Classification of UMLS Source Vocabularies through Semantic Group Profiles

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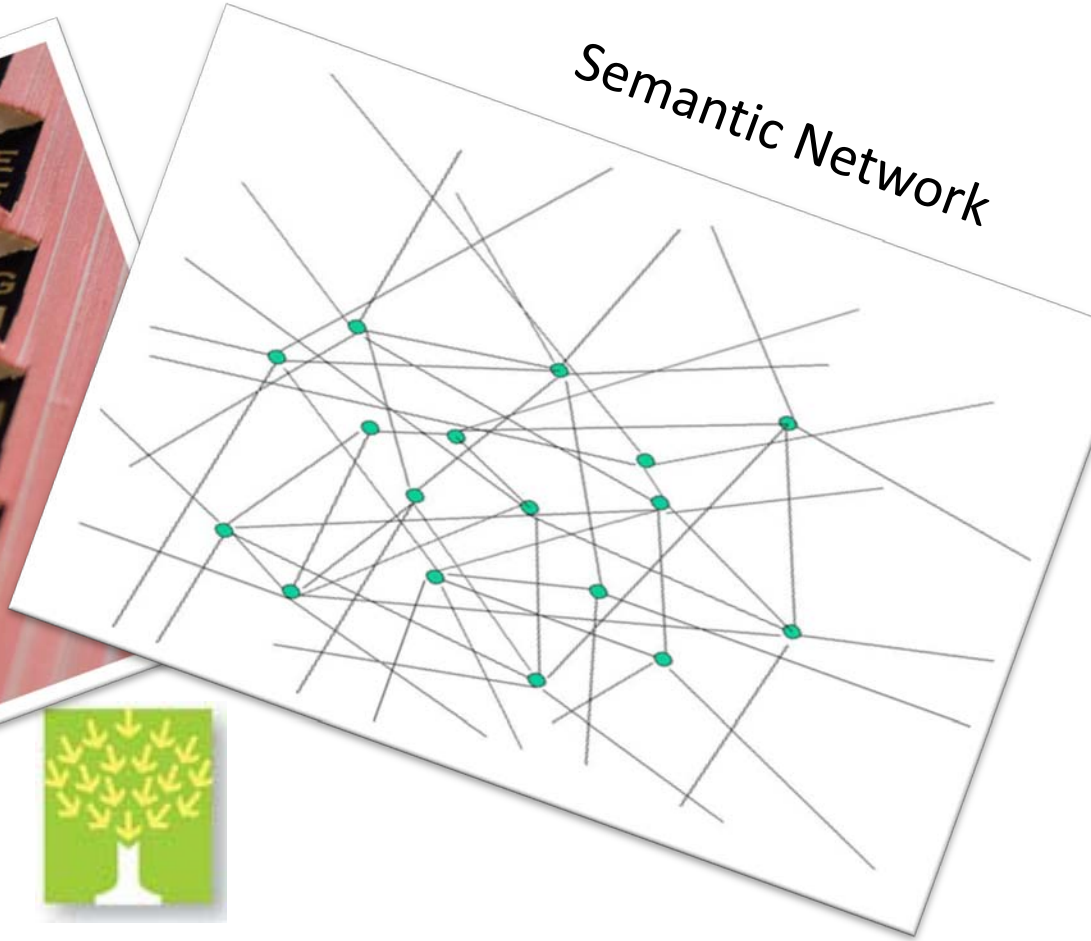
University of Washington
NLM Trainee Summer Rotation
8/1/11

Biomedical literature is vast.

What is the UMLS?

MLS?


Metathesaurus


Semantic Network

SPECIALIST Lexicon

155 Source Vocabularies

Clinical Procedural Terminology

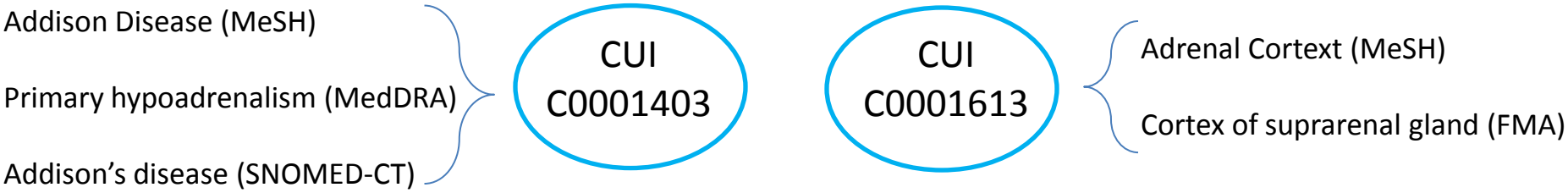
ICD 10

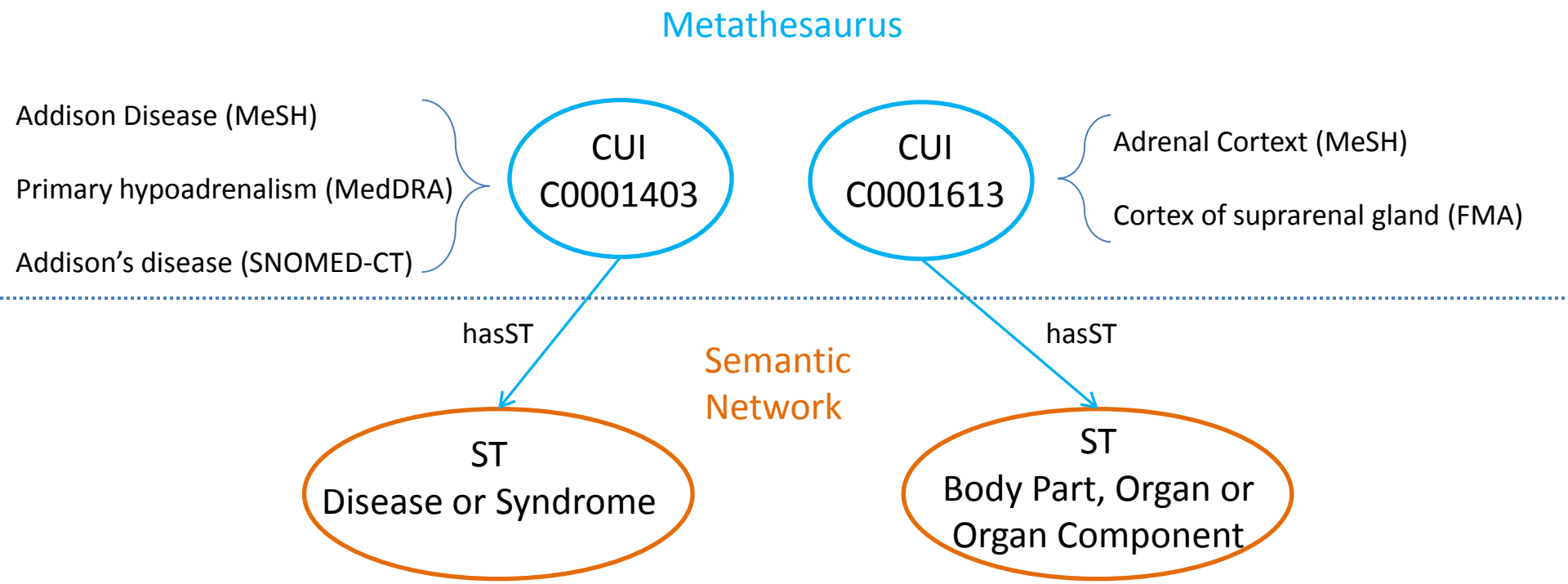
155 Source Vocabularies

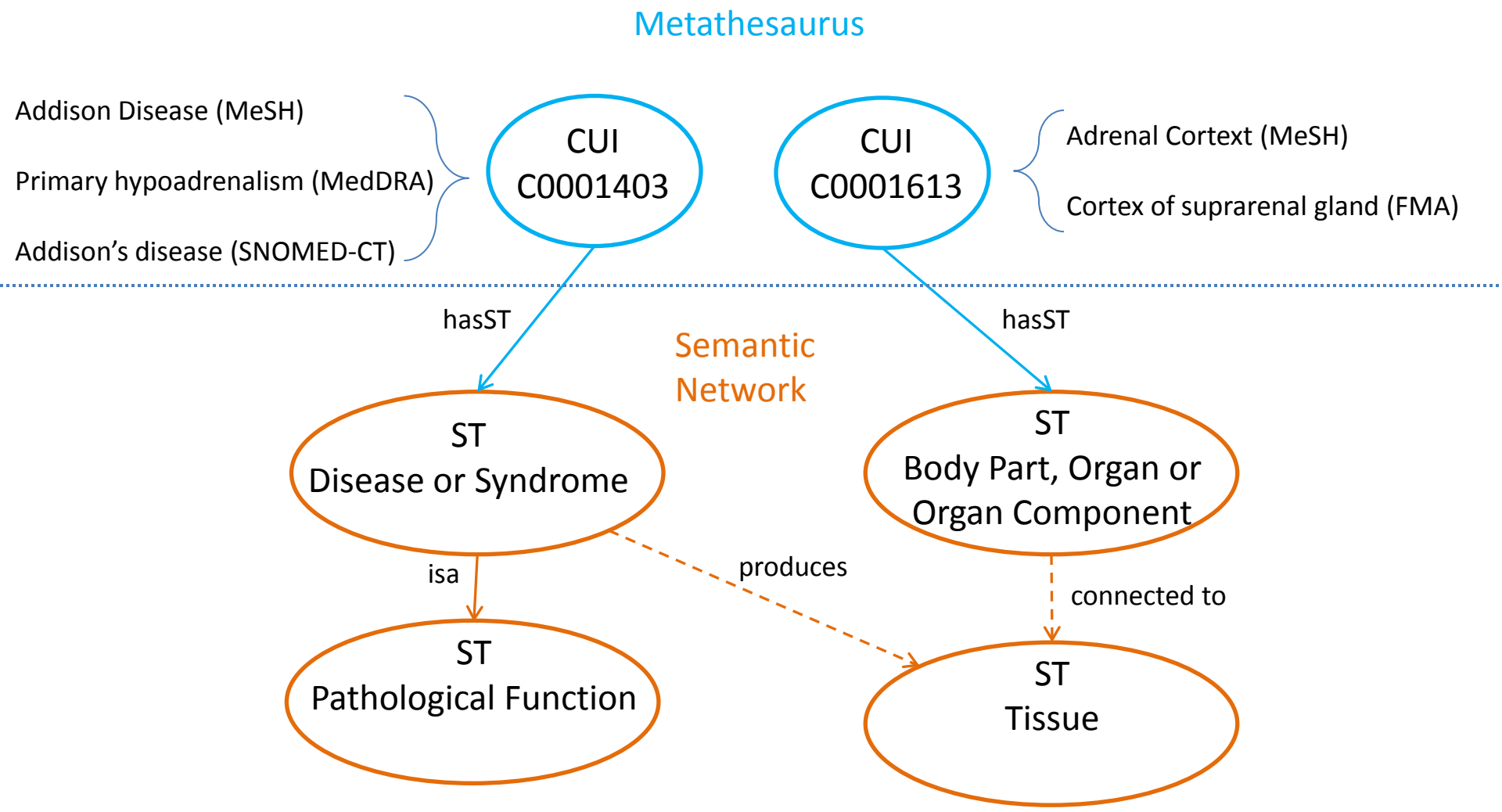
Gene Ontology

RxNorm

Metathesaurus




Metathesaurus
Addison Disease (MeSH)
Primary hypoadrenalism (MedDRA)
Addison's disease (SNOMED-CT)
CUI
C0001403
CUI
C0001613
Adrenal Cortext (MeSH)
Cortex of suprarenal gland (FMA)
hasST
hasST
Semantic
Network
ST
Disease or Syndrome
ST
Body Part, Organ or
Organ Component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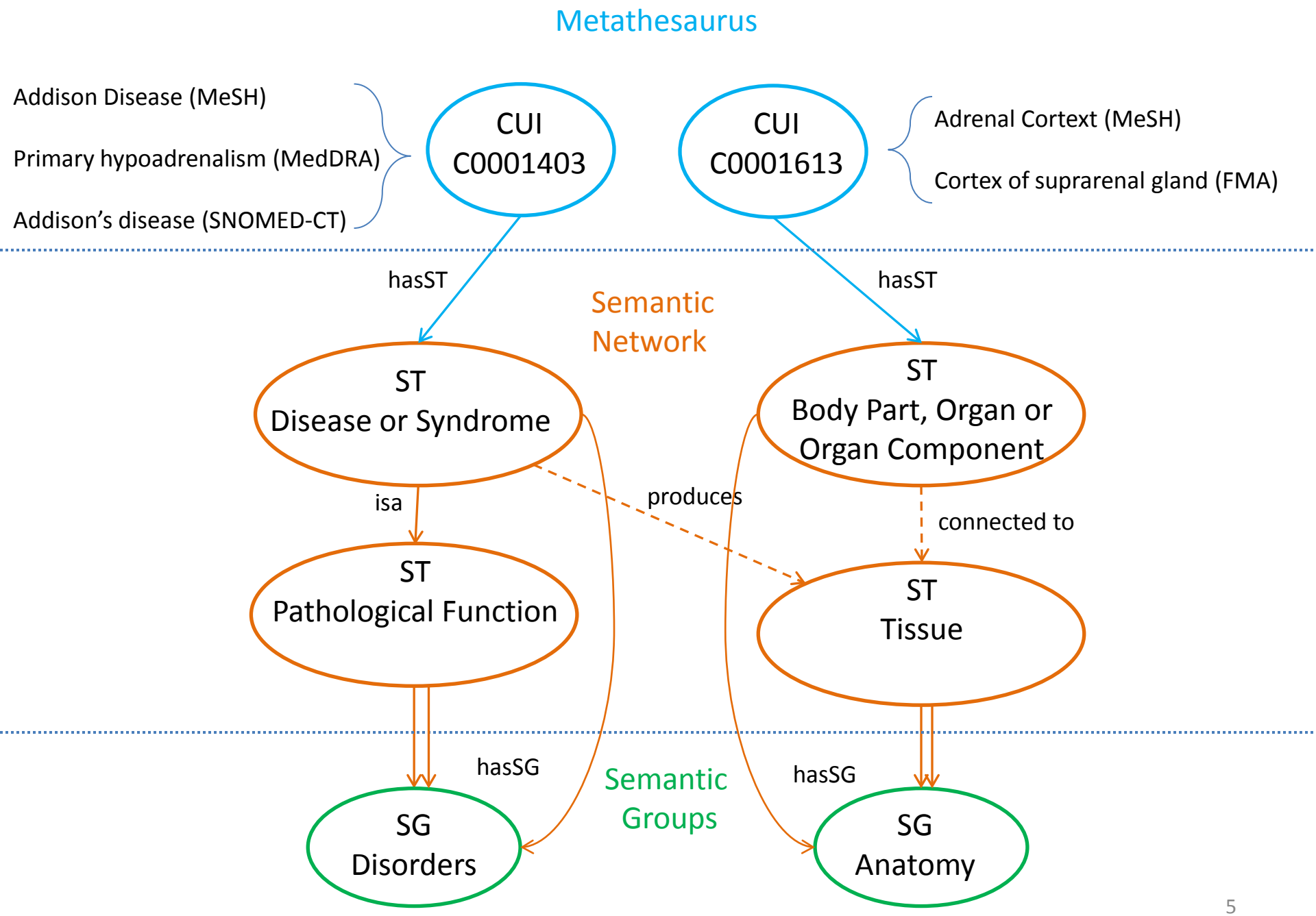
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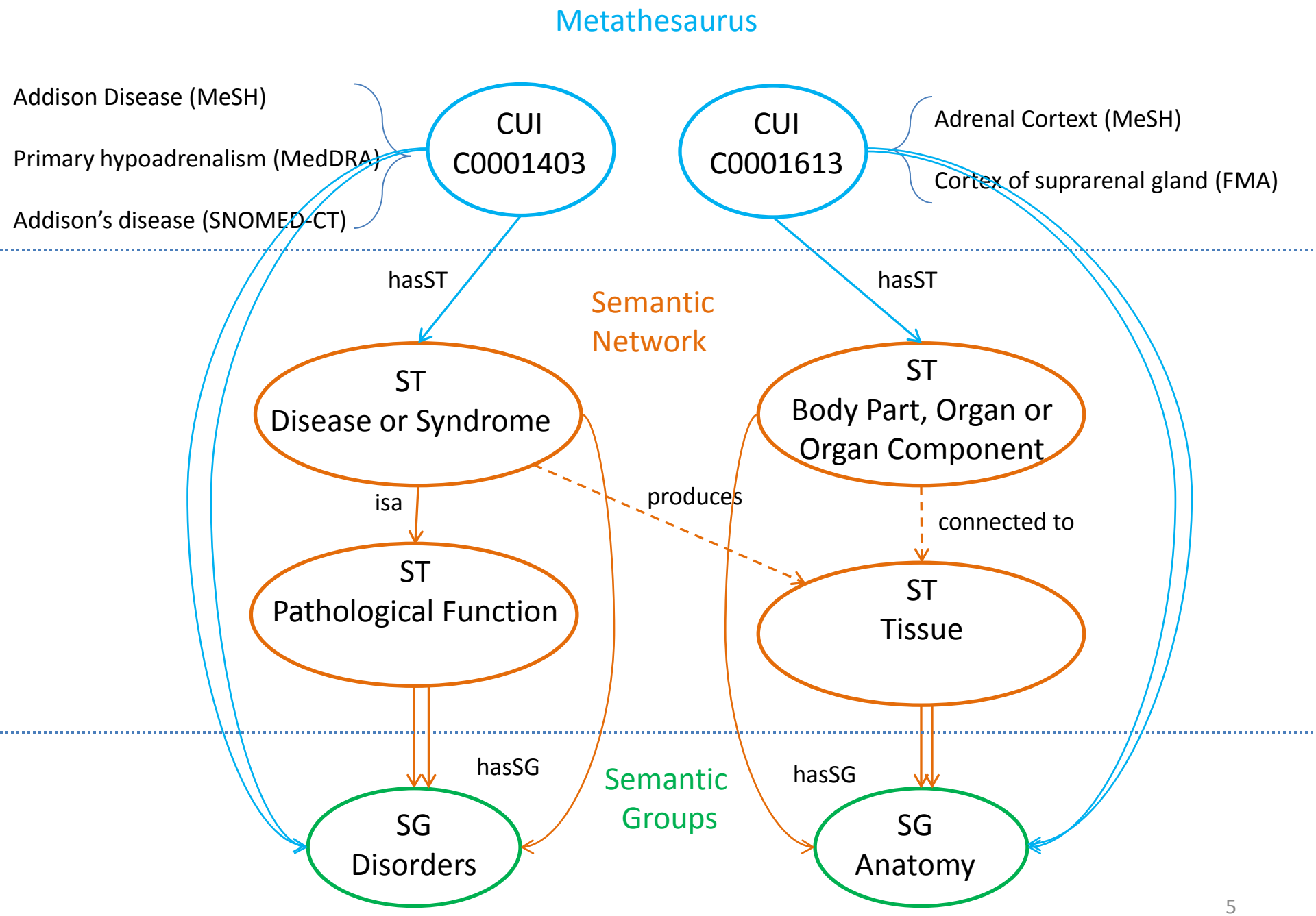
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What are semantic groups?

Semantic Group	Abbreviation
Activities & Behavior	ACTI
Anatomy	ANAT
Chemicals & Drugs	CHEM
Concepts & Ideas	CONC
Devices	DEVI
Disorders	DISO
Genes and Molecular Sequences	GENE
Geographic Areas	GEOG
Living Beings	LIVB
Objects	OBJC
Occupations	OCCU
Organizations	ORGA
Phenomena	PHEN
Physiology	PHYS
Procedures	PROC

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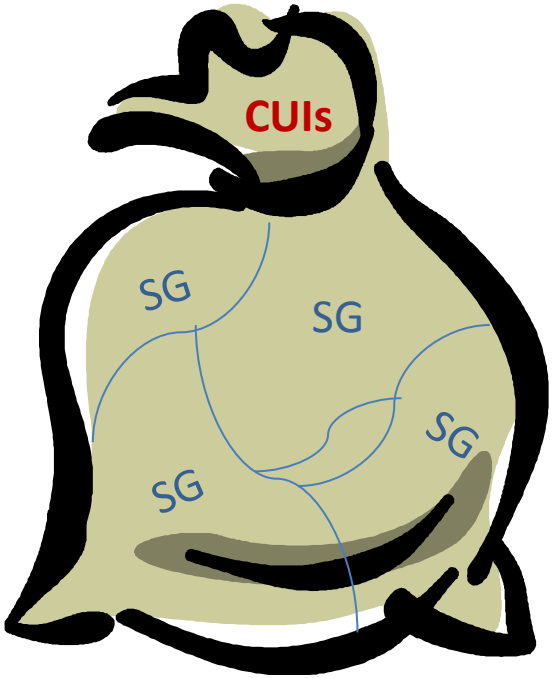
Semantic Types
Acquired Abnormality
Anatomical Abnormality
Cell or Molecular Dysfunction
Congenital Abnormality
Disease or Syndrome
Experimental Model of Disease
Finding
Injury or Poisoning
Mental or Behavioral Dysfunction
Neoplastic Process
Pathological Function
Sign or Symptom

2.4 million concepts → 133 semantic types → 15 semantic groups



Concepts can be categorized into more than one semantic group (1029 such concepts)

Semantic groups form a 99.96 % partition of all concepts.

Project Goals

1. Demonstrate feasibility of using semantic group profiles to classify source vocabularies

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1. Demonstrate feasibility of using semantic group profiles to classify source vocabularies

2. Compare with a functional classification of source vocabularies

Source Vocabulary Filtering

Difficult to display all source vocabularies

Filtered based on criteria:

-Greater than 1000 CUIs

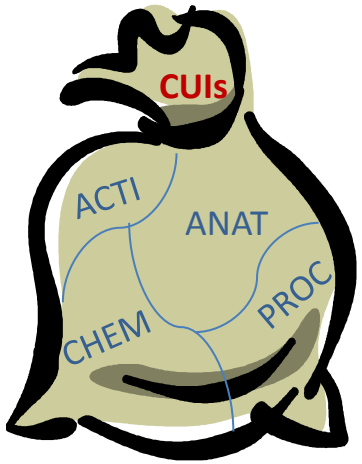
-Only English vocabularies (removes redundancy)

155 source vocabularies → 57 filtered source vocabularies

Classification based on:

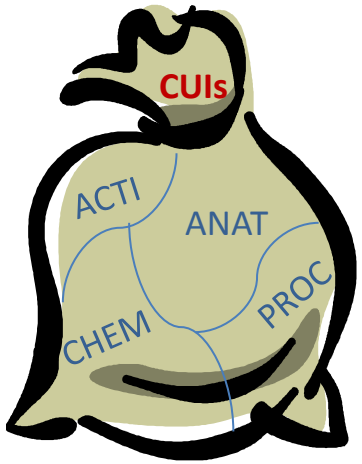
Semantic Group Profiles

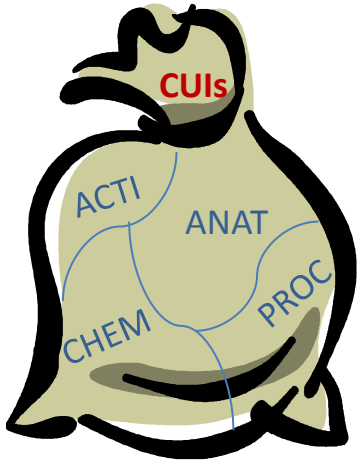
Generating Semantic Group Profiles



Source	CONC	PHEN	CHEM	…	PROC
CSP	4.02	2.11	30.1	…	11.11

Generating Semantic Group Profiles





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CSP	4.02	2.11	30.1	…	11.11
PSY	18.23	1.71	8.26	…	12.33

Define Euclidian Distance Matrix for Hierarchical Clustering

Source	CONC	PHEN	CHEM	LIVB	ACTI	DISO	GEOG	ANAT	GENE	OCCU	OBJ	DEVI	ORGA	PHYS	PROC
CSP	4.02	2.11	30.1	11.5	2.08	18.1	0.58	7.15	0.73	2.11	1.72	1.12	0.51	7.09	11.11
PSY	18.23	1.71	8.26	8.9	10.77	14.44	0.17	4.72	0.06	2.71	2.65	0.49	1.51	13.05	12.33

Define Euclidian Distance Matrix for Hierarchical Clustering

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Euclidian distance = 28.65

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-	-	-	0	Source 4
-	28.65	0	-	CSP
-	0	28.65	-	PSY
0	-	-	-	Source 1
Source 1	PSY	CSP	Source 4	

Hierarchical Clustering

100.1	100.2	0	**PSY**
0.236	0	100.2	**UWDA**
0	0.236	100.1	**FMA**
FMA	**UWDA**	**PSY**	

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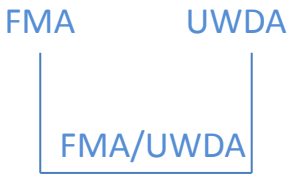
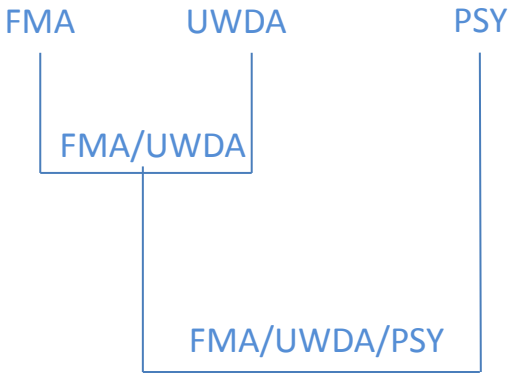


Hierarchical Clustering

100.2	0	PSY
0	100.2	UWDA/ FMA
FMA/UWDA	PSY	



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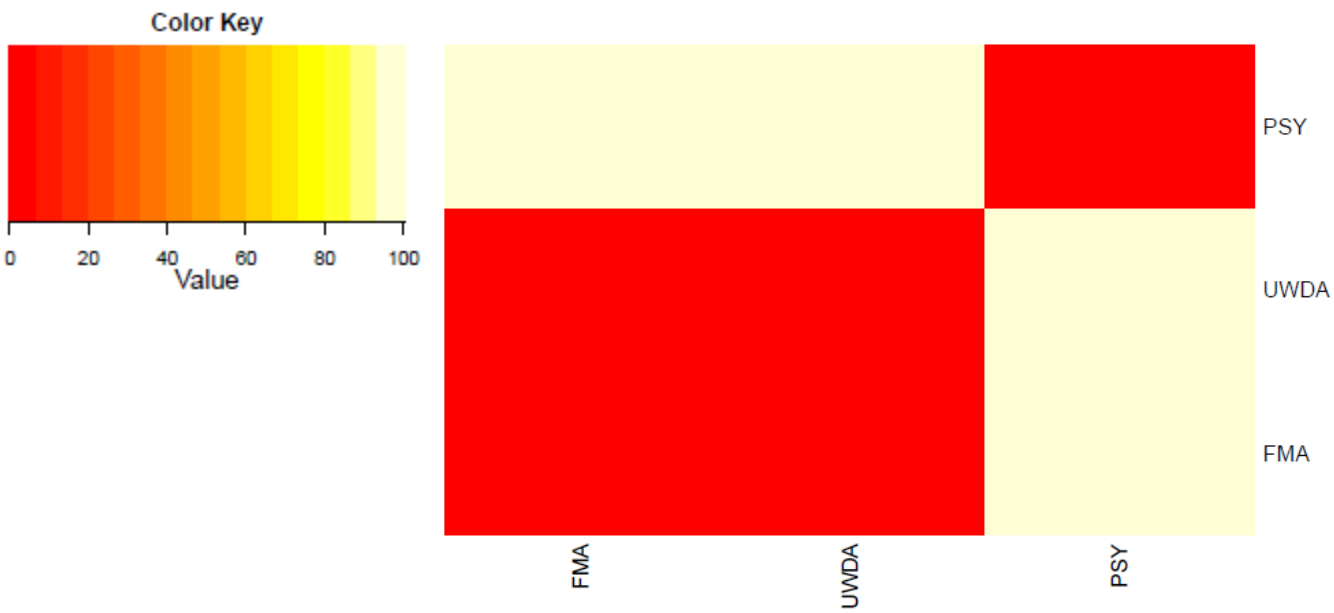
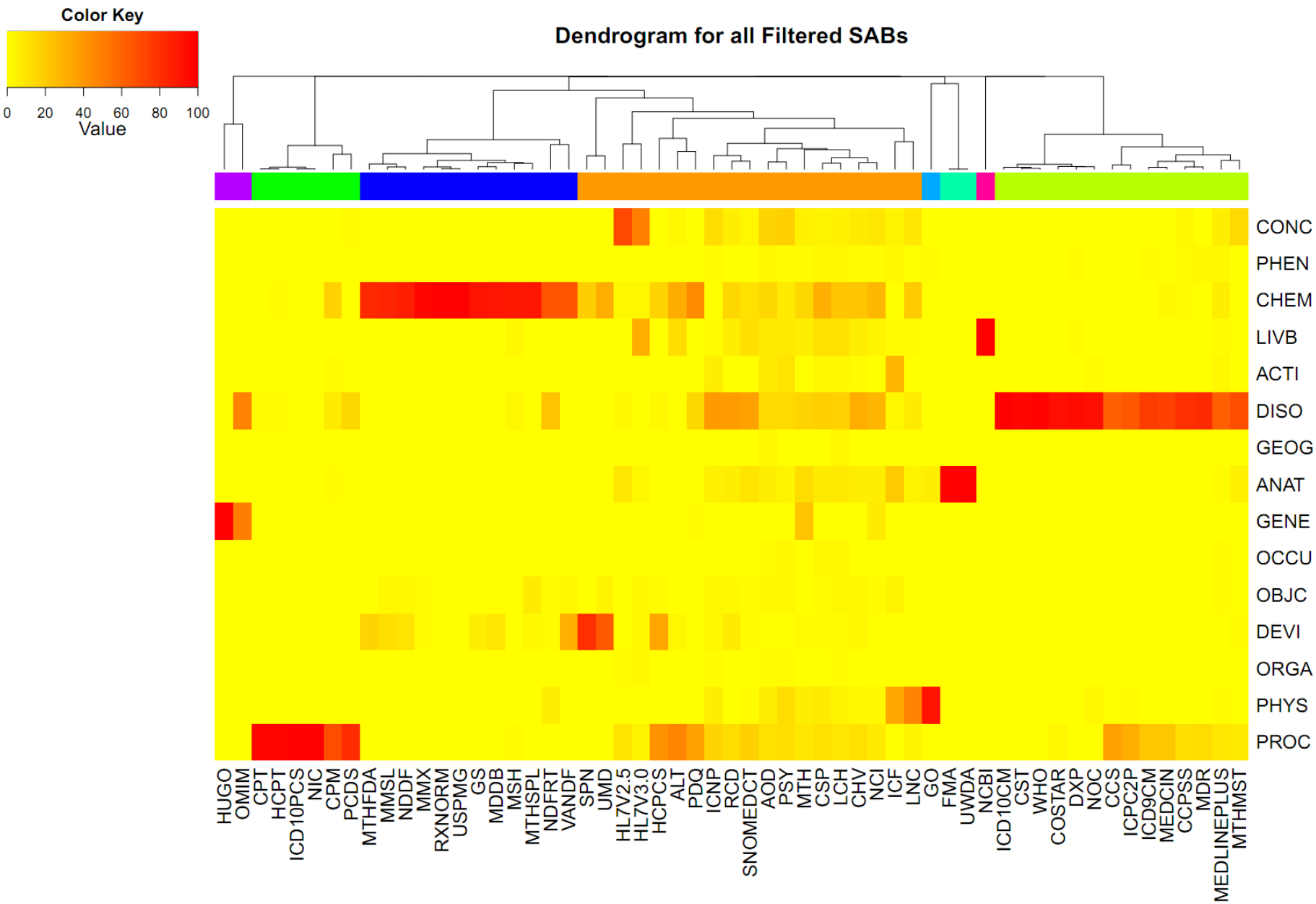


Results and analysis:

Semantic Group Profile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Dendrogram for all Filtered SABs
CONC
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ORGA
PHYS
PROC
HUGO
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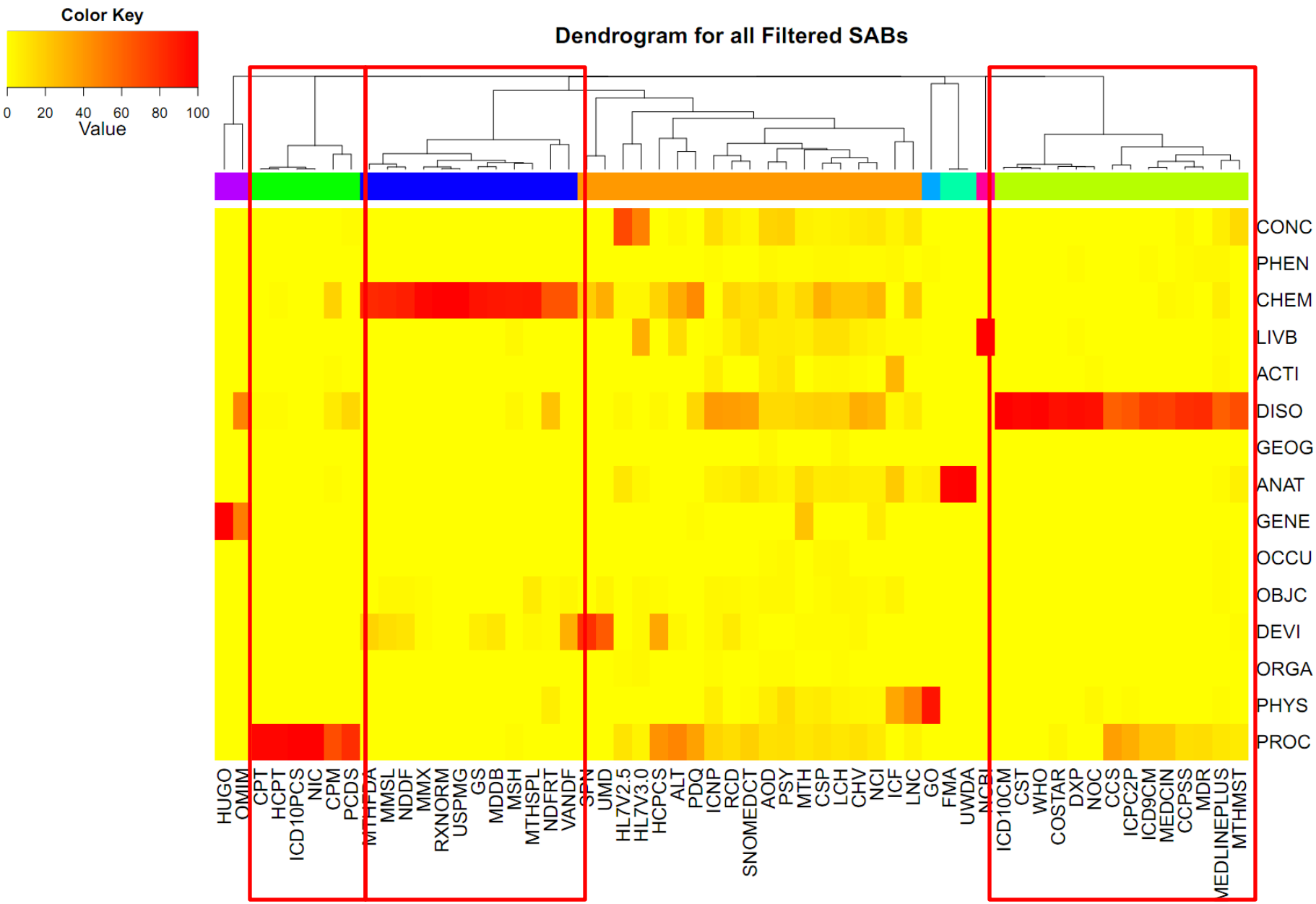
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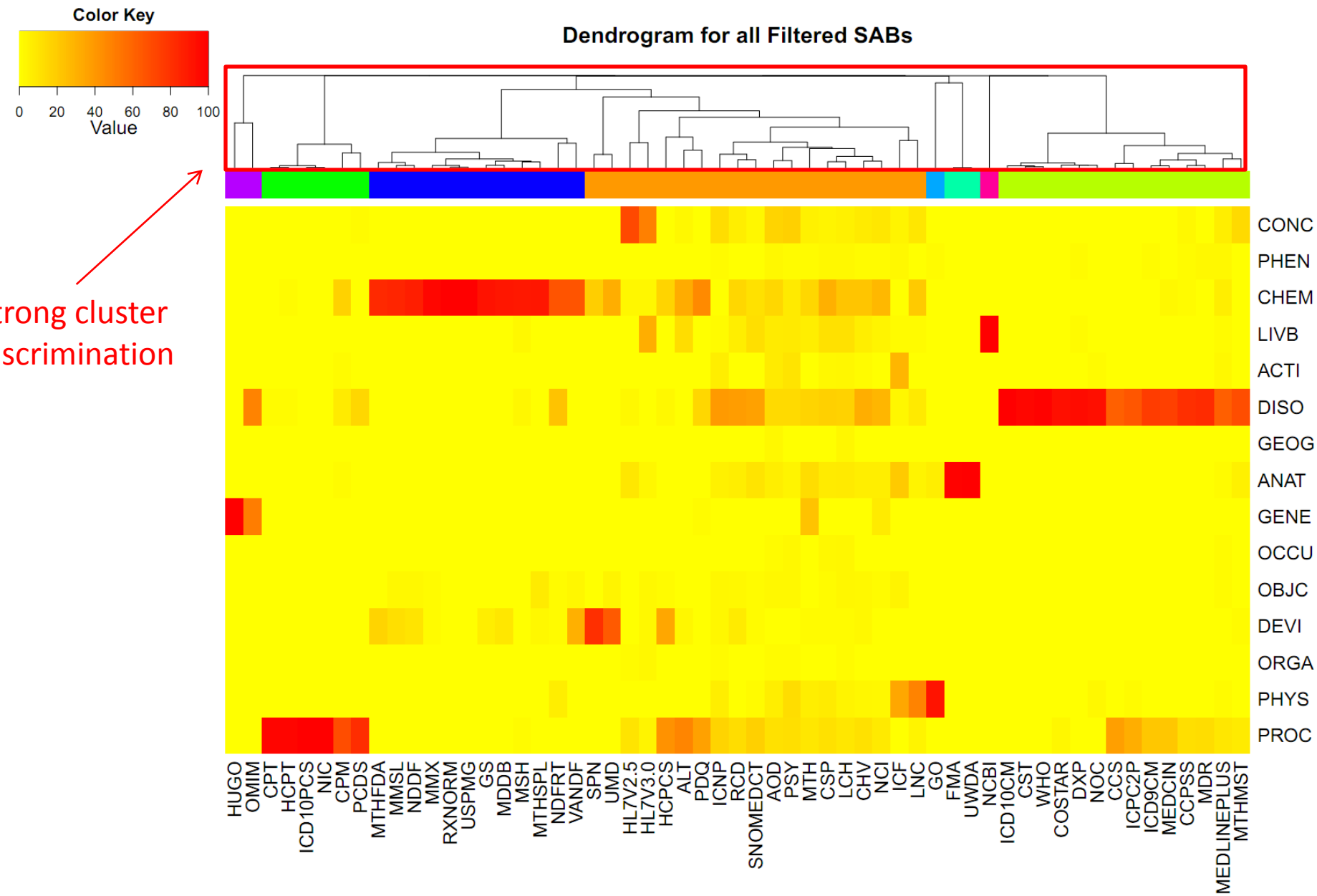
MTHMST
Procedures
Drug vocabularies
Disorders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Strong cluster discrimination
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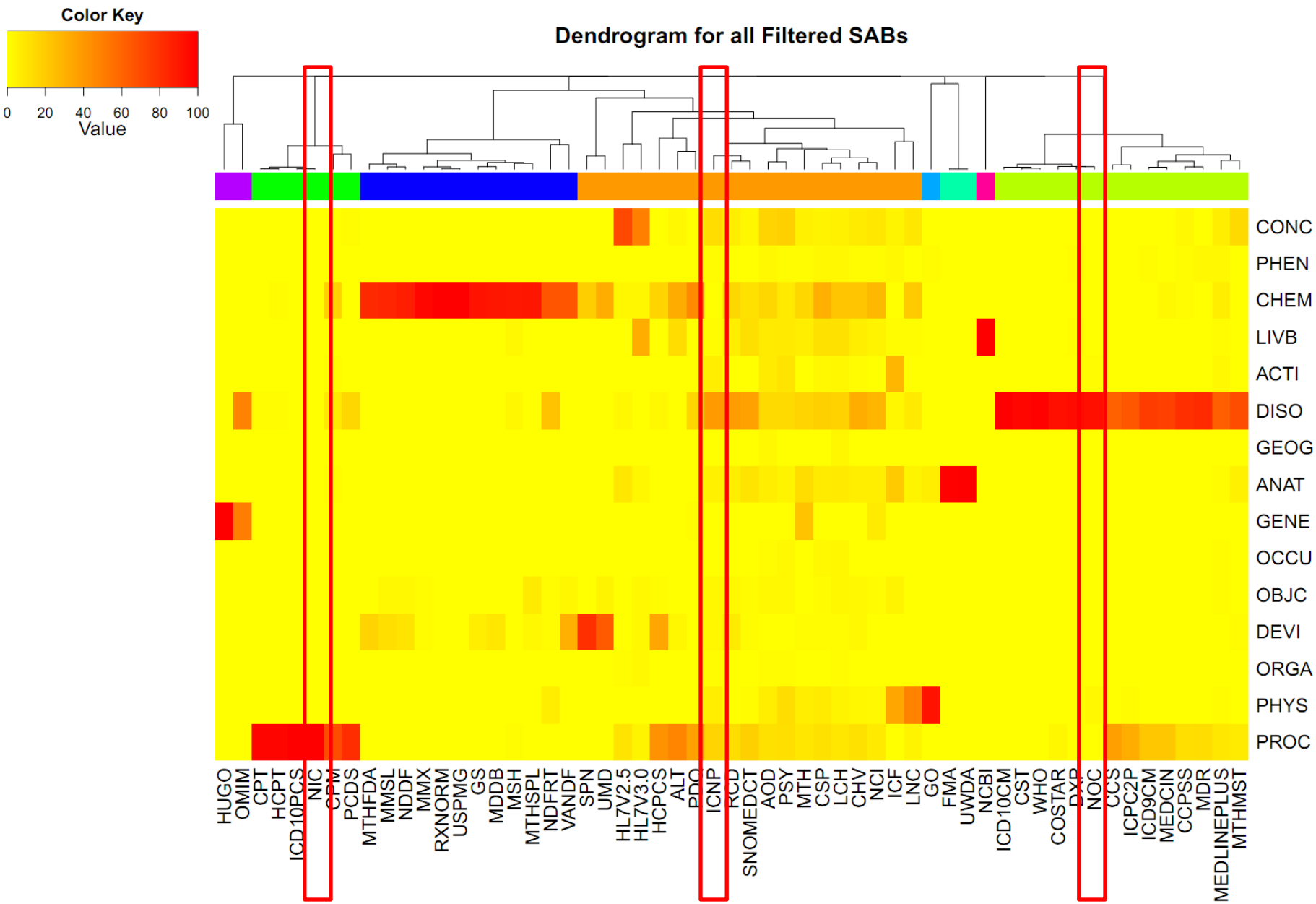

Nursing vocabularies are in distinct clusters

Classification based on:

Source Usage

UMLS Functional Classification

Biomedical vocabularies in the UMLS include:

"thesauri, classifications, code sets, and lists of controlled terms used in patient care, health services billing, public health statistics, indexing and cataloging biomedical literature, and/or basic, clinical, and health services research."

Reference: US National Library of Medicine. UMLS Metathesaurus Fact Sheet. http://www.nlm.nih.gov/pubs/factsheets/umlsmeta.html

Gene Ontology (GO)

Purpose

GO is a collaborative effort to address the need for consistent descriptions of gene products in different databases. The current ontologies of the GO project are molecular function, biological process, and cellular component.

Audience

GO is intended for use by system developers who are addressing the need for consistent descriptions of gene products in different databases.

Functional Classification

Basic Research

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Functional Classification

Basic Research

Healthcare Common Procedure Coding System (HCPCS)

Purpose

HCPCS is a collection of standardized codes that represent medical procedures, supplies, products and services. The codes are used to facilitate the processing of health insurance claims by Medicare and other insurers.

Audience

HCPCS is used by physicians and other health care professionals and insurance programs.

Functional Classification

Health Services Billing

Comparisons across:

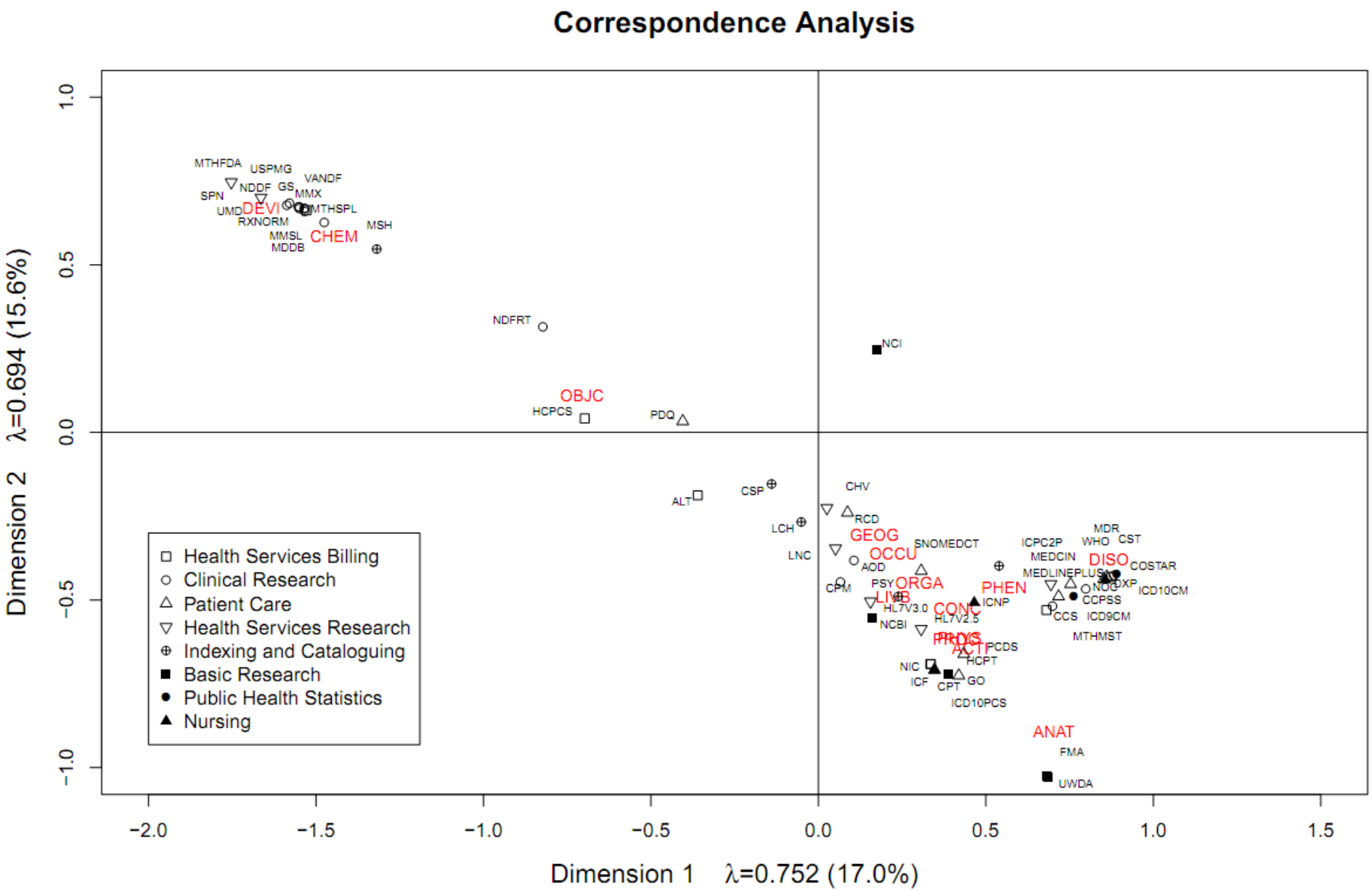
Source Classifications

Correspondence Analysis

Similar to principal component analysis

Compares row and column profiles for significance

Projects onto 2D plot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Dimension 1 λ=0.752 (17.0%)
1.0
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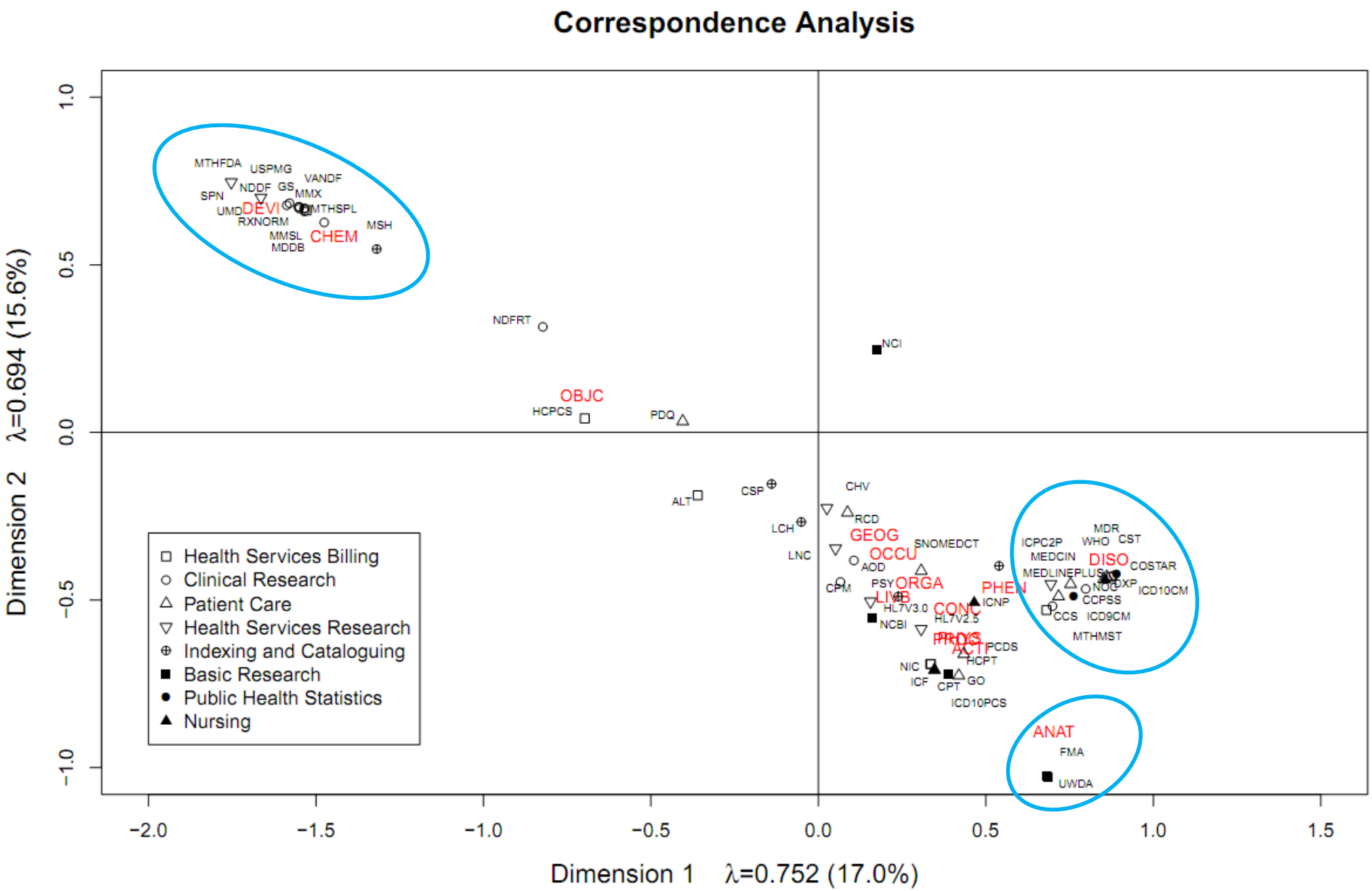
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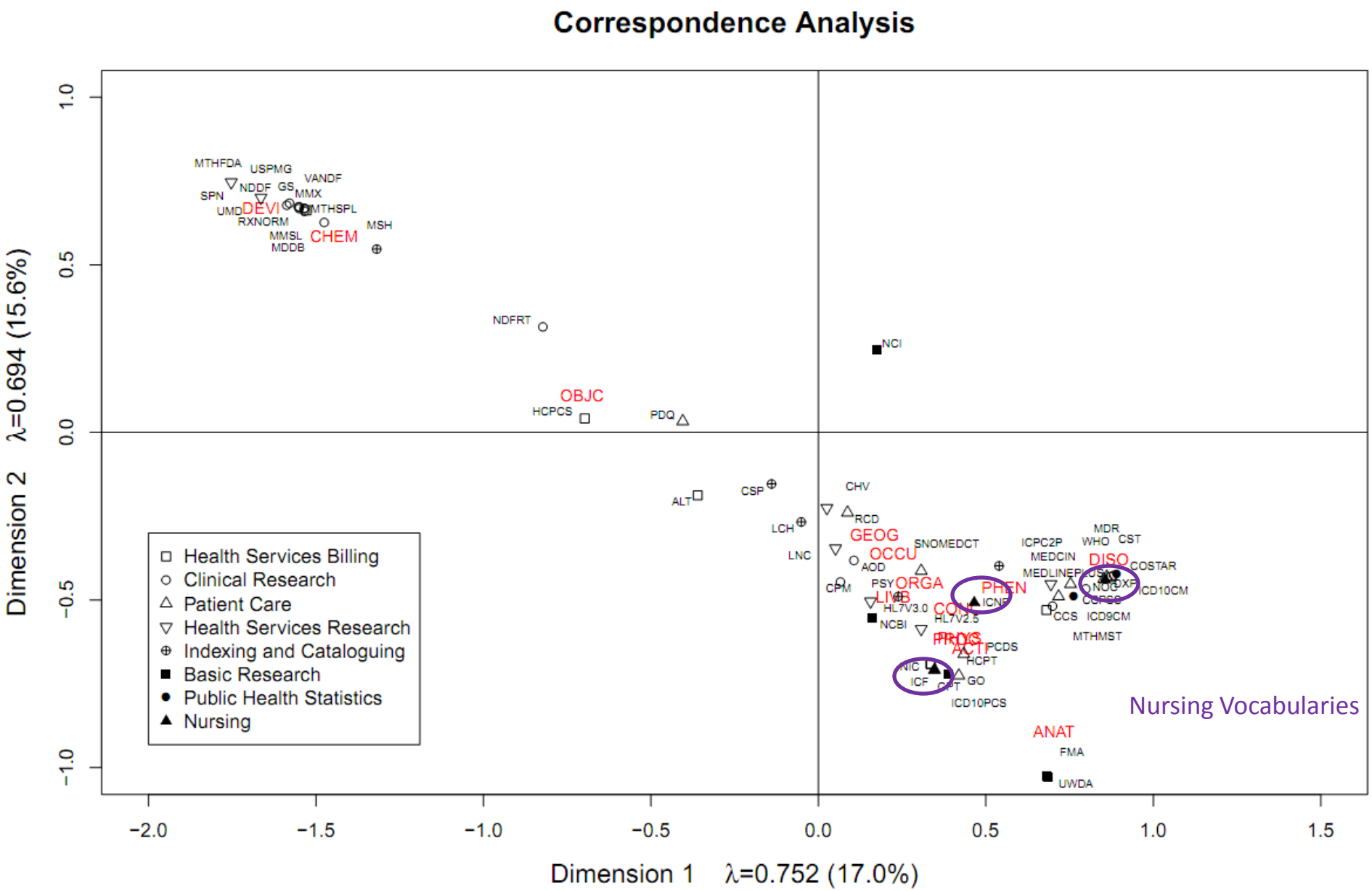
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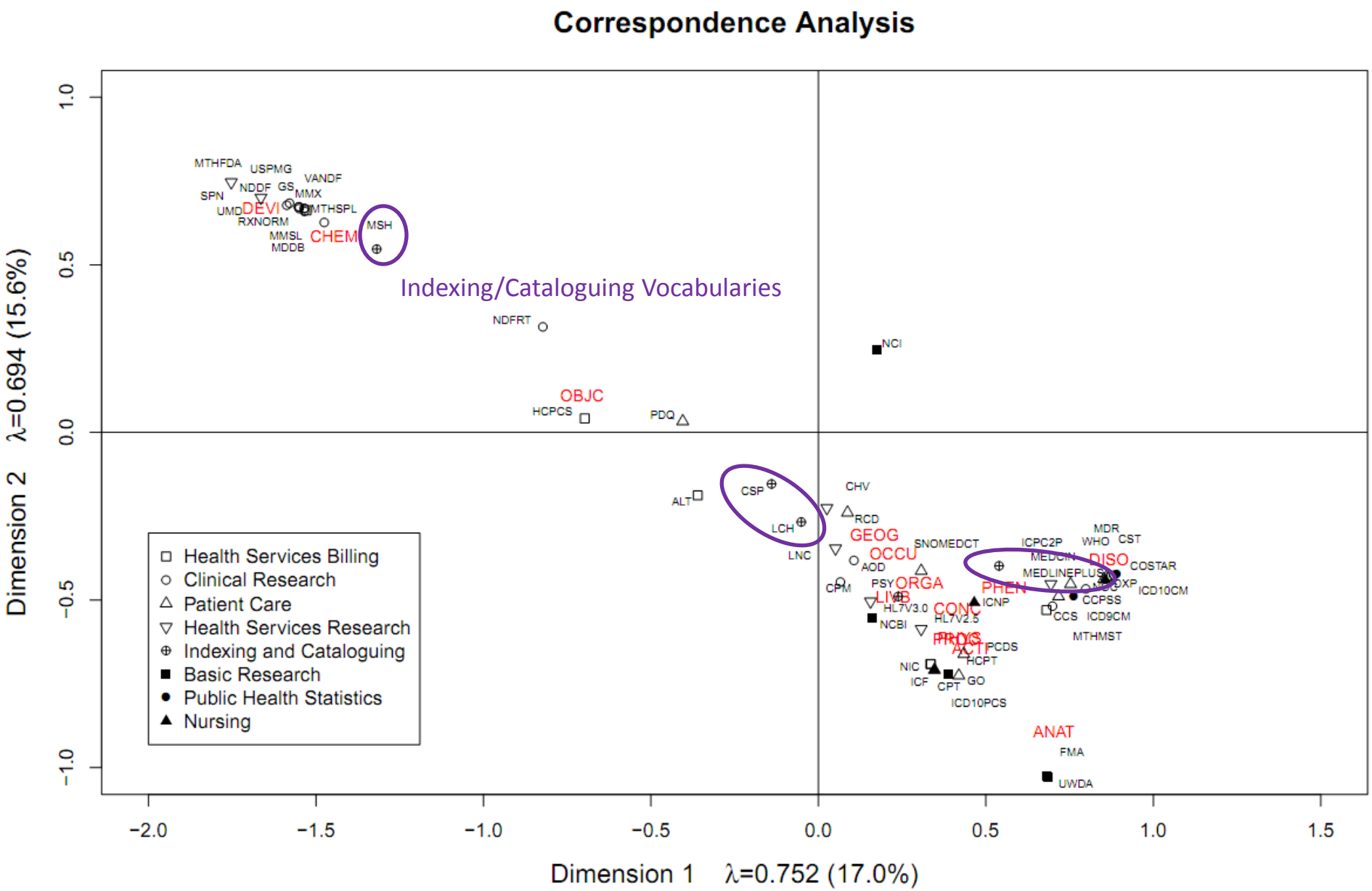
Nursing
Nursing Vocabularies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Health Services Billing
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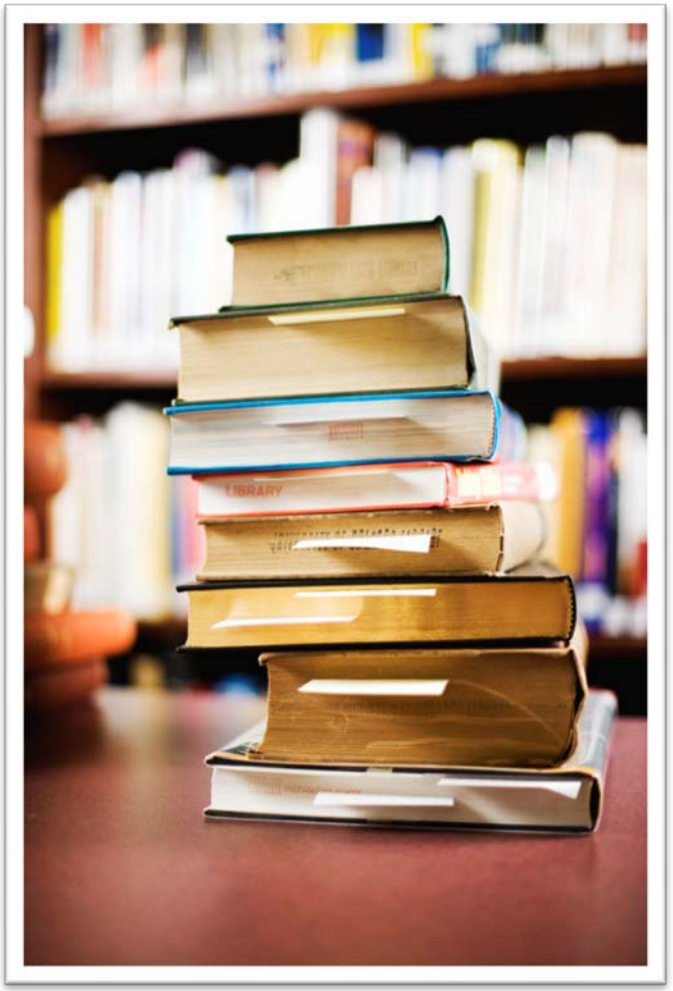
CHV
RCD
GEOG
SNOMEDCT
OCCU
AOD
CPM
PSY
ORGA
LIVB
HL7V3.0
NCBI
CONC
HL7V2.5
PHEN
ICNP
ICPC2P
MEDCIN
MEDLINEPLUS
MDR
WHO
CST
DISO
COSTAR
DXP
ICD10CM
CCPSS
CCS
ICD9CM
MTHMST
PCDS
HCPT
NIC
ICF
CPT
GO
ICD10PCS
ANAT
FMA
UWDA
Dimension 1 λ=0.752 (17.0%)
Dimension 2 λ=0.694 (15.6%)
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
−1.0
−0.5
0.0
0.5
1.0

Conclusion

Combine complementary source classification techniques

Support system developers selecting source vocabularies

Other use case scenarios?



Thank You!

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Dr. Bastien Rance
Ms. May Cheh