The following all have to be true before we can continue:

1. The user has to have specified the "showETs" option.
2. The MeSH Heading must have at least one valid Entry Term identified by MetaMap as a trigger for the MeSH Heading. If we don't have a valid Entry Term for the MeSH Heading, we simply display the MeSH Heading.

Once these conditions exist, we then have to review the following rules:

1. If the MeSH Heading was found in the Title, it was specified directly from MetaMap, and not derived via the Restrict to MeSH process - we display the original MeSH Heading.
2. If the MeSH Heading (directly from MetaMap) was found only in the Abstract and a valid Entry Term for this MeSH Heading was also only found in the Abstract, we keep the original MeSH Heading.
3. If the MeSH Heading (directly from MetaMap) was found only in the Abstract and a valid Entry Term for this MeSH Heading was found in the Title, we make the substitution and display the Entry Term.
4. If the MeSH Heading was derived via Restrict to MeSH instead of coming directly from MetaMap – we make the substitution and display the Entry Term.

When we substitute the Entry Term for the MeSH Heading, we display the first Entry Term identified by MetaMap.

The following example illustrates the different set of recommendations provided with and without the "showETs" option set. The side with the option set also illustrates the process of going through the conditions and rules before decisions are made. The example consists of a real citation found in PubMed and then modified slightly to illustrate the "showETs" option.

PMID- 99999999
TI - Cross-species retroviral transmission from macaques to human beings.
AB - Cross-species transmission of simian foamy virus (SFV) to human beings from chimpanzees, baboons, and African green monkeys has been described. Although macaques are the non-human primate most often handled in research, human infection with SFV from macaques has not been reported. Two of 46 primate-facility workers tested positive for antibodies that reacted with an immunoblot that contained macaque foamy virus antigens. Phylogenetic assessment of a 96-bp fragment of amplified proviral DNA isolated from peripheral-blood mononuclear cells from one infected individual was consistent with SFV infection of macaque origin. Frequent use of macaques in biomedical research, and identification of persistent retroviral infection from macaques to human beings, could have implications for public-health policy and occupational health and safety. We performed this evaluation using a critique, and an evaluation methodology using measures of theoretical effectiveness.

Without showETs Option	With showETs Option
*Macaca|C0024398|29574|MH||TI|MM;RC	*Macaques|C0024398|29574|ET|
Spumavirus|C0080180|9075|MH||AB|MM;RC	**Replaces "Macaca" - Alternative(s) (Macaque)**|TI|MM;RC
Cercopithecus aethiops|C0007754|6371|MH||AB|MM;RC	Simian Foamy Virus|C0080153|9075|ET|
*Retroviridae|C0035366|4026|MH||TI|MM;RC	Replaces **"Spumavirus" - Alternative(s) (Foamy Virus)**|AB|MM;RC
Papio|C0030362|3951|MH||AB|MM;RC	Monkey, African Green|C1022339|6371|ET|
Retroviridae Infections|C0035369|3151|MH||AB|MM;RC	**Replaces "Cercopithecus aethiops"**|AB|MM;RC
Simian T-lymphotropic virus 1|C0038344|1610|MH|||RC	*Retroviridae|C0035366|4026|MH||TI|MM;RC
Pan troglodytes|C0008111|1429|MH||AB|MM;RC	Baboons|C0030362|3951|ET|**Replaces "Papio"**|AB|MM;RC
Primates|C0033147|1162|MH||AB|MM;RC	Retroviridae Infections|C0035369|3151|MH||AB|MM;RC
Molecular Sequence Data|C0026382|981|MH|||RC	Simian T-lymphotropic virus 1|C0038344|1610|MH|||RC
Monkey Diseases|C0026431|981|MH|||RC	Chimpanzees|C0008111|1429|ET|**Replaces "Pan troglodytes"**|AB|MM;RC
Macaca mulatta|C0024400|837|MH|||RC	Primates|C0033147|1162|MH||AB|MM;RC
Base Sequence|C0004793|612|MH|||RC	Molecular Sequence Data|C0026382|981|MH|||RC
Deltaretrovirus Infections|C0020091|529|MH|||RC	Monkey Diseases|C0026431|981|MH|||RC
Gorilla gorilla|C0018090|460|MH|||RC	Macaca mulatta|C0024400|837|MH|||RC
DNA Primers|C0206416|421|MH|||RC	Base Sequence|C0004793|612|MH|||RC
Macaca nemestrina|C0024401|390|MH|||RC	Deltaretrovirus Infections|C0020091|529|MH|||RC
Primate Diseases|C0242634|353|MH|||RC	Gorilla gorilla|C0018090|460|MH|||RC
Simian Acquired Immunodeficiency Syndrome|C0080151|319|MH|||RC	DNA Primers|C0206416|421|MH|||RC
Polymerase Chain Reaction|C0032520|317|MH|||RC	Macaca nemestrina|C0024401|390|MH|||RC
Antigens, Viral|C0003342|313|MH|||RC	Primate Diseases|C0242634|353|MH|||RC
Genes, pol|C0017360|287|MH|||RC	Simian Acquired Immunodeficiency Syndrome|C0080151|319|MH|||RC
Phylogeny|C0031797|264|MH|||RC	Polymerase Chain Reaction|C0032520|317|MH|||RC
Antibodies, Viral|C0003253|259|MH|||RC	Antigens, Viral|C0003342|313|MH|||RC
Amino Acid Sequence|C0002518|239|MH|||RC	Genes, pol|C0017360|287|MH|||RC
	Phylogeny|C0031797|264|MH|||RC
	Antibodies, Viral|C0003253|259|MH|||RC
	Amino Acid Sequence|C0002518|239|MH|||RC

Decisions

Original String: **Macaca**
MetaMap Triggers: ["Macaque"-ab,"Macaques"-ab,"Macaques"-ti]
Replacing current term - Rule 3 (no Direct MetaMap MH found)
-- Replace with: Macaques
-- Alt. Replacement[0]: Macaque

Original String: **Spumavirus**
MetaMap Triggers: ["Simian Foamy Virus"-ab]:["Foamy Virus"-ab]
Replacing current term - Rule 3 (no Direct MetaMap MH found)
-- Replace with: Simian Foamy Virus
-- Alt. Replacement[1]: Foamy Virus

Original String: **Cercopithecus aethiops**
MetaMap Triggers: ["Monkey, African Green"-ab]
Replacing current term - Rule 3 (no Direct MetaMap MH found)
-- Replace with: Monkey, African Green

Original String: **Retroviridae**
MetaMap Triggers: ["Retroviral"-ti]
-- Retroviral (Title) [NOT a valid Entry Term]
Do nothing - 3) no Direct MetaMap MH found, no alternatives found!

Original String: **Papio**
MetaMap Triggers: ["Baboons"-ab]
Replacing current term - Rule 3 (no Direct MetaMap MH found)
-- Replace with: Baboons

Original String: **Retroviridae Infections**
-- Retroviral infection NOS (Abstract) [NOT a valid Entry Term]
Do nothing - 3) no Direct MetaMap MH found, no alternatives found!

Original String: **Pan troglodytes**
MetaMap Triggers: ["Chimpanzees"-ab]
Replacing current term - Rule 3 (no Direct MetaMap MH found)
-- Replace with: Chimpanzees

Original String: **Primates**
MetaMap Triggers: ["Primate, NOS"-ab]
-- Primate, NOS (Abstract) [NOT a valid Entry Term]
Do nothing - 3) no Direct MetaMap MH found, no alternatives found!

Appendix A – MTI Exceptions for Medium Filtering

strcheck A more general term can be a term of which the term to be acted upon is a sublist. (e.g., "Life" is more general than "Quality of Life" and "Quality of Life" is more specific than "Life"). Strcheck is not used when the difference in number of words is greater than 4, or on Heuristic #7.

0. When Surgery (MH) is in topN treat it as being E04 (*Surgical Procedures, Operative*) as well. (Add E04 to the tree code list for Surgery)

A. When a term is in E03 (*Anesthesia and Analgesia*), consider the term to be more specific than the top-level term in E02 (*Therapeutics*).

B. When a term is in E04 (*Surgical Procedures, Operative*) and not also in E01 (*Diagnosis*), consider the term to be more specific than the top-level term in E02 (*Therapeutics*).

C. When a term is in both E01 (*Diagnosis*) and E04 (*Surgical Procedures, Operative*), ignore any and all E04 tree numbers.

D. When a term is in both E01 (*Diagnosis*) and E05 (*Investigative Techniques*), ignore any and all E05 tree numbers.

E. When a term is in G01 (*Biological Sciences*) or G02 (*Health Occupations*), and also in some other subcategory, ignore any and all G01 and G02 tree numbers.

F. When a term is in E04 (*Surgical Procedures, Operative*), consider the term to be more specific than G02.403.810.762 (*Surgery*).

G. When a term has tree number G02.403.810.762 (*Surgery*) consider the term to be more specific than the top-level term in E02 (*Therapeutics*).

Appendix B – MTI Heuristics for Medium Filtering

- Heuristic #1 items to be exempted:
    a. If the same term has been assigned by both methods, keep it.
    b. Don't remove NMs
    c. Don't remove SHs
    d. Keep items in Z01 (*Geographics*) tree recommended by MetaMap
    e. Keep MH items in topN that are substitutes for SHs when recommended by MetaMap only
    f. When a term meets the following criteria, mark it as exempt:
        1. If we have any item in topN that is in range of D01-D25 AND NOT in range D26-D27 AND Recommended by both MM AND RC proceed,
        2. For each term in the topN AND in the range of D01-D25 AND in the range of D26-D27 AND not in any other categories outside of these Dnn categories AND is recommended by the RC path only, proceed for each term fitting this criteria,
        3. For each term, compile a list of all descendant terms in the topN that are in the range of D01-D27 AND NOT IN ANY other category including this term and find the highest scoring item in this pool of terms and mark it as exempt.
    g. Keep CT items recommended by MetaMap only.

- Heuristic #2: For removing terms when the method is MetaMap only. Remove terms resulting from Restrict to MeSH having no Semantic Type (ST) in common with the set of Semantic Types for the concepts that were recommended by MetaMap before Restrict to MeSH was run.

- Heuristic #3 is for removing terms when the method is Related Citations only. Remove the following:
    a. Check Tags
    b. Z01 (*Geographics*)

- Heuristic #4 is for removing terms when the method is Related Citations only. Remove any term in range D01 - D25 AND in range D26 - D27 AND NOT in any other categories AND when MetaMap hasn't recommended any term within range D01 - D25.

- Heuristic #5 is for removing terms when the method is MetaMap only. In any instance, when MM assigns a term which is more general or more specific OR RC assigns a term which is more specific, add the term to a collection of kept terms. When the collection is not empty, remove a term when it is not a member of the collection of kept terms AND the score for the term is lower than the lowest-scoring term in the collection of kept terms. The removal is not done unless the lowest_scoring term in the collection is less than 10,000.

- Heuristic #6 is for removing terms when only MetaMap recommends a term. In any instance, when both methods assign a more specific term, remove the term. **Note:** Uses Exceptions from above.

- Heuristic #7 is for removing terms when the method is Related Citations only. In every instance, when MetaMap assigns no term which is more general, remove the term. **Note:** Uses Exceptions from above.

- Heuristic #8 is for removing terms when the method is Related Citations only. In any instance, when both methods assign a more general term, remove the term. **Note:** Uses Exceptions from above.

- Heuristic #9 is for removing terms when only MetaMap recommends a term. In any instance, when there is no RC term from the same category, remove the term - provided the term is not in categories H or I.

- Heuristic #10 is for removing terms when the method is MetaMap only. Remove any term which is an NM when there are no terms that are a Heading Mapped-to (HM).

Appendix C – Lookup Lists

```
Adolescence (6):
         1) C0001580 - Adolescent Behavior
         2) C0001585 - Adolescent, Hospitalized
         3) C0001586 - Adolescent, Institutionalized
         4) C0032968 - Pregnancy in Adolescence
         5) C0085100 - Adolescent Health Services
         6) C0162630 - Adolescent Nutrition

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Aged (5):
         1) C0001795 - Aged, 80 and over
         2) C0013772 - Elder Abuse
         3) C0018753 - Health Services for the Aged
         4) C0019870 - Homes for the Aged
         5) C0079204 - Dental Care for Aged

Aged Trees (1):
       M01.060.116.100 (Aged)

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Animal (206):
         1) C0000780 - Abomasum
         2) C0000823 - Abortion, Veterinary
         3) C0001247 - Actinobacillosis
         4) C0001748 - African Horse Sickness
         5) C0001752 - African Swine Fever
         6) C0001878 - Air Sacs
         7) C0002016 - Aleutian Mink Disease
         8) C0002757 - Anal Gland Neoplasms
         9) C0002759 - Anal Sacs
        10) C0002797 - Anaplasmosis
        11) C0003046 - Animal Communication
        12) C0003047 - Animal Diseases
        13) C0003054 - Animal Nutrition
        14) C0003452 - Antlers
        15) C0004421 - Avian Leukosis
        16) C0004426 - Sarcoma, Avian
        17) C0004576 - Babesiosis
        18) C0004895 - Beak
        19) C0004935 - Behavior, Animal
        20) C0005591 - Bird Diseases
        21) C0005866 - Bluetongue
        22) C0006008 - Border Disease
        23) C0006023 - Borna Disease
        24) C0006075 - Bovine Virus Diarrhea-Mucosal Disease
        25) C0006311 - Brucellosis, Bovine
        26) C0006440 - Bursa of Fabricius
        27) C0007098 - Carcinoma 256, Walker
        28) C0007122 - Carcinoma, Brown-Pearce
        29) C0007125 - Carcinoma, Ehrlich Tumor
        30) C0007128 - Carcinoma, Krebs 2
        31) C0007288 - Carpus, Animal
        32) C0007350 - Cat Diseases
        33) C0007450 - Cats
        34) C0007452 - Cattle
        35) C0007453 - Cattle Diseases
        36) C0008046 - Chick Embryo
        37) C0009424 - Comb and Wattles
        38) C0009990 - Copulation
        39) C0010085 - Corpora Allata
        40) C0010352 - Crop, Avian
        41) C0010418 - Cryptosporidiosis
        42) C0011853 - Diabetes Mellitus, Experimental
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Animal (continued):
43) C0012118 - Dictyocaulus Infections
44) C0012602 - Dirofilariasis
45) C0012754 - Distemper
46) C0012979 - Dog Diseases
47) C0012984 - Dogs
48) C0013076 - Dourine
49) C0013529 - Echolocation
50) C0013570 - Ecthyma, Contagious
51) C0013591 - Ectromelia, Infectious
52) C0013605 - Edema Disease of Swine
53) C0013702 - Egg Shell
54) C0013782 - Electric Organ
55) C0013897 - Eliminative Behavior, Animal
56) C0013940 - Embryo, Nonmammalian
57) C0014073 - Encephalomyelitis, Enzootic Porcine
58) C0014342 - Enteritis, Transmissible, of Turkeys
59) C0014371 - Enterotoxemia
60) C0014481 - Ephemeral Fever
61) C0014521 - Epidermitis, Exudative, of Swine
62) C0014661 - Equine Infectious Anemia
63) C0014736 - Erysipelothrix Infections
64) C0015655 - Fascioloidiasis
65) C0015665 - Fat Body
66) C0015731 - Feathers
67) C0015765 - Feline Panleukopenia
68) C0016154 - Fish Diseases
69) C0016513 - Foot Rot
70) C0016514 - Foot-and-Mouth Disease
71) C0016555 - Forelimb
72) C0016627 - Fowl Plague
73) C0016629 - Fowlpox
74) C0016697 - Freemartinism
75) C0017162 - Gastroenteritis, Transmissible, of Swine
76) C0017558 - Gills
77) C0017584 - Gizzard
78) C0017589 - Glanders
79) C0018018 - Goat Diseases
80) C0018249 - Grooming
81) C0018382 - Guinea Pigs
82) C0018557 - Hamsters
83) C0018597 - Harderian Gland
84) C0018835 - Heartwater Disease
85) C0018891 - Helminthiasis, Animal
86) C0019051 - Hemolymph
87) C0019188 - Hepatitis, Animal
88) C0019191 - Hepatitis, Infectious Canine
89) C0019194 - Hepatitis, Viral, Animal
90) C0019549 - Hindlimb
91) C0019556 - Hip Dysplasia, Canine
92) C0019841 - Hog Cholera
93) C0019861 - Homing Behavior
94) C0019909 - Hoof and Claw
95) C0019939 - Horns
96) C0019940 - Horse Diseases
97) C0021334 - Infectious Bovine Rhinotracheitis
98) C0021800 - Interrenal Gland
99) C0022576 - Keratoconjunctivitis, Infectious
100) C0022976 - Lameness, Animal
101) C0023420 - Leukemia L1210
102) C0023421 - Leukemia L5178
103) C0023429 - Leukemia P388
104) C0023904 - Liver Neoplasms, Experimental
105) C0024003 - Lordosis
106) C0024025 - Louping Ill
107) C0024106 - Lumpy Skin Disease
108) C0024533 - Malaria, Avian
109) C0024587 - Malignant Catarrh

Animal (continued):
110) C0024648 - Malpighian Tubules
111) C0024659 - Mammae
112) C0024667 - Mammary Neoplasms
113) C0024668 - Mammary Neoplasms, Experimental
114) C0024788 - Marburg Virus Disease
115) C0024793 - Marek's Disease
116) C0024895 - Mastitis, Bovine
117) C0025864 - Metrial Gland
118) C0025914 - Mice
119) C0026131 - Milk
120) C0026414 - Monieziasis
121) C0026431 - Monkey Diseases
122) C0026851 - Muscular Dystrophy, Animal
123) C0027152 - Myxomatosis, Infectious
124) C0027345 - Nairobi Sheep Disease
125) C0027776 - Nesting Behavior
126) C0027983 - Newcastle Disease
127) C0028058 - Nictitating Membrane
128) C0028972 - Omasum
129) C0029129 - Optic Lobe
130) C0029954 - Oviducts
131) C0030209 - Pair Bond
132) C0030500 - Parasitic Diseases, Animal
133) C0030524 - Paratuberculosis
134) C0030612 - Parturient Paresis
135) C0031021 - Perianal Glands
136) C0032243 - Pleuropneumonia, Contagious
137) C0032291 - Pneumonia, Atypical Interstitial, of Cattle
138) C0032306 - Pneumonia, Progressive Interstitial, of Sheep
139) C0032851 - Poultry Diseases
140) C0032942 - Predatory Behavior
141) C0033741 - Protozoan Infections, Animal
142) C0033745 - Proventriculus
143) C0033839 - Pseudorabies
144) C0034049 - Pulmonary Adenomatosis, Ovine
145) C0034493 - Rabbits
146) C0034531 - Radiation Injuries, Experimental
147) C0034693 - Rats
148) C0035295 - Reticulum
149) C0035613 - Rift Valley Fever
150) C0035637 - Rinderpest
151) C0035801 - Rodent Diseases
152) C0035946 - Rumen
153) C0036118 - Salmonella Infections, Animal
154) C0036139 - Salt Gland
155) C0036294 - Scent Glands
156) C0036457 - Scrapie
157) C0036850 - Setariasis
158) C0036865 - Sex Behavior, Animal
159) C0036946 - Sheep Diseases
160) C0036969 - Pasteurellosis, Pneumonic
161) C0038235 - Steatitis
162) C0038328 - Stifle
163) C0038360 - Stomach, Avian
164) C0038361 - Stomach, Ruminant
165) C0038459 - Strongyle Infections, Equine
166) C0038981 - Swayback
167) C0039006 - Swine Diseases
168) C0039007 - Swine Erysipelas
169) C0039010 - Swine Vesicular Disease
170) C0039259 - Tail
171) C0039325 - Tarsus, Animal
172) C0039753 - Theileriasis
173) C0040553 - Toxocariasis
174) C0040559 - Toxoplasmosis, Animal
175) C0041230 - Trypanosomiasis, Bovine
176) C0041306 - Tuberculosis, Avian

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Animal (continued):
       177) C0041307 - Tuberculosis, Bovine
       178) C0041605 - Ultimobranchial Body
       179) C0042465 - Venereal Tumors, Veterinary
       180) C0042542 - Vero Cells
       181) C0042567 - Vertebrates
       182) C0042584 - Vesicular Exanthema of Swine
       183) C0042640 - Vibrissae
       184) C0042932 - Vocalization, Animal
       185) C0043153 - White Muscle Disease
       186) C0043189 - Wing
       187) C0043220 - Wool
       188) C0043528 - Zoonoses
       189) C0079335 - Feline Acquired Immunodeficiency Syndrome
       190) C0079864 - Murine Acquired Immunodeficiency Syndrome
       191) C0080151 - Simian Acquired Immunodeficiency Syndrome
       192) C0080323 - Visna
       193) C0085164 - Leukemia, Feline
       194) C0085165 - Enzootic Bovine Leukosis
       195) C0085209 - Encephalopathy, Bovine Spongiform
       196) C0085262 - PC12 Cells
       197) C0085306 - Feline Infectious Peritonitis
       198) C0206436 - Photoreceptors, Invertebrate
       199) C0242598 - LLC-PK1 Cells
       200) C0242634 - Primate Diseases
       201) C0242635 - Ape Diseases
       202) C0243038 - Carcinoma, Lewis Lung
       203) C0376538 - Porcine Reproductive and Respiratory Syndrome
       204) C0376702 - COS Cells
       205) C0518461 - Grooming self-care
       206) C0600243 - Home Range

Animal Trees (16):
       A13.350 (Embryo, Nonmammalian)
       A13.395 (Forelimb)
       A13.473 (Hindlimb)
       A13.507 (Horns)
       A13.853 (Stomach, Avian)
       A13.869 (Stomach, Ruminant)
       F01.145.113.111.453 (Grooming)
       F01.145.113.252.748 (Sex Behavior, Animal)
       G03.230.150.360.250 (Housing, Animal)
       C22.595 (Muscular Dystrophy, Animal)
       G08.520.780 (Pregnancy, Animal)
       C04.619.857 (Sarcoma, Experimental)
       C22.021 (Abortion, Veterinary)
       A11.251.210.955 (Vero Cells)
       B01 (Animals)
       I01.880.604.100.100 (Animal Welfare)

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Cattle (15):
         1) C0006075 - Bovine Virus Diarrhea-Mucosal Disease
         2) C0006311 - Brucellosis, Bovine
         3) C0007453 - Cattle Diseases
         4) C0014481 - Ephemeral Fever
         5) C0016697 - Freemartinism
         6) C0021334 - Infectious Bovine Rhinotracheitis
         7) C0024106 - Lumpy Skin Disease
         8) C0024587 - Malignant Catarrh
         9) C0024895 - Mastitis, Bovine
        10) C0032291 - Pneumonia, Atypical Interstitial, of Cattle
        11) C0039753 - Theileriasis
        12) C0041230 - Trypanosomiasis, Bovine
        13) C0041307 - Tuberculosis, Bovine
        14) C0085165 - Enzootic Bovine Leukosis
        15) C0085209 - Encephalopathy, Bovine Spongiform

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Cat (4):
         1) C0007350 - Cat Diseases
         2) C0079335 - Feline Acquired Immunodeficiency Syndrome
         3) C0085164 - Leukemia, Feline
         4) C0085306 - Feline Infectious Peritonitis

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Dog (3):
         1) C0012979 - Dog Diseases
         2) C0019191 - Hepatitis, Infectious Canine
         3) C0019556 - Hip Dysplasia, Canine

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Female (171):
         1) C0000806 - Abortion, Eugenic
         2) C0000811 - Abortion, Induced
         3) C0000812 - Abortion, Legal
         4) C0000820 - Abortion, Therapeutic
         5) C0001575 - Adnexa Uteri
         6) C0001576 - Adnexal Diseases
         7) C0001577 - Adnexitis
         8) C0002453 - Amenorrhea
         9) C0002935 - Anestrus
        10) C0003128 - Anovulation
        11) C0004768 - Bartholin's Glands
        12) C0006205 - Broad Ligament
        13) C0006852 - Candidiasis of vagina
        14) C0007860 - Cervicitis
        15) C0007867 - Cervix Diseases
        16) C0007868 - Cervix Dysplasia
        17) C0007869 - Cervix Erosion
        18) C0007871 - Cervix Incompetence
        19) C0007873 - Cervix Neoplasms
        20) C0007874 - Cervix Uteri
        21) C0007876 - Cesarean Section
        22) C0008043 - Chiari-Frommel Syndrome
        23) C0008984 - Clitoris
        24) C0010092 - Corpus Luteum
        25) C0010096 - Corpus Luteum Regression
        26) C0011106 - Decidua
        27) C0011209 - Delivery
        28) C0012154 - Diestrus
        29) C0012358 - Dilatation and Curettage
        30) C0013390 - Dysmenorrhea
        31) C0013394 - Dyspareunia
        32) C0014170 - Endometrial Neoplasms
        33) C0014173 - Endometrial Hyperplasia
        34) C0014175 - Endometriosis
        35) C0014179 - Endometritis
        36) C0014180 - Endometrium
        37) C0014586 - Episiotomy
        38) C0014935 - Estrogen Replacement Therapy
        39) C0014948 - Estrus
        40) C0014950 - Estrus Synchronization
        41) C0015362 - Extraction, Obstetrical
        42) C0015556 - Fallopian Tube Diseases
        43) C0015558 - Fallopian Tube Neoplasms
        44) C0015560 - Fallopian Tubes
        45) C0016426 - Follicular Atresia
        46) C0016431 - Follicular Fluid
        47) C0016434 - Follicular Phase
        48) C0016722 - Frigidity
        49) C0016941 - Galactorrhea
        50) C0016999 - Gamete Intrafallopian Transfer
        51) C0017411 - Genital Diseases, Female
        52) C0017416 - Genital Neoplasms, Female
        53) C0017421 - Genitalia, Female
        54) C0018120 - Ovarian Follicle
        55) C0018207 - Granulosa Cells
Female (continued):
        56) C0018414 - Gynatresia
        57) C0018934 - Hematocolpos
        58) C0018948 - Hematometra
        59) C0019857 - Home Childbirth
        60) C0020412 - Hymen
        61) C0020699 - Hysterectomy
        62) C0020700 - Hysterectomy, Vaginal
        63) C0021361 - Infertility, Female
        64) C0022783 - Kraurosis Vulvae
        65) C0022875 - Labor, Induced
        66) C0022925 - Lactation
        67) C0022927 - Lactation Disorders
        68) C0023372 - Homosexuality, Female
        69) C0023533 - Leukorrhea
        70) C0024153 - Luteal Phase
        71) C0024156 - Lutein Cells
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         72) C0024894 - Mastitis
         73) C0024895 - Mastitis, Bovine
         74) C0025184 - Meigs' Syndrome
         75) C0025274 - Menarche
         76) C0025320 - Menopause
         77) C0025322 - Menopause, Premature
         78) C0025323 - Menorrhagia
         79) C0025329 - Menstrual Cycle
         80) C0025344 - Menstruation
         81) C0025345 - Menstruation Disturbances
         82) C0025597 - Metestrus
         83) C0025874 - Metrorrhagia
         84) C0026132 - Milk Ejection
         85) C0027088 - Myometrium
         86) C0027484 - Natural Childbirth
         87) C0028949 - Oligomenorrhea
         88) C0029051 - Oophoritis
         89) C0029458 - Osteoporosis, Postmenopausal
         90) C0029927 - Ovarian Cysts
         91) C0029928 - Ovarian Diseases
         92) C0029936 - Ovariectomy
         93) C0029939 - Ovary
         94) C0029957 - Oviposition
         95) C0029965 - Ovulation
         96) C0029976 - Ovum Implantation
         97) C0029977 - Ovum Implantation, Delayed
         98) C0029979 - Ovum Transport
         99) C0030455 - Parametritis
        100) C0030563 - Parity
        101) C0030584 - Parovarian Cyst
        102) C0032460 - Polycystic Ovary Syndrome
        103) C0032797 - Postpartum Hemorrhage
        104) C0032961 - Pregnancy
        105) C0032986 - Pregnancy, Animal
        106) C0033046 - Premenstrual Syndrome
        107) C0033274 - Proestrus
        108) C0033778 - Pruritus Vulvae
        109) C0033831 - Pseudopregnancy
        110) C0034040 - Puerperal Disorders
        111) C0034041 - Puerperal Infection
        112) C0034042 - Puerperium
        113) C0034895 - Rectovaginal Fistula
        114) C0035877 - Round Ligament
        115) C0036130 - Salpingitis
        116) C0036136 - Salpingostomy
        117) C0037853 - Sperm-Ovum Interactions
        118) C0038289 - Sterilization, Tubal
        119) C0038835 - Superovulation
        120) C0038902 - Gynecologic Surgical Procedures
        121) C0038906 - Obstetric Surgical Procedures
        122) C0039748 - Theca Cells
        123) C0040923 - Trichomonas Vaginitis
        124) C0041311 - Tuberculosis, Female Genital
        125) C0042130 - Uterine Contraction
Female (continued):
        126) C0042131 - Uterine Diseases
        127) C0042134 - Uterine Hemorrhage
        128) C0042138 - Uterine Neoplasms
        129) C0042139 - Uterine Perforation
        130) C0042140 - Uterine Prolapse
        131) C0042143 - Uterine Rupture
        132) C0042149 - Uterus
        133) C0042223 - Vacuum Curettage
        134) C0042225 - Vacuum Extraction, Obstetrical
        135) C0042232 - Vagina
        136) C0042251 - Vaginal Diseases
        137) C0042253 - Vaginal Fistula
        138) C0042258 - Vaginal Neoplasms
        139) C0042261 - Vaginal Smears
        140) C0042267 - Vaginitis
        141) C0042556 - Version, Fetal
        142) C0042582 - Vesicovaginal Fistula
        143) C0042993 - Vulva
        144) C0042994 - Vulvar Diseases
        145) C0042995 - Vulvar Neoplasms
        146) C0042996 - Vulvitis
        147) C0042998 - Vulvovaginitis
        148) C0043209 - Woman
        149) C0043210 - Women
        150) C0079341 - Circumcision, Female
        151) C0080301 - Vaginal Birth after Cesarean
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        152) C0080339 - Women's Health
        153) C0085076 - Mammaplasty
        154) C0085083 - Ovarian Hyperstimulation Syndrome
        155) C0085166 - Vaginosis, Bacterial
        156) C0085215 - Ovarian Failure, Premature
        157) C0162482 - Uterine Inversion
        158) C0206076 - Reproductive History
        159) C0206101 - Cesarean Section, Repeat
        160) C0206158 - Premenopause
        161) C0206159 - Postmenopause
        162) C0221074 - Depression, Postpartum
        163) C0227791 - Vaginal Discharge
        164) C0242810 - Battered Women
        165) C0242836 - Pregnancy Reduction, Multifetal
        166) C0243033 - Maternal Exposure
        167) C0269886 - Inversion of uterus during delivery
        168) C0269995 - Galactorrhea associated with childbirth
        169) C0392535 - Diagnosis of induced abortion
        170) C0496920 - Ovarian Neoplasms
        171) C0600454 - Cervical Ripening

Female Trees (13):
        A05.360.319 (Genitalia, Female)
        C13.371.56 (Adnexal Diseases)
        C23.550.568 (Menstruation Disturbances)
        C13.371.852 (Uterine Diseases)
        C13.371.894 (Vaginal Diseases)
        C13.371.944 (Vulvar Diseases)
        C13.703.844.253 (Depression, Postpartum)
        G08.520.440 (Menstrual Cycle)
        G08.520.188 (Estrous Cycle)
        G08.520.188.500 (Estrous)
        E04.520 (Obstetric Surgical Procedures)
        E04.950.300 (Gynecologic Surgical Procedures)
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Human (27):
          1) C0001578 - Adolescence
          2) C0001587 - Adolescent
          3) C0001675 - Adult
          4) C0001792 - Aged
          5) C0008059 - Child
          6) C0008100 - Child, Preschool
          7) C0016539 - Forefoot, Human
          8) C0017429 - Genome, Human
          9) C0018873 - Hela Cells
         10) C0019874 - Hominidae
         11) C0021270 - Infant
         12) C0021289 - Infant, Newborn
         13) C0022539 - KB Cells
         14) C0025266 - Men
         15) C0026062 - Middle Age
         16) C0029458 - Osteoporosis, Postmenopausal
         17) C0030705 - Patients
         18) C0043209 - Woman
         19) C0043210 - Women
         20) C0079204 - Dental Care for Aged
         21) C0079377 - Frail Elderly
         22) C0080339 - Women's Health
         23) C0085429 - Koro
         24) C0282549 - HL-60 Cells
         25) C0282560 - Caco-2 Cells
         26) C0282639 - HT29 Cells
         27) C0376448 - Jurkat Cells

Human Trees (5):
        A11.284.187.520.300 (Chromosomes, Human)
        G14.162.520.300 (Chromosomes, Human)
        M01.060 (Age Groups)
        A01.378.610.250.300 (Forefoot, Human)
        A01.378.610.250.149 (Ankle)

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Newborn (22):
          1) C0002636 - Amniotic Band Syndrome
          2) C0002891 - Anemia, Neonatal
          3) C0004045 - Asphyxia Neonatorum
          4) C0006287 - Bronchopulmonary Dysplasia
          5) C0014761 - Erythroblastosis, Fetal
          6) C0019088 - Hemorrhagic Disease of Newborn
          7) C0020192 - Hyaline Membrane Disease
          8) C0021290 - Infant, Newborn, Diseases
          9) C0021295 - Infant, Premature, Diseases
         10) C0021709 - Intensive Care Units, Neonatal
         11) C0021711 - Intensive Care, Neonatal
         12) C0022353 - Jaundice, Neonatal
         13) C0023529 - Leukomalacia, Periventricular
         14) C0025048 - Meconium Aspiration
         15) C0027609 - Neonatal Abstinence Syndrome
         16) C0027617 - Neonatal Screening
         17) C0029076 - Ophthalmia Neonatorum
         18) C0031190 - Persistent Fetal Circulation Syndrome
         19) C0035220 - Respiratory Distress Syndrome
         20) C0035344 - Retinopathy of Prematurity
         21) C0036415 - Sclerema Neonatorum
         22) C0079893 - Neonatal Nursing

Newborn Trees (2):
        C16.614.521 (Infant, Premature, Diseases)
        M01.060.703.520 (Infant, Newborn)
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Male (84):
         1) C0001216 - Acrosome
         2) C0004690 - Balanitis
         3) C0006366 - Bulbourethral Glands
         4) C0008819 - Circumcision
         5) C0010417 - Cryptorchidism
         6) C0013746 - Ejaculation
         7) C0013747 - Ejaculatory Ducts
         8) C0014533 - Epididymis
         9) C0014534 - Epididymitis
        10) C0017412 - Genital Diseases, Male
        11) C0017417 - Genital Neoplasms, Male
        12) C0017422 - Genitalia, Male
        13) C0018418 - Gynecomastia
        14) C0018931 - Hematocele
        15) C0020252 - Hydrocele
        16) C0020646 - Hypospadias
        17) C0021116 - Impotence
        18) C0021364 - Infertility, Male
        19) C0023602 - Leydig Cells
        20) C0025266 - Men
        21) C0028960 - Oligospermia
        22) C0029191 - Orchitis
        23) C0030483 - Paraphimosis
        24) C0030846 - Penile Diseases
        25) C0030847 - Penile Erection
        26) C0030848 - Penile Induration
        27) C0030849 - Penile Neoplasms
        28) C0030851 - Penis
        29) C0031538 - Phimosis
        30) C0033117 - Priapism
        31) C0033572 - Prostate
        32) C0033573 - Prostatectomy
        33) C0033575 - Prostatic Diseases
        34) C0033577 - Prostatic Hyperplasia
        35) C0033578 - Prostatic Neoplasms
        36) C0033581 - Prostatitis
        37) C0034919 - Redundant prepuce and phimosis
        38) C0035278 - Rete Testis
        39) C0036471 - Scrotum
        40) C0036628 - Seminal Vesicles
        41) C0036629 - Seminiferous Epithelium
        42) C0036630 - Seminiferous Tubules
        43) C0036770 - Sertoli Cells
        44) C0037839 - Sperm Agglutination
        45) C0037840 - Sperm Banks
        46) C0037841 - Sperm Capacitation
        47) C0037842 - Sperm Count
        48) C0037844 - Sperm Head
        49) C0037846 - Sperm Maturation
        50) C0037848 - Sperm Motility
        51) C0037851 - Sperm Tail
        52) C0037852 - Sperm Transport
        53) C0037853 - Sperm-Ovum Interactions
        54) C0037855 - Spermatic Cord
        55) C0037856 - Spermatic Cord Torsion
        56) C0037857 - Spermatids
        57) C0037859 - Spermatocele
        58) C0037863 - Spermatocytes
        59) C0037864 - Spermatogenesis
        60) C0037866 - Spermatogonia
        61) C0037868 - Spermatozoa
        62) C0038914 - Urologic Surgical Procedures, Male
        63) C0039584 - Testicular Diseases
        64) C0039585 - Testicular Feminization
        65) C0039590 - Testicular Neoplasms
        66) C0039597 - Testis
        67) C0041317 - Tuberculosis, Male Genital
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Male (continued):
        68) C0042341 - Varicocele
        69) C0042360 - Vas Deferens
        70) C0042421 - Vasovasostomy
        71) C0085429 - Koro
        72) C0153604 - Malignant neoplasm of scrotum
        73) C0242658 - Homosexuality, Male
        74) C0242788 - Breast Neoplasms, Male
        75) C0243000 - Impotence, Vasculogenic
        76) C0243034 - Paternal Exposure
        77) C0268896 - Disease of seminal vesicle
        78) C0268919 - Disease of scrotum
        79) C0345326 - Congenital phimosis
        80) C0403766 - Acquired phimosis
        81) C0428003 - Sperm motility measurement
        82) C0600338 - Sperm Number
        83) C0678217 - Encounter due to sperm count
        84) C0700113 - Epididymis disorders


Male Trees (8):
       A05.360.444.849 (Testis)
       C12.294.365.700 (Infertility, Male)
       C12.294.494 (Penile Diseases)
       C12.294.565 (Prostatic Diseases)
       C12.294.829 (Testicular Diseases)
       G08.520.310.760 (Spermatogenesis)
       A11.497.760 (Spermatozoa)
       E04.950.774.860 (Urologic Surgical Procedures, Male)

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Pregnant (88):
         1) C0000786 - Abortion, Spontaneous
         2) C0000809 - Abortion, Habitual
         3) C0000810 - Abortion, Incomplete
         4) C0000814 - Abortion, Missed
         5) C0000817 - Abortion, Septic
         6) C0000821 - Abortion, Threatened
         7) C0000823 - Abortion, Veterinary
         8) C0000832 - Abruptio Placentae
         9) C0006157 - Breech Presentation
        10) C0007871 - Cervix Incompetence
        11) C0008493 - Hydatidiform Mole, Invasive
        12) C0008495 - Chorioamnionitis
        13) C0008497 - Choriocarcinoma
        14) C0008509 - Chorionic Villi Sampling
        15) C0010095 - Corpus Luteum Maintenance
        16) C0013418 - Dystocia
        17) C0013537 - Eclampsia
        18) C0013927 - Embolism, Amniotic Fluid
        19) C0015944 - Fetal Membranes, Premature Rupture
        20) C0015958 - Fetofetal Transfusion
        21) C0015959 - Fetomaternal Transfusion
        22) C0017506 - Gestosis, EPH
        23) C0018811 - Heart Rate, Fetal
        24) C0019343 - Herpes Gestationis
        25) C0020217 - Hydatidiform Mole
        26) C0020224 - Polyhydramnios
        27) C0020450 - Hyperemesis Gravidarum
        28) C0022864 - Labor
        29) C0022865 - Labor Complications
        30) C0022868 - Labor Onset
        31) C0022869 - Labor Presentation
        32) C0022871 - Labor Stage, First
        33) C0022872 - Labor Stage, Second
        34) C0022873 - Labor Stage, Third
        35) C0022876 - Labor, Premature
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Pregnant (continued):
        36) C0024929 - Maternal-Fetal Exchange
        37) C0030612 - Parturient Paresis
        38) C0032044 - Placenta Accreta
        39) C0032045 - Placenta Diseases
        40) C0032046 - Placenta Praevia
        41) C0032051 - Placental Insufficiency
        42) C0032058 - Placentation
        43) C0032770 - Postimplantation Phase
        44) C0032797 - Postpartum Hemorrhage
        45) C0032914 - Pre-Eclampsia
        46) C0032961 - Pregnancy
        47) C0032962 - Pregnancy Complications
        48) C0032963 - Pregnancy Complications, Cardiovascular
        49) C0032964 - Pregnancy Complications, Hematologic
        50) C0032965 - Pregnancy Complications, Infectious
        51) C0032966 - Pregnancy Complications, Neoplastic
        52) C0032968 - Pregnancy in Adolescence
        53) C0032969 - Pregnancy in Diabetes
        54) C0032971 - Pregnancy Maintenance
        55) C0032972 - Pregnancy Outcome
        56) C0032975 - Pregnancy Rate
        57) C0032978 - Pregnancy Toxemias
        58) C0032984 - Pregnancy, Abdominal
        59) C0032986 - Pregnancy, Animal
        60) C0032987 - Pregnancy, Ectopic
        61) C0032989 - Pregnancy, Multiple
        62) C0032993 - Pregnancy, Prolonged
        63) C0032994 - Pregnancy, Tubal
        64) C0032995 - Pregnancy, Unwanted
        65) C0033022 - Preimplantation Phase
        66) C0033054 - Prenatal Exposure Delayed Effects
        67) C0038822 - Superfetation
        68) C0040345 - Uterine Monitoring
        69) C0040348 - Tocolysis
        70) C0040862 - Trial of Labor
        71) C0041182 - Trophoblastic Neoplasms
        72) C0042130 - Uterine Contraction
        73) C0042135 - Uterine Inertia
        74) C0042143 - Uterine Rupture
        75) C0079924 - Oligohydramnios
        76) C0080265 - Ultrasonography, Prenatal
        77) C0085207 - Diabetes, Gestational
        78) C0085547 - Phenylketonuria, Maternal
        79) C0162494 - Pregnancy Complications, Parasitic
        80) C0162739 - HELLP Syndrome
        81) C0206666 - Trophoblastic Tumor, Placental Site
        82) C0242622 - Uteroplacental Circulation
        83) C0242669 - Placenta, Retained
        84) C0242786 - Pregnancy, High-Risk
        85) C0242836 - Pregnancy Reduction, Multifetal
        86) C0342008 - Amniotic fluid pulmonary embolism
        87) C0600107 - Incomplete legal abortion
        88) C0600454 - Cervical Ripening

Pregnant Trees (9):
       G08.520.769.326.200 (Labor Onset)
       G08.520.769.362 (Labor Presentation)
       G08.520.840 (Pregnancy Trimesters)
       C13.703.039 (Abortion, Spontaneous)
       C13.703.590 (Placenta Diseases)
       C13.703.634 (Pregnancy Complications, Cardiovascular)
       C13.703.733 (Pregnancy, Ectopic)
       C13.703.799 (Pregnancy Toxemias)
       G09.330.612.509.430 (Heart Rate, Fetal)
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Sheep (5):
         1) C0027345 - Nairobi Sheep Disease
         2) C0032306 - Pneumonia, Progressive Interstitial, of Sheep
         3) C0034049 - Pulmonary Adenomatosis, Ovine
         4) C0036946 - Sheep Diseases
         5) C0038981 - Swayback

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Swine (13):
         1) C0001752 - African Swine Fever
         2) C0013605 - Edema Disease of Swine
         3) C0014073 - Encephalomyelitis, Enzootic Porcine
         4) C0014521 - Epidermitis, Exudative, of Swine
         5) C0017162 - Gastroenteritis, Transmissible, of Swine
         6) C0019841 - Hog Cholera
         7) C0039006 - Swine Diseases
         8) C0039007 - Swine Erysipelas
         9) C0039010 - Swine Vesicular Disease
        10) C0039011 - Swine, Miniature
        11) C0042584 - Vesicular Exanthema of Swine
        12) C0242598 - LLC-PK1 Cells
        13) C0376538 - Porcine Reproductive and Respiratory Syndrome

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United States (54):
         1) C0002455 - American Cancer Society
         2) C0002456 - American Dental Association
         3) C0002458 - American Heart Association
         4) C0002459 - American Hospital Association
         5) C0002461 - American Medical Association
         6) C0002463 - American Nurses' Association
         7) C0007670 - Centers for Disease Control and Prevention (U.S.)
         8) C0009434 - Commission on Professional and Hospital Activities
         9) C0018727 - Health Planning
        10) C0018763 - Health Systems Agencies
        11) C0018764 - Health Systems Plans
        12) C0020007 - Hospitals, Federal
        13) C0020012 - Hospitals, Military
        14) C0021621 - Institute of Medicine (U.S.)
        15) C0022405 - Joint Commission on Accreditation of Healthcare Organizations
        16) C0025071 - Medicaid
        17) C0025140 - MEDLARS
        18) C0025141 - MEDLINE
        19) C0027446 - National Academy of Sciences (U.S.)
        20) C0027447 - National Center for Health Care Technology
        21) C0027450 - National Center for Health Statistics (U.S.)
        22) C0027454 - National Health Insurance, United States
        23) C0027456 - National Health Planning Information Center
        24) C0027463 - National Institute for Occupational Safety and Health
        25) C0027466 - National Institute of Mental Health (U.S.)
        26) C0027468 - National Institutes of Health (U.S.)
        27) C0027470 - National Library of Medicine (U.S.)
        28) C0031826 - Physician Payment Review Commission
        29) C0033518 - Prospective Payment Assessment Commission
        30) C0038192 - State Health Planning and Development Agencies
        31) C0038194 - State Health Plans
        32) C0041704 - United States Substance Abuse and Mental Health Services Administration
        33) C0041711 - United States Dept. of Health and Human Services
        34) C0041712 - United States Environmental Protection Agency
        35) C0041713 - United States Federal Trade Commission
        36) C0041714 - United States Food and Drug Administration
        37) C0041718 - United States Health Care Financing Administration
        38) C0041720 - United States Health Resources and Services Administration
        39) C0041731 - United States Occupational Safety and Health Administration
        40) C0041732 - United States Office of Economic Opportunity
        41) C0041733 - United States Office of Technology Assessment
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United States (continued):
        42) C0041734 - United States Public Health Service
        43) C0041735 - United States Department of Veterans Affairs
        44) C0078936 - American Speech-Language-Hearing Association
        45) C0080268 - United States Agency for Health Care Policy and Research
        46) C0085141 - United States Indian Health Service
        47) C0085291 - National Practitioner Data Bank
        48) C0085410 - United States Department of Agriculture
        49) C0206601 - United States Office of Research Integrity
        50) C0242776 - United States National Aeronautics and Space Administration
        51) C0282438 - Consensus Development Conferences, NIH
        52) C0282680 - United States Social Security Administration
        53) C0376631 - Employee Retirement Income Security Act
        54) C0600418 - Patient Self-Determination Act

United States Trees (4):
       N03.540.427.300 (United States Dept. of Health and Human Services)
       N03.540.452.508 (State Health Planning and Development Agencies)
       N03.540.427.550 (United States Office of Technology Assessment)
       N03.219.521.576.343.840 (Medicare)

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Mice (28):
         1) C0022827 - L Cells (Cell Line)
         2) C0025917 - Mice, Inbred A
         3) C0025918 - Mice, Inbred AKR
         4) C0025919 - Mice, Inbred BALB C
         5) C0025920 - Mice, Inbred C3H
         6) C0025921 - Mice, Inbred C57BL
         7) C0025922 - Mice, Inbred CBA
         8) C0025923 - Mice, Inbred DBA
         9) C0025924 - Mice, Inbred HRS
        10) C0025925 - Mice, Inbred ICR
        11) C0025926 - Mice, Inbred NZB
        12) C0025927 - Mice, Inbred Strains
        13) C0025928 - Mice, Jimpy
        14) C0025930 - Mice, Mutant Strains
        15) C0025931 - Mice, Neurologic Mutants
        16) C0025932 - Mice, Nude
        17) C0025933 - Mice, Obese
        18) C0025934 - Mice, Quaking
        19) C0025936 - Mice, Transgenic
        20) C0085087 - 3T3 Cells
        21) C0085112 - Mice, SCID
        22) C0085243 - Mice, Inbred NOD
        23) C0206535 - Mice, Inbred mdx
        24) C0206610 - Mice, Inbred CFTR
        25) C0206745 - Mice, Knockout
        26) C0242854 - Mice, Inbred SENCAR
        27) C0376632 - Mice, Inbred MRL lpr
        28) C0600530 - Mice, Congenic

Mice Trees (2):
       B02.649.865.635.500.380 (Mice, Inbred Strains)
       B02.649.865.635.500.440 (Mice, Mutant Strains)
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Rats (22):
          1) C0034694 - Rats, Brattleboro
          2) C0034696 - Rats, Gunn
          3) C0034698 - Rats, Inbred ACI
          4) C0034699 - Rats, Inbred BB
          5) C0034700 - Rats, Inbred BN
          6) C0034701 - Rats, Inbred BUF
          7) C0034703 - Rats, Inbred F344
          8) C0034704 - Rats, Inbred Lew
          9) C0034705 - Rats, Inbred SHR
         10) C0034706 - Rats, Inbred Strains
         11) C0034707 - Rats, Inbred WF
         12) C0034709 - Rats, Inbred WKY
         13) C0034711 - Rats, Mutant Strains
         14) C0034713 - Rats, Nude
         15) C0034715 - Rats, Sprague-Dawley
         16) C0034716 - Rats, Wistar
         17) C0034719 - Rats, Zucker
         18) C0085262 - PC12 Cells
         19) C0324537 - Rats, Long-Evans
         20) C0600533 - Rats, Inbred Dahl
         21) C0600547 - Rats, Inbred LEC
         22) C0600548 - Rats, Inbred OLETF

Rat Trees (2):
        B02.649.865.635.560.500 (Rats, Inbred Strains)
        B02.649.865.635.560.610 (Rats, Mutant Strains)

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Hamster Trees (1):
        B02.649.865.635.325 (Hamsters)
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Appendix D – CheckTag Lookup & Substitution List

Term	CheckTag(s) Added
3t3 cells	ANIMAL:MICE
abomasum	ANIMAL
abortion	FEMALE:PREGNANCY
abruptio placentae	FEMALE:PREGNANCY
acrosome	MALE
actinobacillosis	ANIMAL
adnexa uteri	FEMALE
adnexal diseases	FEMALE
adnexitis	FEMALE
adolescent	ADOLESCENCE
adult	ADULT
african horse sickness	ANIMAL
african swine fever	ANIMAL
aged	HUMAN
aged, 80 and over	AGED:HUMAN
air sacs	ANIMAL
aleutian mink disease	ANIMAL
amenorrhea	FEMALE
amniotic band syndrome	HUMAN:INFANT, NEWBORN
anal gland neoplasms	ANIMAL
anal sacs	ANIMAL
anaplasmosis	ANIMAL
anemia, neonatal	HUMAN:INFANT, NEWBORN
anestrus	FEMALE
animal communication	ANIMAL
animal diseases	ANIMAL
animal nutrition	ANIMAL
anovulation	FEMALE
antlers	ANIMAL
ape diseases	ANIMAL
asphyxia neonatorum	HUMAN:INFANT, NEWBORN
avian leukosis	ANIMAL
babesiosis	ANIMAL
baby	INFANT
babies	INFANT
balanitis	MALE
bartholin's glands	FEMALE
battered women	FEMALE
beak	ANIMAL
behavior, animal	ANIMAL
bird diseases	ANIMAL
bluetongue	ANIMAL
border disease	ANIMAL
borna disease	ANIMAL
bovine	ANIMAL:CATTLE
boy	MALE
breast neoplasms, male	MALE
breech presentation	FEMALE:PREGNANCY
broad ligament	FEMALE
bronchopulmonary dysplasia	HUMAN:INFANT, NEWBORN
brucellosis, bovine	ANIMAL:CATTLE
bulbourethral glands	MALE
bursa of fabricius	ANIMAL
caco-2 cells	HUMAN
carcinoma 256, walker	ANIMAL

Term	CheckTag(s) Added
carcinoma, brown-pearce	ANIMAL
carcinoma, ehrlich tumor	ANIMAL
carcinoma, krebs 2	ANIMAL
carcinoma, lewis lung	ANIMAL
carpus, animal	ANIMAL
cat	CATS:ANIMAL
cattle	ANIMAL:CATTLE
cervical ripening	FEMALE:PREGNANCY
cervicitis	FEMALE
cervix	FEMALE
cervix incompetence	PREGNANCY
cesarean	FEMALE:PREGNANCY
chiari-frommel syndrome	FEMALE
chick embryo	ANIMAL
child	CHILD:HUMAN
children	CHILD
chorioamnionitis	FEMALE:PREGNANCY
choriocarcinoma	FEMALE:PREGNANCY
chorionic villi sampling	FEMALE:PREGNANCY
circumcision	MALE
circumcision, female	FEMALE
clitoris	FEMALE
comb and wattles	ANIMAL
copulation	ANIMAL
corpora allata	ANIMAL
corpus luteum maintenance	FEMALE:PREGNANCY
corpus luteum regression	FEMALE
corpus luteum	FEMALE
cos cells	ANIMAL
crop, avian	ANIMAL
cryptorchidism	MALE
cryptosporidiosis	ANIMAL
decidua	FEMALE
dental care for aged	AGED:HUMAN
depression, postpartum	FEMALE
diabetes mellitus, experimental	ANIMAL
diabetes, gestational	FEMALE:PREGNANCY
dictyocaulus infections	ANIMAL
diestrus	FEMALE
dilatation and curettage	FEMALE
dirofilariasis	ANIMAL
distemper	ANIMAL
dog	DOGS:ANIMAL
dourine	ANIMAL
dysmenorrhea	FEMALE
dyspareunia	FEMALE
dystocia	FEMALE:PREGNANCY
echolocation	ANIMAL
eclampsia	FEMALE:PREGNANCY
ecthyma, contagious	ANIMAL
ectromelia, infectious	ANIMAL
edema disease of swine	ANIMAL
egg shell	ANIMAL
ejaculation	MALE
ejaculatory ducts	MALE
elder abuse	AGED:HUMAN
electric organ	ANIMAL
eliminative behavior, animal	ANIMAL

Term	CheckTag(s) Added
embolism, amniotic fluid	FEMALE:PREGNANCY
embryo, nonmammalian	ANIMAL
encephalomyelitis, enzootic porcine	ANIMAL
encephalopathy, bovine spongiform	ANIMAL:CATTLE
endometrial hyperplasia	FEMALE
endometrial neoplasms	FEMALE
endometriosis	FEMALE
endometritis	FEMALE
endometrium	FEMALE
enteritis, transmissible, of turkeys	ANIMAL
enterotoxemia	ANIMAL
enzootic bovine leukosis	ANIMAL:CATTLE
ephemeral fever	ANIMAL:CATTLE
epidermitis, exudative, of swine	ANIMAL
epididymis	MALE
epididymitis	MALE
episiotomy	FEMALE
equine infectious anemia	ANIMAL
erysipelothrix infections	ANIMAL
erythroblastosis, fetal	HUMAN:INFANT, NEWBORN
estrogen replacement therapy	FEMALE
estrus synchronization	FEMALE
estrus	FEMALE
extraction, obstetrical	FEMALE
fallopian tube diseases	FEMALE
fallopian tube neoplasms	FEMALE
fallopian tubes	FEMALE
fascioloidiasis	ANIMAL
fat body	ANIMAL
feathers	ANIMAL
feline acquired immunodeficiency syndrome	ANIMAL:CATS
feline infectious peritonitis	ANIMAL:CATS
feline panleukopenia	ANIMAL
feline	ANIMAL:CATS
female	FEMALE
fetal membranes, premature rupture	FEMALE:PREGNANCY
fetofetal transfusion	FEMALE:PREGNANCY
fetomaternal transfusion	FEMALE:PREGNANCY
fish diseases	ANIMAL
follicular atresia	FEMALE
follicular fluid	FEMALE
follicular phase	FEMALE
foot rot	ANIMAL
foot-and-mouth disease	ANIMAL
forefoot, human	HUMAN
forelimb	ANIMAL
fowl plague	ANIMAL
fowlpox	ANIMAL
frail elderly	HUMAN
freemartinism	ANIMAL:CATTLE
galactorrhea	FEMALE
gamete intrafallopian transfer	FEMALE
gastroenteritis, transmissible, of swine	ANIMAL
genital diseases, female	FEMALE
genital diseases, male	MALE
genital neoplasms, female	FEMALE
genital neoplasms, male	MALE

Term	CheckTag(s) Added
genitalia, female	FEMALE
genitalia, male	MALE
genome, human	HUMAN
gestosis, eph	FEMALE:PREGNANCY
gills	ANIMAL
girl	FEMALE
gizzard	ANIMAL
glanders	ANIMAL
goat diseases	ANIMAL
granulosa cells	FEMALE
grooming	ANIMAL
guinea pigs	ANIMAL
gynatresia	FEMALE
gynecologic surgical procedures	FEMALE
gynecomastia	MALE
hamster	HAMSTERS:ANIMAL
harderian gland	ANIMAL
health services for the aged	AGED:HUMAN
heart rate, fetal	FEMALE:PREGNANCY
heartwater disease	ANIMAL
hela cells	HUMAN
hellp syndrome	FEMALE:PREGNANCY
helminthiasis, animal	ANIMAL
hematocele	MALE
hematocolpos	FEMALE
hematometra	FEMALE
hemolymph	ANIMAL
hemorrhagic disease of newborn	HUMAN:INFANT, NEWBORN
hepatitis, animal	ANIMAL
hepatitis, infectious canine	ANIMAL:DOGS
hepatitis, viral, animal	ANIMAL
herpes gestationis	FEMALE:PREGNANCY
hindlimb	ANIMAL
hip dysplasia, canine	ANIMAL:DOGS
hl-60 cells	HUMAN
hog cholera	ANIMAL
home childbirth	FEMALE
homes for the aged	AGED:HUMAN
homing behavior	ANIMAL
hominidae	HUMAN
homosexuality, female	FEMALE
homosexuality, male	MALE
hoof and claw	ANIMAL
horns	ANIMAL
horse diseases	ANIMAL
ht29 cells	HUMAN
human	HUMAN
hyaline membrane disease	HUMAN:INFANT, NEWBORN
hydatidiform mole	FEMALE:PREGNANCY
hydatidiform mole, invasive	FEMALE:PREGNANCY
hydrocele	MALE
hymen	FEMALE
hyperemesis gravidarum	FEMALE:PREGNANCY
hypospadias	MALE
hysterectomy	FEMALE
hysterectomy, vaginal	FEMALE
impotence	MALE
impotence, vasculogenic	MALE

Term	CheckTag(s) Added
infant	HUMAN:INFANT
infant, newborn	HUMAN:INFANT, NEWBORN
infant, premature, diseases	HUMAN:INFANT, NEWBORN
infectious bovine rhinotracheitis	ANIMAL:CATTLE
infertility, female	FEMALE
infertility, male	MALE
intensive care units, neonatal	HUMAN:INFANT, NEWBORN
intensive care, neonatal	HUMAN:INFANT, NEWBORN
interrenal gland	ANIMAL
invitro	IN VITRO
in vitro	IN VITRO
jaundice, neonatal	HUMAN:INFANT, NEWBORN
jurkat cells	HUMAN
kb cells	HUMAN
keratoconjunctivitis, infectious	ANIMAL
koro	HUMAN:MALE
kraurosis vulvae	FEMALE
l cells (cell line)	ANIMAL:MICE
labor complications	FEMALE:PREGNANCY
labor onset	FEMALE:PREGNANCY
labor presentation	FEMALE:PREGNANCY
labor stage, first	FEMALE:PREGNANCY
labor stage, second	FEMALE:PREGNANCY
labor stage, third	FEMALE:PREGNANCY
labor, induced	FEMALE
labor, premature	FEMALE:PREGNANCY
lactation disorders	FEMALE
lactation	FEMALE
lameness, animal	ANIMAL
leukemia l1210	ANIMAL
leukemia l5178	ANIMAL
leukemia p388	ANIMAL
leukemia, feline	ANIMAL:CATS
leukomalacia, periventricular	HUMAN:INFANT, NEWBORN
leukorrhea	FEMALE
leydig cells	MALE
liver neoplasms, experimental	ANIMAL
llc-pk1 cells	ANIMAL
lordosis	ANIMAL
louping ill	ANIMAL
lumpy skin disease	ANIMAL:CATTLE
luteal phase	FEMALE
lutein cells	FEMALE
malaria, avian	ANIMAL
male	MALE
malignant catarrh	ANIMAL:CATTLE
malpighian tubules	ANIMAL
mammae	ANIMAL
mammaplasty	FEMALE
mammary neoplasms	ANIMAL
mammary neoplasms, experimental	ANIMAL
man	HUMAN:MALE
marburg virus disease	ANIMAL
marek disease	ANIMAL
mastitis	FEMALE
mastitis, bovine	ANIMAL:CATTLE:FEMALE
maternal exposure	FEMALE
maternal-fetal exchange	FEMALE:PREGNANCY

Term	CheckTag(s) Added
meconium aspiration	HUMAN:INFANT, NEWBORN
meigs' syndrome	FEMALE
men	HUMAN:MALE
menarche	FEMALE
menopause	FEMALE
menopause, premature	FEMALE
menorrhagia	FEMALE
menstrual cycle	FEMALE
menstruation disturbances	FEMALE
menstruation	FEMALE
metestrus	FEMALE
metrial gland	ANIMAL
metrorrhagia	FEMALE
mice	ANIMAL:MICE
middle age	HUMAN
milk ejection	FEMALE
monieziasis	ANIMAL
monkey diseases	ANIMAL
mouse	ANIMAL:MICE
murine acquired immunodeficiency syndrome	ANIMAL
muscular dystrophy, animal	ANIMAL
myometrium	FEMALE
myxomatosis, infectious	ANIMAL
nairobi sheep disease	ANIMAL
natural childbirth	FEMALE
neonatal abstinence syndrome	HUMAN:INFANT, NEWBORN
neonatal nursing	HUMAN:INFANT, NEWBORN
neonatal screening	HUMAN:INFANT, NEWBORN
nesting behavior	ANIMAL
newborn	INFANT, NEWBORN
newborn infant	HUMAN:INFANT, NEWBORN
newcastle disease	ANIMAL
nictitating membrane	ANIMAL
obstetric surgical procedures	FEMALE
oligohydramnios	FEMALE:PREGNANCY
oligomenorrhea	FEMALE
oligospermia	MALE
omasum	ANIMAL
oophoritis	FEMALE
ophthalmia neonatorum	HUMAN:INFANT, NEWBORN
optic lobe	ANIMAL
orchitis	MALE
osteoporosis, postmenopausal	FEMALE:HUMAN
ovarian cysts	FEMALE
ovarian diseases	FEMALE
ovarian failure, premature	FEMALE
ovarian follicle	FEMALE
ovarian hyperstimulation syndrome	FEMALE
ovariectomy	FEMALE
ovary	FEMALE
oviducts	ANIMAL
oviposition	FEMALE
ovulation	FEMALE
ovum implantation	FEMALE
ovum implantation, delayed	FEMALE
ovum transport	FEMALE
paediatric	CHILD

Term	CheckTag(s) Added
pair bond	ANIMAL
parametritis	FEMALE
paraphimosis	MALE
parasitic diseases, animal	ANIMAL
paratuberculosis	ANIMAL
parity	FEMALE
parovarian cyst	FEMALE
parturient paresis	ANIMAL:FEMALE:PREGNANCY
pasteurellosis, pneumonic	ANIMAL
paternal exposure	MALE
patient	HUMAN
pc12 cells	ANIMAL:RATS
pediatric	CHILD
penile diseases	MALE
penile erection	MALE
penile induration	MALE
penile neoplasms	MALE
penis	MALE
perianal glands	ANIMAL
persistent fetal circulation syndrome	HUMAN:INFANT, NEWBORN
phenylketonuria, maternal	FEMALE:PREGNANCY
phimosis	MALE
photoreceptors, invertebrate	ANIMAL
placenta accreta	FEMALE:PREGNANCY
placenta diseases	FEMALE:PREGNANCY
placenta praevia	FEMALE:PREGNANCY
placenta, retained	FEMALE:PREGNANCY
placental insufficiency	FEMALE:PREGNANCY
placentation	FEMALE:PREGNANCY
pleuropneumonia, contagious	ANIMAL
pneumonia, atypical interstitial, of cattle	ANIMAL:CATTLE
pneumonia, progressive interstitial, of sheep	ANIMAL
polycystic ovary syndrome	FEMALE
polyhydramnios	FEMALE:PREGNANCY
porcine reproductive and respiratory syndrome	ANIMAL
postimplantation phase	FEMALE:PREGNANCY
postmenopause	FEMALE
postpartum hemorrhage	FEMALE:PREGNANCY
poultry diseases	ANIMAL
pre-eclampsia	FEMALE:PREGNANCY
predatory behavior	ANIMAL
pregnancy complications	FEMALE:PREGNANCY
pregnancy complications, cardiovascular	FEMALE:PREGNANCY
pregnancy complications, hematologic	FEMALE:PREGNANCY
pregnancy complications, infectious	FEMALE:PREGNANCY
pregnancy complications, neoplastic	FEMALE:PREGNANCY
pregnancy complications, parasitic	FEMALE:PREGNANCY
pregnancy in adolescence	ADOLESCENCE:FEMALE:PREGNANCY
pregnancy in diabetics	FEMALE:PREGNANCY
pregnancy maintenance	FEMALE:PREGNANCY
pregnancy outcome	FEMALE:PREGNANCY
pregnancy rate	FEMALE:PREGNANCY
pregnancy reduction, multifetal	FEMALE:PREGNANCY
pregnancy toxemias	FEMALE:PREGNANCY
pregnancy	FEMALE:PREGNANCY
pregnancy, abdominal	FEMALE:PREGNANCY

Term	CheckTag(s) Added
pregnancy, animal	FEMALE:PREGNANCY
pregnancy, ectopic	FEMALE:PREGNANCY
pregnancy, high-risk	FEMALE:PREGNANCY
pregnancy, multiple	FEMALE:PREGNANCY
pregnancy, prolonged	FEMALE:PREGNANCY
pregnancy, tubal	FEMALE:PREGNANCY
pregnancy, unwanted	FEMALE:PREGNANCY
pregnant	PREGNANCY
preimplantation phase	FEMALE:PREGNANCY
premenopause	FEMALE
premenstrual syndrome	FEMALE
prenatal exposure delayed effects	FEMALE:PREGNANCY
priapism	MALE
primate diseases	ANIMAL
proestrus	FEMALE
prostate	MALE
prostatectomy	MALE
prostatic diseases	MALE
prostatic hyperplasia	MALE
prostatic neoplasms	MALE
prostatitis	MALE
protozoan infections, animal	ANIMAL
proventriculus	ANIMAL
pruritus vulvae	FEMALE
pseudopregnancy	FEMALE
pseudorabies	ANIMAL
puerperal disorders	FEMALE
puerperal infection	FEMALE
puerperium	FEMALE
pulmonary adenomatosis, ovine	ANIMAL
rabbit	ANIMAL:RABBITS
radiation injuries, experimental	ANIMAL
rat	RATS:ANIMAL
rectovaginal fistula	FEMALE
reproductive history	FEMALE
respiratory distress syndrome	HUMAN:INFANT, NEWBORN
rete testis	MALE
reticulum	ANIMAL
retinopathy of prematurity	HUMAN:INFANT, NEWBORN
rift valley fever	ANIMAL
rinderpest	ANIMAL
rodent diseases	ANIMAL
round ligament	FEMALE
rumen	ANIMAL
salmonella infections, animal	ANIMAL
salpingitis	FEMALE
salpingostomy	FEMALE
salt gland	ANIMAL
sarcoma, avian	ANIMAL
scent glands	ANIMAL
sclerema neonatorum	HUMAN:INFANT, NEWBORN
scrapie	ANIMAL
scrotum	MALE
seminal vesicles	MALE
seminiferous epithelium	MALE
seminiferous tubules	MALE
sertoli cells	MALE
setariasis	ANIMAL

Term	CheckTag(s) Added
sex behavior, animal	ANIMAL
sheep diseases	ANIMAL
simian acquired immunodeficiency syndrome	ANIMAL
sperm agglutination	MALE
sperm banks	MALE
sperm capacitation	MALE
sperm count	MALE
sperm head	MALE
sperm maturation	MALE
sperm motility	MALE
sperm tail	MALE
sperm transport	MALE
sperm-ovum interactions	FEMALE:MALE
spermatic cord torsion	MALE
spermatic cord	MALE
spermatids	MALE
spermatocele	MALE
spermatocytes	MALE
spermatogenesis	MALE
spermatogonia	MALE
spermatozoa	MALE
steatitis	ANIMAL
sterilization, tubal	FEMALE
stifle	ANIMAL
stomach, avian	ANIMAL
stomach, ruminant	ANIMAL
strongyle infections, equine	ANIMAL
superfetation	FEMALE:PREGNANCY
superovulation	FEMALE
swayback	ANIMAL
swine diseases	ANIMAL
swine erysipelas	ANIMAL
swine vesicular disease	ANIMAL
swine, miniature	ANIMAL
tail	ANIMAL
tarsus, animal	ANIMAL
teenage	ADOLESCENCE
teenaged	ADOLESCENCE
teenager	ADOLESCENCE
testicular diseases	MALE
testicular feminization	MALE
testicular neoplasms	MALE
testis	MALE
theca cells	FEMALE
theileriasis	ANIMAL:CATTLE
tocolysis	FEMALE:PREGNANCY
toxocariasis	ANIMAL
toxoplasmosis, animal	ANIMAL
trial of labor	FEMALE:PREGNANCY
trichomonas vaginitis	FEMALE
trophoblastic neoplasms	FEMALE:PREGNANCY
trophoblastic tumor, placental site	FEMALE:PREGNANCY
trypanosomiasis, bovine	ANIMAL:CATTLE
tuberculosis, avian	ANIMAL
tuberculosis, bovine	ANIMAL:CATTLE
tuberculosis, female genital	FEMALE
tuberculosis, male genital	MALE

Term	CheckTag(s) Added
ultimobranchial body	ANIMAL
ultrasonography, prenatal	FEMALE:PREGNANCY
urologic surgical procedures, male	MALE
uterine contraction	FEMALE:PREGNANCY
uterine diseases	FEMALE
uterine hemorrhage	FEMALE
uterine inertia	FEMALE:PREGNANCY
uterine inversion	FEMALE
uterine monitoring	FEMALE:PREGNANCY
uterine neoplasms	FEMALE
uterine perforation	FEMALE
uterine prolapse	FEMALE
uterine rupture	FEMALE:PREGNANCY
uterus	FEMALE
vacuum curettage	FEMALE
vacuum extraction, obstetrical	FEMALE
vagina	FEMALE
vaginal	FEMALE
vaginitis	FEMALE
vaginosis, bacterial	FEMALE
varicocele	MALE
vas deferens	MALE
vasovasostomy	MALE
venereal tumors, veterinary	ANIMAL
vero cells	ANIMAL
version, fetal	FEMALE
vertebrates	ANIMAL
vesicovaginal fistula	FEMALE
vesicular exanthema of swine	ANIMAL
vibrissae	ANIMAL
visna	ANIMAL
vocalization, animal	ANIMAL
vulva	FEMALE
vulvar diseases	FEMALE
vulvar neoplasms	FEMALE
vulvitis	FEMALE
vulvovaginitis	FEMALE
white muscle disease	ANIMAL
wing	ANIMAL
woman	FEMALE:HUMAN
women	FEMALE:HUMAN
zoonoses	ANIMAL

Appendix E – Geographics Lookup & Substitution List

Town/City	Country Added
Dhaka	Bangladesh
Bangkok	Thailand
Chiang Rai	Thailand
Cape Town	South Africa
Carletonville	South Africa
Durban	South Africa
Gauteng	South Africa
Johannesburg	South Africa
Kwazulu-Natal	South Africa
Lusaka	Zambia
Ndola	Zambia
Harare	Zimbabwe
Yaounde	Cameroon
Bangui	Central African Republic
Katanga	Democratic Republic of Congo
Kinshasa	Democratic Republic of Congo
Mombasa	Kenya
Nairobi	Kenya
Nyanza Province	Kenya
Dar es Salaam	Tanzania
Kagera	Tanzania
Mwanza	Tanzania
Rakai	Uganda
Kampala	Uganda
Kigali	Rwanda
Abidjan	Cote d'Ivoire
Bouake	Cote d'Ivoire
Conakry	Guinea
Lagos	Nigeria
Dakar	Senegal
Cotonou	Benin
Guangxi	China
Shanghai	China
Yunnan	China
Manila	Philippines
Bangalore	India
Calcutta	India
Chennai	India
Karnataka	India
Madurai	India
Madras	India
Maharashtra	India
Manipur	India
Pune	India
Rajasthan	India
Addis Ababa	Ethiopia

Appendix F – MH/SH Lookup & Substitution List

MH	SH
Abnormalities	abnormalities
Allergy and Immunology	immunology
Blood	blood
Blood Circulation	blood supply
Cerebrospinal Fluid	cerebrospinal fluid
Chemistry	chemistry
Chemistry, Analytical	analysis
Classification	classification
Cytology	cytology
Deficiency Diseases	deficiency
Diagnosis	diagnosis
Diet Therapy	diet therapy
Disease Transmission	transmission
Drug Therapy	drug therapy
Economics	economics
Education	education
Embryology	embryology
Enzymes	enzymology
Epidemiology	epidemiology
Equipment and Supplies	instrumentation
Ethnology.	ethnology
Genetics	genetics
Health Manpower	manpower
History	history
Metabolism	metabolism
Methods	methods
Microbiology	microbiology
Mortality	mortality
Neoplasm Metastasis	secondary
Nursing	nursing
Nursing Care	nursing
Organization and Administration	organization & administration
Parasitology	parasitology
Pathology	pathology
Pharmacokinetics	pharmacokinetics
Pharmacology	pharmacology
Physiology	physiology
Poisoning	poisoning
Preventive Medicine	prevention & control
Psychology	psychology
Radiation Effects	radiation effects
Radiography	radiography
Radionuclide Imaging	radionuclide imaging
Radiotherapy	radiotherapy
Rehabilitation	rehabilitation
Statistics	statistics & numerical data
Surgery	surgery
Surgical Procedures, Operative	surgery
Therapeutics	therapy
Toxicology	toxicity
Transplantation	transplantation
Ultrasonography	ultrasonography
Urine	urine
Veterinary Medicine	veterinary
Virology	virology

Appendix G – MH Exclusion List

MeSH Term	Special
Age Groups	
Algae and Fungi	
Amino Acids, Peptides, and Proteins	
Analysis of Variance	**X**
Anesthesia and Analgesia	
Animal Structures	
Animals	
Anti-Allergic and Respiratory System Agents	
Anti-Inflammatory Agents, Antirheumatic Agents, and Inflammation Mediators	
Antineoplastic and Immunosuppressive Agents	
Bacterial Infections and Mycoses	
Behavior and Behavior Mechanisms	
Behavioral Disciplines and Activities	
Biochemical Phenomena, Metabolism, and Nutrition	
Biological Phenomena, Cell Phenomena, and Immunity	
Blood Chemical Analysis	
Bodily Secretions	**X**
Body Regions	
Body Temperature Changes	
Body Weight Changes	
Bones of Upper Extremity	
Budding and Appendaged Bacteria	**X**
Carbohydrates and Hypoglycemic Agents	
Causality	
Cell Division Phases	
Cell Membrane Structures	**X**
Cell Surface Extensions	**X**
Cells	
Cellular Structures	
Chemical Actions	
Chemical Actions and Uses	
Chemical and Pharmacologic Phenomena	
Chromosome Structures	
Chromosomes, Human	
Circulatory and Respiratory Physiology	
Cohort Effect	**X**
Colorectal Surgery	**X**
Congenital, Hereditary, and Neonatal Diseases and Abnormalities	
Cytoplasmic Structures	**X**
Diagnostic Imaging	**X**
Digestive, Oral, and Skin Physiology	
Disease Attributes	
Disorders of Environmental Origin	
Dosage Forms	**X**
Embolism and Thrombosis	
Endospore-Forming Bacteria	**X**
Environment and Public Health	
Environmental Pollutants, Noxae, and Pesticides	
Enzymes, Coenzymes, and Enzyme Inhibitors	
Epidemiologic Factors	**X**
Epidemiologic Methods	**X**
Epidemiologic Study Characteristics	
Epidermolysis Bullosa	**X**
Eye Manifestations	
Female Genital Diseases and Pregnancy Complications	

MeSH Term	Special
Fluids and Secretions	
Food and Beverages	
Fungi, Unclassified	X
Genes	
Genetic Phenomena	
Genetic Processes	
Genetic Structures	
Geographic Locations	
Gram-Negative Aerobic Bacteria	X
Gram-Negative Anaerobic Bacteria	X
Gram-Negative Anaerobic Cocci	X
Gram-Negative Anaerobic Straight, Curved, and Helical Rods	X
Gram-Negative Chemolithotrophic Bacteria	X
Gram-Positive Asporogenous Rods, Irregular	X
Gram-Positive Endospore-Forming Bacteria	X
Gram-Positive Endospore-Forming Rods	X
Gram-Positive Rods	X
Growth and Embryonic Development	
Growth Substances, Pigments, and Vitamins	
Health Care Economics and Organizations	
Health Care Evaluation Mechanisms	
Health Care Facilities, Manpower, and Services	
Health Care Quality, Access, and Evaluation	
Healthy Worker Effect	X
Hemic and Immune Systems	
Hormones, Hormone Substitutes, and Hormone Antagonists	
Immunity	
Immunologic and Biological Factors	
Infant, Newborn, Diseases	X
Intervention Studies	
Investigative Techniques	
Ions	
Isomerases	
Jaw Abnormalities	X
Jurisprudence	
Least-Squares Analysis	
Lipids and Antilipemic Agents	
Matched-Pair Analysis	X
Mercury Poisoning	X
Methanogens	X
Microbiologic Phenomena	
Mind-Body and Relaxation Techniques	X
Monitoring, Immunologic	X
Mouth Rehabilitation	X
Multivariate Analysis	X
Musculoskeletal, Neural, and Ocular Physiology	
Neoplasms by Histologic Type	
Neoplasms by Site	
Neurobehavioral Manifestations	
Neurologic Manifestations	
Neuromuscular Manifestations	
Neurotransmitters and Neurotransmitter Agents	
Nevi and Melanomas	
Normal Distribution	X
Nucleic Acids, Nucleotides, and Nucleosides	
Nutritional and Metabolic Diseases	
Occupational Groups	
Oral Manifestations	

MeSH Term	Special
Pathologic Processes	
Pathological Conditions, Signs and Symptoms	
Persons	
Plant Families and Groups	
Plants, Toxic	**X**
Population Characteristics	
Psychological Phenomena and Processes	
Publications	
Radioactivity	
Random Allocation	**X**
Rehabilitation of Speech and Language Disorders	
Reproductive and Urinary Physiology	
Reproductive Techniques	**X**
Rickettsiales Infections	**X**
Risk	
Schizophrenia and Disorders with Psychotic Features	
Sexual and Gender Disorders	
Signs and Symptoms	
Signs and Symptoms, Digestive	
Signs and Symptoms, Respiratory	
Single-Blind Method	**X**
Skin and Connective Tissue Diseases	
Skin Manifestations	
Specialty Chemicals and Products	
Spiral and Curved Bacteria	**X**
Surgical Procedures, Minor	**X**
Technology, Industry, and Agriculture	
Tissues	
Tooth Components	
Urinary Tract Physiology	**X**
Urologic and Male Genital Diseases	
Urological Manifestations	
Uses of Chemicals and Drugs	
Vertebrate Viruses	

Appendix H – Special Publication Type List

Publication Type	Recommendation Limit
Review	14
News	14
Editorial	9
Letter	8