S88 – Health Data Sources & Networks

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RxNav

Browser and Application Programming Interfaces for Drug Information Sources

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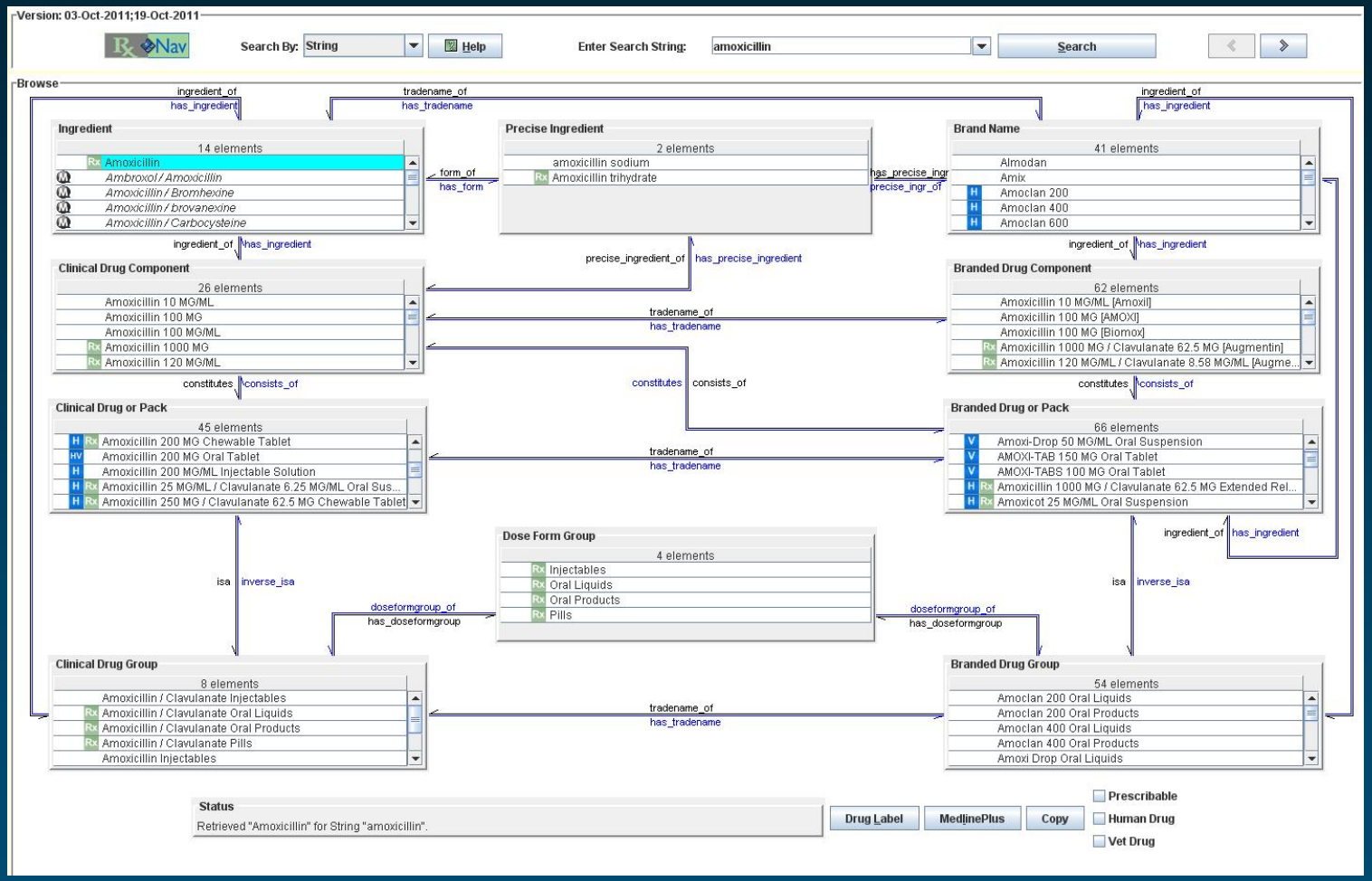
Outline

- Overview of Drug Information Sources
  - RxNorm – standard names and codes for drugs
  - RxTerms – interface terminology for drugs
  - NDF-RT – clinical information about drugs
- Visualize Drug Information Sources: RxNav
- Processing drug information: application programming interfaces (APIs) for RxNorm, RxTerms and NDF-RT
- 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/


Version: 03-Oct-2011;19-Oct-2011
RxNav
Search By: String
Help
Enter Search String: amoxicillin
Search
Browse
ingredient_of
has_ingredient
tradename_of
has_tradename
Ingredient
14 elements
Amoxicillin
Ambroxol / Amoxicillin
Amoxicillin / Bromhexine
Amoxicillin / brovanexine
Amoxicillin / Carbocysteine
form_of
has_form
Precise Ingredient
2 elements
amoxicillin sodium
Amoxicillin trihydrate
has_precise_ingr
precise_ingr_of
Brand Name
41 elements
Almodan
Amix
Amoclan 200
Amoclan 400
Amoclan 600
precise_ingredient_of
has_precise_ingredient
Clinical Drug Component
26 elements
Amoxicillin 10 MG/ML
Amoxicillin 100 MG
Amoxicillin 100 MG/ML
Amoxicillin 1000 MG
Amoxicillin 120 MG/ML
Branded Drug Component
62 elements
Amoxicillin 10 MG/ML [Amoxil]
Amoxicillin 100 MG [AMOXI]
Amoxicillin 100 MG [Biomox]
Amoxicillin 1000 MG / Clavulanate 62.5 MG [Augmentin]
Amoxicillin 120 MG/ML / Clavulanate 8.58 MG/ML [Augme...
constitutes
consists_of
Clinical Drug or Pack
45 elements
Amoxicillin 200 MG Chewable Tablet
Amoxicillin 200 MG Oral Tablet
Amoxicillin 200 MG/ML Injectable Solution
Amoxicillin 25 MG/ML / Clavulanate 6.25 MG/ML Oral Sus...
Amoxicillin 250 MG / Clavulanate 62.5 MG Chewable Tablet
Branded Drug or Pack
66 elements
Amoxi-Drop 50 MG/ML Oral Suspension
AMOXI-TAB 150 MG Oral Tablet
AMOXI-TABS 100 MG Oral Tablet
Amoxicillin 1000 MG / Clavulanate 62.5 MG Extended Rel...
Amoxicot 25 MG/ML Oral Suspension
Dose Form Group
4 elements
Injectables
Oral Liquids
Oral Products
Pills
isa
inverse_isa
doseformgroup_of
has_doseformgroup
Clinical Drug Group
8 elements
Amoxicillin / Clavulanate Injectables
Amoxicillin / Clavulanate Oral Liquids
Amoxicillin / Clavulanate Oral Products
Amoxicillin / Clavulanate Pills
Amoxicillin Injectables
Branded Drug Group
54 elements
Amoclan 200 Oral Liquids
Amoclan 200 Oral Products
Amoclan 400 Oral Liquids
Amoclan 400 Oral Products
Amoxi Drop Oral Liquids
Status
Retrieved "Amoxicillin" for String "amoxicillin".
Drug Label
MedlinePlus
Copy
Prescribable
Human Drug
Vet Drug

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

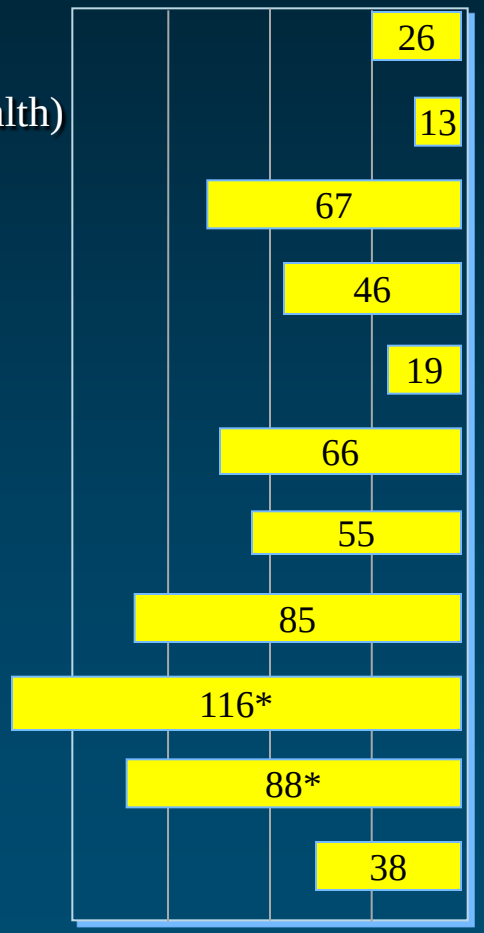
- 11 source vocabularies
- Synonymous names grouped into an RxNorm concept
- Unique identifiers (RxCUI)
- RRF format

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

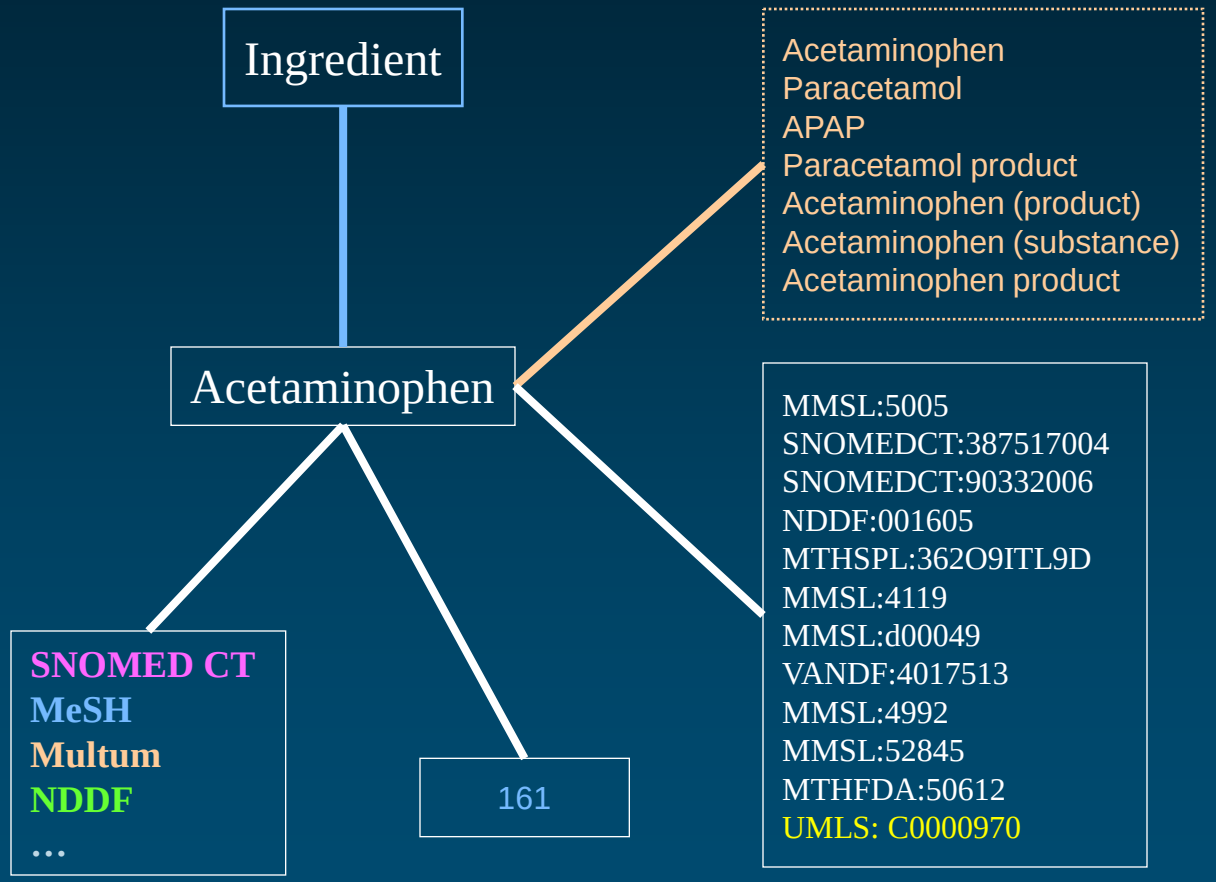
Source vocabularies in RxNorm

(terms in thousands, as of October 2011)

- Gold Standard Alchemy
- Master Drug Data Base (Medi-Span, Wolters Kluwer Health)
- Multum MediSource Lexicon
- Micromedex DRUGDEX
- Medical Subject Headings
- FDA National Drug Code Directory
- FDA Structured Product Labels
- Nat'l Drug Data File (First DataBank Inc.)
- VHA National Drug File – RT
- SNOMED Clinical Terms (drug information)
- VHA National Drug File



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 (grouped into Dose form groups)
  - Generic vs. Brand names
  - Principle set of relationships among the different types

Normalized form

DF group

Oral Liquids

Strength

4mg/ml

Ingredient

Fluoxetine

Dose form

Oral Solution

Ingredient **DF group**

Semantic clinical drug group

Ingredient **Dose form**

Semantic clinical drug form

Strength **Ingredient** **Dose form**

Semantic clinical drug

Strength **Ingredient**

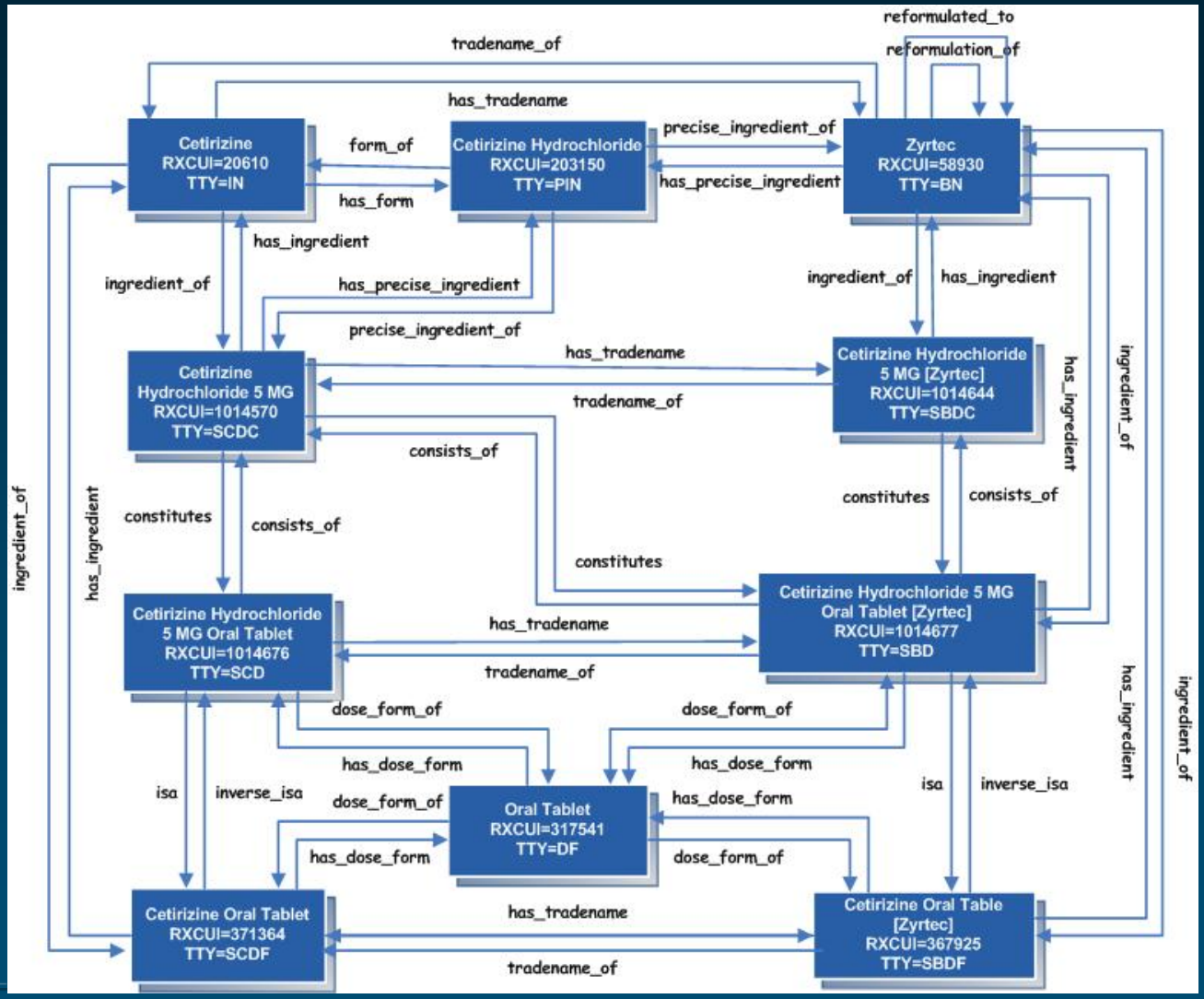
Semantic clinical drug component

Generic *vs.* Brand

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

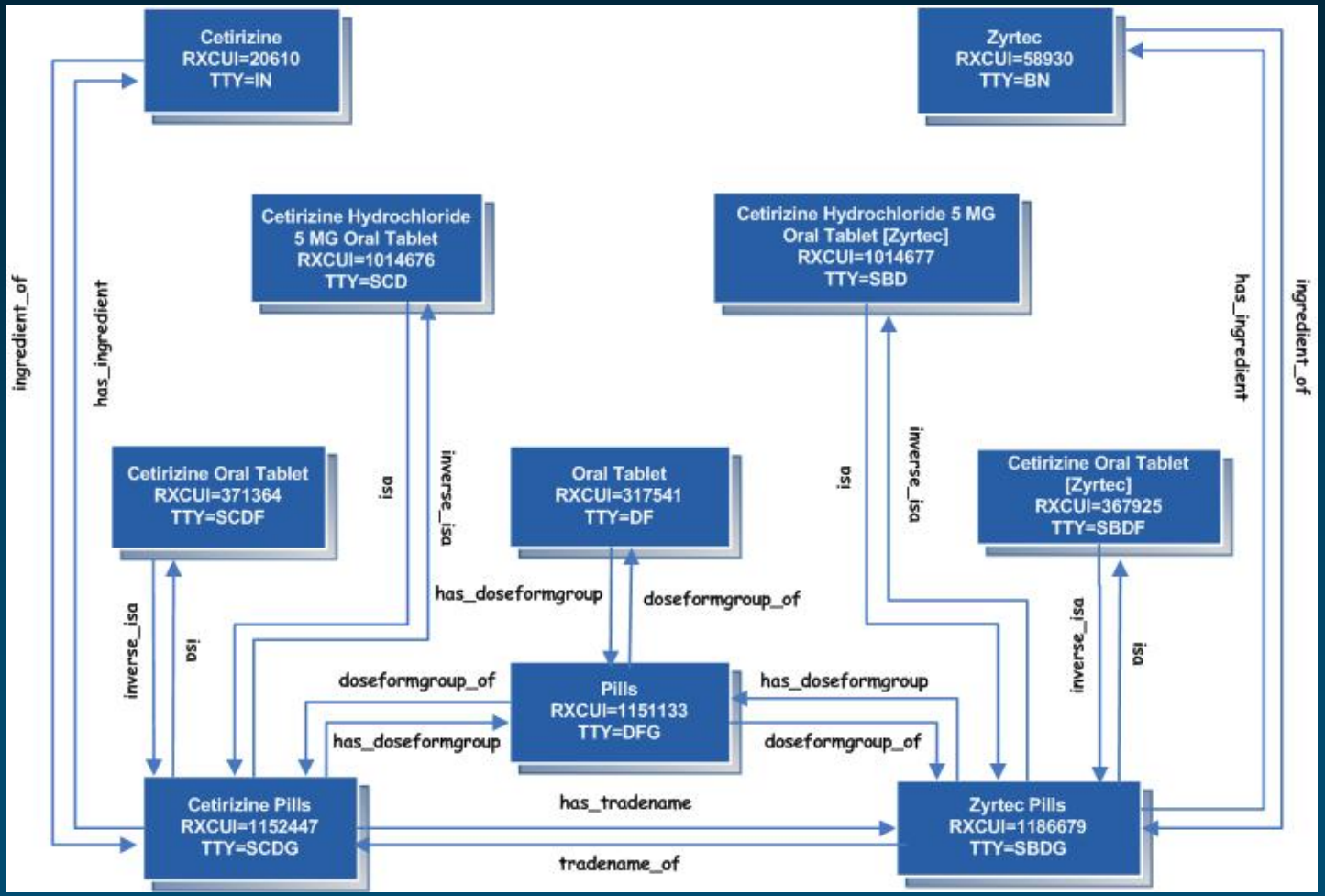
tradename_of

Relations among drug entities (1/2)



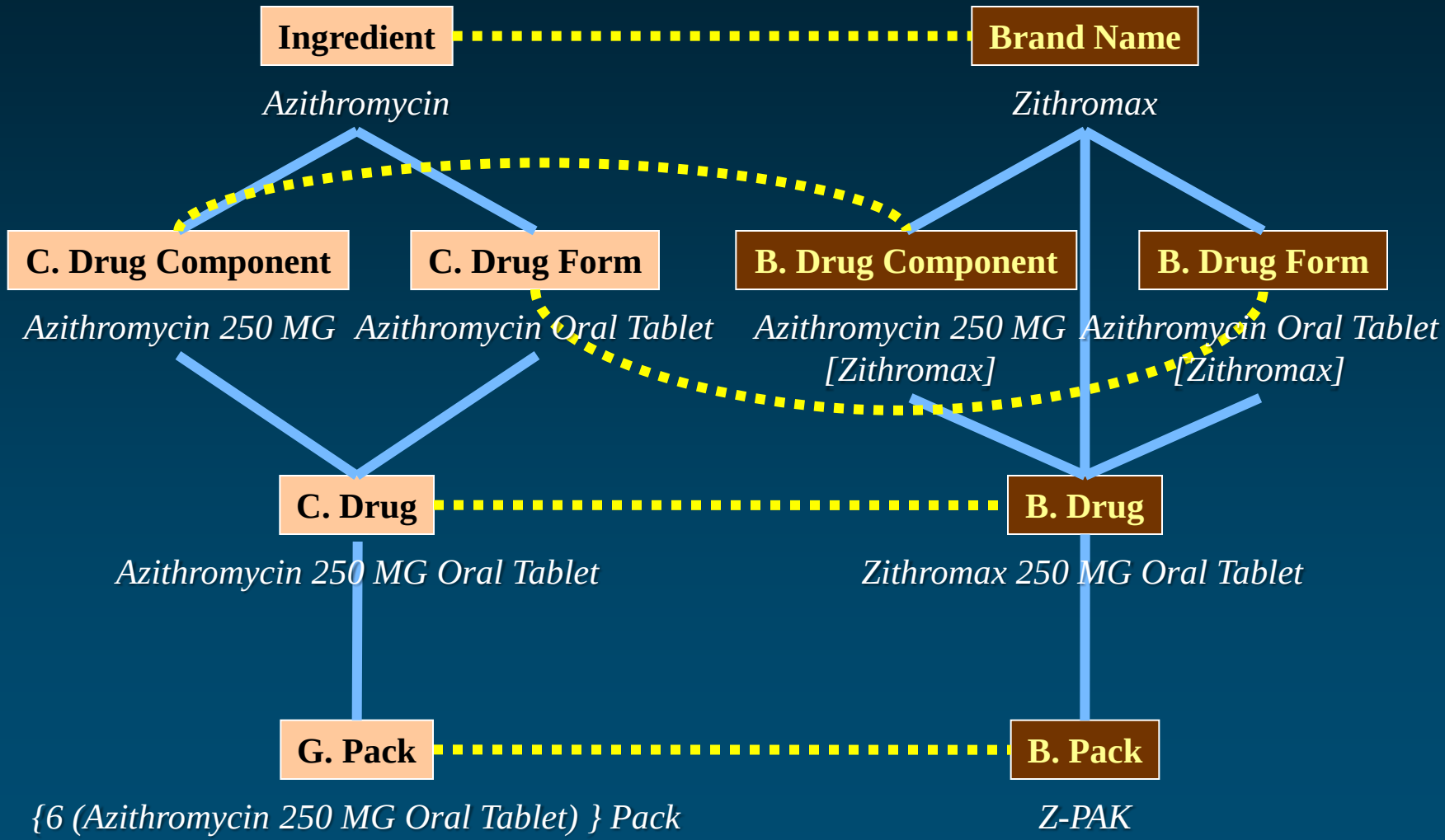
(From the RxNorm documentation)

Relations among drug entities (2/2)



(From the RxNorm documentation)

Relations among drug entities (revisited)



RxNorm database

- Content
  - 5,001 ingredients
  - 16,137 clinical drug comp.
  - 19,413 clinical drugs
  - 8,587 clinical drug forms
  - 11,958 clinical drug groups
  - 316 generic packs
  - 100 dose forms
  - 15,415 brand names
  - 15,367 branded drug comp.
  - 17,020 branded drugs
  - 12,750 branded drug forms
  - 18,582 branded drug groups
  - 393 branded packs
  - 21 dose form groups

(as of October 3, 2011; excluding obsolete data)

RxTerms

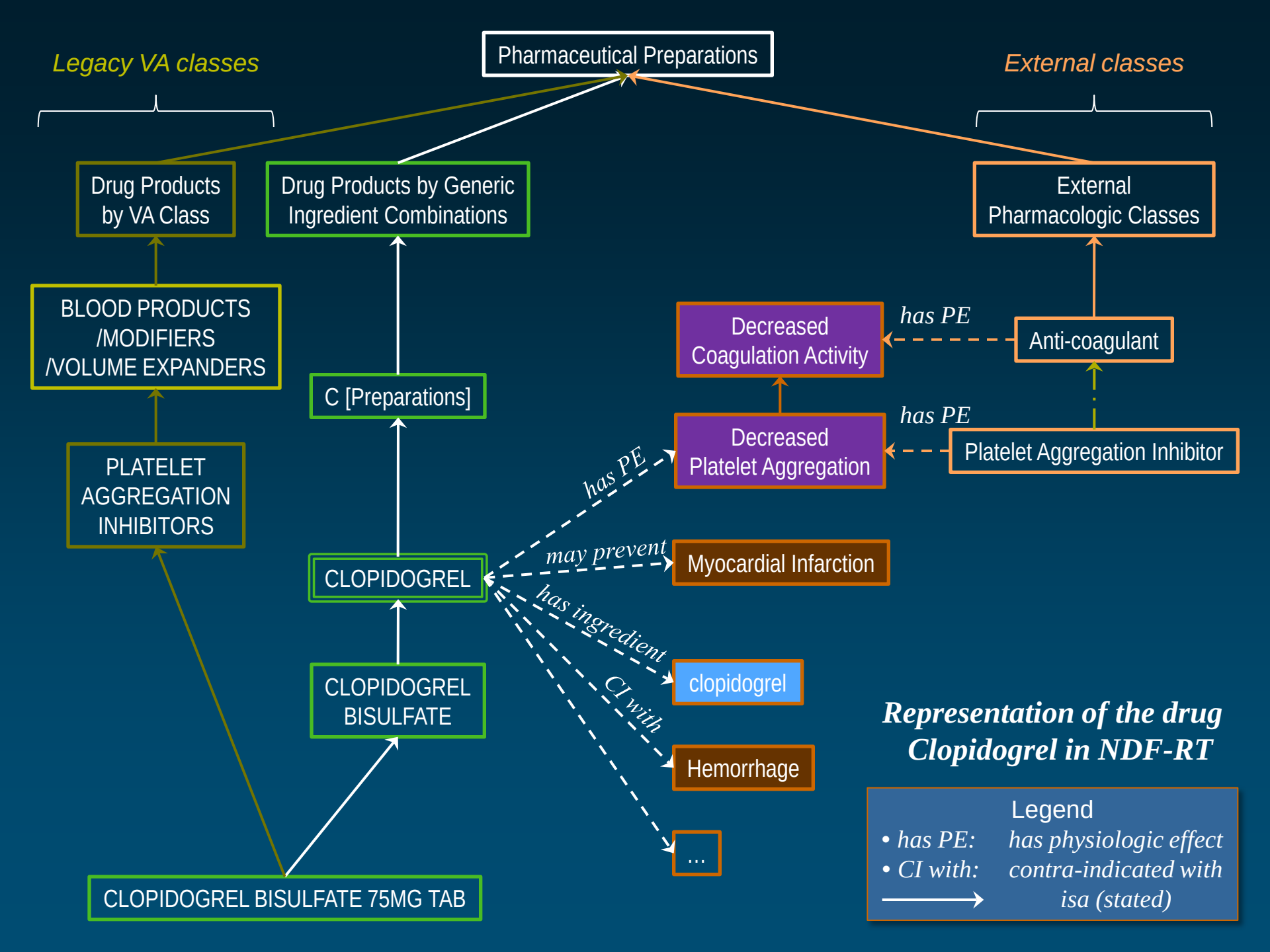
- Drug interface terminology derived from RxNorm for prescription writing or medication history recording
  - Commonly used synonyms and abbreviations (e.g. HCTZ for hydrochlorothiazide)
  - "tall man" lettering recommended by FDA to avoid medication errors (e.g. ChlorproMAZINE and ChlorproPAMIDE)
- 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
- Non-terminological information
  - Pharmacologic class (*isa*)
  - Therapeutic intent (*may_treat*, *may_diagnose*, *may_prevent*)
  - Contraindications (*drug_contraindicated_for*)
  - Mechanism of action (*mechanism_of_action_of*)
  - Physiology (*has_physiologic_effect*)
  - Metabolism (*metabolic_site_of*, *metabolizes*, *pharmacokinetics_of*)
  - Drug-drug interactions (*contraindicated_with*)

NDF-RT Examples

- Cetirizine
  - *drug_contraindicated_for* *Drug Allergy*
  - *may_treat* *Rhinitis, Allergic, Perennial*
  - *may_treat* *Urticaria*
  - *has_mechanism_of_action* *Histamine H1 Antagonists*
  - *has_physiologic_effect* *Decreased Histamine Activity*


Legacy VA classes
Pharmaceutical Preparations
External classes
Drug Products by VA Class
Drug Products by Generic Ingredient Combinations
External Pharmacologic Classes
BLOOD PRODUCTS /MODIFIERS /VOLUME EXPANDERS
C [Preparations]
Decreased Coagulation Activity
has PE
Anti-coagulant
Decreased Platelet Aggregation
has PE
Platelet Aggregation Inhibitor
PLATELET AGGREGATION INHIBITORS
has PE
may prevent
Myocardial Infarction
CLOPIDOGREL
has ingredient
clopidogrel
CI with
Hemorrhage
CLOPIDOGREL BISULFATE
...
CLOPIDOGREL BISULFATE 75MG TAB
Representation of the drug Clopidogrel in NDF-RT
Legend
• has PE: has physiologic effect
• CI with: contra-indicated with
isa (stated)

Visualizing drug information

RxNav

RxNav

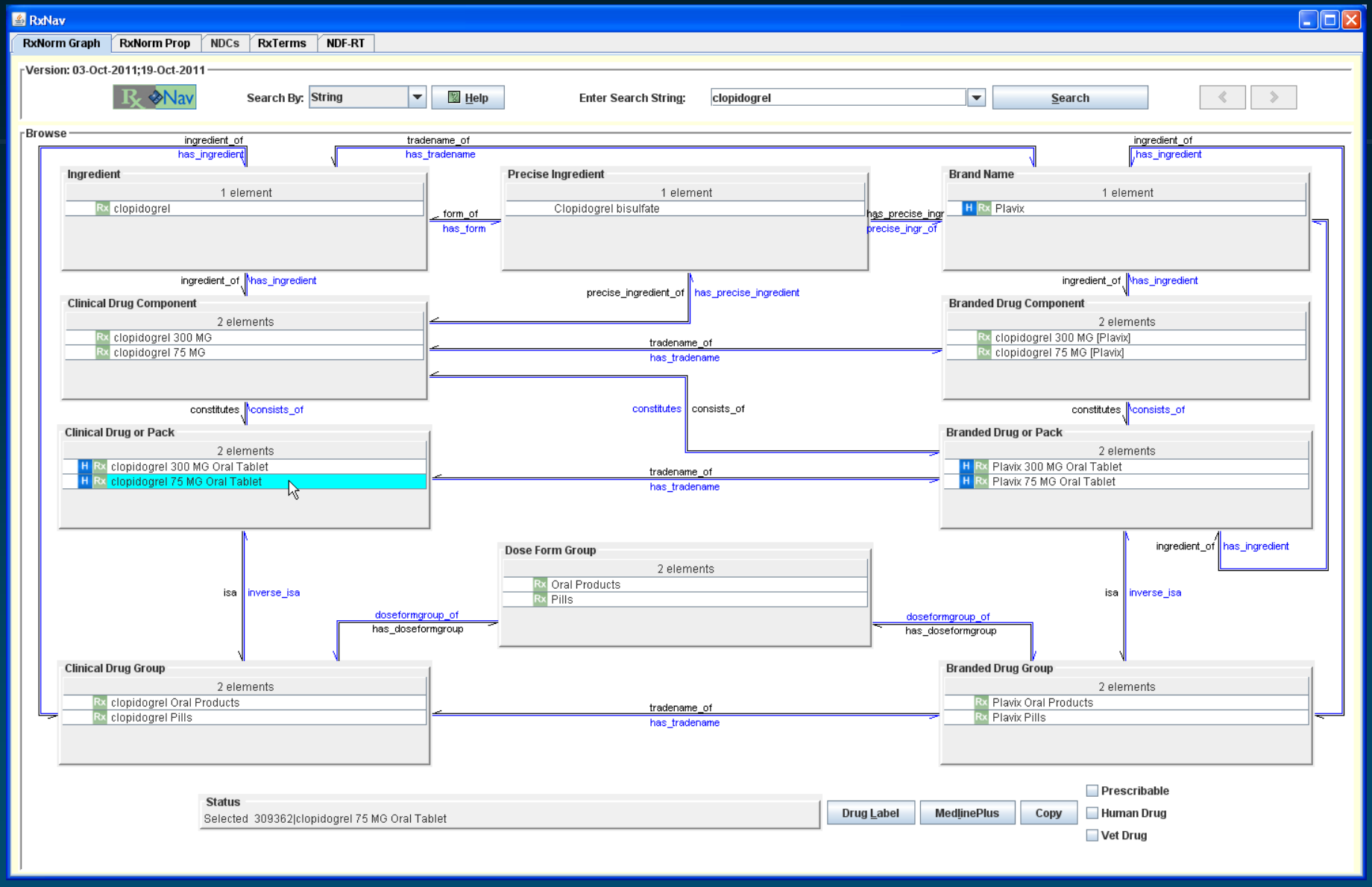
- Visualization and navigation
  - Browser for RxNorm, RxTerms and NDF-RT
  - Serves the latest version of the datasets
  - Displays information as graphs
  - Drug-centric
    - Auto-completion and spelling correction
    - Search on names and codes (including proprietary)
    - Links to DailyMed and MedlinePlus
  - Technically
    - Standalone application
    - Communicates via web services
      - RxNorm API, RxTerms API, NDF-RT API

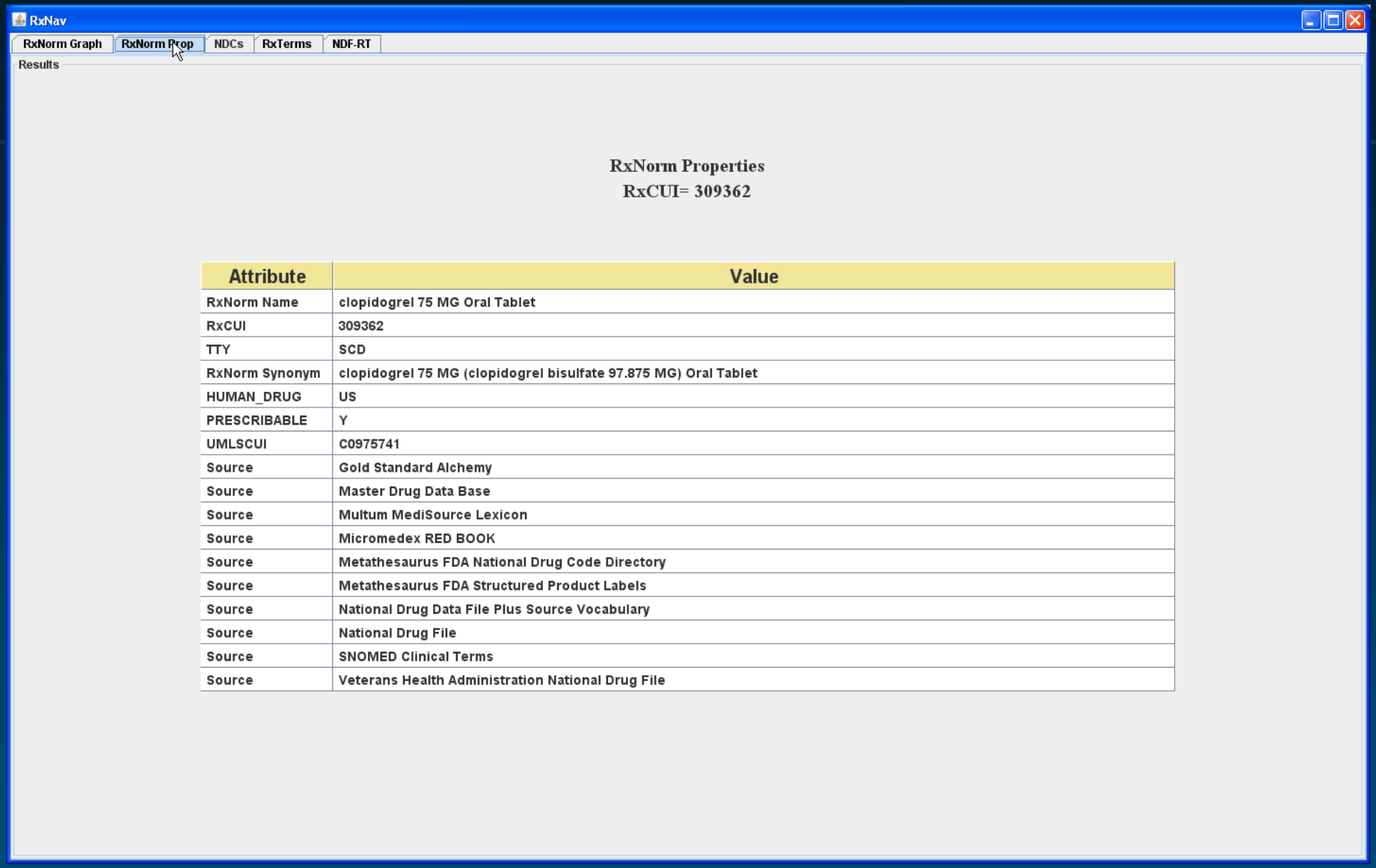
New features coming soon

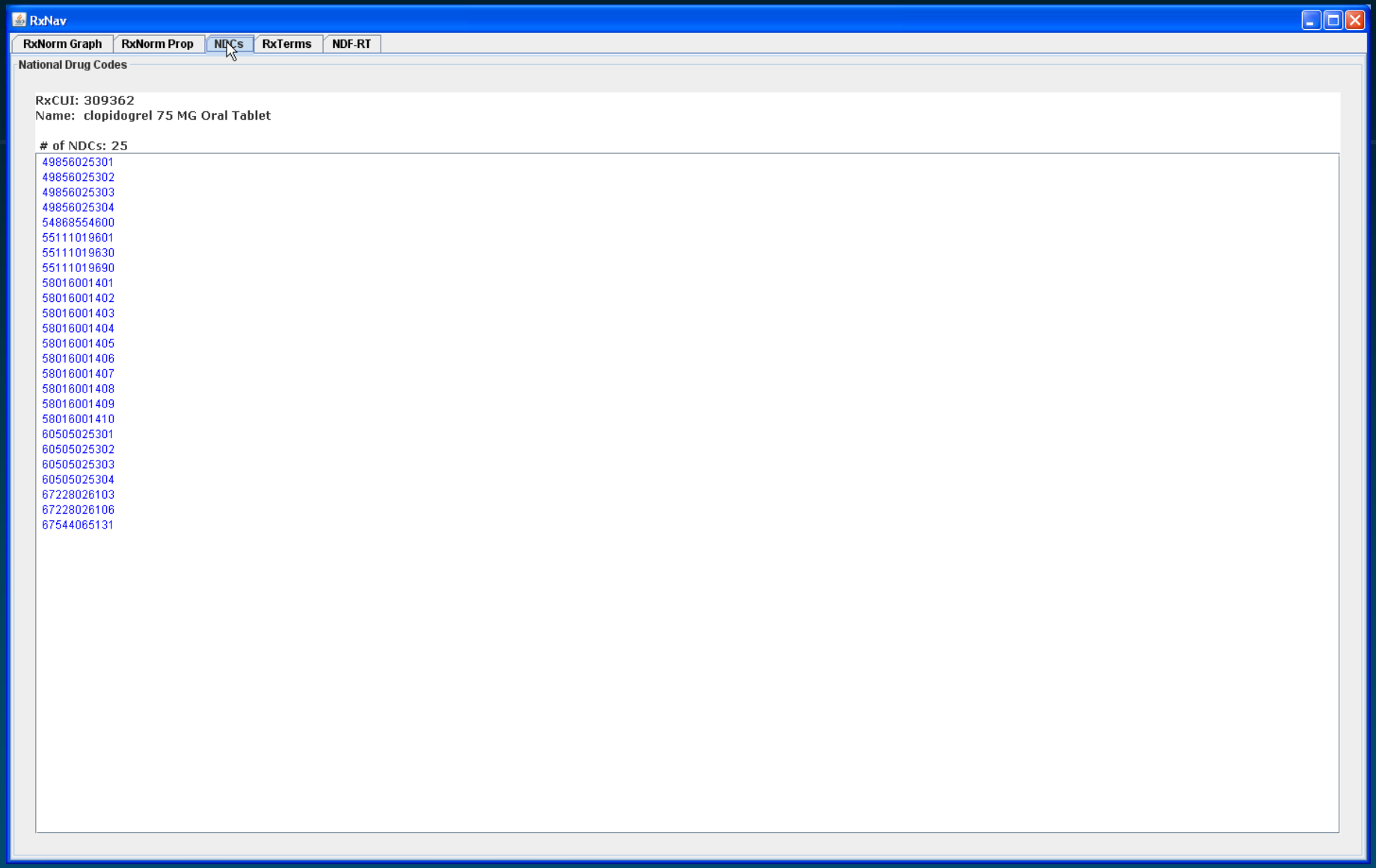
- RxNav
  - Replacing DF with DFG, SCDF with SCDG, SBDF with SBDG in graph
  - Adding prescribable attribute to graph
  - Adding human drug attribute to graph
  - Adding veterinary drug attribute to graph
  - Filter graph on prescribable, human, veterinary attributes
  - More properties displayed in RxNorm prop tab
  - Tall man lettering used

RxNav demo

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


RxNav
RxNorm Graph
RxNorm Prop
NDCs
RxTerms
NDF-RT
Version: 03-Oct-2011;19-Oct-2011
RxNav
Search By:
String
Help
Enter Search String:
clopidogrel
Search
Browse
ingredient_of
has_ingredient
tradename_of
has_tradename
Ingredient
1 element
clopidogrel
form_of
has_form
Precise Ingredient
1 element
Clopidogrel bisulfate
has_precise_ingr
precise_ingr_of
Brand Name
1 element
Plavix
precise_ingredient_of
has_precise_ingredient
Clinical Drug Component
2 elements
clopidogrel 300 MG
clopidogrel 75 MG
Branded Drug Component
2 elements
clopidogrel 300 MG [Plavix]
clopidogrel 75 MG [Plavix]
constitutes
consists_of
Clinical Drug or Pack
2 elements
clopidogrel 300 MG Oral Tablet
clopidogrel 75 MG Oral Tablet
Branded Drug or Pack
2 elements
Plavix 300 MG Oral Tablet
Plavix 75 MG Oral Tablet
isa
inverse_isa
Dose Form Group
2 elements
Oral Products
Pills
doseformgroup_of
has_doseformgroup
Clinical Drug Group
2 elements
clopidogrel Oral Products
clopidogrel Pills
Branded Drug Group
2 elements
Plavix Oral Products
Plavix Pills
Status
Selected 309362|clopidogrel 75 MG Oral Tablet
Drug Label
MedlinePlus
Copy
Prescribable
Human Drug
Vet Drug


RxNav
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
RxNorm Synonym
clopidogrel 75 MG (clopidogrel bisulfate 97.875 MG) Oral Tablet
HUMAN_DRUG
US
PRESCRIBABLE
Y
UMLSCUI
C0975741
Source
Gold Standard Alchemy
Source
Master Drug Data Base
Source
Multum MediSource Lexicon
Source
Micromedex RED BOOK
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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RxNorm Graph
RxNorm Prop
NDCs
RxTerms
NDF-RT
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# of NDCs: 25
49856025301
49856025302
49856025303
49856025304
54868554600
55111019601
55111019630
55111019690
58016001401
58016001402
58016001403
58016001404
58016001405
58016001406
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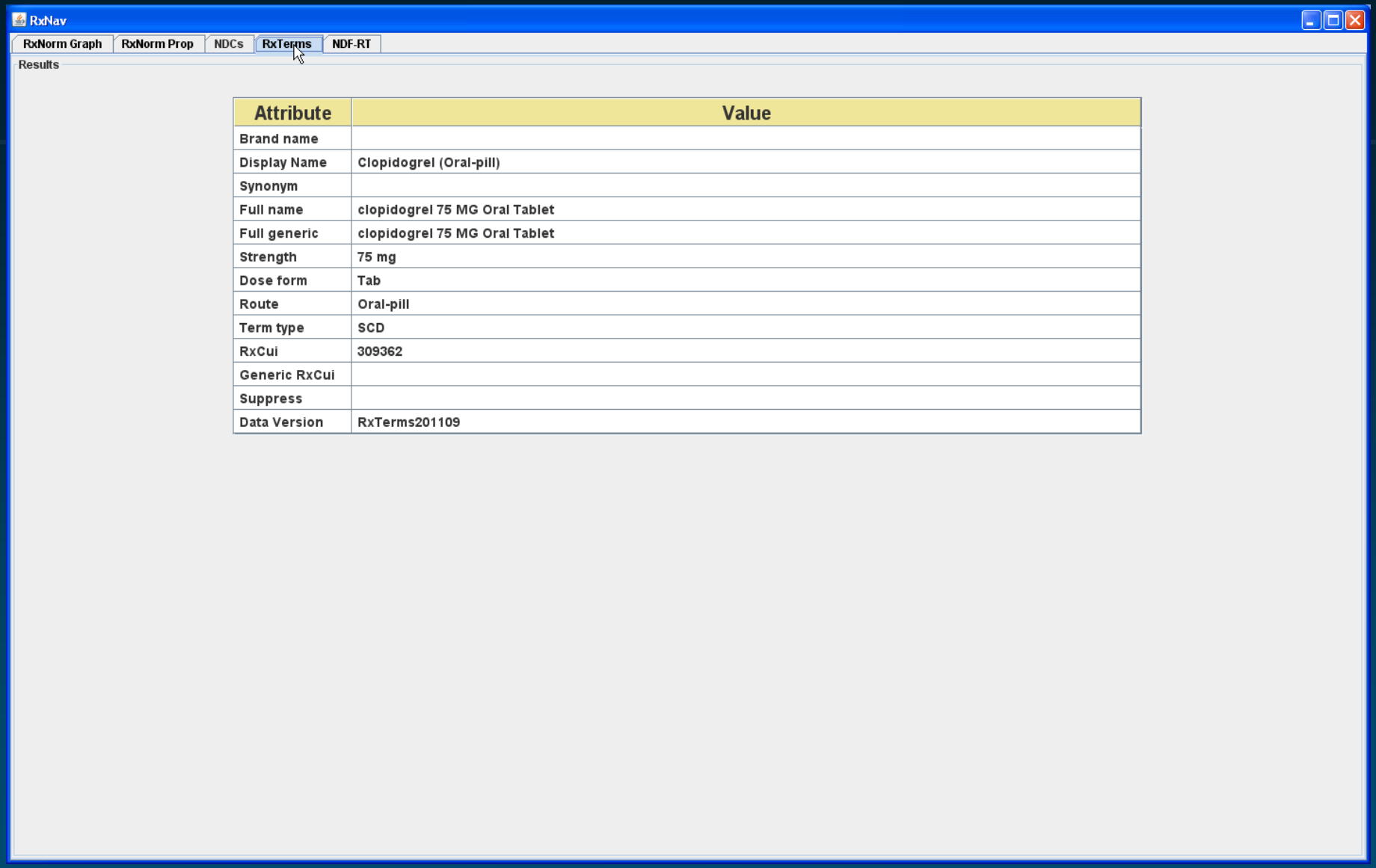
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RxNorm Graph
RxNorm Prop
NDCs
RxTerms
NDF-RT
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Attribute
Value
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Display Name
Clopidogrel (Oral-pill)
Synonym
Full name
clopidogrel 75 MG Oral Tablet
Full generic
clopidogrel 75 MG Oral Tablet
Strength
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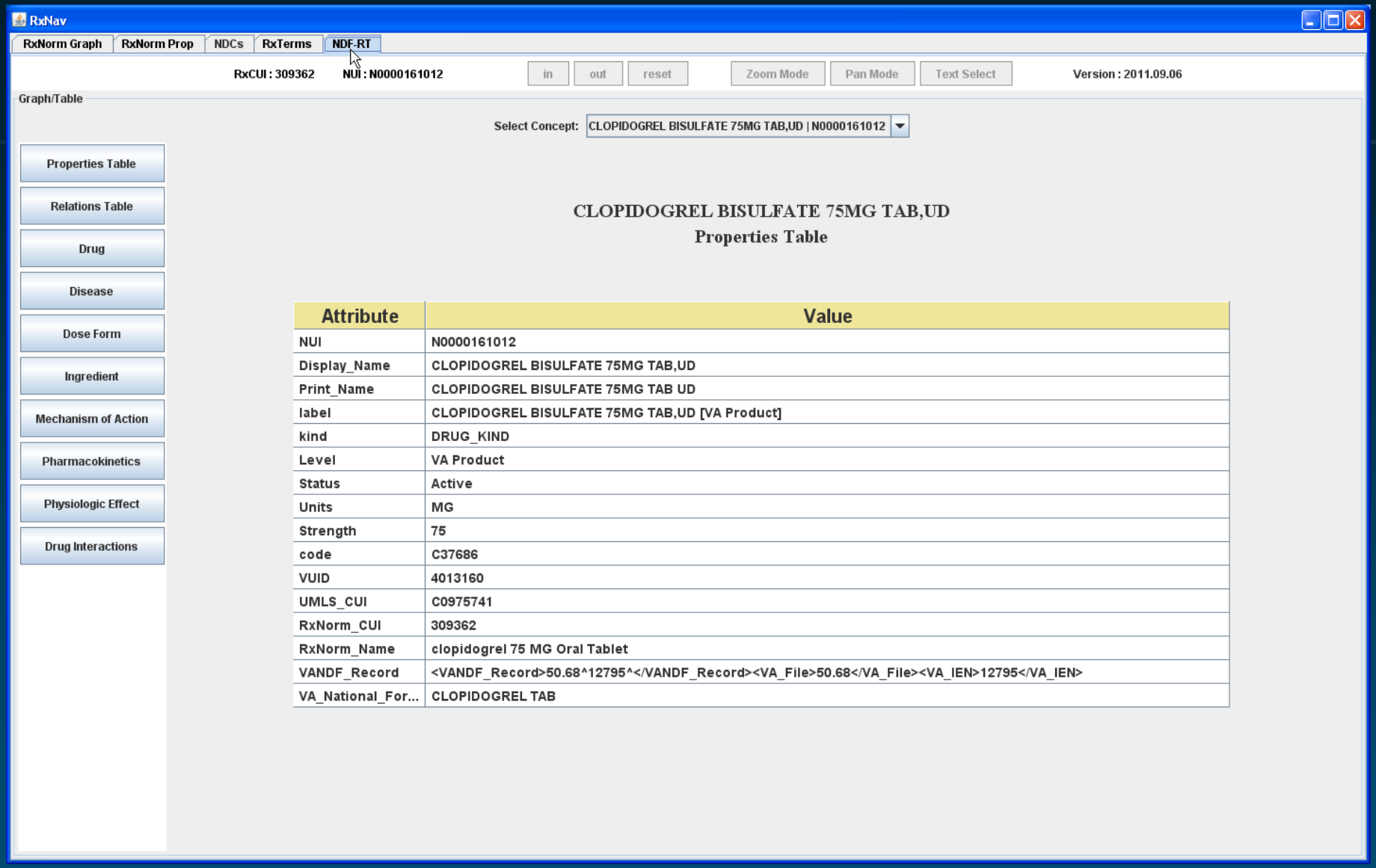
Dose form
Tab
Route
Oral-pill
Term type
SCD
RxCui
309362
Generic RxCui
Suppress
Data Version
RxTerms201109


RxNav
RxNorm Graph
RxNorm Prop
NDCs
RxTerms
NDF-RT
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NUI : N0000161012
in
out
reset
Zoom Mode
Pan Mode
Text Select
Version : 2011.09.06
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
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CLOPIDOGREL BISULFATE 75MG TAB,UD
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CLOPIDOGREL BISULFATE 75MG TAB,UD [VA Product]
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DRUG_KIND
Level
VA Product
Status
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Units
MG
Strength
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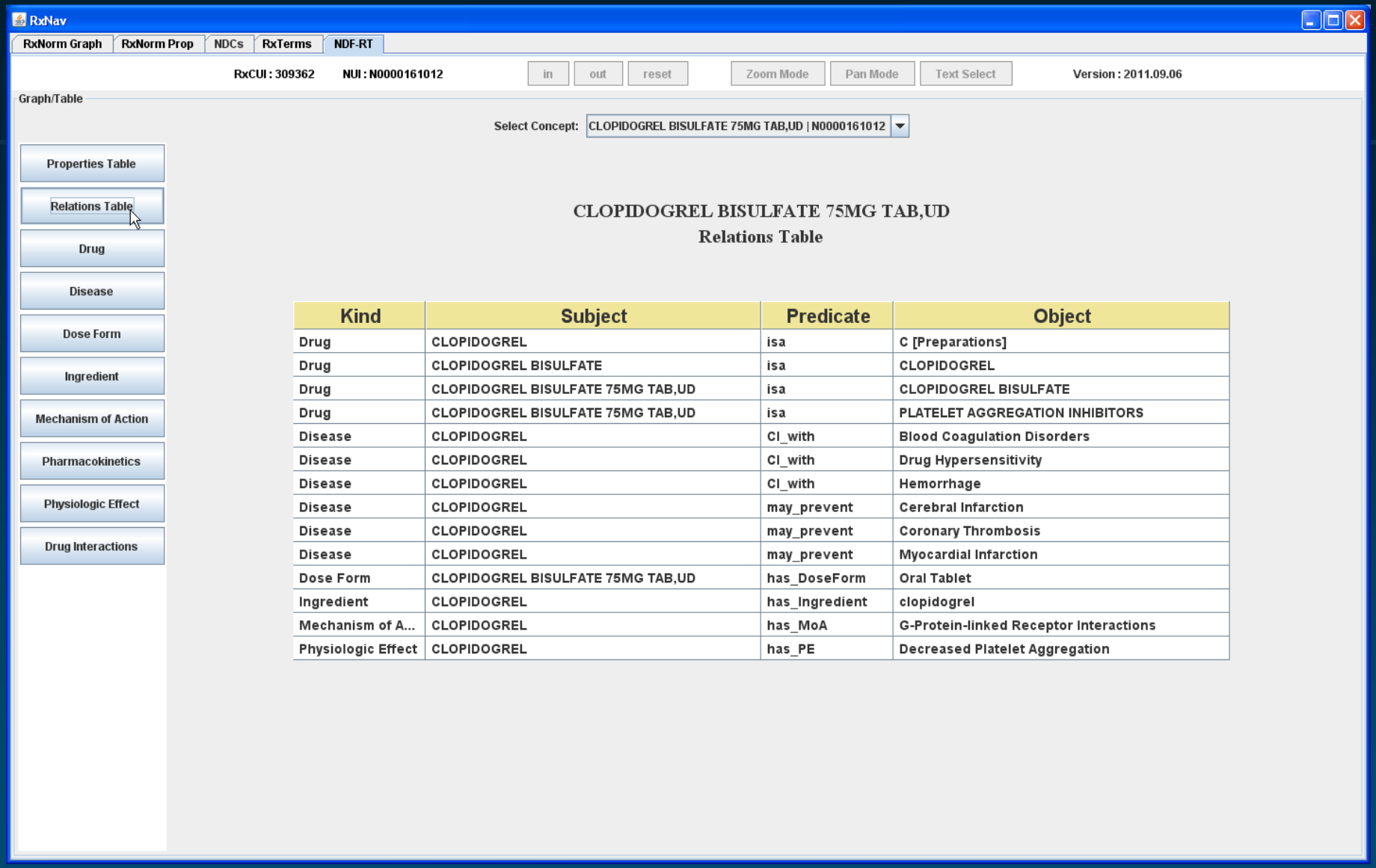
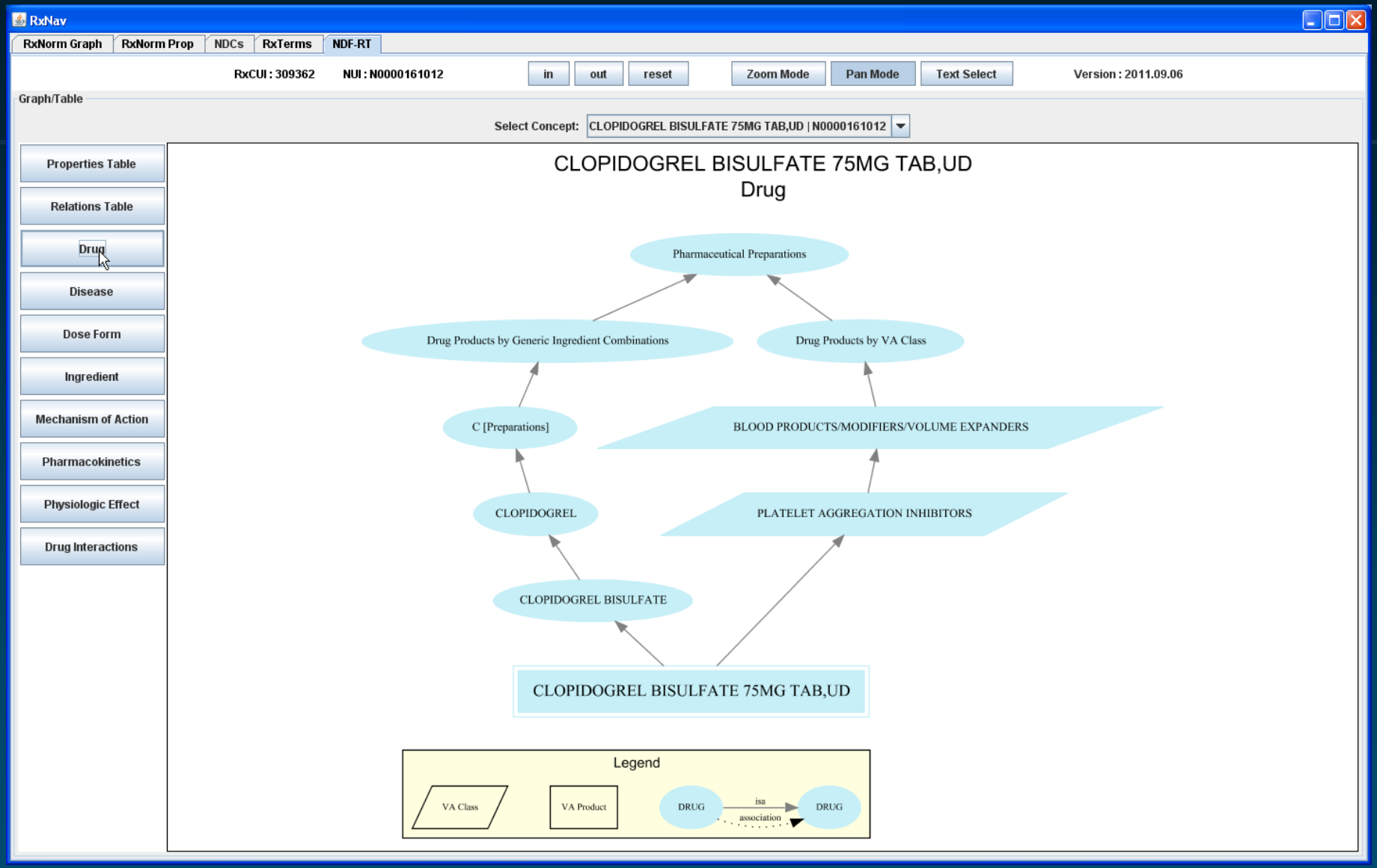
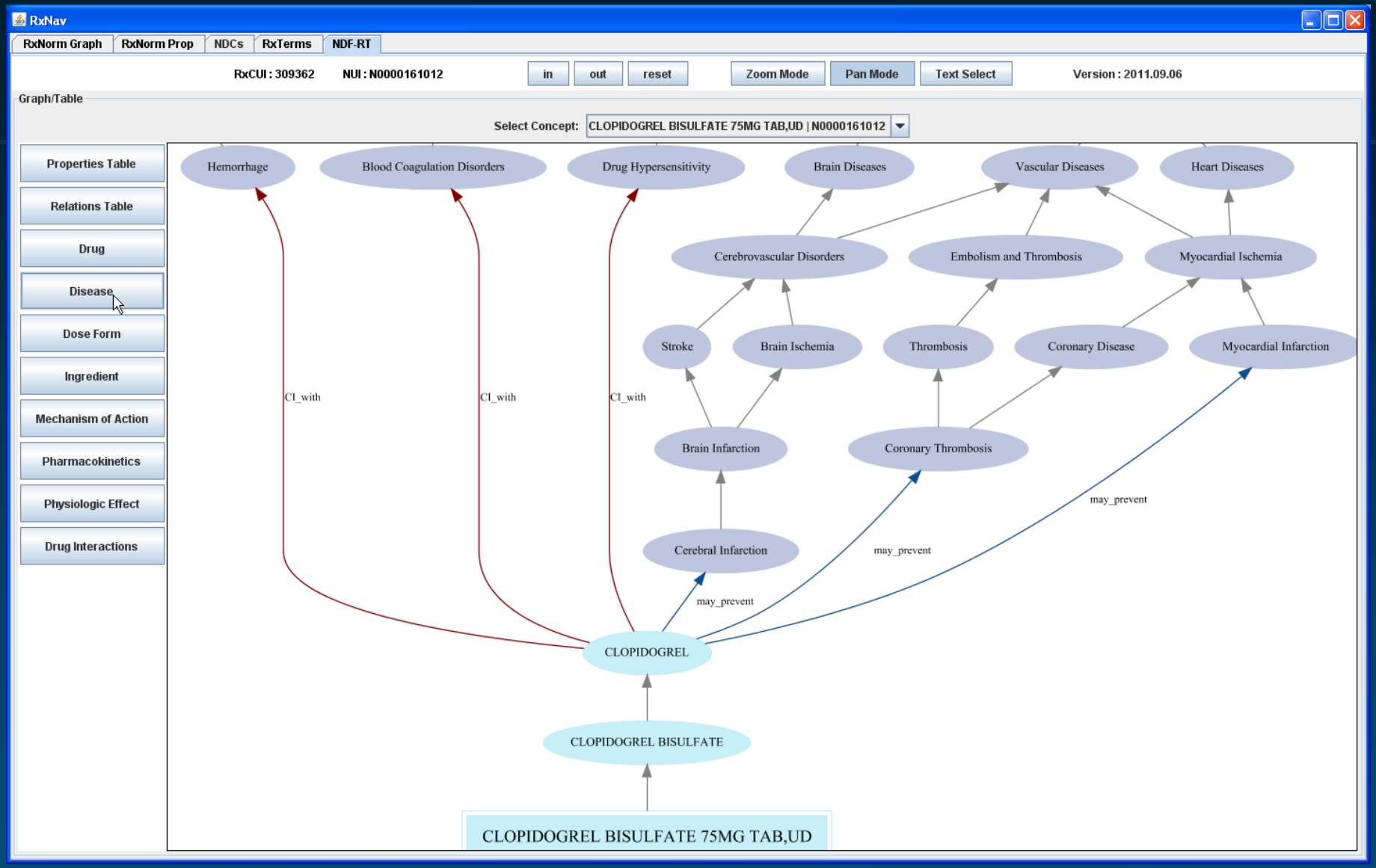


Kind	Subject	Predicate	Object
Drug	CLOPIDOGREL	isa	C [Preparations]
Drug	CLOPIDOGREL BISULFATE	isa	CLOPIDOGREL
Drug	CLOPIDOGREL BISULFATE 75MG TAB,UD	isa	CLOPIDOGREL BISULFATE
Drug	CLOPIDOGREL BISULFATE 75MG TAB,UD	isa	PLATELET AGGREGATION INHIBITORS
Disease	CLOPIDOGREL	CI_with	Blood Coagulation Disorders
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
RxNorm Graph
RxNorm Prop
NDCs
RxTerms
NDF-RT
RxCUI : 309362
NUI : N0000161012
in
out
reset
Zoom Mode
Pan Mode
Text Select
Version : 2011.09.06
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
Drug
Pharmaceutical Preparations
Drug Products by Generic Ingredient Combinations
Drug Products by VA Class
C [Preparations]
BLOOD PRODUCTS/MODIFIERS/VOLUME EXPANDERS
CLOPIDOGREL
PLATELET AGGREGATION INHIBITORS
CLOPIDOGREL BISULFATE
CLOPIDOGREL BISULFATE 75MG TAB,UD
Legend
VA Class
VA Product
DRUG
isa
association
DRUG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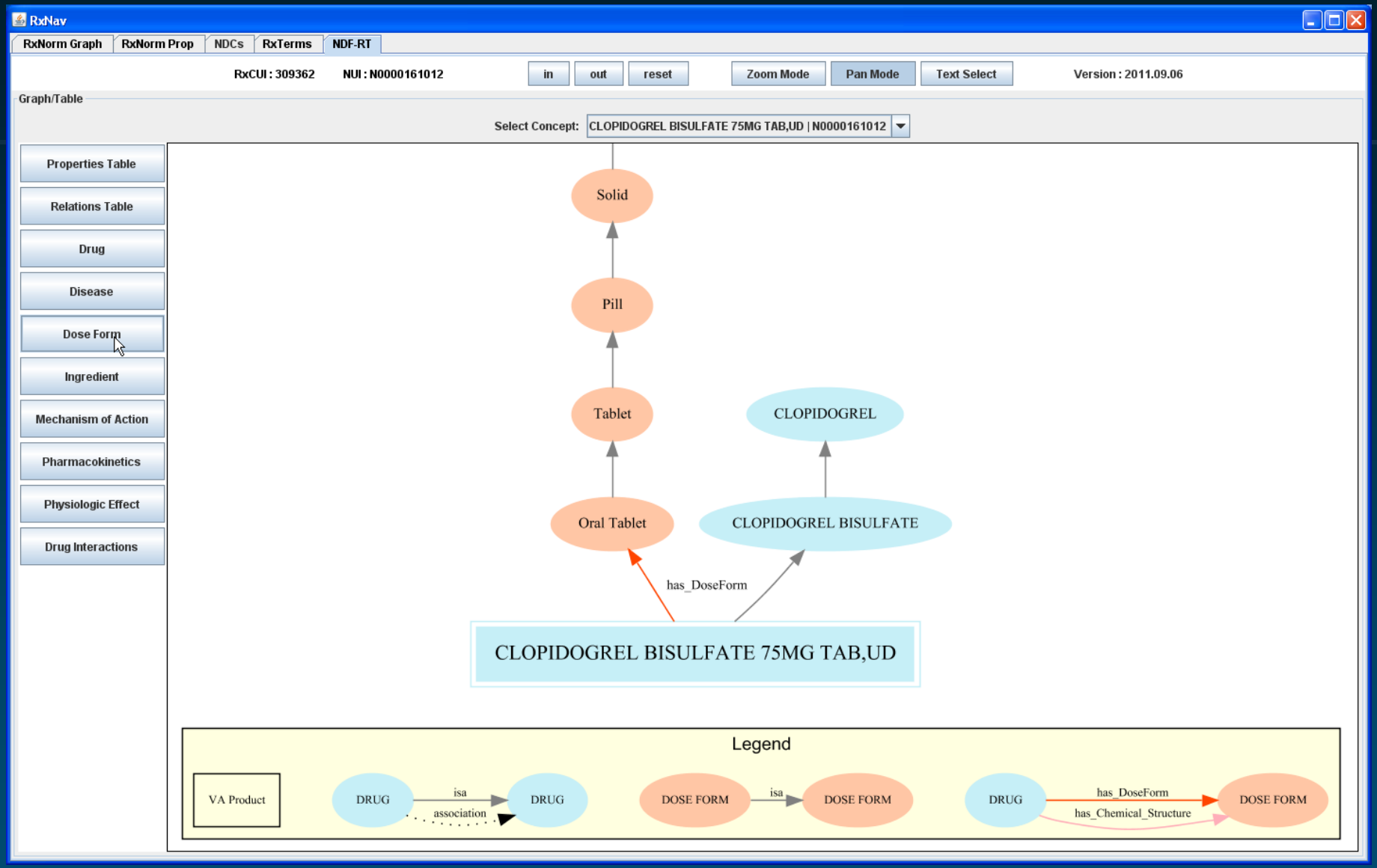
Physiologic Effect
Drug Interactions
Hemorrhage
Blood Coagulation Disorders
Drug Hypersensitivity
Brain Diseases
Vascular Diseases
Heart Diseases
Cerebrovascular Disorders
Embolism and Thrombosis
Myocardial Ischemia
Stroke
Brain Ischemia
Thrombosis
Coronary Disease
Myocardial Infarction
CI_with
CI_with
CI_with
Brain Infarction
Coronary Thrombosis
may_prevent
Cerebral Infarction
may_prevent
may_prevent
CLOPIDOGREL
CLOPIDOGREL BISULFATE
CLOPIDOGREL BISULFATE 75MG TAB,UD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RxNorm Prop
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RxTerms
NDF-RT
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NUI : N0000161012
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out
reset
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Pan Mode
Text Select
Version : 2011.09.06
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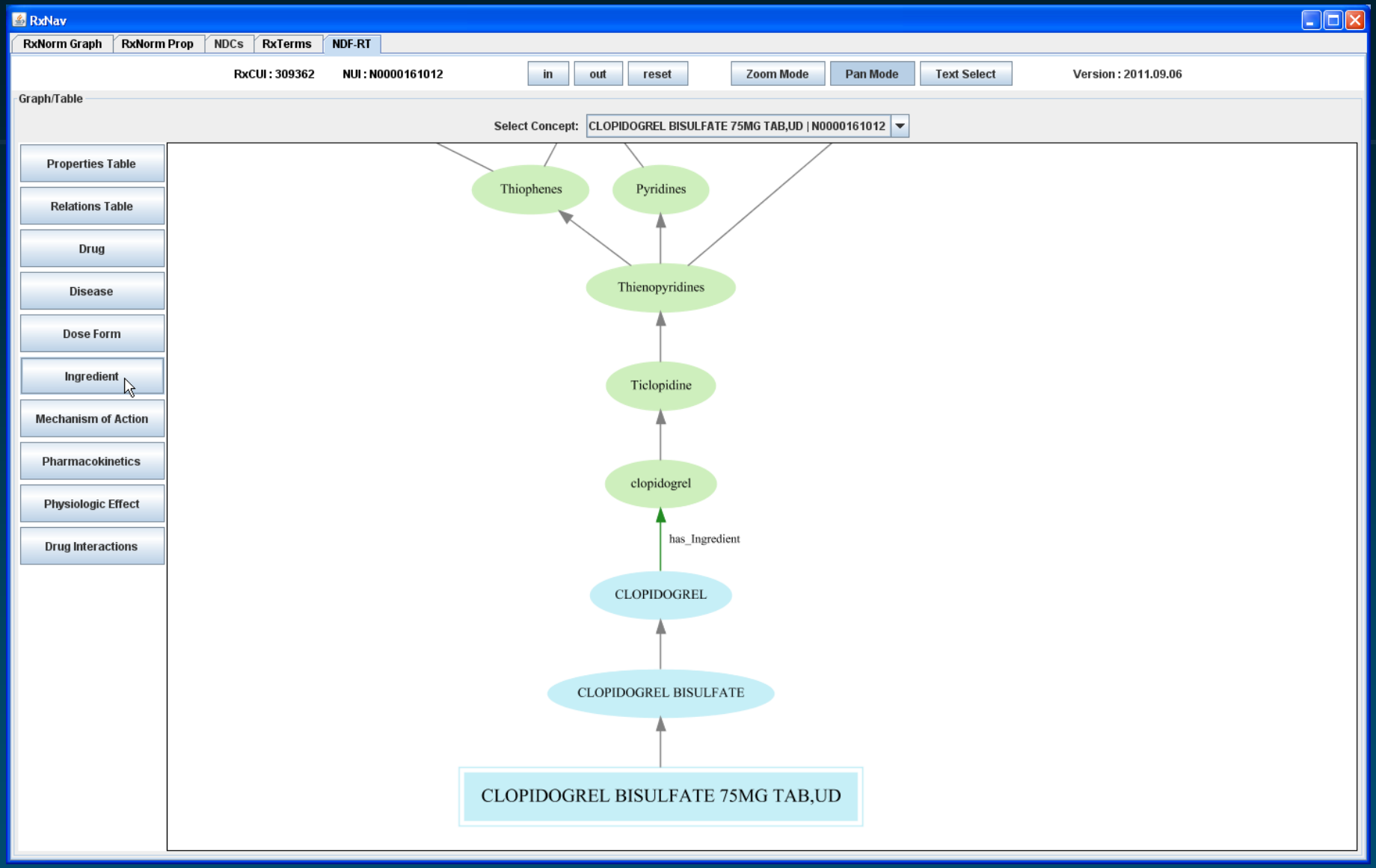
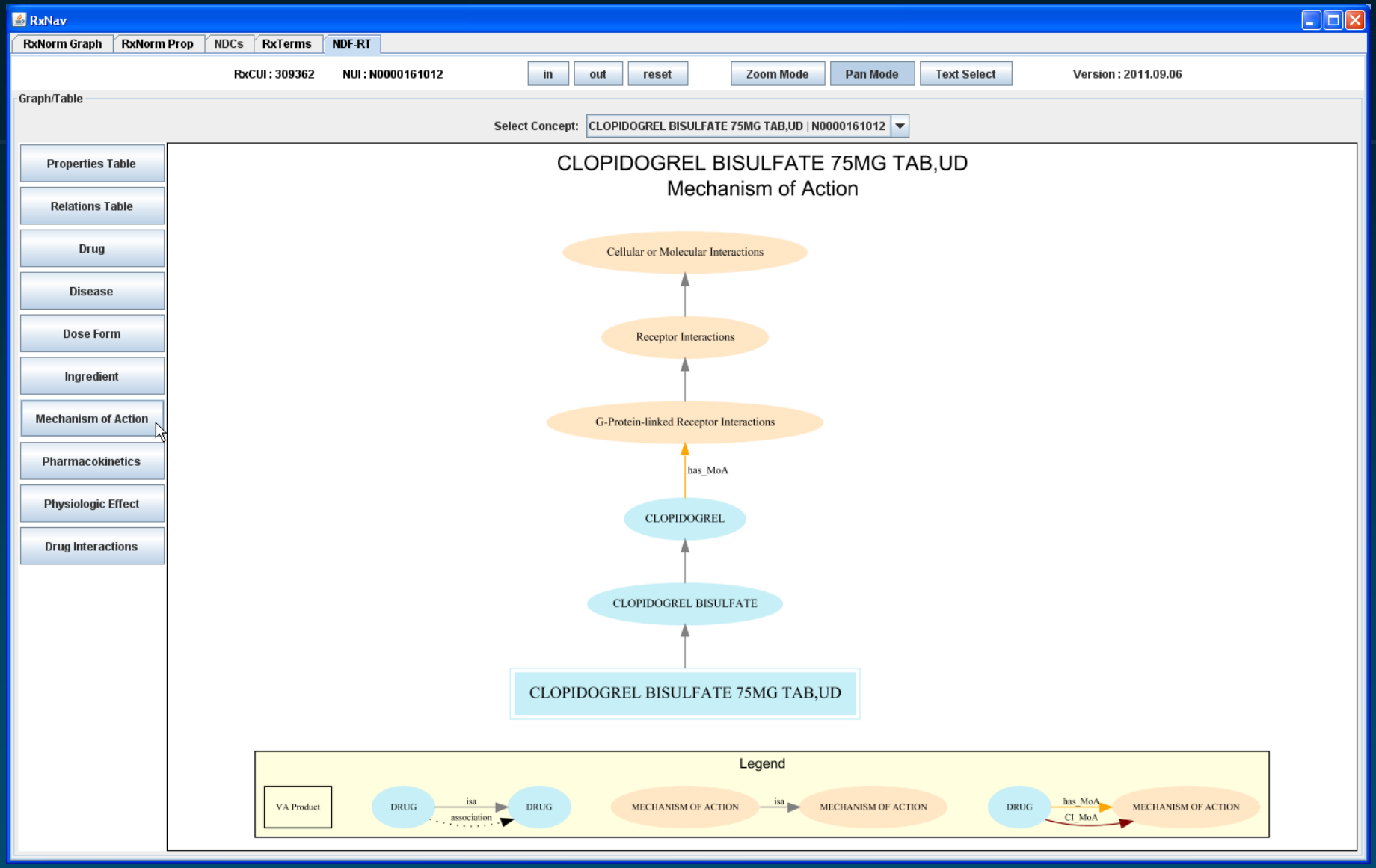
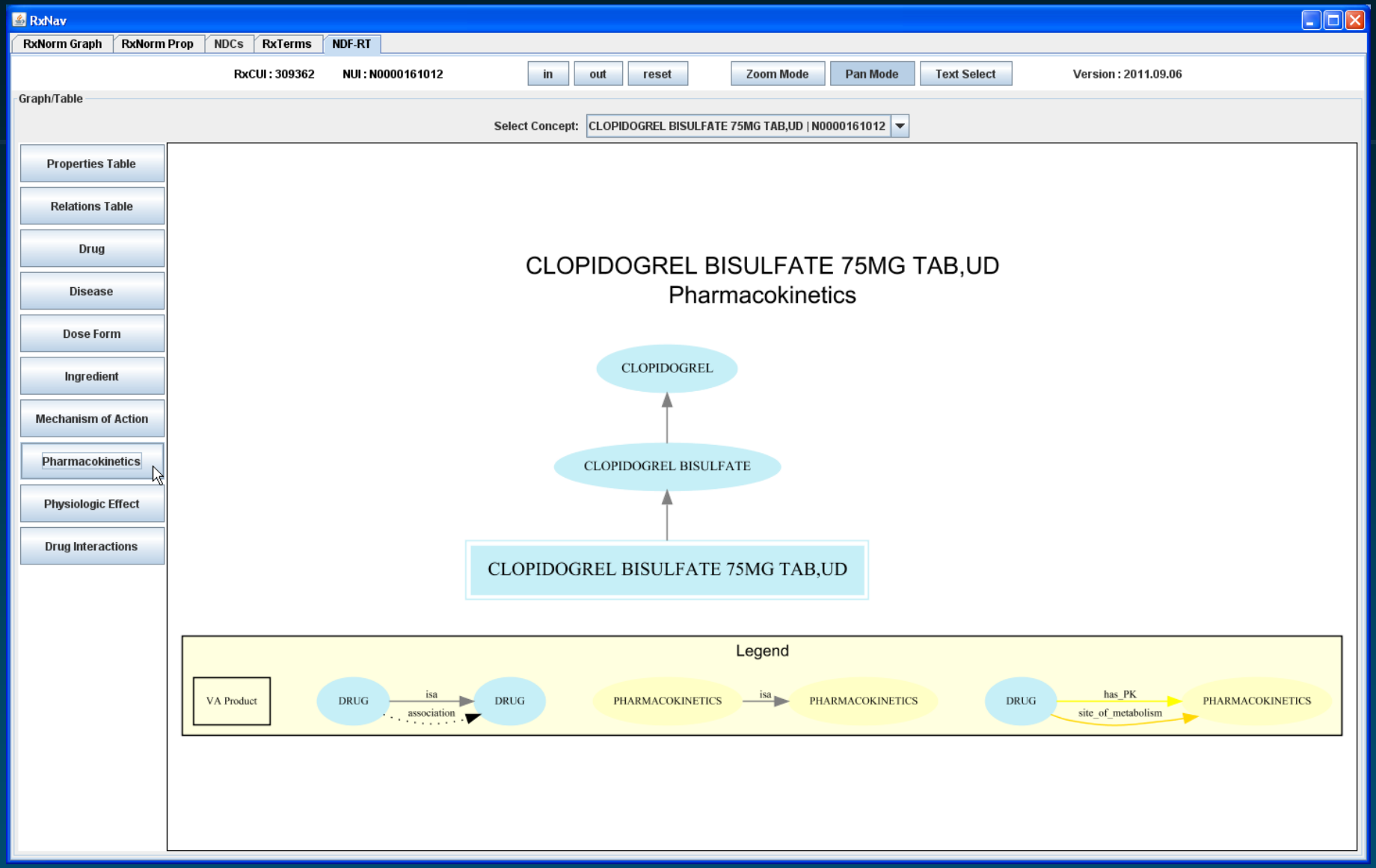
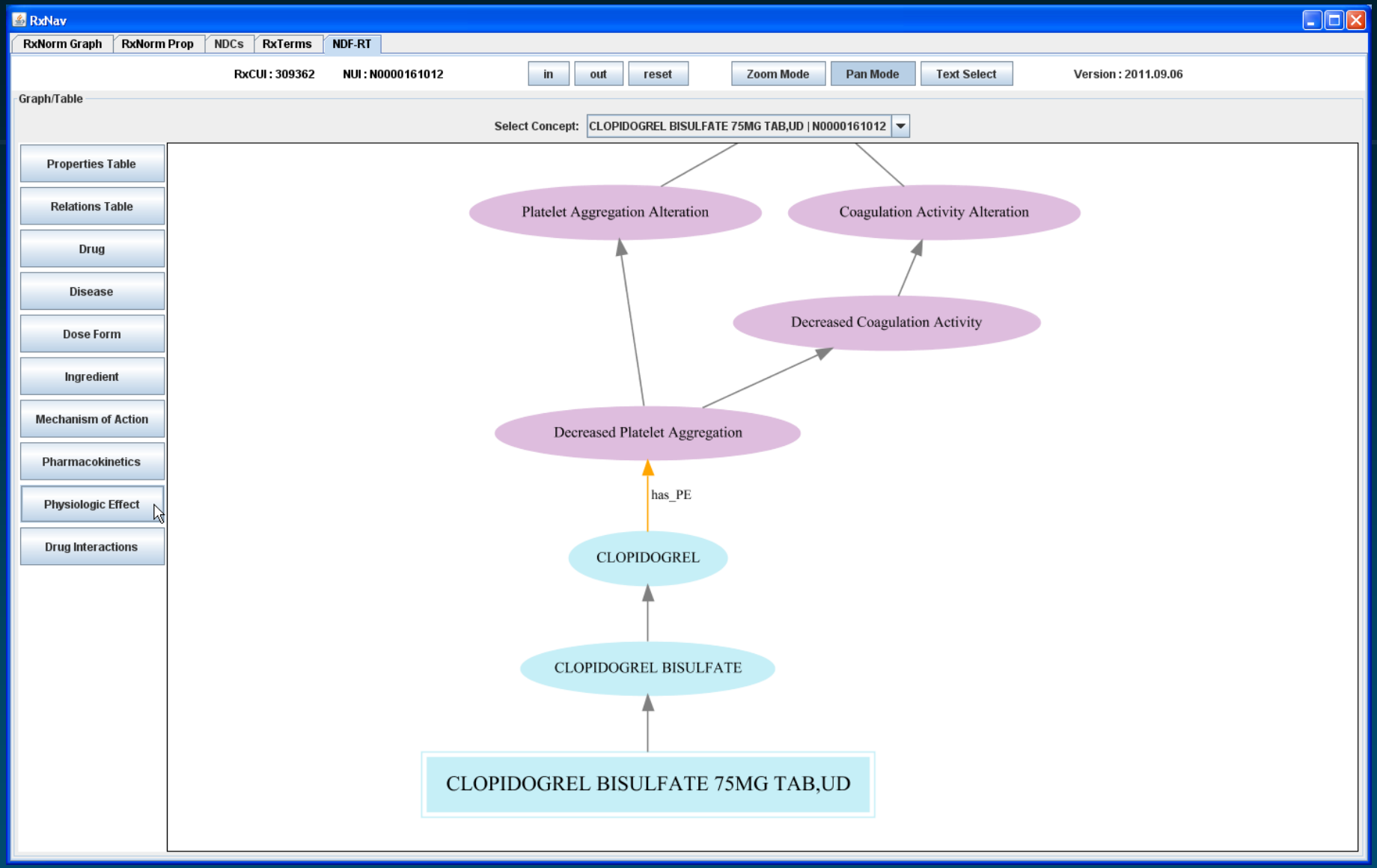
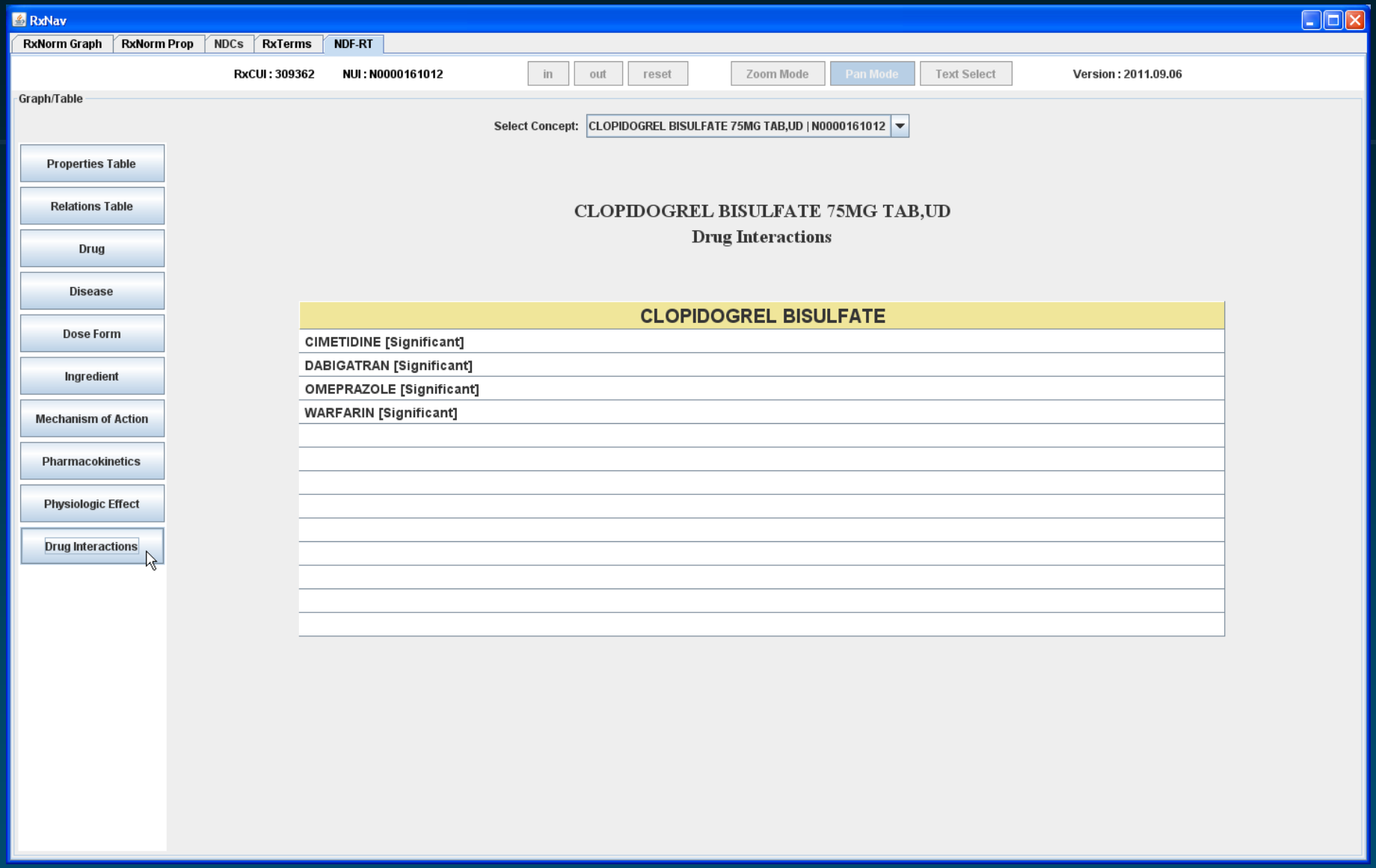
Properties Table
Relations Table
Drug
Disease
Dose Form
Ingredient
Mechanism of Action
Pharmacokinetics
Physiologic Effect
Drug Interactions
Solid
Pill
Tablet
CLOPIDOGREL
Oral Tablet
CLOPIDOGREL BISULFATE
has_DoseForm
CLOPIDOGREL BISULFATE 75MG TAB,UD
Legend
VA Product
DRUG
isa
association
DRUG
DOSE FORM
isa
DOSE FORM
DRUG
has_DoseForm
has_Chemical_Structure
DOSE FORM


RxNav
RxNorm Graph
RxNorm Prop
NDCs
RxTerms
NDF-RT
RxCUI : 309362
NUI : N0000161012
in
out
reset
Zoom Mode
Pan Mode
Text Select
Version : 2011.09.06
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
Thiophenes
Pyridines
Thienopyridines
Ticlopidine
clopidogrel
has_Ingredient
CLOPIDOGREL
CLOPIDOGREL BISULFATE
CLOPIDOGREL BISULFATE 75MG TAB,UD


RxNav
RxNorm Graph
RxNorm Prop
NDCs
RxTerms
NDF-RT
RxCUI : 309362
NUI : N0000161012
in
out
reset
Zoom Mode
Pan Mode
Text Select
Version : 2011.09.06
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
has_MoA
CLOPIDOGREL
CLOPIDOGREL BISULFATE
CLOPIDOGREL BISULFATE 75MG TAB,UD
Legend
VA Product
DRUG
isa
association
DRUG
MECHANISM OF ACTION
isa
MECHANISM OF ACTION
DRUG
has_MoA
CI_MoA
MECHANISM OF ACTION


RxNav
RxNorm Graph
RxNorm Prop
NDCs
RxTerms
NDF-RT
RxCUI : 309362
NUI : N0000161012
in
out
reset
Zoom Mode
Pan Mode
Text Select
Version : 2011.09.06
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
association
DRUG
PHARMACOKINETICS
isa
PHARMACOKINETICS
DRUG
has_PK
site_of_metabolism
PHARMACOKINETICS


RxNav
RxNorm Graph
RxNorm Prop
NDCs
RxTerms
NDF-RT
RxCUI : 309362
NUI : N0000161012
in
out
reset
Zoom Mode
Pan Mode
Text Select
Version : 2011.09.06
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
Platelet Aggregation Alteration
Coagulation Activity Alteration
Decreased Coagulation Activity
Decreased Platelet Aggregation
has_PE
CLOPIDOGREL
CLOPIDOGREL BISULFATE
CLOPIDOGREL BISULFATE 75MG TAB,UD


RxNav
RxNorm Graph
RxNorm Prop
NDCs
RxTerms
NDF-RT
RxCUI : 309362
NUI : N0000161012
in
out
reset
Zoom Mode
Pan Mode
Text Select
Version : 2011.09.06
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
Drug Interactions
CLOPIDOGREL BISULFATE
CIMETIDINE [Significant]
DABIGATRAN [Significant]
OMEPRAZOLE [Significant]
WARFARIN [Significant]

Processing drug information

Drug Information
Application Programming Interfaces

RxNorm API

- 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

- Find RxNorm concepts
  - By name: findRxcuiByString(*searchString*, *source-list*, *allSourcesFlag* , *searchType*)
  - By name: approxMatch(*searchString*)
  - By code: findRxcuiById(*idType*, *id*, *allSourcesFlag*)
  - By RxCUI: findRemapped(*rxcui*)
- Get RxNorm concept relations
  - By rel.: getRelatedByRelationship(*rxcui*, *rel-list*)
  - By type: getRelatedByType(*rxcui*, *type-list*)
  - All: getAllRelatedInfo(*rxcui*)

List of functions (SOAP) 2/3

- Spelling
  - getSpellingSuggestions(*name*)
- Get RxNorm concept properties
  - getRxConceptProperties(*rxcui*)
  - getStrength(*rxcui*)
  - getQuantity(*rxcui*)
  - getNDCs(*rxcui*)
  - getUNII(*rxcui*)
  - getProprietaryInformation(*rxcui*, *source-list*, *ticket*)
  - getSplSetId(*rxcui*)

List of functions (SOAP) 3/3

- Miscellaneous functions
  - getDrugs(*name*)
  - getDisplayTerms()
  - getMultiIngredBrand(*rxcui-list*)
- Housekeeping functions
  - getRxNormVersion( )
  - getIdTypes()
  - getRelaTypes()
  - getSourceTypes()
  - getTermTypes()

Approximate Match Recently released

- To find closest strings to a drug name variant
- Use case: mapping of local formularies to RxNorm
- Drug-centric approach with token matching
- *approxMatch* function in (SOAP) API
- Returns top 20 candidates
  - Score
  - RxCUI
  - RxAUI

RESTful API

- Base URI
  - http://rxnav.nlm.nih.gov/REST/
- List of resources
  - http://rxnav.nlm.nih.gov/RxNormRestAPI.html

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

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

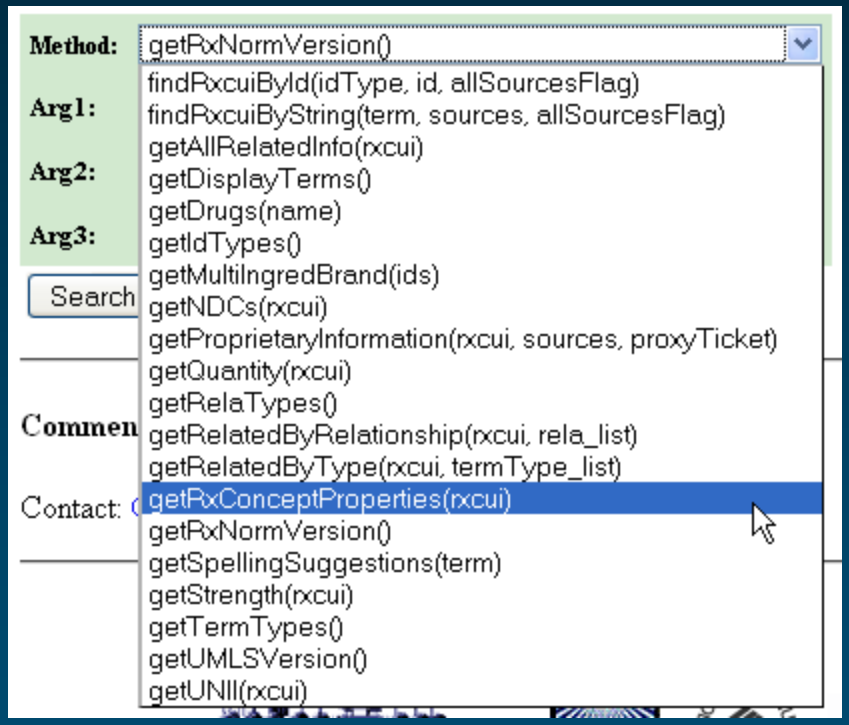
http://rxnav.nlm.nih.gov/REST/rxcui?name=bactrim

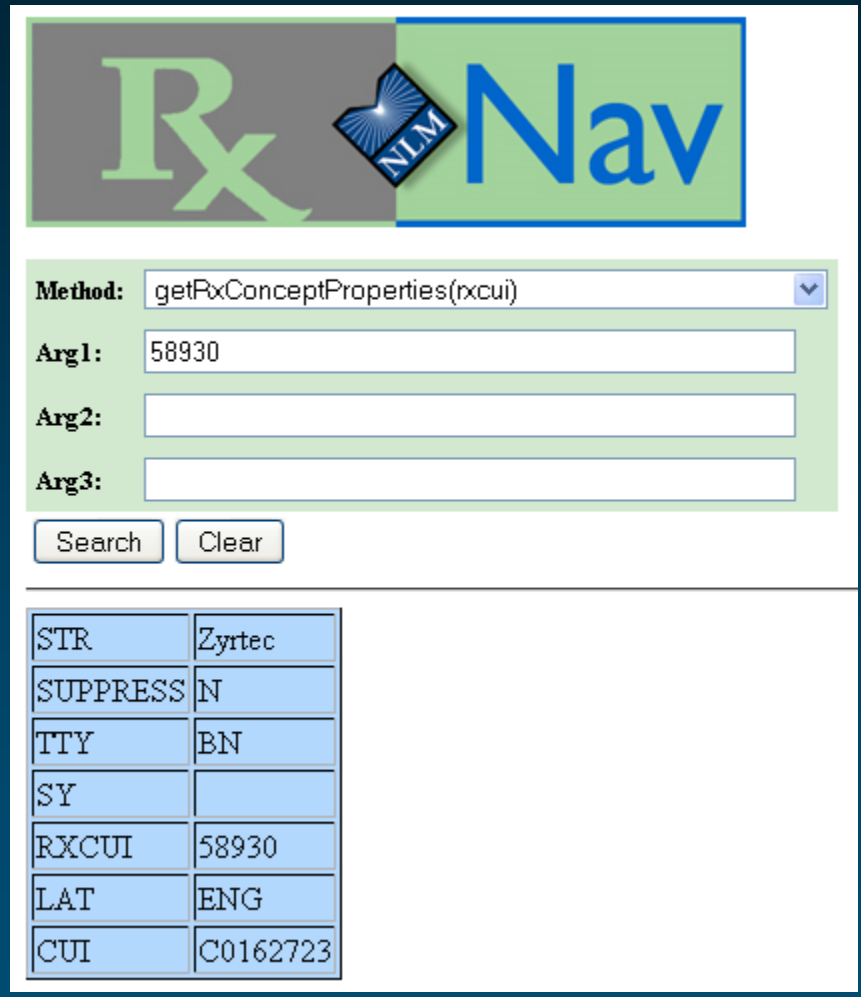
JSON output


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

Implementation Perl client

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





RxTerms API

- Released in December 2010
- SOAP and RESTful Web Services
- Used by *RxNav* and other applications
- Documentation
  - SOAP http://rxnav.nlm.nih.gov/RxTermsAPI.html
  - REST http://rxnav.nlm.nih.gov/RxTermsRestAPI.html
- Testing environment (SOAP client demo)
  - http://mor.nlm.nih.gov/perl/rxterms_api_demo.pl

RxTerms API functions (SOAP)

- Get RxTerms information
  - getAllRxTermInfo (*rxcui*)
- Get RxTerms display name
  - getRxTermDisplayName (*rxcui*)
- Get RxTerms data set version
  - getRxTermVersion ( )

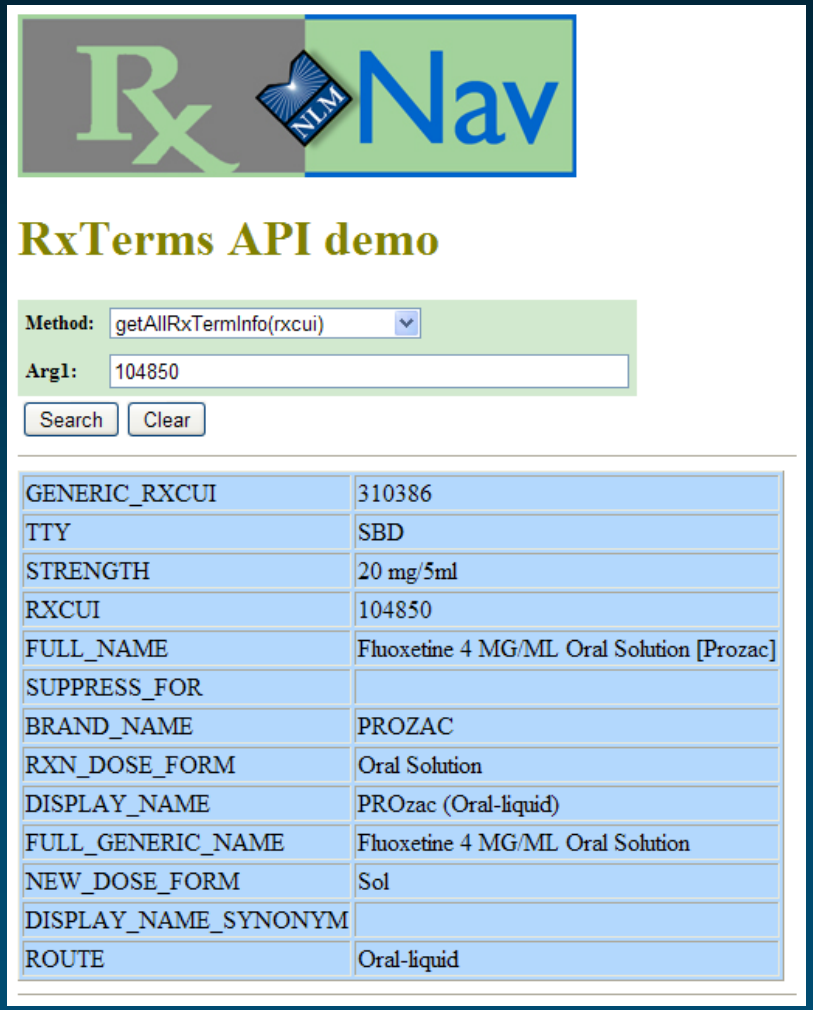
RxTerms API REST

Base URL http://rxnav.nlm.nih.gov/REST/RxTerms

RESTful Resource	SOAP Function
/rxcui/{rxcui}/allinfo	getAllRxTermInfo
/rxcui/{rxcui}/name	getRxTermDisplayName
version	getRxTermVersion

Implementation Perl client

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



GENERIC_RXCUI	310386
TTY	SBD
STRENGTH	20 mg/5ml
RXCUI	104850
FULL_NAME	Fluoxetine 4 MG/ML Oral Solution [Prozac]
SUPPRESS_FOR	
BRAND_NAME	PROZAC
RXN_DOSE_FORM	Oral Solution
DISPLAY_NAME	PROzac (Oral-liquid)
FULL_GENERIC_NAME	Fluoxetine 4 MG/ML Oral Solution
NEW_DOSE_FORM	Sol
DISPLAY_NAME_SYNONYM	
ROUTE	Oral-liquid

NDF-RT API

- Released in February 2011
- SOAP and RESTful Web Services
- Used by *RxNav* and other applications
- Documentation
  - SOAP http://rxnav.nlm.nih.gov/NdfrtAPI.html
  - REST http://rxnav.nlm.nih.gov/NdfrtRestAPI.html
- Testing environment (SOAP client demo)
  - http://mor.nlm.nih.gov/perl/ndfrt_api_demo.pl

NDF-RT API functions (SOAP) 1/3

- Find NDF-RT concepts
  - By name: findConceptsByName(*conceptName*, *kindName*)
  - By code: findConceptsByID(*idType*, *idString*)
- Get NDF-RT concept properties
  - All: getAllInfo(*nui*)
  - By NUI: getConceptProperties (*nui*, *propName*)
  - By Property: getConceptsByProperty(*propertyName*, *propertyValue*)

NDF-RT API functions (SOAP) 2/3

- Get NDF-RT related concepts
  - Children: getChildConcepts (*nui*, *transitive*)
  - Parents: getParentConcepts(*nui*, *transitive*)
  - Association: getRelatedConceptsByAssociation(*nui*, *assocName*)
  - Role (reversed): getRelatedConceptsByReverseRole (*nui*, *rolename*, *transitive*)
  - Role: getRelatedConceptsByRole (*nui*, *rolename*, *transitive*)
  - VA class: getVAClassMembers (*nui*)
  - VA class: getVAClassofConcept (*nui*)

NDF-RT API functions (SOAP) 3/3

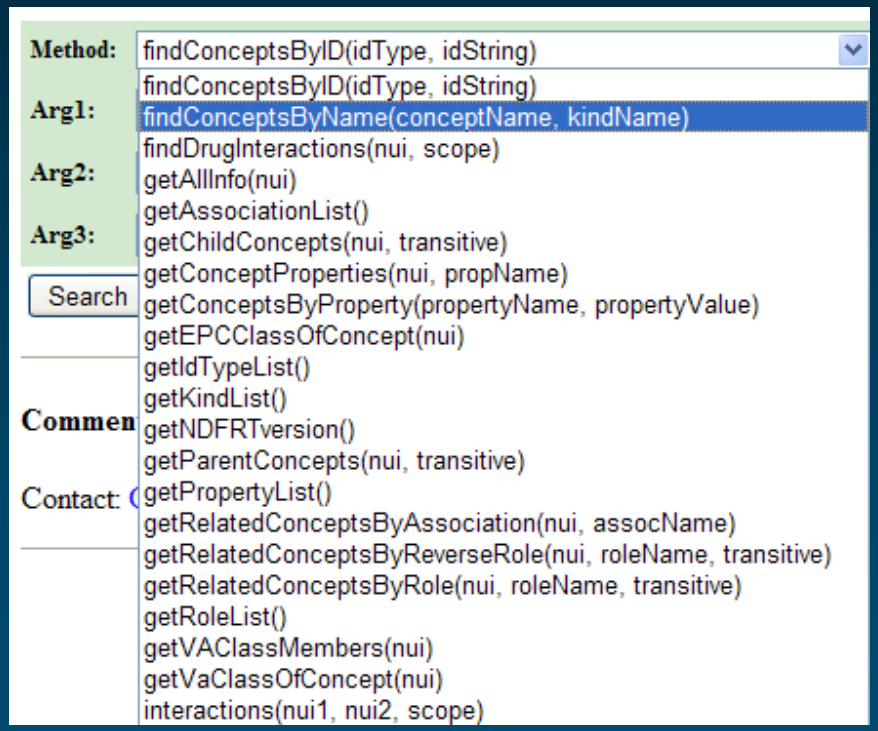
- Drug Interactions
  - findDrugInteractions (*nui*, *scope*)
  - interactions (*nui1*, *nui2*, *scope*)
- Housekeeping
  - getAssociationList ()
  - getIdTypeList ()
  - getKindList ()
  - getNDFRTversion ()
  - getPropertyList ()
  - getRoleList ()

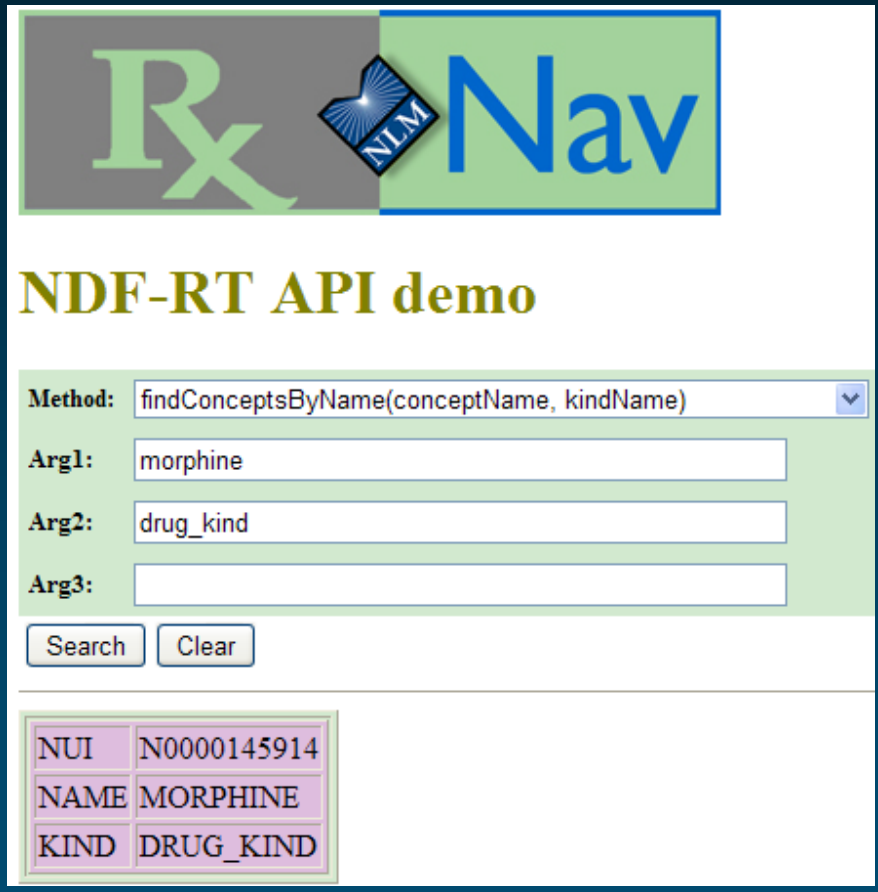
NDF-RT API REST

RESTful resource Base URL: http://rxnav.nlm.nih.gov/REST/Ndfrt	SOAP-based function
/	(none)
/conceptName=*{conceptName}*&kindName=*{kindName}*	findConceptsByName
/idType=*{idType}*&idString=*{idString}*	findConceptsByID
/propertyName=*{propertyName}*&propertyValue=*{propertyValue}*	getConceptsByProperty
/properties/nui=*{nui}*&propertyName=*{propertyName}*	getConceptProperties
/childConcepts/nui=*{nui}*&transitive=*{transitive}*	getChildConcepts
/parentConcepts/nui=*{nui}*&transitive=*{transitive}*	getParentConcepts
/associations/nui=*{nui}*&associationName=*{associationName}*	getRelatedConceptsByAssociation
/nui=*{nui}*&roleName=*{roleName}*&transitive=*{transitive}*	getRelatedConceptsByRole
/reverse/nui=*{nui}*&roleName=*{roleName}*&transitive=*{transitive}*	getRelatedConceptsByReverseRole
/interaction/nui=*{nui}*&scope=*{scope}*	findDrugInteractions
/interaction/nui1=*{nui1}*&nui2=*{nui2}*&scope=*{scope}*	interactions
/VA/*{nui}*	getVaClassOfConcept
/VAMember/*{nui}*	getVAClassMembers
/allInfo/*{nui}*	getAllInfo
/associationList	getAssociationList
/typeList	getIdTypeList
/kindList	getKindList
/propertyList	getPropertyList
/roleList	getRoleList
/version	getNDFRTversion

Implementation Perl client

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

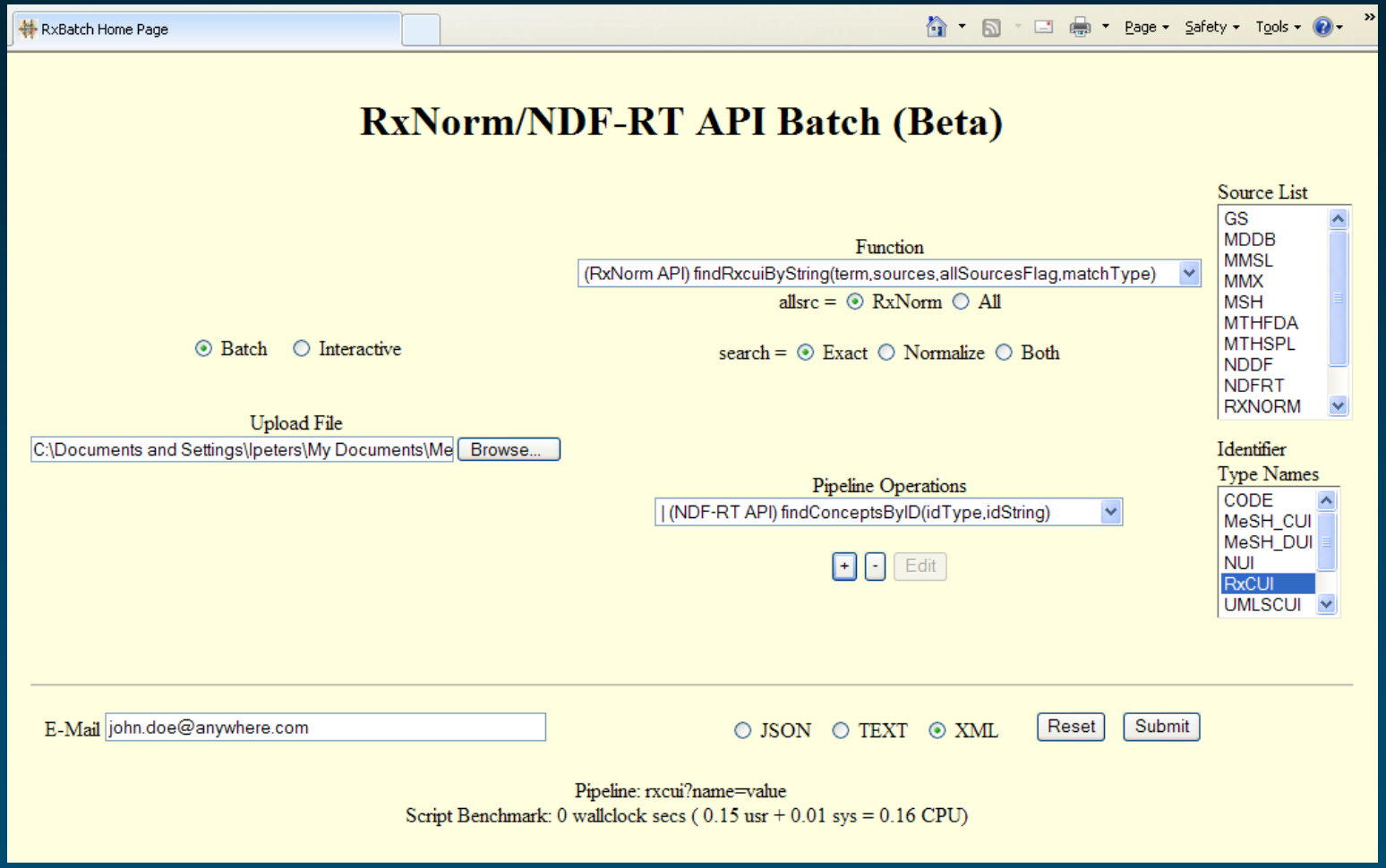




New Features coming soon

- *RxBatch*
  - Batch processing for API operations (RxNorm, NDF-RT)
  - Modeled after MetaMap batch processing
  - Supports composition of operations
  - Example: Get all NDCs for a given ingredient
    - Find an RxNorm concept from a string (`findRxcuiByString`)
    - Find related RxNorm clinical drug concepts (`findRelatedByType`)
    - Find NDCs for the clinical drug concepts (`getNDCs`)
  - Output in XML
  - Interactive mode available for testing

RxBatch Coming soon

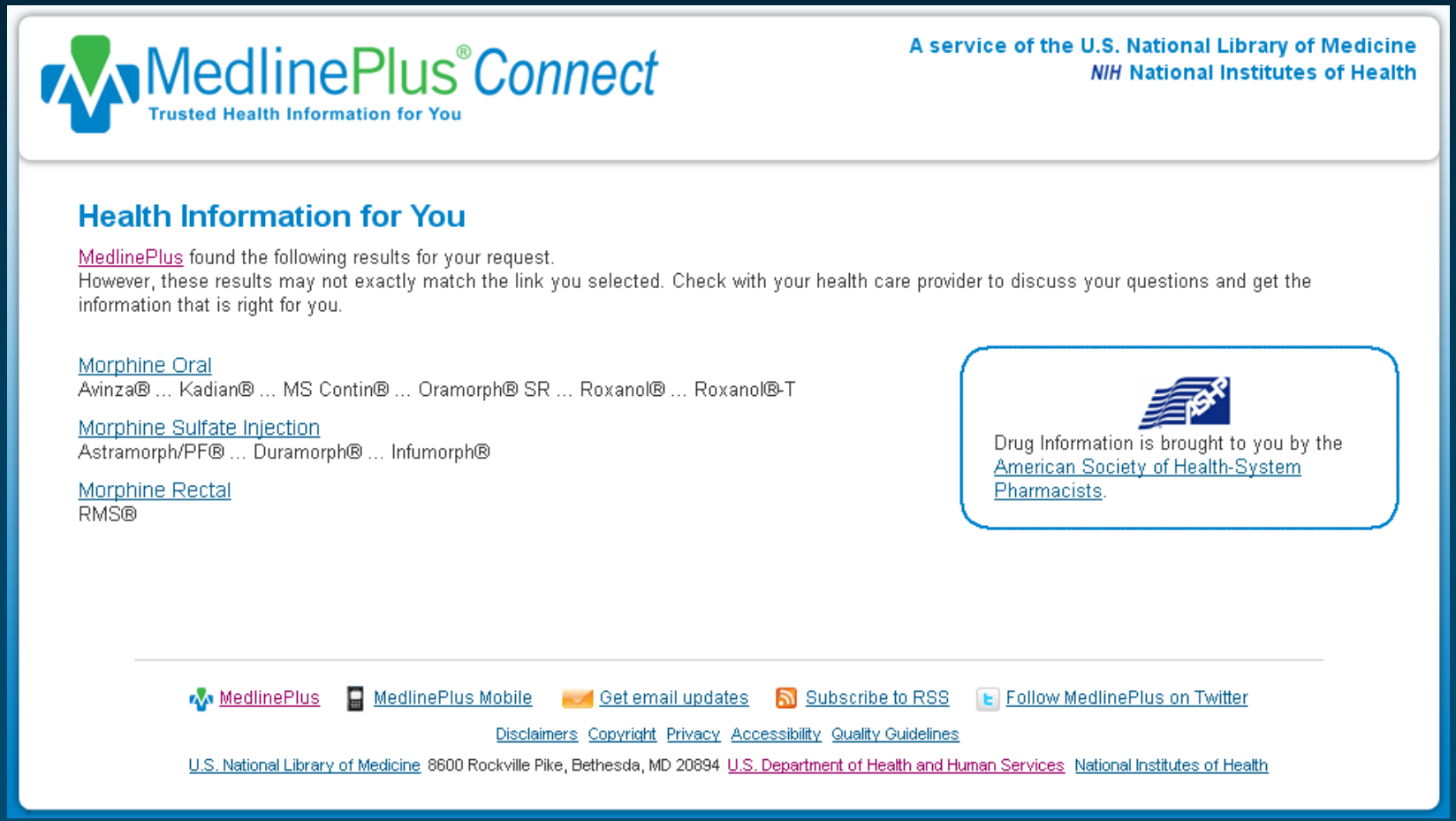


Applications

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

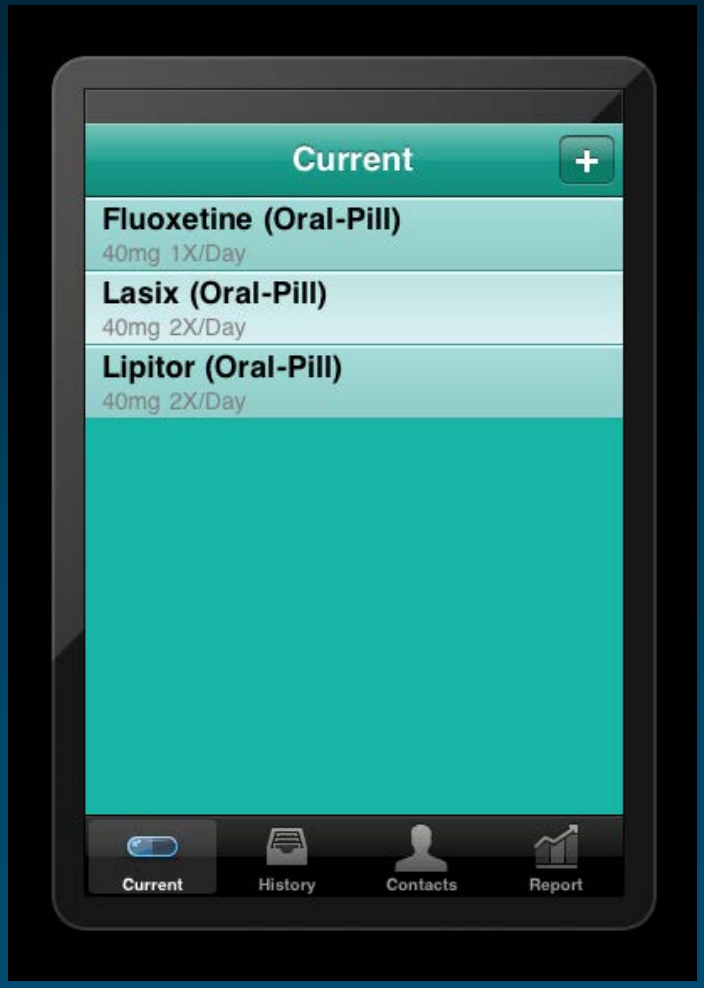
Applications MedlinePlus Connect



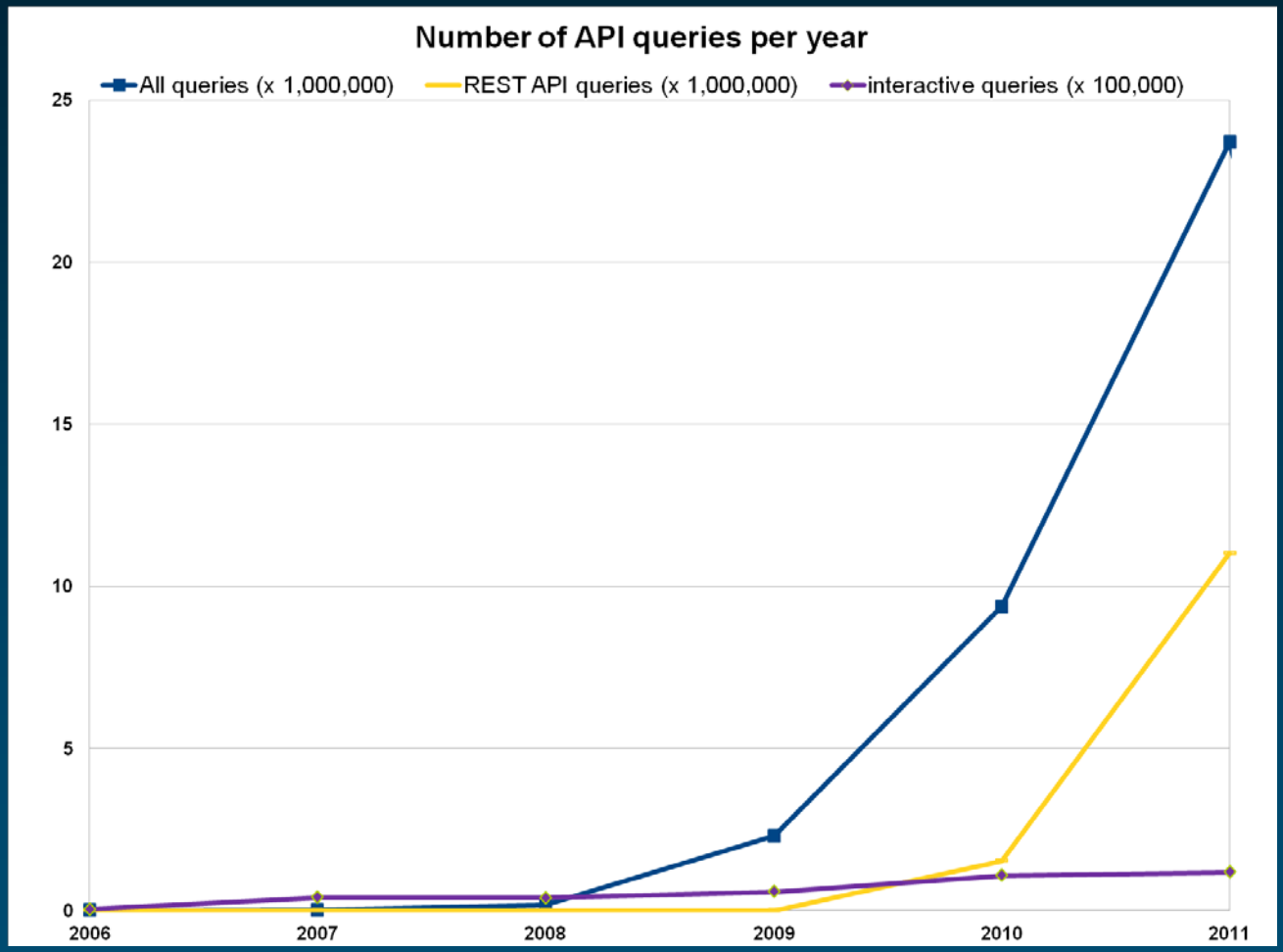
Applications outside NLM

- 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

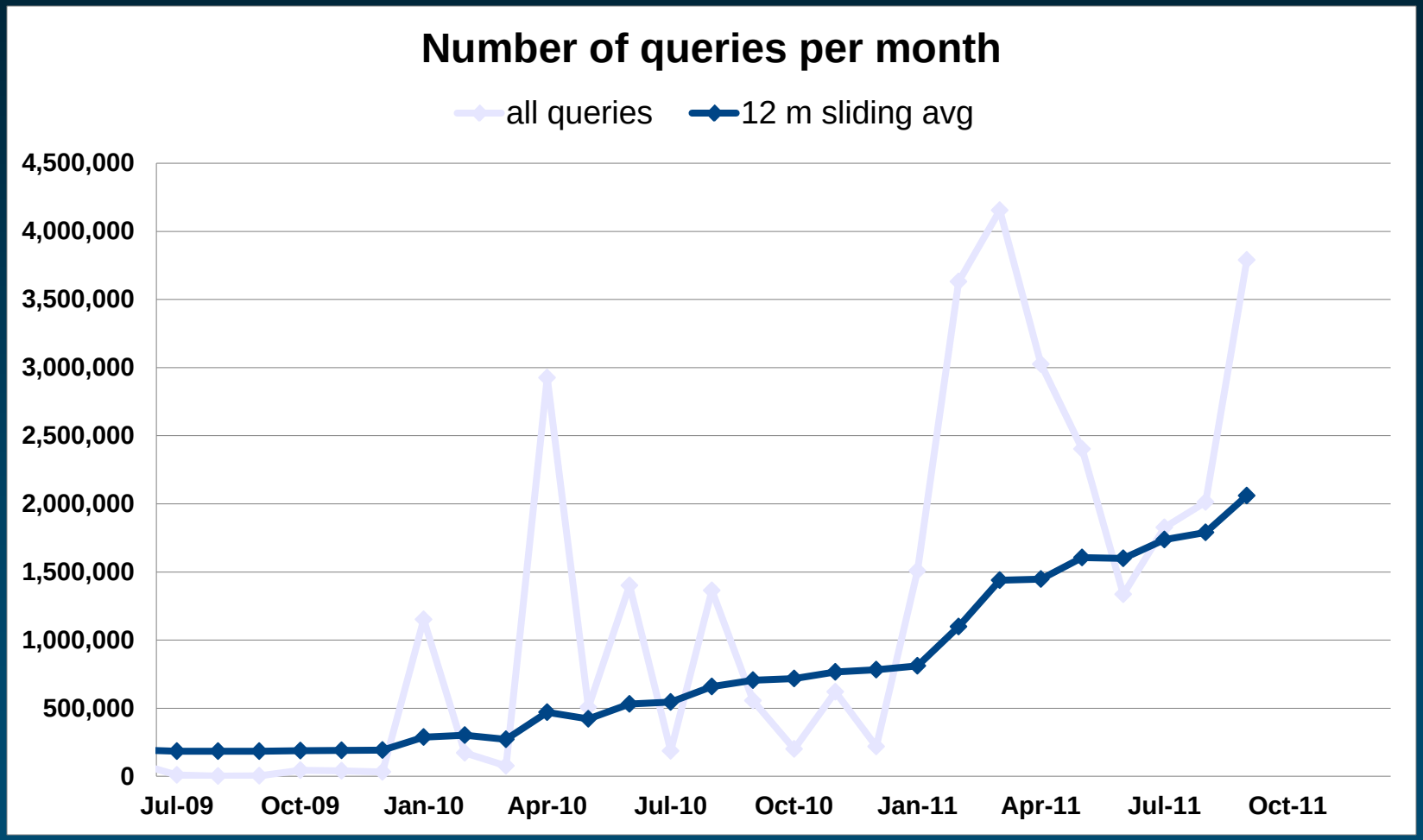
Applications DrugDiary iPhone app



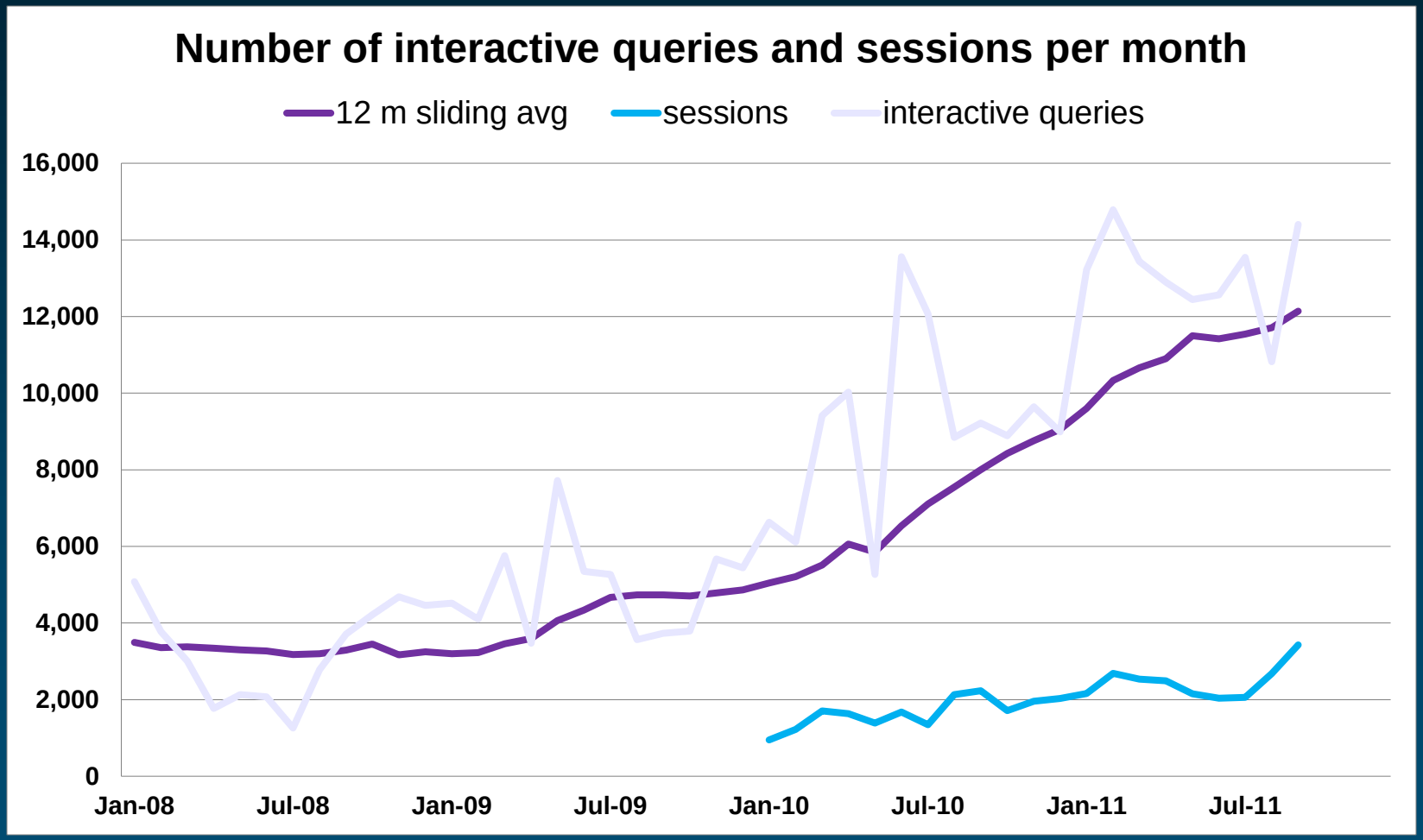
Usage statistics Growth



Usage statistics Queries



Usage statistics RxNav sessions



Contact: RXNAVINFO@LIST.NIH.GOV

Web: http://rxnav.nlm.nih.gov/

Lister Hill National Center
for Biomedical Communications
Bethesda, Maryland - USA