

**MEETING OF HEADS OF WHO COLLABORATING CENTRES
FOR THE CLASSIFICATION OF DISEASES**

Brisbane, Queensland, Australia

14-19th October 2002

Title: ICD-10 and the Unified Medical Language System (UMLS)

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Purpose: for information

Recommendations:

- ♦ ICD-10 should be incorporated into the UMLS in as many languages as possible.
- ♦ Discuss current layout of Tabular List
- ♦ Discuss current format of Alphabetical Index

Abstract:

The Unified Medical Language System has been published by the US National Library of Medicine in its twelfth edition (2001). It consists of three components: a Metathesaurus with 800,000 distinct concepts from about 100 vocabularies, a Semantic Network which provides a consistent categorization of these concepts, and the Specialist Lexicon and lexical programs for processing of biomedical texts in English language. These components and extensive documentation are accessible via the INTERNET by a browser (Knowledge Source Server) and on CD-ROM.

After an overview over the structure of UMLS, the paper will focus on the Metathesaurus and show how ICD-10 has been integrated. Examples for applications of the UMLS in classification work are given. Finally, certain problems of the integration of ICD-10 will be discussed and improvements suggested.

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Overview of the Unified Medical Language System

One of the major barriers to effective retrieval and use of medical information systems is the variety of vocabularies, classifications and nomenclatures used by different sources and users. The UMLS project of the US National Library of Medicine is a long-term effort to overcome this barrier by “the development of ‘intellectual middleware’ in the form of machine-readable ‘Knowledge Sources’ that can be used by a wide variety of applications programs to compensate for differences in the way concepts are expressed in different machine-readable sources and by different users.” [1]

The UMLS consists of three components:

1. The *Metathesaurus* is organized by biomedical concepts and lists their various names and the relationship between these concepts. The 2001 edition contains almost 1.5 million terms for nearly 800,000 different concepts from 100 classifications, thesauri, nomenclatures, coding systems and term lists.
2. All concepts of the *Metathesaurus* have been assigned to a *Semantic Network* with 134 semantic types which are linked by 54 relationships.
3. The *SPECIALIST Lexicon* is a linguistic lexicon with syntactic information on biomedical terms plus a suite of computer programs for effective searching, indexing and lexical processing.

The UMLS is distributed free of charge by the National Library of Medicine via the INTERNET or on CD-Rom after signing a licence agreement. Licencees can access all Knowledge Sources directly via the INTERNET using the UMLS Knowledge Source Server. This access mode is very suitable for occasional queries and bypasses the considerable intellectual and computational effort necessary for a local implementation of the sources in a database system (raw data size is more than 3 Gbytes).

This paper will focus on the structure and contents of the *Metathesaurus* and will show, how ICD-10 has been integrated. A few examples for applications based on the *Metathesaurus* will be given. Certain problems of the integration of ICD-10 will be discussed and improvements will be suggested.

Among the vocabularies integrated into the UMLS are the Medical Subject Headings (MeSH) in eight languages, ICPC-93 in 14 languages, WHO Adverse Drug Reaction Terminology in 5 languages, SNOMED-2, SNOMED-3, and the UK Clinical Terms (former Read Codes). The WHO version of ICD-10 is available in two languages: English (plus an Americanized version) and German. Furthermore, the Australian modification ICD-10-AM has been integrated (also with an additional Americanized version). ICD-9 is only available in its US clinical modification.

The *Metathesaurus* comes as a suite of files in relational database format. A good starting point is the relation MRCON which lists strings per concept. The following table gives an overview over the size of MRCON and the coverage of languages:

Language	Number of strings	Percentage
English	1,462,202	84.2 %
German	66,381	3.8 %
Spanish	49,664	2.9 %
Portuguese	43,348	2.5 %
Russian	40,716	2.4 %
French	33,011	1.9 %
Finnish	20,178	1.2 %
Italian	14,417	0.8 %
Danish	723	< 0.1 %
Dutch	723	< 0.1 %
Swedish	723	< 0.1 %
Norwegian	722	< 0.1 %
Hungarian	718	< 0.1 %
Basque	695	< 0.1 %
Hebrew	485	< 0.1 %
All languages	1,734,706	100 %

The next table shows a few lines from the relation MRCON:

MRCON				
CUI	LAT	TS	SUI	STR
Concept Unique Identifier	Language of Term	Term Status	String Unique Identifier	String
C0002871	ENG	P	S0013742	Anemia
C0002871	ENG	P	S0352787	ANEMIA
C0002871	ENG	P	S0470197	Anemia, NOS
C0002871	ENG	P	S0013787	Anemias
C0002871	ENG	S	S0803242	Anaemia
C0002871	ENG	S	S0500659	Oligocythemia of red blood cells
C0002871	ENG	S	S0500660	Oligocytosis of red blood cells
C0002871	ENG	S	S0589617	Anemia, unspecified
C0002871	ENG	S	S0793729	Absolute anaemia
C0002871	ENG	S	S1922798	Anemia, essential
C0002871	FIN	P	S1846776	anemia
C0002871	FRE	P	S0227229	ANEMIE
C0002871	GER	P	S1473607	Anaemie
C0002871	GER	S	S1480292	Blutarmut
C0002871	ITA	P	S1474094	Anemia
C0002871	POR	P	S0428686	ANEMIA
C0002871	RUS	P	S1093802	ANEMIIA
C0002871	SPA	P	S0446440	ANEMIA

Term Status: P = preferred term, S = synonym

MRCON is linked to other relations via the unique identifiers CUI (Concept Unique Identifier) and SUI (String Unique Identifier).

MRDEF contains definitions for concepts in MRCON from various sources (unfortunately only for some 30,000 concepts):

MRDEF		
CUI	SAB	DEF
Concept Unique Identifier	Source Abbreviation	Definition
C0002871	CSP2000	subnormal levels or function of erythrocytes, resulting in symptoms of tissue hypoxia.
C0002871	MSH2001	A reduction in the number of circulating erythrocytes or in the quantity of hemoglobin.
C0002871	PDQ2000	A condition in which the number of red blood cells is below normal.
Source Abbreviations are listed in the Appendix.		

MRSO indicates which sources a string comes from and which code has been assigned in a source to this string:

MRSO				
SUI	STR	SAB	TTY	SCD
String Unique Identifier	String	Source Abbreviation	Term Type	Source Code
S0013742	Anemia	ICPCPAE	PT	B82005
S0013742	Anemia	MSH2001	MH	D000740
S0013742	Anemia	RCDAE	PT	XM05A
S0013742	Anemia	SNM2	PT	D-4010
S0227229	ANEMIE	INS2001	MH	D000740
S0227229	ANEMIE	WHOFRE	PT	0544
S0428686	ANEMIA	WHOPOR	PT	0544
S0446440	ANEMIA	BRMS200	MH	D000740
S0446440	ANEMIA	WHOSPA	PT	0544
S0470197	Anemia, NOS	MTHICD9	ET	285.9
S0470197	Anemia, NOS	SNMI98	PT	DC-10010
S0500659	Oligocythemia of red blood cells	SNMI98	SY	DC-10010
S0500660	Oligocytosis of red blood cells	SNMI98	SY	DC-10010
S0589617	Anemia, unspecified	ICD10AE	PT	D64.9
S0589617	Anemia, unspecified	ICD2001	PT	285.9
S0589617	Anemia, unspecified	ICDAMAE	PT	D64.9
S0793729	Absolute anaemia	SNMI98	SY	DC-10010
S0803242	Anaemia	ICPC2P	PT	B82005
S0803242	Anaemia	RCD99	PT	XM05A
S1093802	ANEMIIA	RUS2001	MH	D000740
S1473607	Anaemie	DMD2001	MH	D000740
S1474094	Anemia	ITA2001	MH	D000740
S1480292	Blutarmut	DMD2001	SY	D000740
S1846776	anemia	FIN2001	MH	D000740
S1922798	Anemia, essential	MTHICD9	ET	285.9
Term Type in Source Vocabulary: PT = preferred term, MH = main heading, ET = entry term, SY = synonym Source Abbreviations are listed in the Appendix.				

MRSTY lists the semantic types for each concept:

MRSTY		
CUI	TUI	STY
Concept Unique Identifier	Type Unique Identifier	Semantic Type
C0002871	T047	Disease or Syndrome

MRSAT contains various attributes of the strings available in their sources (e.g. and ICD code or an ICD-9-CM code assigned to a string in SNOMED-3):

MRSAT					
CUI	SUI	SCD	SAB	ATN	ATV
Concept Unique Identifier	String Unique Identifier	Source Code	Source Abbreviation	Attribute Name	Attribute Value
C0002871	S0589617	285.9	ICD2001	ICE	Anemia: {NOS; essential; normocytic, not due to blood loss; profound; progressive; secondary}; Oligocythemia
C0002871	S0589617	285.9	ICD2001	ICS	ANEMIA NOS
C0002871	S0589617	285.9	ICD2001	SOS	Excludes: anemia (due to): {blood loss: {acute (285.1); chronic or unspecified (280.0)}; iron deficiency (280.0-280.9)}
C0002871	S0013742	02450	PSY97	PYR	1973
C0002871	S0803242	XM05A	RCD99	RID	Y20Yc
C0002871	S0793729	DC-10010	SNMI98	SIC	285.9
Attribute Name ICE = ICD entry term, ICS = ICD short form, SOS = scope statement, PYR = PsycInfo year designation, RID = Read Codes term id, SIC = SNOMED ICD-9-CM reference Source Abbreviations are listed in the Appendix.					

And finally MRREL lists relations between concepts (e.g. broader term or narrower term):

MRREL		
String1 is a	Relation	of String2
Anemia	CHD	Hematologic Diseases
Anemia	CHD	Blood and Lymphatic Disorders
Anemia	CHD	Red blood cell disorder, NOS
Anemia	PAR	Anemia, Dyserythropoietic, Congenital
Anemia	PAR	Anemia, Hemolytic
Anemia	PAR	Microcytic anemia
Anemia	RB	Megaloblastic anemia due to vitamin B12 deficiency
Anemia	RB	Anemia, Iron-Deficiency
Anemia	RB	Anemia, Aplastic
Anemia	RN	Hematologic Diseases
Anemia	RN	Red blood cell disorder, NOS
Anemia	RO	Lymphoma
Anemia	RO	ZODOVUDINE ADVERSE REACTION
Anemia	RO	Folic Acid Deficiency
Anemia	RO	Gastritis
Anemia	RO	AMPHOTERICIN B ADVERSE REACTION
Relation:	CHD = child, PAR = parent, RB = broader term, RN = narrower term, RO = other relation than broader, narrower or synonym	

Applications of the Unified Medical Language System

First of all the UMLS Metathesaurus is a valuable source for any kind of classification work as it allows a quick view into many sources and their different hierarchies. A variety of synonyms and lexical variants is available for most concepts. The UMLS answers questions like:

- What is the preferred term for a concept in different vocabularies?
- Which synonyms are available for a concept?
- Where is a concept situated in the hierarchy in different systems?
- How is a concept defined?
- What are the meanings and relationships of an unknown concept?

Computer supported translation of medical vocabularies

Every year the MeSH thesaurus (Medical Subject Headings) is updated by the US National Library of Medicine. Before translating the update into German, the "new" strings in the updated vocabulary are checked against MRCON and a very first translation is generated from the terms having a German translation in MRCON.

Switching between vocabularies

A useful application of the UMLS is to switch from one vocabulary to another. E.g. it would be helpful to start a bibliographic database search with an ICD code from a patient record. After entering an ICD code the corresponding concept can be identified

in MRCON and the MeSH term for that concept can be picked up for a search in the MEDLINE database. Such an application has been described by Cimino (2).

How has the information available in ICD-10 been integrated into the Metathesaurus?

Chapter III	
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50–D89)	
Nutritional anaemias (D50–D53)	
D50	Iron deficiency anaemia <i>Includes:</i> anaemia: • asiderotic • hypochromic
D50.1	Sideropenic dysphagia Kelly-Paterson syndrome Plummer-Vinson syndrome

As an example, information on *sideropenic dysphagia* from ICD-10 shall be located in the Metathesaurus:

The terms from the hierarchy of ICD-10 can be found in MRCON, the codes and term types in MRSO (both tables are linked for the following table):

MRCON × MRSO					
CUI	STT	SUI	STR	TTY	SCD
Concept Unique Identifier	String Type	String Unique Identifier	String	Term Type	Source Code
C0032249	PF	S0000587	Sideropenic dysphagia	PT	D50.1
C0162316	PF	S0919819	Iron deficiency anaemia	HT	D50
C0271903	PF	S0698060	Nutritional anaemias	HT	D50-D53.9
C0694451	PF	S1458425	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanisms	HT	D50-D89.9
String Type: PF = preferred form					
Term Type: PT = preferred term, HT = hierarchical term					

The hierarchy of the classification is represented in MRREL as follows:

MRREL		
STR1	REL	STR2
First string	has relation	to second string
Sideropenic dysphagia	CHD	Iron deficiency anaemia
Iron deficiency anaemia	PAR	Sideropenic dysphagia
Iron deficiency anaemia	CHD	Nutritional anaemias
Nutritional anaemias	PAR	Iron deficiency anaemia
Nutritional anaemias	CHD	Diseases of blood and blood-forming organs and certain disorders involving the immune mechanisms
Diseases of blood and blood-forming organs and certain disorders involving the immune mechanisms	PAR	Nutritional anaemias

Relation: CHD = child, PAR = parent

This is the only information from ICD-10 stored in the UMLS. MRSAT does not list any source attributes for ICD-10. The strings "Kelly-Paterson syndrome" or "Plummer-Vinson syndrome" are inclusion notes in ICD-10. They are stored in MRCON, but they are not related to ICD-10. That means that ICD-10 was not among the sources which have been used to add these terms. Instead they come from many other vocabularies:

MRCON × MRSO			
CUI	SUI	STR	SAB
Concept Unique Identifier	String Unique Identifier	String	Source Abbreviation
C0032249	S0003849	Kelly-Patterson syndrome	SNM2
C0032249	S0605423	Brown-Kelly-Paterson syndrome	RCD99
C0032249	S0393083	PATERSON-BROWN-KELLY SYNDROME	DXP94
C0032249	S0503312	Paterson-Kelly syndrome	MTHICD9
C0032249	S0503312	Paterson-Kelly syndrome	SNMI98
C0032249	S1603957	Kelly-Paterson syndrome	RCD99
C0032249	S0715521	Plummer-Vinson-Patterson-Kelly syndrome	RCD99
C0032249	S0074474	Plummer-Vinson Syndrome	MSH2001
C0032249	S0393811	PLUMMER-VINSON SYNDROME	DXP94
C0032249	S0396550	Plummer-Vinson syndrome	MTHICD9
C0032249	S0396550	Plummer-Vinson syndrome	RCD99
C0032249	S0396550	Plummer-Vinson syndrome	SNMI98
C0032249	S0074473	Plummer Vinson Syndrome	MSH2001
C0032249	S1660197	PLUMMER VINSON SYNDROME	CCPSS99
C0032249	S0715521	Plummer-Vinson-Patterson-Kelly syndrome	RCD99
C0032249	S0237440	PLUMMER-VINSON, SYNDROME	INS2001

Source Abbreviations are listed in the Appendix.

A search for codes like D50.8 in the UMLS will only find the string "Other iron-deficiency anemias". But what happened to the terms from the Alphabetical Index? E.g.

Anemia

- achlorhydric D50.8
- chlorotic D50.8
- hypochromic
- - microcytic D50.8

If we search for these concepts in MRCON, we will find them, but again they do not come from ICD-10:

MRCON × MRSO			
SUI	STR	SAB	SCD
String Unique Identifier	String	Source Abbreviation	Source code
S0584094	Achlorhydric anaemia	RCD99	D00z0
S0584094	Achlorhydric anaemia	SNMI98	DC-13018
S0468348	Achlorhydric anemia	MTHICD9	280.9
S0468348	Achlorhydric anemia	RCDAE	D00z0
S0468348	Achlorhydric anemia	SNMI98	DC-13018
S0837055	Chlorotic anaemia	RCD99	D00z1
S0837055	Chlorotic anaemia	SNMI98	DC-13010
S0476050	Chlorotic anemia	MTHICD9	280.9
S0476050	Chlorotic anemia	RCDAE	D00z1
S0476050	Chlorotic anemia	SNMI98	DC-13010
S0905802	Hypochromic microcytic anaemia	SNMI98	DC-10030
S0490195	Hypochromic microcytic anemia	SNM2	D-4015
S0490195	Hypochromic microcytic anemia	SNMI98	DC-10030

Source Abbreviations are listed in the Appendix.

Problems of the representation of ICD-10 in the UMLS*Languages*

Although, ICD-10 has been translated into many languages, only English and German are available in the UMLS. The major obstacle to having these translations included in UMLS has been concerns over intellectual property rights. The NLM has a well developed process for protecting those rights in the UMLS license agreements, and translators should be encouraged to review and utilize them.

Detail of Information

Many data items from ICD-10 are totally missing: the inclusion terms or terms from the Alphabetical Index are only available when they come from other vocabularies and they are not linked to ICD-10. Users of the UMLS will get the impression that many clinical terms are totally missing from ICD-10.

Manifestation codes are not distinguished from etiology codes. Furthermore, all information on dual coding is entirely missing.

The representation of ICD-9-CM (Clinical Modification for the United States of America) is much better and shows reasons for the weakness in the representation of ICD-10 and what could be done to improve the situation.

Obviously the format of the ICD-10 electronic version does not support complete inclusion into the UMLS. The format of the inclusion notes (lists, tables with curly braces) are a major obstacle to the integration. For ICD-9-CM inclusion notes have been reformatted without curly braces and thus we will find all inclusion notes in the relation MRSAT. The use of elliptical references (incompletely specified terms, becoming complete only by including the proper grammatical form of the head) in the inclusion notes provides a barrier to the processing of these notes. The use of fully-specified terms as inclusion notes should be encouraged.

280	Iron deficiency anemias
Includes:	anemia: asiderotic hypochromic-microcytic sideropenic
Excludes:	familial microcytic anemia (282.4)
	280.0 Secondary to blood loss (chronic) Normocytic anemia due to blood loss
Excludes:	acute posthemorrhagic anemia (285.1)

MRSAT				
SUI	SAB	SCD	ATN	ATV
String Unique Identifier	Source Abbreviation	Source Code	Attribute Name	Attribute Value
S0217892	ICD2001	280	ICS	IRON DEFICIENCY ANEMIAS*
S0217892	ICD2001	280	SOS	Excludes: familial microcytic anemia (282.4)
S0217892	ICD2001	280	SOS	Includes: anemia: {asiderotic; hypochromic-microcytic; sideropenic}
S0245654	ICD2001	280.0	ICE	Normocytic anemia due to blood loss
S0245654	ICD2001	280.0	SOS	Excludes: acute posthemorrhagic anemia (285.1)
Attribute Name: ICE = ICD entry term, SOS = scope statement				
Source Abbreviations are listed in the Appendix.				

Furthermore, there is a special vocabulary MTHICD9 which contains “NLM-generated entry terms” for ICD-9-CM. This source contains the inclusion notes, converted into more natural strings and takes them out of MRSAT to become real concepts in MRCON:

280.9	Iron deficiency anemia, unspecified
	Anemia: achlorhydric chlorotic idiopathic hypochromic iron [Fe] deficiency NOS

MRCON × MRSO			
SUI	STR	SAB	SCD
String Unique Identifier	String	Source Abbreviation	Source Code
S0468348	Achlorhydric anemia	MTHICD9	280.9
S0476050	Chlorotic anemia	MTHICD9	280.9
S0490730	Idiopathic hypochromic anemia	MTHICD9	280.9
S0919829	Iron deficiency anemia NOS	MTHICD9	280.9
S1922790	Fe deficiency anemia NOS	MTHICD9	280.9
Source Abbreviations are listed in the Appendix.			

Alphabetical Index

The current format of the Alphabetical Index is designed for a book reader. It is not very suitable for electronic data processing, as it does not list self-containing texts or use a semantic structure which can support database searches. This format is a major obstacle for any other use of the Alphabetical Index besides reading.

Due to the broad scope of the Metathesaurus and due to the variety of sources included, it is to be expected that many terms from the Alphabetical Index can be found in MRCON, however, these terms cannot be linked to ICD-10.

We have compared a small sample of terms from the Alphabetical Index with the Metathesaurus to find out how many terms have already been included: 2,351 out of 3,756 terms from the index (all terms without any modifiers and with an ICD code) matched against MRCON (using normalized string processing from the Specialist Lexicon of the UMLS). Thus, only about 2/3 of the index terms can be found in MRCON. Missing are terms like "assam fever" or "atelocardia". However, many terms simply do not match due to the format of the Alphabetical Index: E.g. "Aspergillois, aspergilloma" is a term consisting of two distinct concepts, which will produce no hits; however, both "aspergillois" and "aspergilloma" are certainly included in the Metathesaurus.

How can we improve this situation?

ICD-10 should be incorporated into the UMLS in as many languages as possible. Thus, all WHO Collaborating Centers are encouraged to send files of their national language versions (codes and titles in ASCII delimited format) to Stuart Nelson (nelson@nlm.nih.gov) at the US National Library of Medicine.

There are two major obstacles in the electronic use of ICD-10, which are related to layout features of the printed book: lists with bullets and tables with curly braces. It should be discussed whether alternatives to these layout features could be used for the next printed version of ICD-10 in order to stimulate the electronic use of the classification.

Furthermore, it should be discussed whether an alternative format for the Alphabetical Index is feasible that would make the index a tool which can be used more easily in a computerized environment.

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2. Cimino JJ; Johnson SB; Peng P; Aguirre A: From ICD9-CM to MeSH Using the UMLS: A How-to Guide. In: Safran C (Ed): Patient centered computing. Proceedings of the Seventeenth Annual Symposium on Computer Applications in Medical Care. October 30 - November 3, 1993, Washington, DC. Pp. 730-4.

Appendix

Source Abbreviations used in the examples of this paper:

BRMS200	Descriptores en Ciencias de la Salud [Spanish translation of MeSH]. Sao Paulo (Brazil): Latin American and Caribbean Center on Health Sciences Information. BIREME/PAHO/WHO, 2001.
CCPSS99	Canonical Clinical Problem Statement System (CCPSS). Version 1.0. Nashville (TN): Department of Biomedical Informatics, Vanderbilt University, 1999.
CSP2000	Computer Retrieval of Information on Scientific Projects (CRISP). Bethesda (MD): National Institutes of Health, Division of Research Grants, Research Documentation Section, 2000.
DMD2001	German translation of the MeSH. Cologne (Germany): Deutsches Institut fuer Medizinische Dokumentation und Information, 2001.
DXP94	DXplain (An expert diagnosis program). Boston (MA): Massachusetts General Hospital.
FIN2001	Finnish translation of MeSH. Helsinki (Finland): Finnish Medical Society Duodecim, 2001.
ICD10AE	International Statistical Classification of Diseases and Related Health Problems (ICD-10). Tenth Revision. Geneva (Switzerland): World Health Organization, 1998. Americanized Version.
ICD2001	International Classification of Diseases: 9th revision, Clinical Modification (ICD-9-CM). 3rd ed. Washington (DC): Health Care Financing Administration; 2001.

ICDAMAE	ICD10AM International Statistical Classification of Diseases and Related Health Problems. Tenth Revision, Australian Modification; 2nd Edition: January 2000. Americanized Version.
ICPC2P	International Classification of Primary Care: Version 2-Plus: Australian Modification; January, 2000.
ICPCPAE	International Classification of Primary Care: Version 2-Plus: Australian Modification; January, 2000. Americanized Version.
INS2001	Thesaurus Biomedical Francais/Anglais [French translation of MeSH]. Paris (France): Institut National de la Sante et Recherche Medicale, 2001.
ITA2001	Italian translation of MeSH. Rome (Italy): Istituto Superiore di Sanita Servizio Documentazione, 2001.
MSH2001	Medical Subject Headings (MeSH). Bethesda (MD): National Library of Medicine, 2001.
MTHICD9	NLM-generated Entry Terms for ICD-9-CM. Bethesda (MD): National Library of Medicine.
PDQ2000	Physician Data Query Online System (PDQ). Bethesda (MD): National Cancer Institute, August 2000.
PSY97	Thesaurus of Psychological Index Terms. Washington (DC): American Psychological Association, 1997.
RCD99	Clinical Terms Version 3 (Read Codes) (Q199). England: National Health Service Centre for Coding and Classification, March 1999.
RCDAE	Clinical Terms Version 3 (Read Codes) (Q199). England: National Health Service Centre for Coding and Classification, March 1999. Americanized Version.
RUS2001	Russian Translation of MeSH. Moscow (Russia): State Central Scientific Medical Library, 2001.
SNM2	Cote, Roger A., editor. Systematized nomenclature of medicine. 2nd ed. Skokie (IL): College of American Pathologists, 1979. SNOMED update, 1982. Skokie (IL): College of American Pathologists, 1982.
SNMI98	SNMI98 Cote, Roger A., editor. Systematized Nomenclature of Human and Veterinary Medicine: SNOMED International. Version 3.5. Northfield (IL): College of American Pathologists; Schaumburg (IL): American Veterinary Medical Association, 1998.

WHOFRE	WHO Adverse Drug Reaction Terminology (WHOART). Uppsala (Sweden): WHO Collaborating Centre for International Drug Monitoring, 1997. French Version.
WHOPOR	WHO Adverse Drug Reaction Terminology (WHOART). Uppsala (Sweden): WHO Collaborating Centre for International Drug Monitoring, 1997. Portuguese Version.
WHOSPA	WHO Adverse Drug Reaction Terminology (WHOART). Uppsala (Sweden): WHO Collaborating Centre for International Drug Monitoring, 1997. Spanish Version.