



THE NATIONAL CENTER FOR
BIOMEDICAL ONTOLOGY

Webinar Series
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RxNav

Browser and Application Programming
Interfaces for Drug Information Sources



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Acknowledgments



- ◆ Lee Peters
- ◆ Thang Nguyen
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- ◆ Stuart Nelson, John Kilbourne (RxNorm)
- ◆ Kin Wah Fung (RxTerms)
- ◆ Mark Erlbaum (NDF-RT)

Outline

- ◆ **RxNorm**
 - Drug vocabulary integration
 - Drug vocabulary standardization
- ◆ Other drug information sources accessible through RxNav
 - RxTerms
 - NDF-RT
- ◆ Visualizing drug information: **RxNav**
- ◆ Processing drug information: **RxNorm API**
- ◆ Applications



References

- ◆  and RxNorm APIs
 - <http://rxnav.nlm.nih.gov/>
- ◆ RxNorm
 - <http://www.nlm.nih.gov/research/umls/rxnorm/index.html>
- ◆ RxTerms
 - <http://wwwcf.nlm.nih.gov/umlslicense/rxtermApp/rxTerm.cfm>
- ◆ NDF-RT
 - <http://evs.nci.nih.gov/ftp1/NDF-RT/>

RxNorm

Overview

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

Drug vocabulary integration

RxNorm



UMLS-like approach

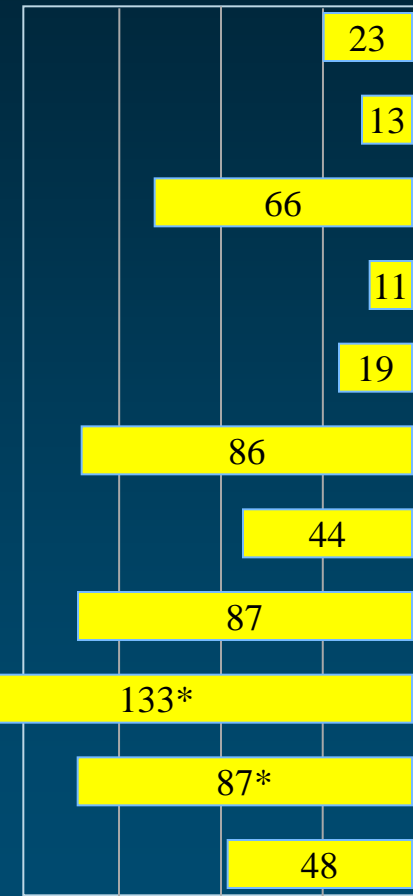
- ◆ 11 source vocabularies
- ◆ Synonymous names grouped into an RxNorm concept
- ◆ Unique identifiers (RxCUI)
- ◆ RRF format

- ◆ Differences
 - RxNorm creates its own names
 - Principled use of named relationships
 - Limited scope: drug names

Source vocabularies in RxNorm

(terms in thousands, as of January 2011)

- ◆ Gold Standard Alchemy
- ◆ Medi-Span Master Drug Data Base
- ◆ Multum MediSource Lexicon
- ◆ Micromedex RED CODE
- ◆ Medical Subject Headings
- ◆ FDA National Drug Code Directory
- ◆ FDA Structured Product Labels
- ◆ First DataBank NDDF Plus
- ◆ VHA National Drug File-Ref. Terminology
- ◆ SNOMED Clinical Terms (drug information)
- ◆ VHA National Drug File

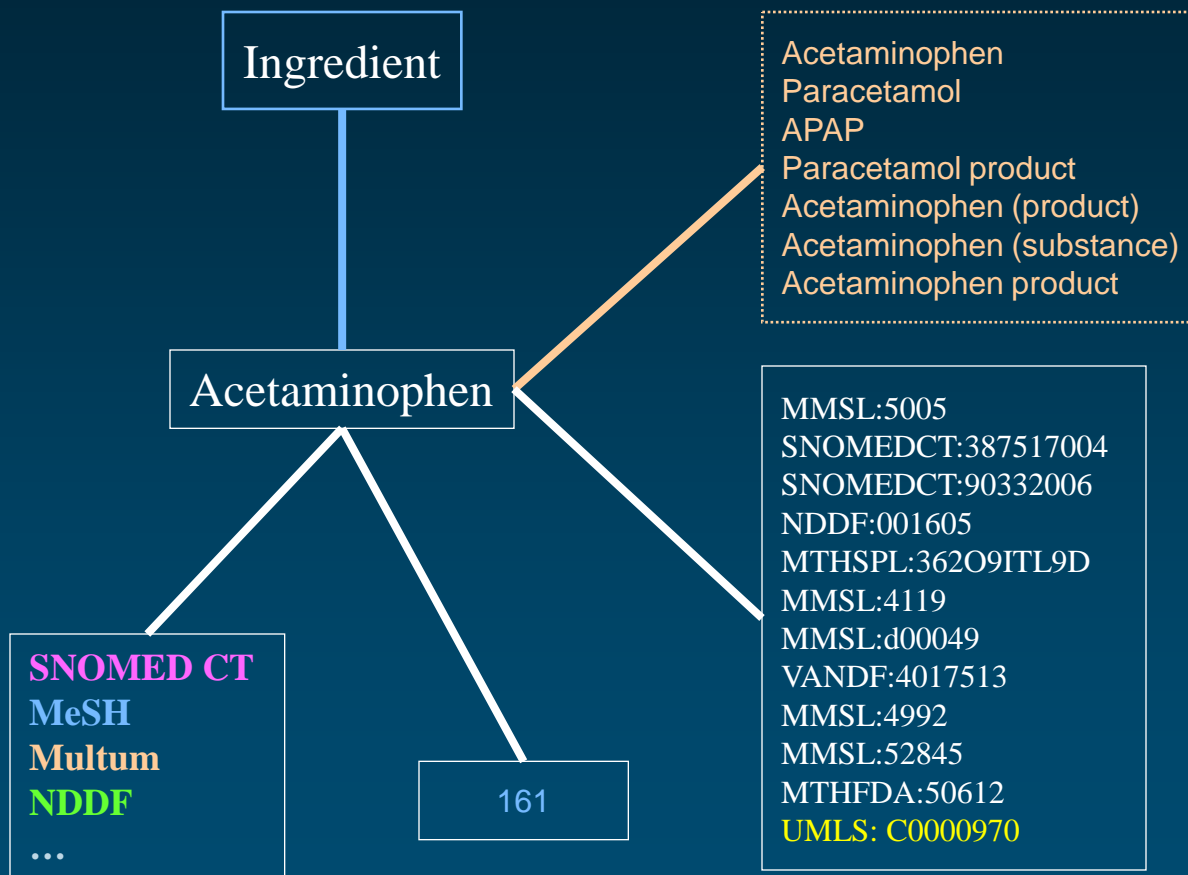


RxNorm

113



RxNorm concept



Drug vocabulary standardization

RxNorm

Normalization

- ◆ Lexical level
 - Conventions for representing names (strength, units, etc.)
- ◆ Structural level
 - Conventions for representing types of drug entities and their interrelations

Normalization Lexical level

- ◆ GS Digoxin 0.25mg/1mL Solution for injection
- ◆ GS Digoxin 500mcg/2mL Solution for injection
- ◆ MDDB 'Digoxin Inj 0.25 MG/ML
- ◆ MMSL digoxin 250 mcg/mL (0.25 mg/mL) injectable solution
- ◆ MMSL Digoxin, 250 mcg/mL (0.25 mg/mL) injectable solution
- ◆ MMX Digoxin 0.25 MG/ML Injection Solution
- ◆ MTHFDA DIGOXIN 0.25 MG INTRAMUSCULAR INJECTION, SOLUTION
- ◆ MTHFDA DIGOXIN 250 MCG INTRAMUSCULAR INJECTION
- ◆ MTHFDA DIGOXIN 250 MCG INTRAVENOUS INJECTION
- ◆ MTHSPL digoxin 0.25 MILLIGRAM In 1.0 MILLILITER INTRAVENOUS INJECTION
- ◆ MTHSPL Digoxin 250 MICROGRAM In 1 MILLILITER INTRAVENOUS INJECTION, SOLUTION
- ◆ NDDF DIGOXIN 250 mcg/mL INJECTION AMPUL (ML)
- ◆ NDDF DIGOXIN 250 mcg/mL INJECTION DISPOSABLE SYRINGE (ML)
- ◆ NDDF DIGOXIN@250 mcg/mL@INJECTION@AMPUL (ML)
- ◆ SNOMEDCT Digoxin 250micrograms/mL injection solution 2mL ampule
- ◆ SNOMEDCT Digoxin 500micrograms/2mL injection
- ◆ VANDF DIGOXIN 0.25MG/ML INJ
- ◆ [...] [...]



Digoxin 0.25 MG/ML Injectable Solution



Normalization Structural level

◆ Structural level

- Atomic elements
 - Ingredient
 - Strength
 - Dose form
- Generic vs. Brand names
- Principle set of relationships among the different types



Normalized form

Strength

4mg/ml

Ingredient

Fluoxetine

Dose form

Oral Solution

Strength

Clinical drug component

Ingredient

Ingredient

Clinical drug form

Dose form

Strength

Ingredient

Clinical drug

Dose form



Generic vs. Brand

◆ Generic

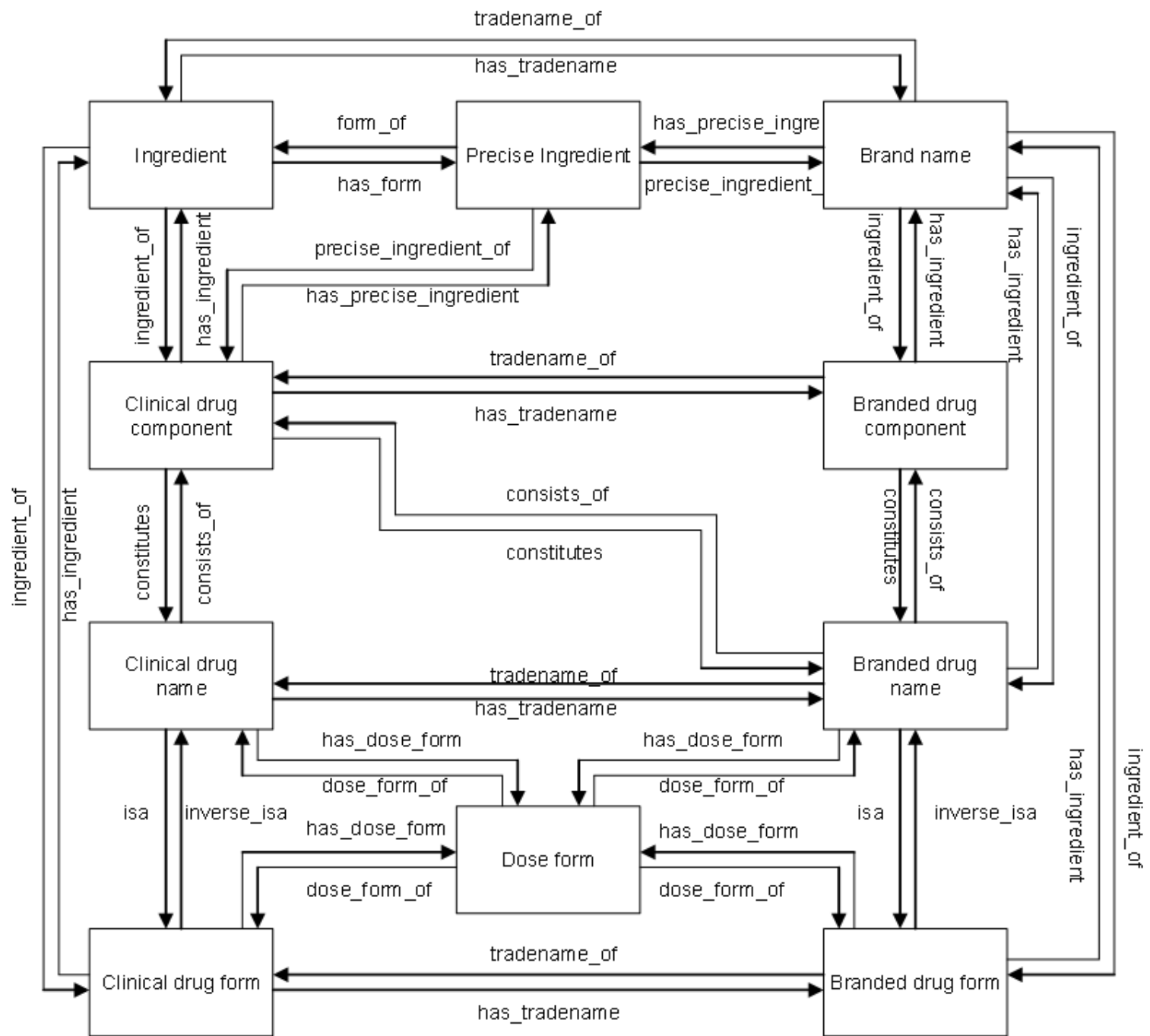
- Ingredient (IN) ←
- Clinical drug form (SCDF) ←
- Clinical drug component (SCDC) ←
- Clinical drug (SCD) ←

◆ Brand

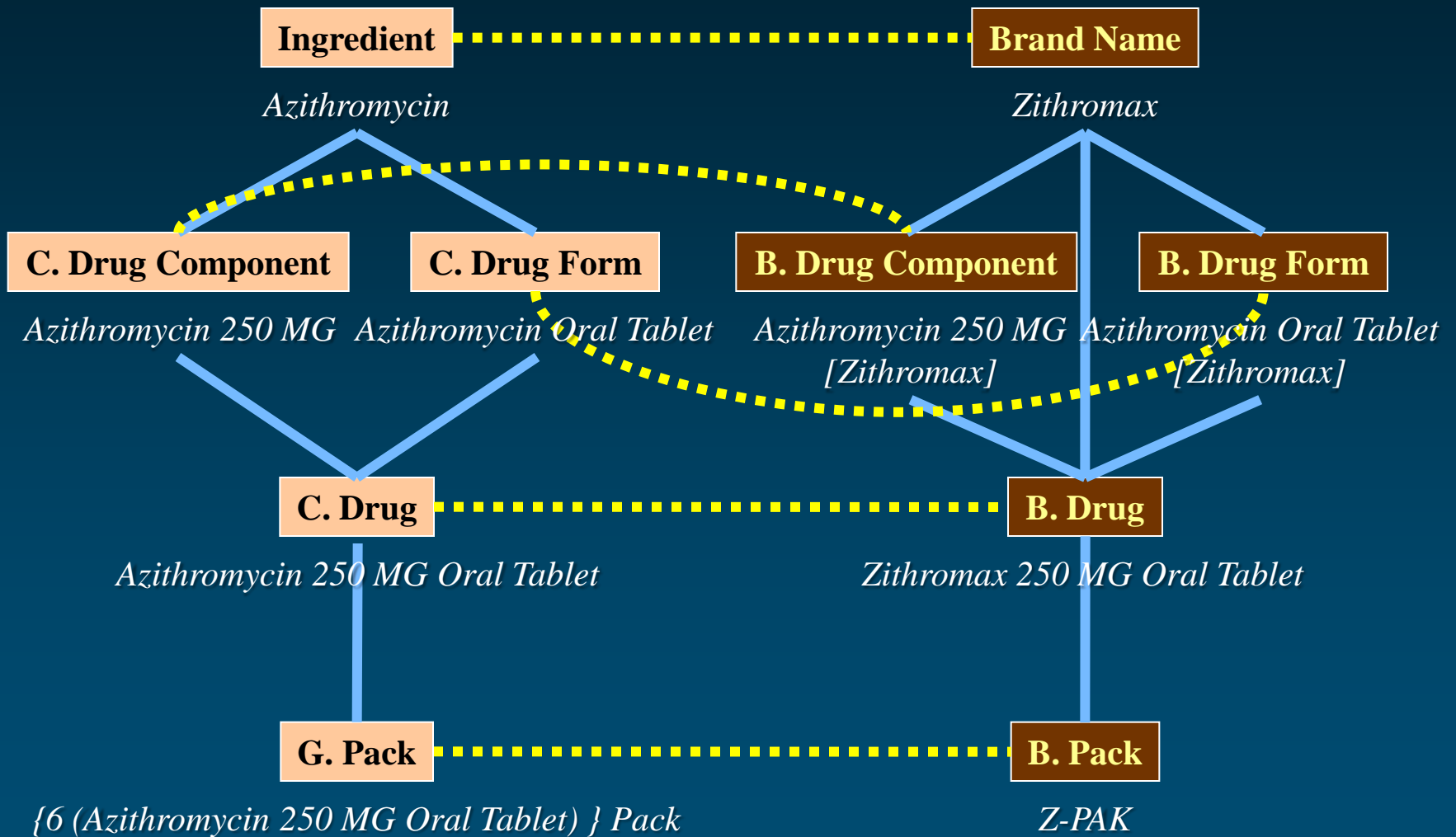
- Brand name (BN)
- Branded drug form (SBDF)
- Branded drug component (SBDC)
- Branded drug (SBD)

tradename_of





Relations among drug entities (revisited)



RxNorm database

◆ 11 data sources

- Gold Standard Alchemy
- Medi-Span Master Drug Data Base
- Multum MediSource Lexicon
- Micromedex RED BOOK
- Medical Subject Headings
- FDA National Drug Code Directory
- FDA Structured Product Labels
- First DataBank NDDF Plus
- VHA NDF – RT
- SNOMED Clinical Terms
- VHA National Drug File

◆ Content

- 4,942 ingredients
- 14,667 brand names
- 19,862 clinical drugs
- 16,275 branded drugs
- 307 generic packs
- 388 branded packs
- 15,715 clinical drug comp.
- 14,680 branded drug comp.
- 8,478 clinical drug forms
- 12,188 branded drug forms
- 100 dose forms

(as of January 26, 2011; excluding obsolete data)



Other drug information sources accessible through RxNav

RxTerms

NDF-RT

RxTerms

- ◆ Drug interface terminology derived from RxNorm for prescription writing or medication history recording
 - Commonly used synonyms and abbreviations (e.g. HCTZ for hydrochlorothiazide)
 - “tall man” lettering recommended by FDA to avoid medication errors
 - ChlorproMAZINE
 - ChlorproPAMIDE
- ◆ <http://wwwcf.nlm.nih.gov/umlslicense/rxtermApp/rxTerm.cfm>
- ◆ Developed at NLM



National Drug File Reference Terminology

- ◆ Developed by the Veterans Health Administration
- ◆ Part of the VA clinical information system
- ◆ Available from the NCI web site (XML, OWL)
 - <http://evs.nci.nih.gov/ftp1/NDF-RT/>
- ◆ Integrated in RxNorm since June 2010

National Drug File Reference Terminology

◆ Clinical information

- Pharmacologic class, Ingredients (*isa*)
- Therapeutic intent (*may_treat, may_diagnose, may_prevent*)
- Chemical ingredient (*has_ingredient, has_active_metabolites*)
- Mechanism of action (*has_MoA*)
- Physiologic effect (*has_PE*)
- Pharmacokinetics/Metabolism (*has_PK, site_of_metabolism*)
- Dose form (*has_dose_form*)
- Contraindications (*CI_with, CI_MoA, CI_PE, induces*)
- Drug-drug interactions

NDF-RT Examples

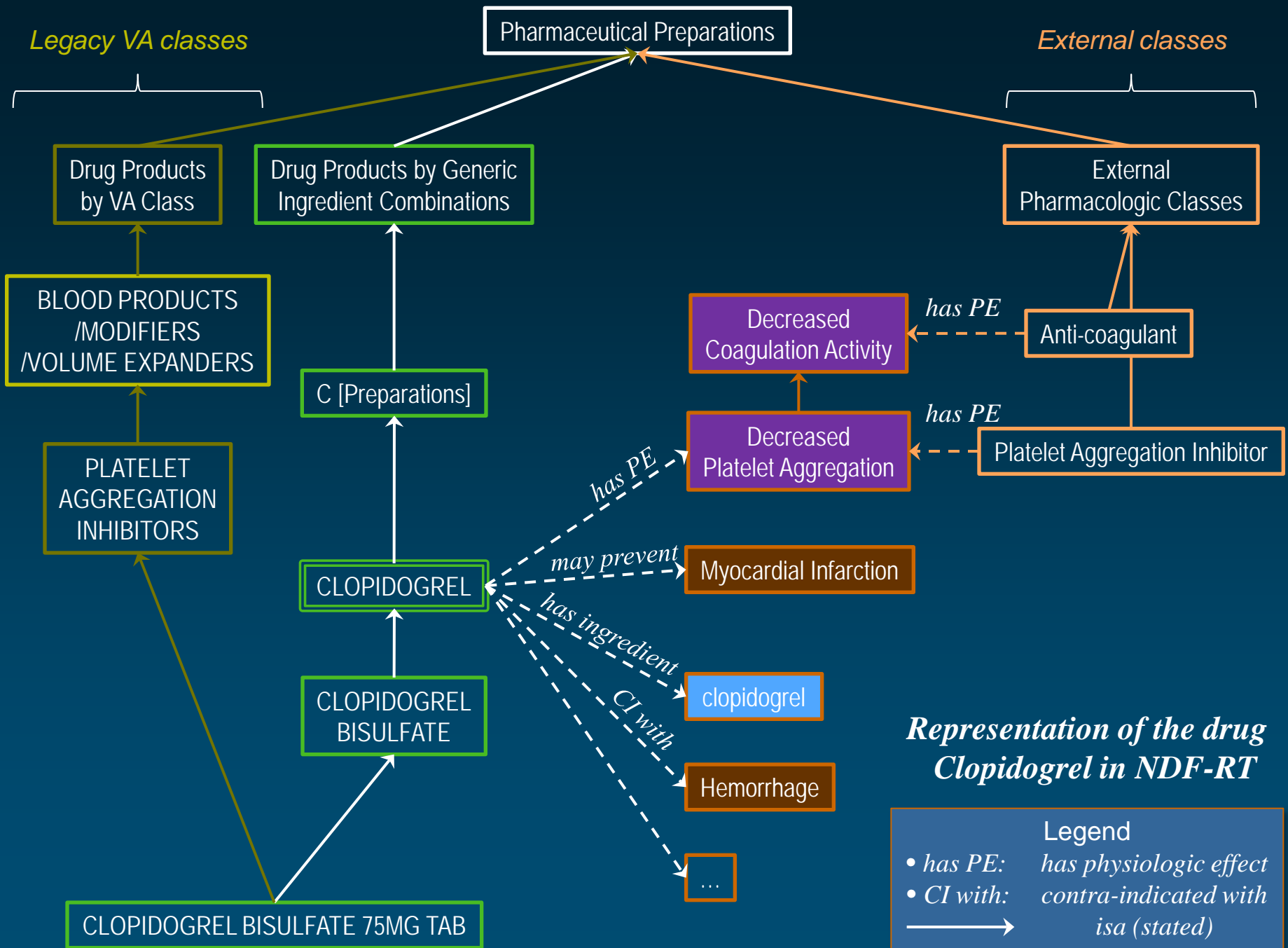
◆ Clopidogrel

- *may_prevent Cerebral Infarction*
- *may_prevent Coronary Thrombosis*
- *may_prevent Myocardial Infarction*
- *CI_with Blood Coagulation Disorders*
- *CI_with Drug Hypersensitivity*
- *CI_with Hemorrhage*
- *has_Ingredient clopidogrel*
- *has_MoA G-Protein-linked Receptor Interactions*
- *has_PE Decreased Platelet Aggregation*

◆ CLOPIDOGREL BISULFATE 75MG TAB,UD

- *isa PLATELET AGGREGATION INHIBITORS*





Visualizing drug information

RxNav





RxNav

- ◆ Visualization and navigation
 - RxNorm browser
 - Integrated with RxTerms and NDF-RT
 - Auto-completion and spelling correction
 - Search on names and codes (including proprietary)
 - Standalone application
 - Queries databases at NLM (RxNorm, RxTerms, NDF-RT)
 - Links to external sources (DailyMed)
- ◆ Drug information processing
 - API to the RxNorm database
 - Web services (SOAP, REST)

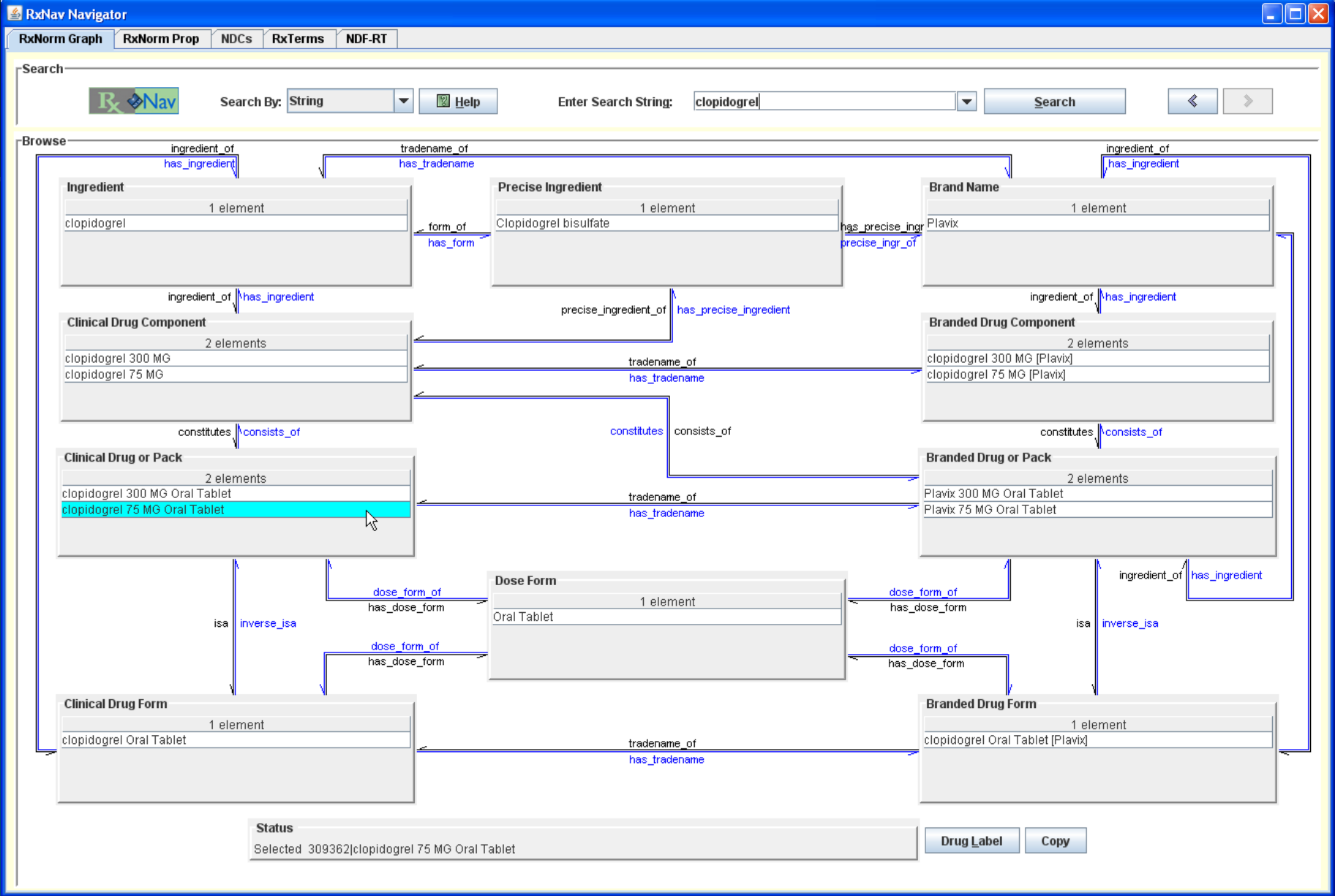




RxNav demo

<http://rxnav.nlm.nih.gov/>





RxNav Navigator

RxNorm Graph RxNorm Prop NDCs RxTerms NDF-RT

Results

RxNorm Properties
RxCUI= 309362

Attribute	Value
RxNorm Name	clopidogrel 75 MG Oral Tablet
RxCUI	309362
TTY	SCD
UMLSCUI	C0975741
Source	Gold Standard Alchemy
Source	Master Drug Data Base
Source	Multum MediSource Lexicon
Source	Metathesaurus FDA National Drug Code Directory
Source	Metathesaurus FDA Structured Product Labels
Source	National Drug Data File Plus Source Vocabulary
Source	National Drug File
Source	SNOMED Clinical Terms
Source	Veterans Health Administration National Drug File
SPL SET ID	EDAE8DF1-CAF9-FF72-1304-5AE8B355F8E7



RxNav Navigator

RxNorm Graph RxNorm Prop **NDCs** RxTerms NDF-RT

National Drug Codes

RxCUI: 309362
Name: clopidogrel 75 MG Oral Tablet

of NDCs: 32

00247227330
00247227360
49856025301
49856025302
49856025303
49856025304
49999086230
54868554600
55111019601
55111019630
55111019690
58016001400
58016001401
58016001402
58016001403
58016001404
58016001405
58016001406
58016001407
58016001408
58016001409
58016001410
58016001430
58016001460
58016001490
60505025301
60505025302
60505025303
60505025304
67228026103
67228026106
67544065131



RxNav Navigator

RxNorm Graph RxNorm Prop NDCs **RxTerms** NDF-RT

Results

Attribute	Value
Brand name	
Display Name	Clopidogrel (Oral-pill)
Synonym	
Full name	clopidogrel 75 MG Oral Tablet
Full generic	clopidogrel 75 MG Oral Tablet
Strength	75 mg
Dose form	Tab
Route	Oral-pill
Term type	SCD
RxCui	309362
Generic RxCui	
Suppress	
Data Version	RxTerms201101



Graph/Table

Select Concept: CLOPIDOGREL BISULFATE 75MG TAB,UD | N0000161012 ▼

- Properties Table
- Relations Table
- Drug
- Disease
- Dose Form
- Ingredient
- Mechanism of Action
- Pharmacokinetics
- Physiologic Effect
- Drug Interactions

CLOPIDOGREL BISULFATE 75MG TAB,UD Properties Table

Attribute	Value
NUI	N0000161012
Display_Name	CLOPIDOGREL BISULFATE 75MG TAB,UD
Print_Name	CLOPIDOGREL BISULFATE 75MG TAB UD
kind	DRUG_KIND
Level	VA Product
Status	Active
Units	MG
Strength	75
code	C37686
VUID	4013160
UMLS_CUI	C0975741
RxNorm_CUI	309362
RxNorm_Name	clopidogrel 75 MG Oral Tablet
VANDF_Record	<VANDF_Record>50.68^12795^</VANDF_Record><VA_File>50.68</VA_File><VA_IEN>12795</VA_IEN>
VA_National_For...	CLOPIDOGREL TAB



Graph/Table

Select Concept: CLOPIDOGREL BISULFATE 75MG TAB,UD | N0000161012 ▼

- Properties Table
- Relations Table**
- Drug
- Disease
- Dose Form
- Ingredient
- Mechanism of Action
- Pharmacokinetics
- Physiologic Effect
- Drug Interactions

CLOPIDOGREL BISULFATE 75MG TAB,UD Relations Table

Kind	Subject	Predicate	Object
Drug	CLOPIDOGREL	isa	C [Preparations]
Drug	CLOPIDOGREL BISULFATE	isa	CLOPIDOGREL
Drug	CLOPIDOGREL BISULFATE 75MG TAB,UD	isa	CLOPIDOGREL BISULFATE
Drug	CLOPIDOGREL BISULFATE 75MG TAB,UD	isa	PLATELET AGGREGATION INHIBITORS
Disease	CLOPIDOGREL	CI_with	Blood Coagulation Disorders
Disease	CLOPIDOGREL	CI_with	Drug Hypersensitivity
Disease	CLOPIDOGREL	CI_with	Hemorrhage
Disease	CLOPIDOGREL	may_prevent	Cerebral Infarction
Disease	CLOPIDOGREL	may_prevent	Coronary Thrombosis
Disease	CLOPIDOGREL	may_prevent	Myocardial Infarction
Dose Form	CLOPIDOGREL BISULFATE 75MG TAB,UD	has_DoseForm	Oral Tablet
Ingredient	CLOPIDOGREL	has_Ingredient	clopidogrel
Mechanism of A...	CLOPIDOGREL	has_MoA	G-Protein-linked Receptor Interactions
Physiologic Effect	CLOPIDOGREL	has_PE	Decreased Platelet Aggregation



RxNav Navigator

RxNorm Graph RxNorm Prop NDCs RxTerms NDF-RT

RxCUI : 309362 NUI : N0000161012 in out reset Zoom Mode Pan Mode Text Select Version : 2011.01.03

Graph/Table

Select Concept: CLOPIDOGREL BISULFATE 75MG TAB,UD | N0000161012

CLOPIDOGREL BISULFATE 75MG TAB,UD
Drug

Properties Table

Relations Table

Drug

Disease

Dose Form

Ingredient

Mechanism of Action

Pharmacokinetics

Physiologic Effect

Drug Interactions

Legend

VA Class (parallelogram)

VA Product (rectangle)

DRUG (oval) -- isa --> DRUG (oval)

DRUG (oval) -.- association -.-> DRUG (oval)



RxNav Navigator

RxNorm Graph RxNorm Prop NDCs RxTerms NDF-RT

RxCUI : 309362 NUI : N0000161012 in out reset Zoom Mode Pan Mode Text Select Version : 2011.01.03

Graph/Table

Select Concept: CLOPIDOGREL BISULFATE 75MG TAB,UD | N0000161012

Properties Table
 Relations Table
 Drug
 Disease
 Dose Form
 Ingredient
 Mechanism of Action
 Pharmacokinetics
 Physiologic Effect
 Drug Interactions

```

    graph BT
      CLOPIDOGREL((CLOPIDOGREL)) --> Cerebral_Infarction((Cerebral Infarction))
      CLOPIDOGREL --> Brain_Infarction((Brain Infarction))
      CLOPIDOGREL --> Stroke((Stroke))
      CLOPIDOGREL --> Brain_Ischemia((Brain Ischemia))
      CLOPIDOGREL --> Coronary_Thrombosis((Coronary Thrombosis))
      CLOPIDOGREL --> Thrombosis((Thrombosis))
      CLOPIDOGREL --> Coronary_Disease((Coronary Disease))
      CLOPIDOGREL --> Embolism_and_Thrombosis((Embolism and Thrombosis))
      CLOPIDOGREL --> Cerebrovascular_Disorders((Cerebrovascular Disorders))
      CLOPIDOGREL --> Vascular_Diseases((Vascular Diseases))
      
      Cerebral_Infarction --> Brain_Infarction
      Brain_Infarction --> Stroke
      Brain_Infarction --> Brain_Ischemia
      
      Coronary_Thrombosis --> Thrombosis
      Coronary_Thrombosis --> Coronary_Disease
      
      Embolism_and_Thrombosis --> Cerebrovascular_Disorders
      Embolism_and_Thrombosis --> Vascular_Diseases
      
      Cerebrovascular_Disorders --> Brain_Diseases((Brain Diseases))
      Cerebrovascular_Disorders --> Vascular_Diseases
      
      Blood_Coagulation_Disorders((Blood Coagulation Disorders))
      Drug_Hypersensitivity((Drug Hypersensitivity))
      Brain_Diseases --> Vascular_Diseases
  
```



RxNav Navigator

RxNorm Graph RxNorm Prop NDCs RxTerms NDF-RT

RxCUI : 309362 NUI : N0000161012 in out reset Zoom Mode Pan Mode Text Select Version : 2011.01.03

Graph/Table

Select Concept: CLOPIDOGREL BISULFATE 75MG TAB,UD

Properties Table

Relations Table

Drug

Disease

Dose Form

Ingredient

Mechanism of Action

Pharmacokinetics

Physiologic Effect

Drug Interactions

Legend

DRUG $\xrightarrow{\text{isa}}$ DRUG

DOSE FORM $\xrightarrow{\text{isa}}$ DOSE FORM

DRUG $\xrightarrow{\text{has_DoseForm}}$ DRUG

DRUG $\xrightarrow{\text{has_Chemical_Structure}}$ DRUG

association



RxNav Navigator

RxNorm Graph RxNorm Prop NDCs RxTerms NDF-RT

RxCUI : 309362 NUI : N0000161012 in out reset Zoom Mode Pan Mode Text Select Version : 2011.01.03

Graph/Table

Select Concept: CLOPIDOGREL BISULFATE 75MG TAB,UD | N0000161012

Properties Table
 Relations Table
 Drug
 Disease
 Dose Form
 Ingredient
 Mechanism of Action
 Pharmacokinetics
 Physiologic Effect
 Drug Interactions

```

graph BT
    Root[CLOPIDOGREL BISULFATE 75MG TAB,UD] --> A[CLOPIDOGREL BISULFATE]
    A --> B[CLOPIDOGREL]
    B --> C[Ticlopidine]
    C --> D[Thienopyridines]
    D --> E[Thiophenes]
    D --> F[Pyridines]
  
```



RxNav Navigator

RxNorm Graph RxNorm Prop NDCs RxTerms NDF-RT

RxCUI : 309362 NUI : N0000161012 in out reset Zoom Mode Pan Mode Text Select Version : 2011.01.03

Graph/Table

Select Concept: CLOPIDOGREL BISULFATE 75MG TAB,UD | N0000161012

Properties Table

Relations Table

Drug

Disease

Dose Form

Ingredient

Mechanism of Action

Pharmacokinetics

Physiologic Effect

Drug Interactions

CLOPIDOGREL BISULFATE 75MG TAB,UD Mechanism of Action

Cellular or Molecular Interactions

Receptor Interactions

G-Protein-linked Receptor Interactions

CLOPIDOGREL

CLOPIDOGREL BISULFATE

CLOPIDOGREL BISULFATE 75MG TAB,UD

Legend

VA Product

DRUG — isa —> DRUG

DRUG - - association - -> DRUG

MECHANISM OF ACTION — isa —> MECHANISM OF ACTION

DRUG — has_MoA —> MECHANISM OF ACTION

DRUG — Cl_MoA —> MECHANISM OF ACTION



RxNav Navigator

RxNorm Graph RxNorm Prop NDCs RxTerms NDF-RT

RxCUI : 309362 NUI : N0000161012 in out reset Zoom Mode Pan Mode Text Select Version : 2011.01.03

Graph/Table

Select Concept: CLOPIDOGREL BISULFATE 75MG TAB,UD | N0000161012

Properties Table

Relations Table

Drug

Disease

Dose Form

Ingredient

Mechanism of Action

Pharmacokinetics

Physiologic Effect

Drug Interactions

CLOPIDOGREL BISULFATE 75MG TAB,UD
Pharmacokinetics

CLOPIDOGREL

CLOPIDOGREL BISULFATE

CLOPIDOGREL BISULFATE 75MG TAB,UD

Legend

VA Product

DRUG — isa —> DRUG

DRUG — association —> DRUG

PHARMACOKINETICS — isa —> PHARMACOKINETICS

DRUG — has_PK —> PHARMACOKINETICS

DRUG — site_of_metabolism —> PHARMACOKINETICS



RxNav Navigator

RxNorm Graph RxNorm Prop NDCs RxTerms NDF-RT

RxCUI : 309362 NUI : N0000161012 in out reset Zoom Mode Pan Mode Text Select Version : 2011.01.03

Graph/Table

Select Concept: CLOPIDOGREL BISULFATE 75MG TAB,UD | N0000161012

Properties Table

Relations Table

Drug

Disease

Dose Form

Ingredient

Mechanism of Action

Pharmacokinetics

Physiologic Effect

Drug Interactions

```

graph BT
    Root[CLOPIDOGREL BISULFATE 75MG TAB,UD] --> CLOPIDOGREL_BISULFATE[CLOPIDOGREL BISULFATE]
    CLOPIDOGREL_BISULFATE --> CLOPIDOGREL[CLOPIDOGREL]
    CLOPIDOGREL --> DPA[Decreased Platelet Aggregation]
    DPA --> PAA[Platelet Aggregation Alteration]
    DPA --> DCA[Decreased Coagulation Activity]
    DCA --> COA[Coagulation Activity Alteration]
  
```

Legend

VA Product

DRUG

-- isa -->

DRUG

PHYSIOLOGIC EFFECT

-- isa -->

PHYSIOLOGIC EFFECT

DRUG

-- has_PE -->

PHYSIOLOGIC EFFECT



Processing drug information

RxNorm Application Programming Interface

RxNorm APIs

- ◆ Made available in March 2008
- ◆ Based on Web Services
 - SOAP, REST
 - Independent of any programming language
- ◆ Used by *RxNav* and other applications
- ◆ Enable access to all information displayed in RxNav
- ◆ Documentation
 - SOAP <http://rxnav.nlm.nih.gov/RxNormAPI.html>
 - REST <http://rxnav.nlm.nih.gov/RxNormRestAPI.html>
- ◆ Testing environment (SOAP client demo)
 - http://mor.nlm.nih.gov/perl/rxnav_api_demo.pl



List of functions (SOAP) 1/3

◆ Housekeeping functions

- `getRxNormVersion()`
- `getIdTypes()`
- `getRelaTypes()`
- `getTermTypes()`
- `getSourceTypes()`

◆ Find RxNorm concepts

- By name: `findRxcuiByString(searchString, source-list, allSourcesFlag, searchType)`
- By code: `findRxcuiById(idType, id, allSourcesFlag)`
- Help: `getSpellingSuggestions(searchString)`
- Versioning: `findRemapped(rx cui)`



List of functions (SOAP) 2/3

◆ Get RxNorm concept properties

- `getRxConceptProperties(rx cui)`
- `getStrength(rx cui)`
- `getQuantity(rx cui)`
- `getNDCs(rx cui)`
- `getUNII(rx cui)`
- `getProprietaryInformation(rx cui, source-list, proxyTicket*)`



List of functions (SOAP) 3/3

- ◆ Get RxNorm concept relations
 - By rel.: `getRelatedByRelationship(rx cui, rel-list)`
 - By type: `getRelatedByType(rx cui, type-list)`
 - All: `getAllRelatedInfo(rx cui)`

- ◆ Miscellaneous functions
 - `getDrugs(name)`
 - `getDisplayTerms()`
 - `getMultiIngridBrand(rx cui-list)`



Documentation

◆ Java

```
import java.net.URL;  
import BeanService.*;  
import gov.nih.nlm.mor.axis.services.RxNormDBService.*;
```

```
String rxhost = "http://mor.nlm.nih.gov";  
String rxURI = rxhost + "/axis/services/RxNormDBService";  
  
// Locate the RxNorm API web service  
URL rxURL = new URL(rxURI);  
DBManagerService rxnormService = new DBManagerServiceLocator();  
DBManager dbmanager = rxnormService.getRxNormDBService(rxURL);
```

◆ Perl, .NET



Implementation Perl client

http://mor.nlm.nih.gov/perl/rxnav_api_demo.pl

RxNorm API demo

Method:

Arg1:


Arg2:

Arg3:

Arg4:

Comment:

Contact:



Method:

Arg1:

Arg2:

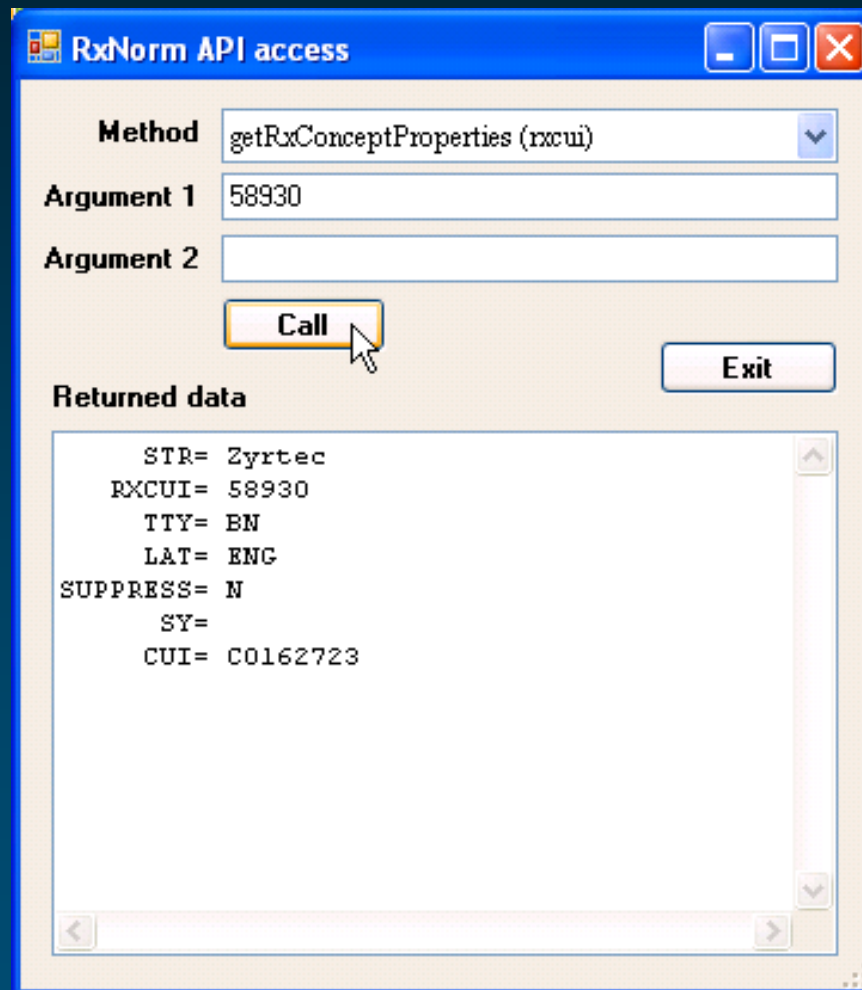
Arg3:

Arg4:

STR	Zyrtec
SUPPRESS	N
TTY	BN
SY	
RXCUI	58930
LAT	ENG
CUI	C0162723



Implementation .NET client



RESTful API

◆ Base URI

- <http://rxnav.nlm.nih.gov/REST/>

◆ List of resources

- <http://rxnav.nlm.nih.gov/RxNormRestAPI.html>



RESTful resource	SOAP-based function
/	(none)
/version	getRxNormVersion
/displaynames	getDisplayNames
/idtypes	getIdTypes
/relatypes	getRelaTypes
/termtypes	getTermTypes
/rxcai?name=value&srclst=value&allsrc=value&search=value	findRxcuiByString
/rxcai?idtype=value&id=value&allsrc=value	findRxcuiById
/rxcai/{rxcai}	(none)
/rxcai/{rxcai}/properties	getRxConceptProperties
/rxcai/{rxcai}/ndcs	getNDCs
/rxcai/{rxcai}/allrelated	getAllRelatedInfo
/rxcai/{rxcai}/related?tty=values	getRelatedByType
/rxcai/{rxcai}/related?rela=values	getRelatedByRelationship
/rxcai/{rxcai}/unii	getUNII
/rxcai/{rxcai}/quantity	getQuantity
/rxcai/{rxcai}/strength	getStrength
/rxcai/{rxcai}/proprietary?srclst=values&ticket=value	getProprietaryInformation
/spellingsuggestions?name=value	getSpellingSuggestions
/brands?ingredientids=value	getMultiIngredBrand
/drugs?name=value	getDrugs

REST output XML

<http://rxnav.nlm.nih.gov/REST/rxcui?name=bactrim>

XML output

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<rxnormdata>
  <idGroup>
    <name>bactrim</name>
    <rxcui>151399</rxcui>
  </idGroup>
</rxnormdata>
```



REST output JSON

<http://rxnav.nlm.nih.gov/REST/rxcui?name=bactrim>

JSON output

```
{
  "idGroup" : {
    "rxcui" : "151399",
    "name" : "bactrim"
  }
}
```

RxNormNorm Recently released

- ◆ Managing variation in clinical drug names
- ◆ Use case: mapping of local formularies to RxNorm
- ◆ Extends the UMLS program *norm*
- ◆ Specific normalization rules
 - **Expansion of abbreviations**
(e.g., tab to tablet)
 - **Reformatting of specific elements**
(e.g., space between number and unit)
 - **Removal of salt variants**
(e.g., *succinate* from *metoprolol succinate*)



New functions Coming up soon

◆ *RxMap*

- Mapping lists of drug names / identifiers to RxNorm
- Batch mode version of
 - `findRxcuiByString()`
 - `findRxcuiById()`

◆ *RxXMap*

- Mapping across vocabularies through RxNorm
- Combines
 - `findRxcuiById()`
 - `getProprietaryInformation()`
- Requires UMLS license



New APIs Coming up soon

◆ *RxTerms*

- SOAP + REST
- List of RxTerms properties for a given RxCUI

◆ *NDF-RT*

- SOAP + REST
- Find NDF-RT entity by name, NUI, RxCUI
- Get properties for a given NDF-RT drug entity
- Get relations for a given NDF-RT drug entity
- Find drug interactions



Applications

Examples of application

- ◆ Terminology integration and standardization (RxNorm) enables interoperability and mapping across vocabularies
- ◆ Specific applications
 - Information exchange (“meaningful use”)
 - Medication lists
 - Medication reconciliation
 - E-prescribing / CPOE
 - CDA R2
 - Personal Health Record



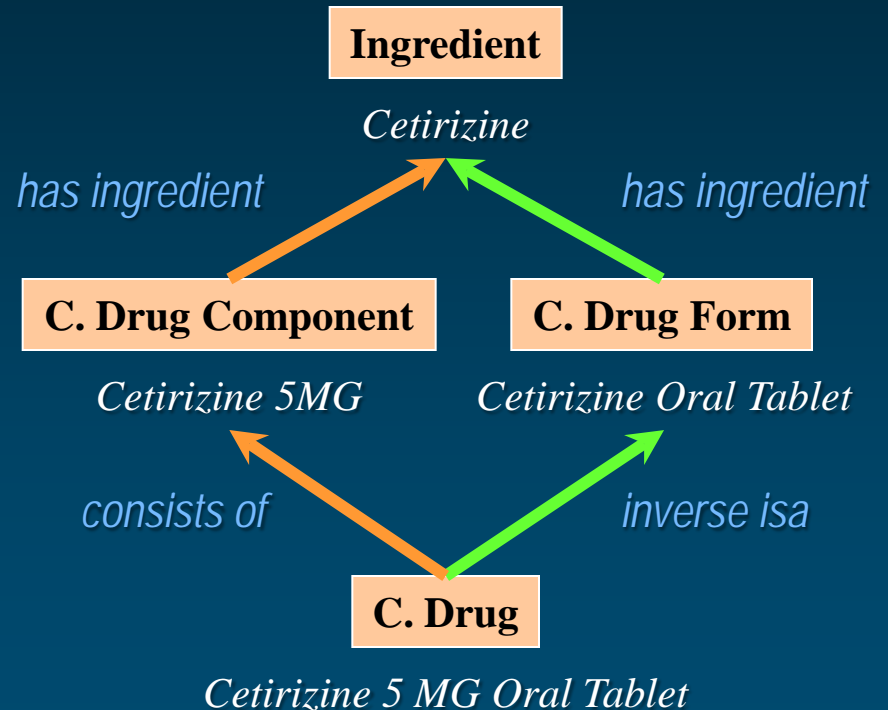
Quality control in RxNorm

- ◆ Multiple equivalent paths between RxNorm entities

getRelatedByRelationship(*r*, *consists of*) o
getRelatedByRelationship(*, *has ingredient*)

?≡

getRelatedByRelationship(*r*, *inverse isa*) o
getRelatedByRelationship(*, *has ingredient*)



Examples of application

- ◆ Quality control in RxNorm: Results
 - 35,000 pairs of paths investigated
 - Few discrepancies detected
 - Types of errors
 - Obsolete brand names
 - Obsolete branded drug forms
 - Erroneous relations
 - Discrepancies reported to the RxNorm team

[Peters, JAMIA 2009]



Applications outside NLM

◆ RxSafe (OHSU)

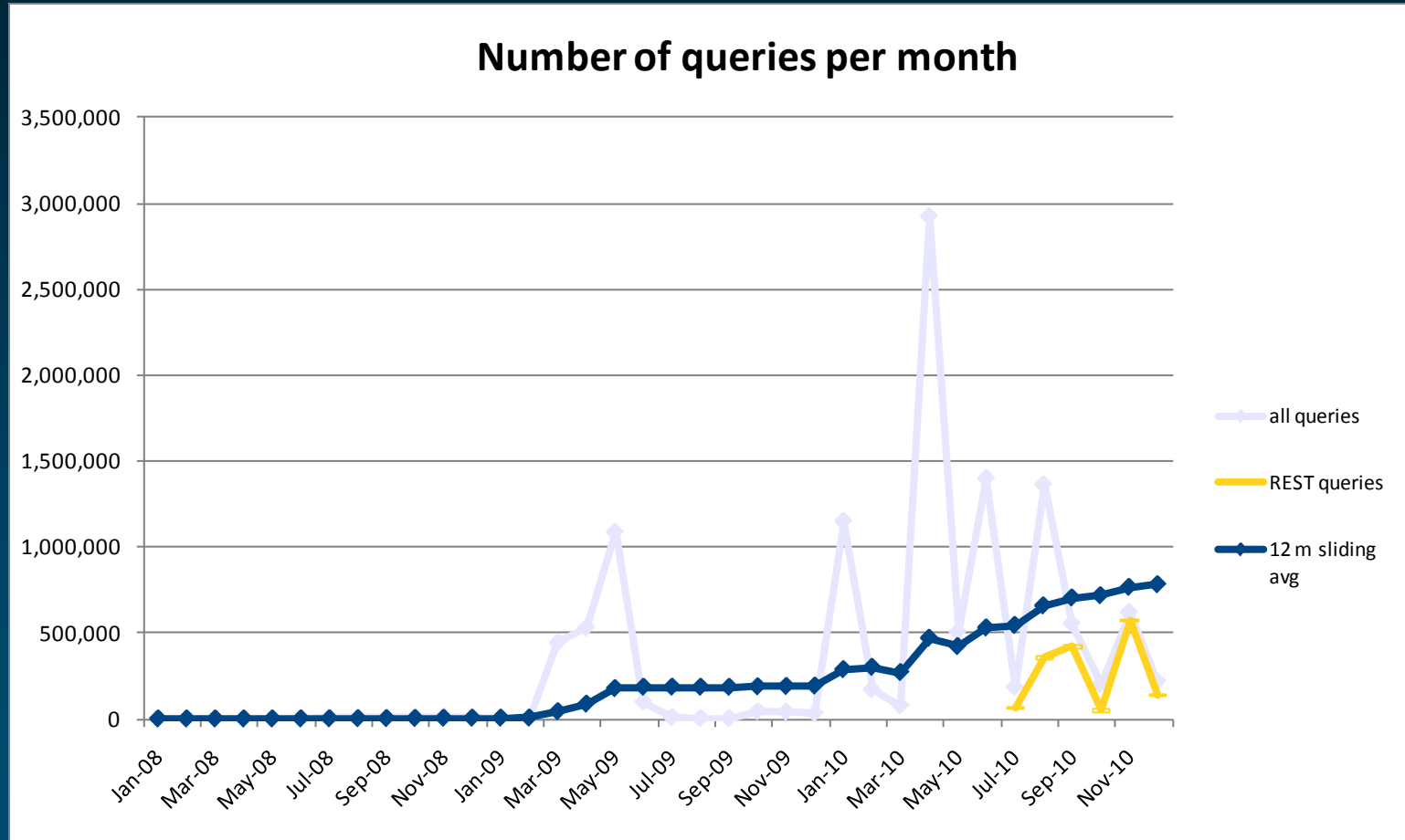
- “improve medication safety for patients”
- <http://www.ohsu.edu/RxSafe/>

◆ My-Medi-Health (Vanderbilt)

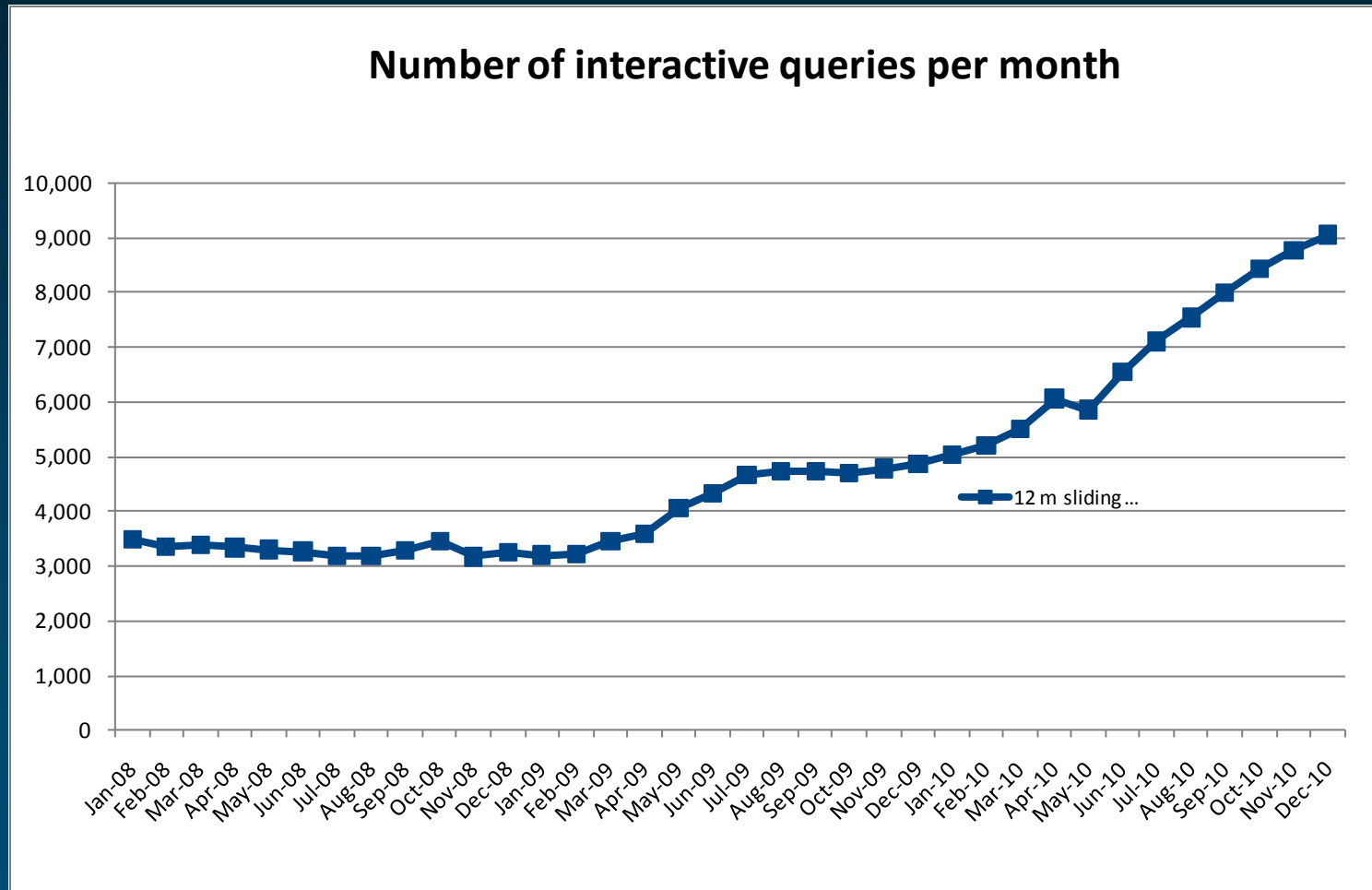
- “Child-Centered Medication Management”
- http://www.projecthealthdesign.org/projects/overview-2006_2008/405594/406293



Usage statistics All queries



Usage statistics Interactive queries





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