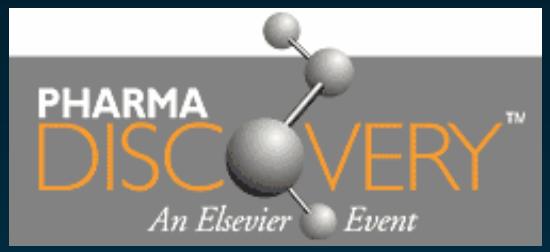

Bethesda, Maryland
May 11, 2006

Biomedical Ontology And Drug Information

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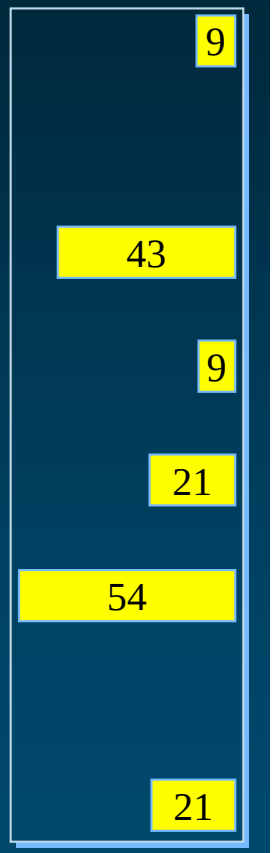
Outline

- Drug vocabularies
- Drug vocabulary integration: UMLS
- Drug vocabulary standardization: RxNorm
- Visualization and processing of drug information: RxNav

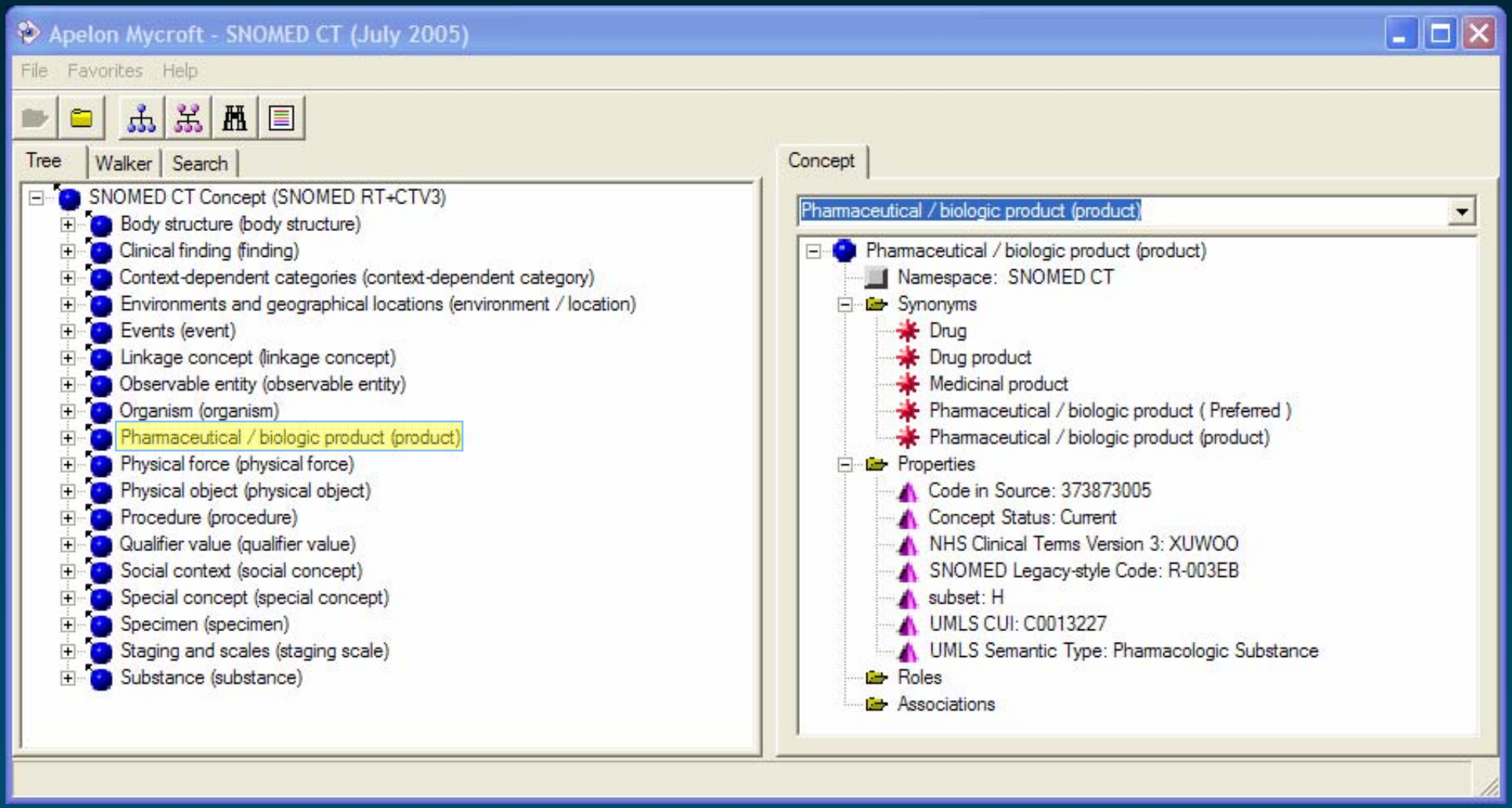
Drug Vocabularies

Drug vocabularies

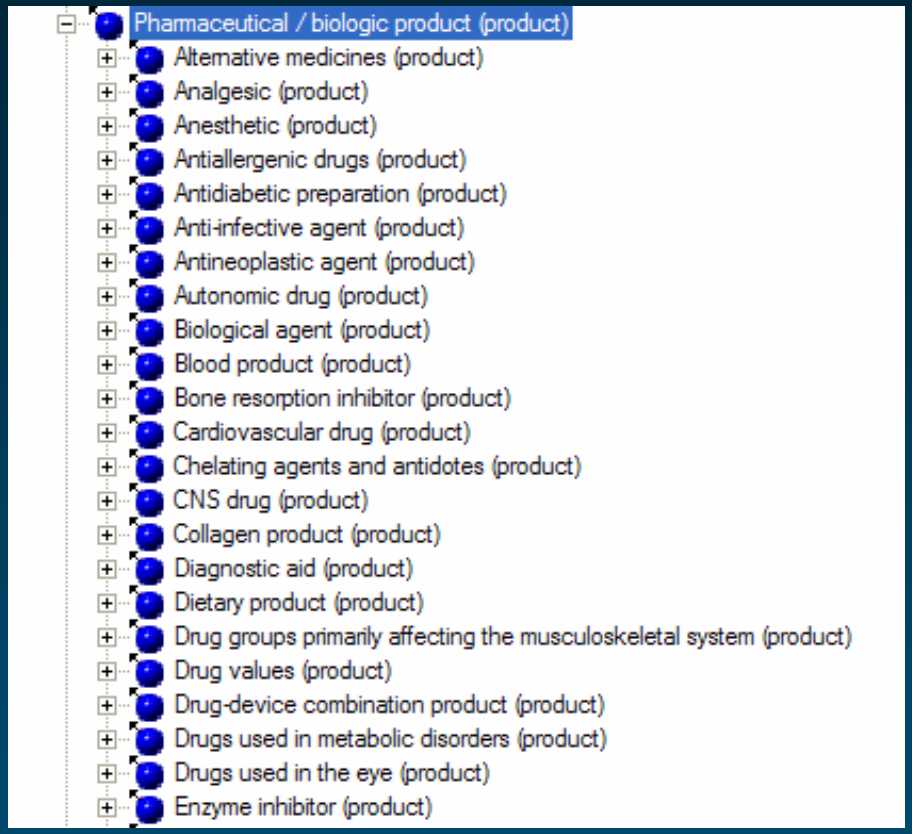
- Master Drug Data Base (Medi-Span, Wolters Kluwer Health)
- Multum MediSource Lexicon
- Micromedex DRUGDEX
- FDA National Drug Code Directory
- Nat'l Drug Data File Plus Source Vocabulary (First DataBank Inc.)
- Veterans Health Administration National Drug File

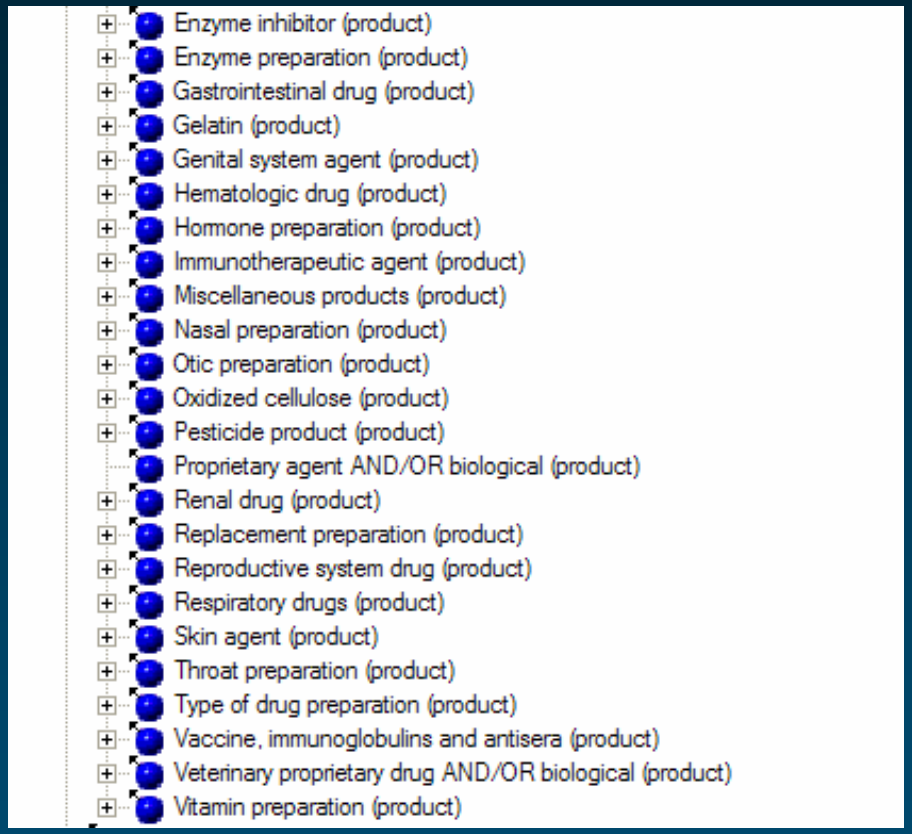


Drugs in SNOMED CT



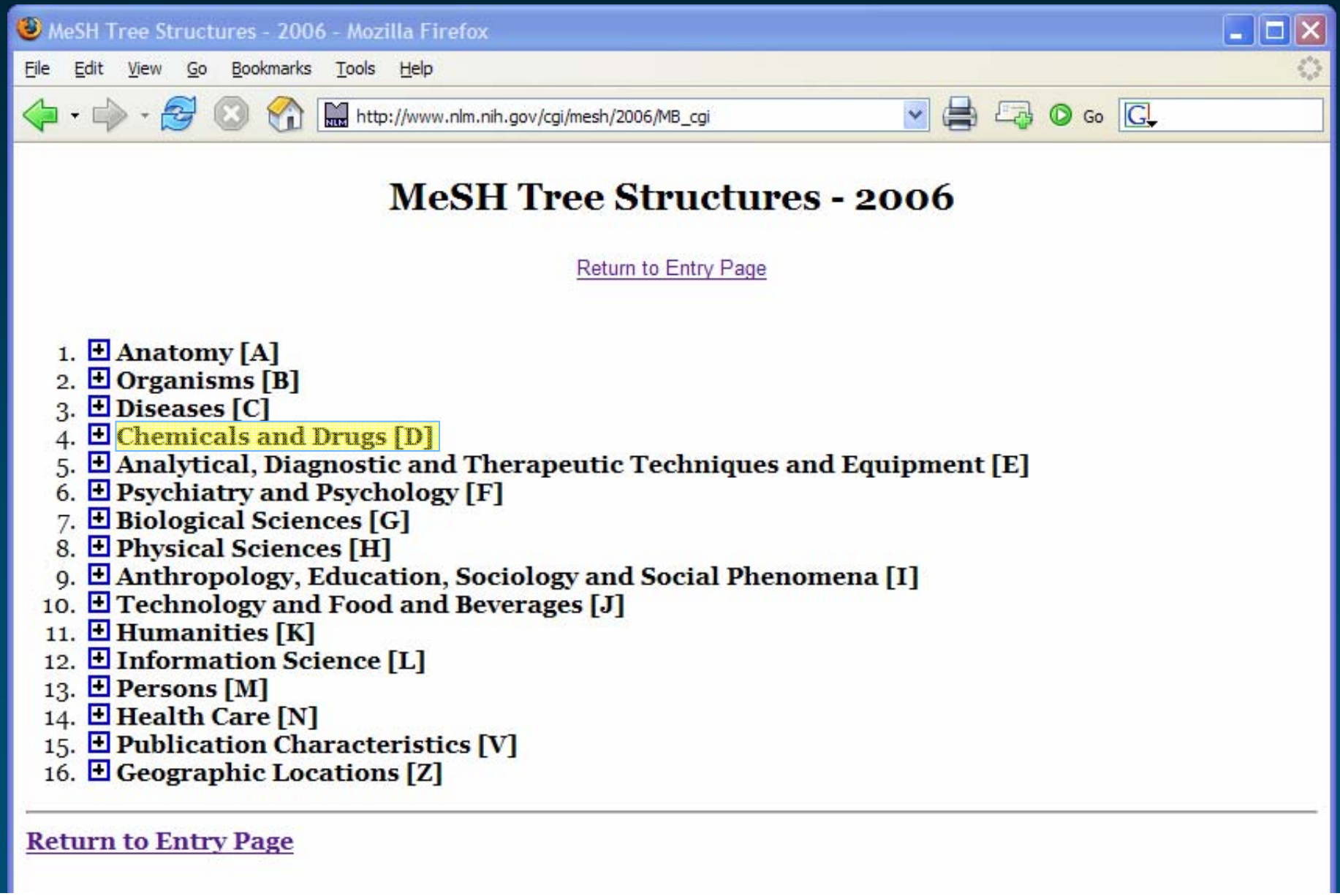
Drugs in SNOMED CT





18,735 drug concepts in SNOMED CT (<10%)

Drugs in MeSH



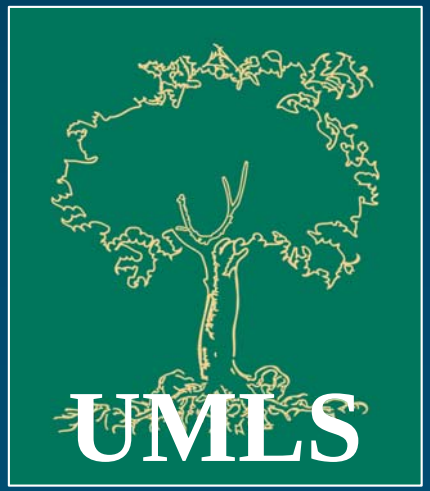
Drugs in MeSH

4. Chemicals and Drugs [D]
   - Inorganic Chemicals [D01] +
   - Organic Chemicals [D02] +
   - Heterocyclic Compounds [D03] +
   - Polycyclic Compounds [D04] +
   - Macromolecular Substances [D05] +
   - Hormones, Hormone Substitutes, and Hormone Antagonists [D06] +
   - Enzymes and Coenzymes [D08] +
   - Carbohydrates [D09] +
   - Lipids [D10] +
   - Amino Acids, Peptides, and Proteins [D12] +
   - Nucleic Acids, Nucleotides, and Nucleosides [D13] +
   - Complex Mixtures [D20] +
   - Biological Factors [D23] +
   - Biomedical and Dental Materials [D25] +
   - Pharmaceutical Preparations [D26] +
   - Chemical Actions and Uses [D27] +

8,140 drug descriptors in MeSH (~30%)

Drug vocabulary integration

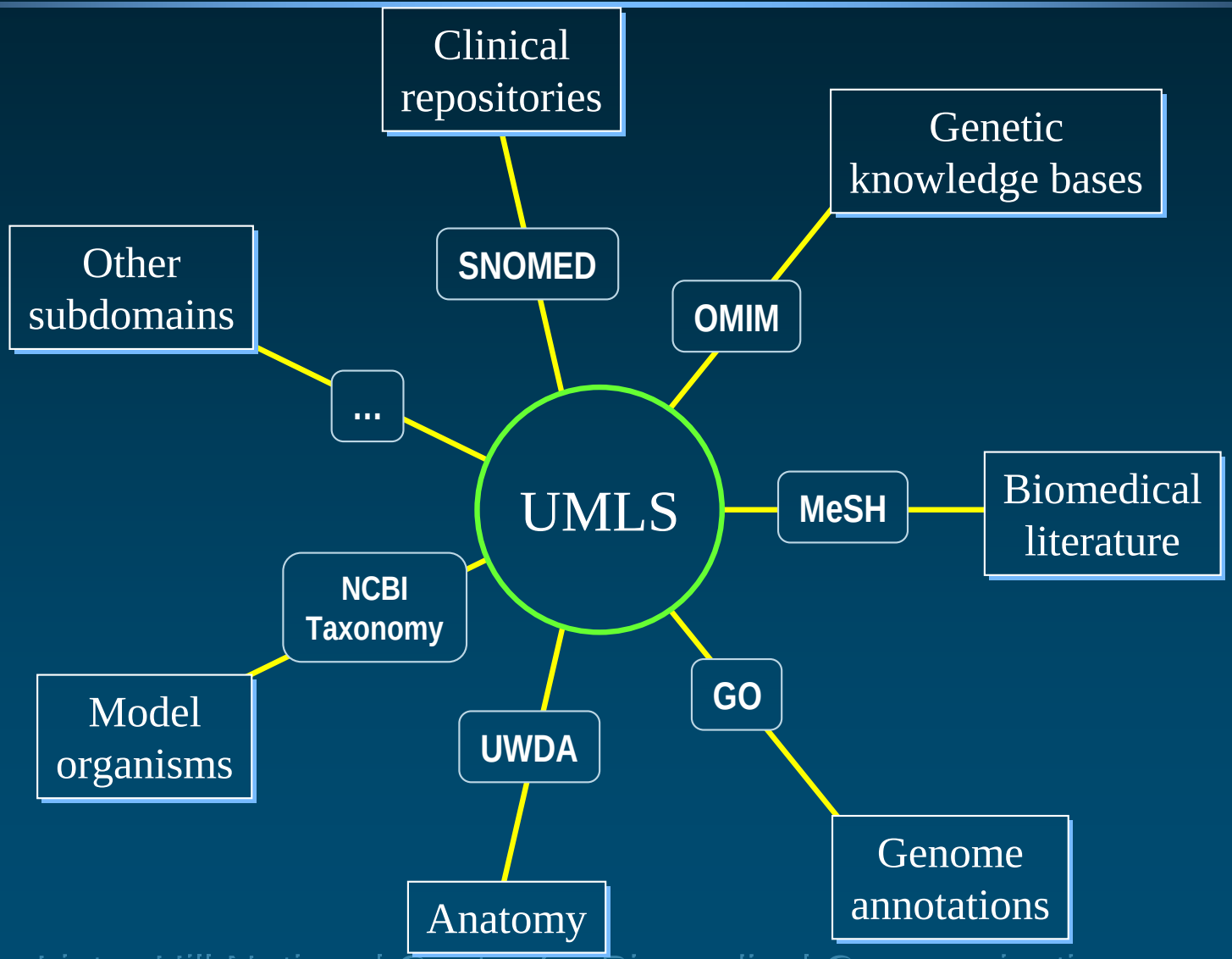
Unified Medical Language System



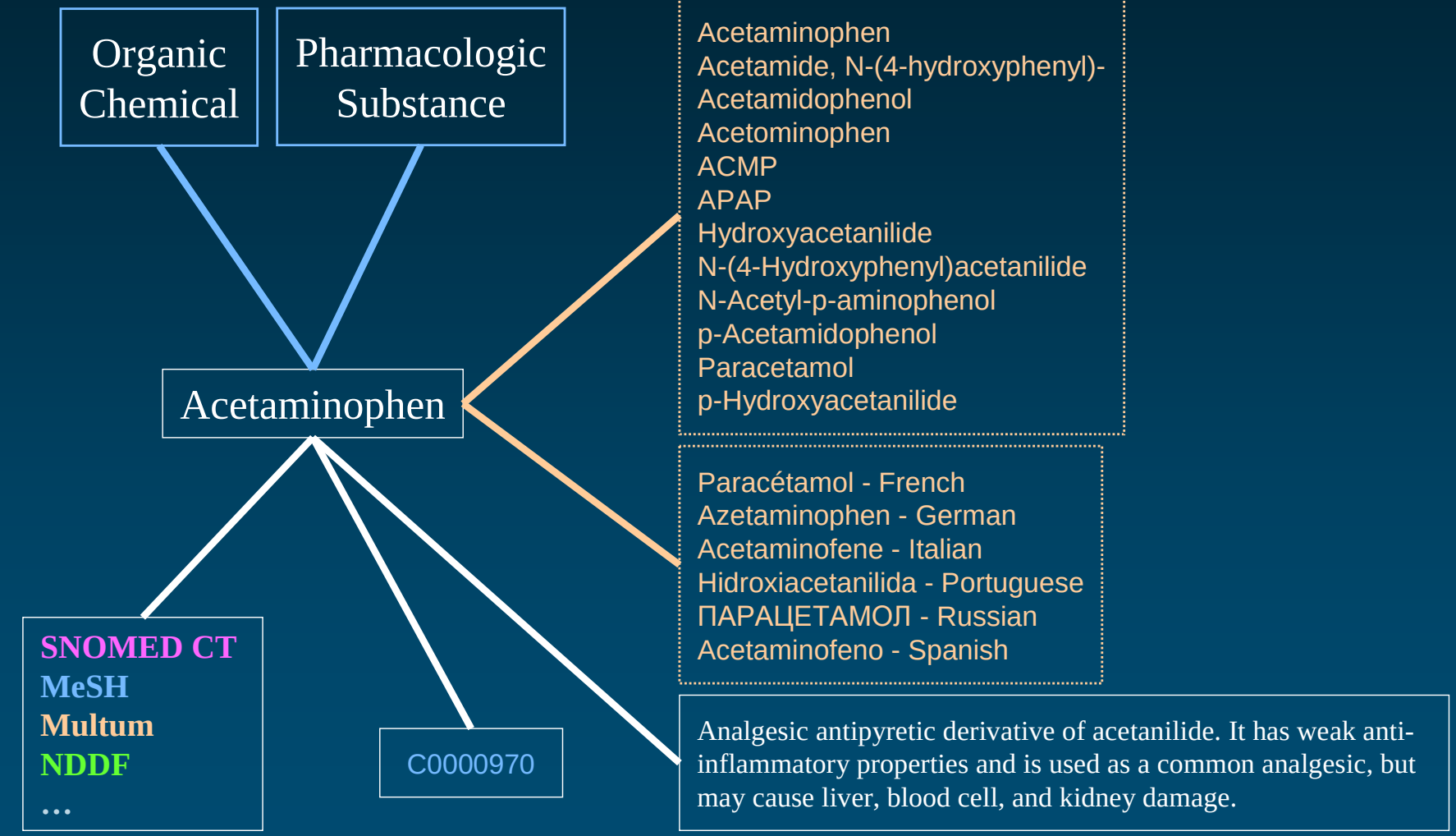
Source Vocabularies (2006AA)

- 140 source vocabularies
  - 17 languages
- Broad coverage of biomedicine
  - 5M names
  - 1.3M concepts
  - 16M relations
- Common presentation

Integrating subdomains



Metathesaurus concept



Metathesaurus drug concepts

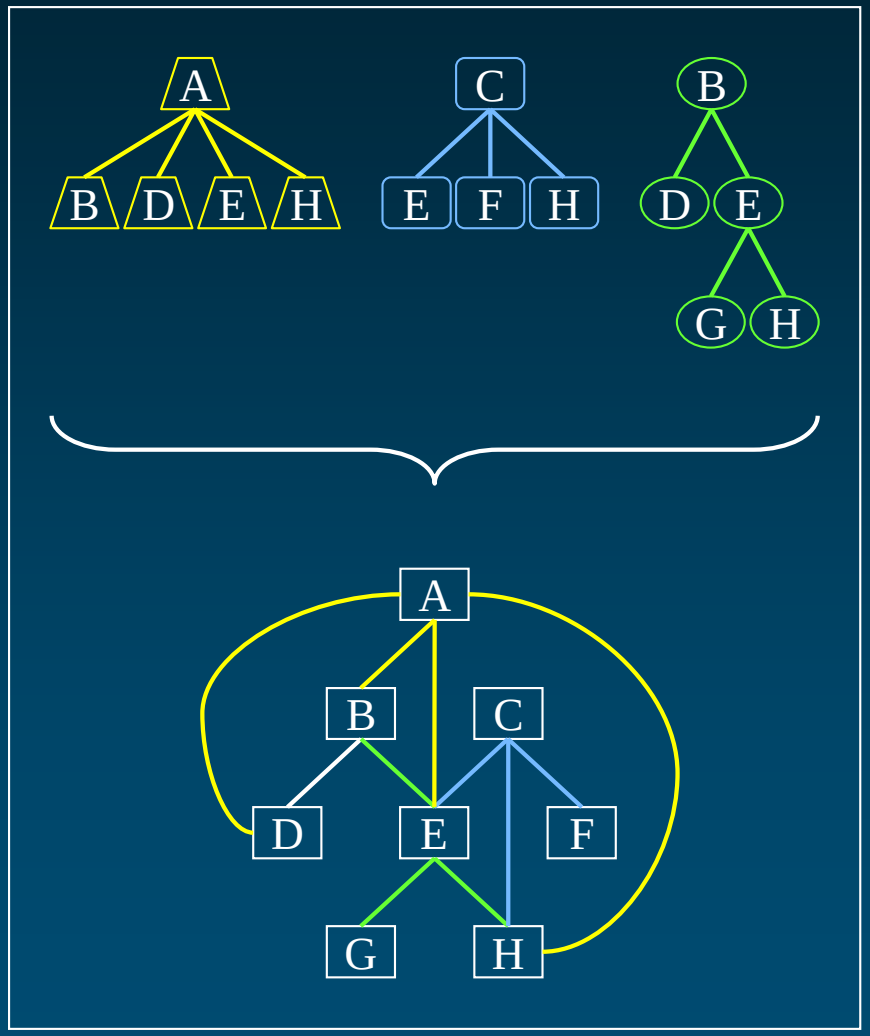
- Semantic types
  - Pharmacologic Substance 101,801
    - Antiparkinson Agents
    - Vidarabine Phosphate
  - Antibiotic 3,592
    - Kanamycin
  - Clinical Drug 165,378
    - Afrin Nose Drops 0.05%
    - Verapamil Oral Tablet [Calan]

270,000 concepts

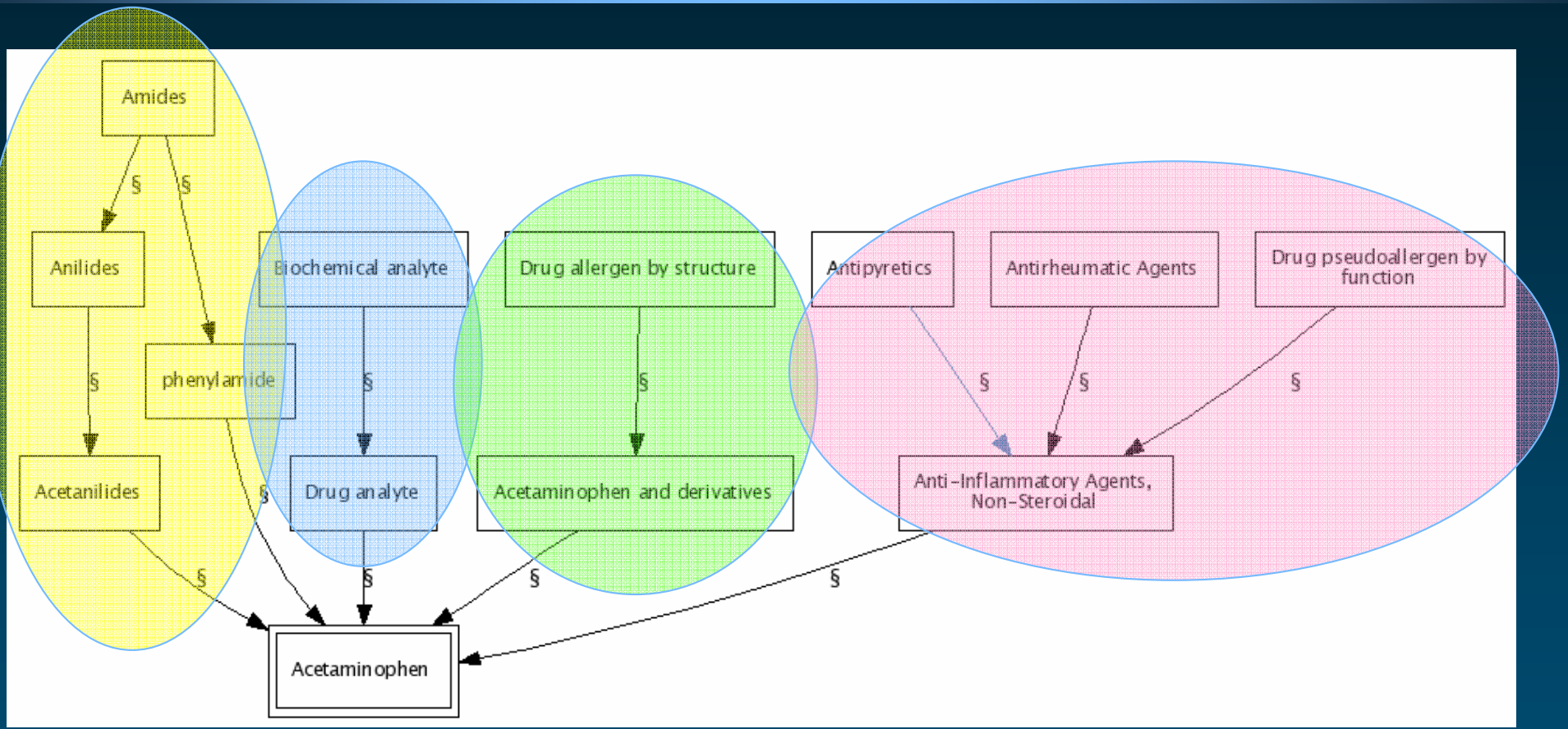
(~21% of all Metathesaurus concepts)

Organize concepts

- Inter-concept relationships: hierarchies from the source vocabularies
- Redundancy: multiple paths
- One graph instead of multiple trees (multiple inheritance)



Metathesaurus relations



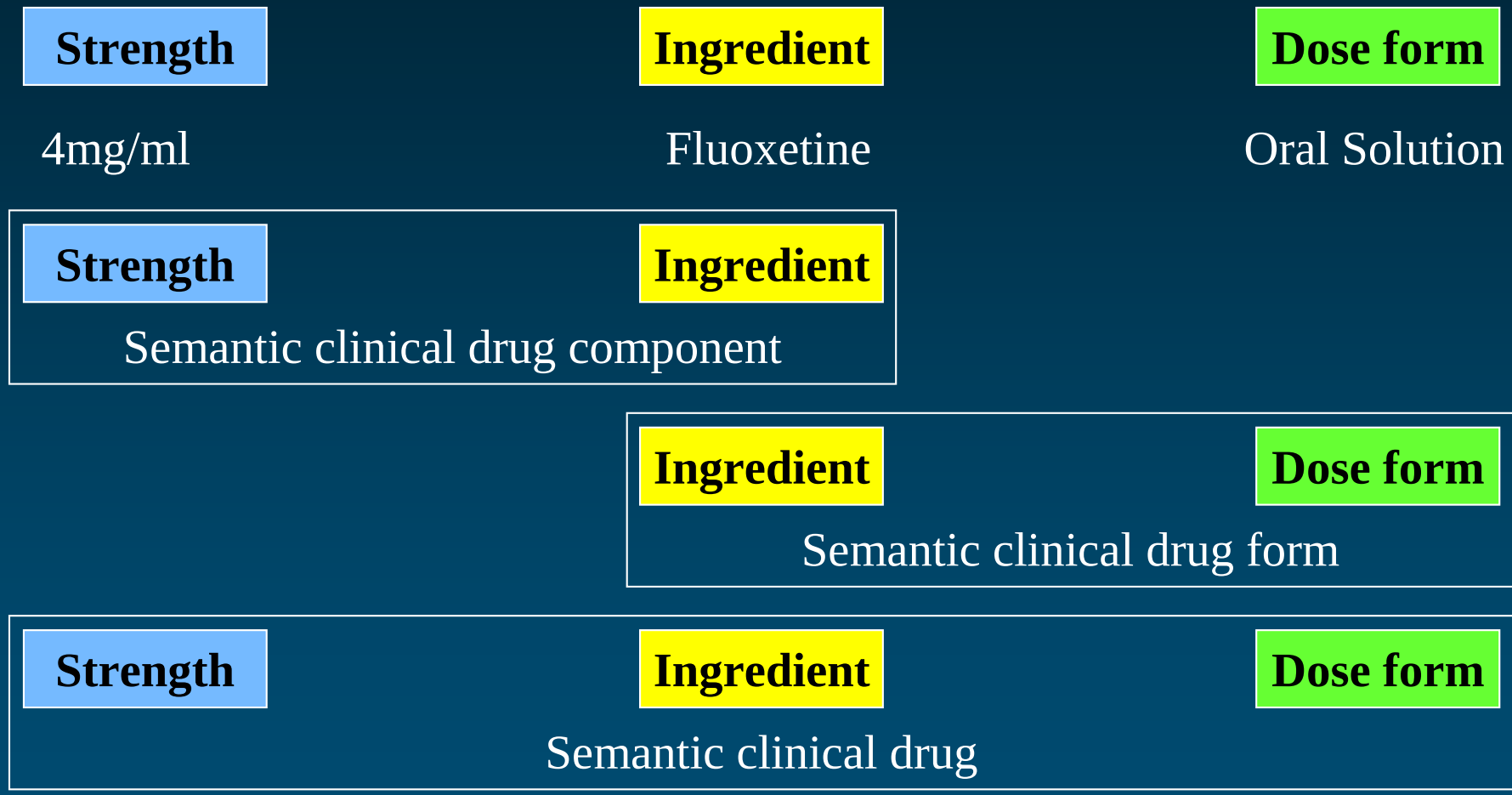
Drug vocabulary standardization

RxNorm

Motivation

- Exchange of information requires standardized names
  - Ordering drugs
  - Checking interactions
  - Inventory management
- No standard naming conventions for drugs
- Integrating drug vocabularies
- Unique identifiers for drugs
- Specify relations among drug entities

Normalized form

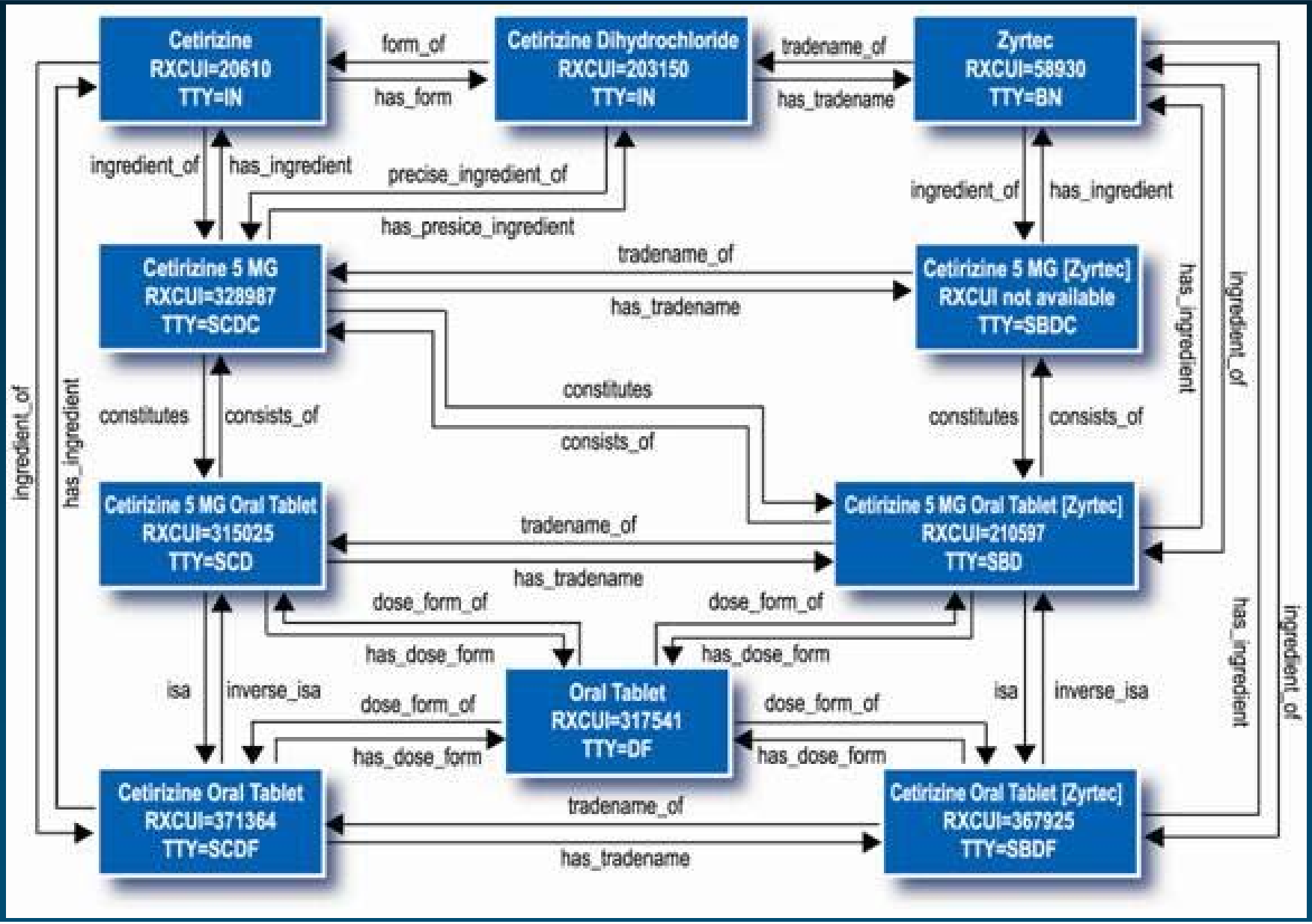


Generic *vs.* Brand

- Generic
  - Ingredient (IN)
  - Clinical drug form (SCDF)
  - Clinical drug component (SCDC)
  - Clinical drug (SCD)
- Brand
  - Brand name (BN)
  - Branded drug form (SBDF)
  - Branded drug component (SBDC)
  - Branded drug (SBD)

tradename_of

Relations among drug entities



RxNorm database

- Data sources
  - Master Drug Data Base
  - Multum MediSource Lex.
  - Micromedex DRUGDEX
  - FDA National Drug Code Directory
  - National Drug Data File Plus Source Vocabulary
  - VA National Drug File
  - SNOMED Clinical Terms
- Content
  - 5,570 ingredients
  - 10,788 brand names
  - 22,724 clinical drug comp.
  - 29,734 clinical drugs
  - 17,149 branded drugs
  - 16,447 branded drug comp.
  - 13,516 clinical drug forms
  - 13,035 branded drug forms
  - 140 dose forms

(as of February 28, 2006)

Visualization and processing of drug information

RxNav

- Visualization and navigation
  - RxNorm browser
  - Spelling correction
  - Search on names and codes
  - Standalone application
    - RxNorm database at NLM
    - Local RxNorm database
- Drug information processing
  - API to the RxNorm database
  - Web services

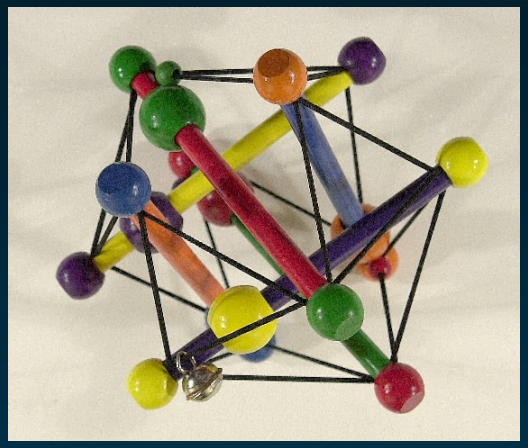
RxNav demo

http://mor.nlm.nih.gov/download/rxnav/

Conclusions

Conclusions

- Biomedical ontology and drug discovery
  - Ontologies provide
    - Terminology for entity recognition (text mining)
    - Relations for reasoning about drugs
  - Terminology integration and standardization (RxNorm) enables interoperability and mapping across vocabularies
    - Entry point into knowledge bases
  - Integration into broad ontologies (UMLS) enables information integration across subdomains



Medical Ontology Research

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NATIONAL LIBRARY OF MEDICINE

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References

Drug vocabularies

- MDDB http://www.medispan.com/Products/index.aspx?id=1
- Multum http://www.multum.com/
- DRUGDEX http://www.micromedex.com/products/drugdex/
- FDA NDC Dir. http://www.fda.gov/cder/ndc/
- NDDF Plus http://www.firstdatabank.com/knowledge_bases/nddf_plus/

Other vocabularies

- MeSH http://www.nlm.nih.gov/mesh/
- SNOMED CT http://www.snomed.org/

References

Unified Medical Language System (UMLS)

- http://www.nlm.nih.gov/research/umls/
- Bodenreider O. (2004). The Unified Medical Language System (UMLS): Integrating biomedical terminology. *Nucleic Acids Research*; D267-D270.

RxNorm

- http://www.nlm.nih.gov/research/umls/rxnorm/index.html

- http://mor.nlm.nih.gov/download/rxnav/