



ashp[®]

Pharmacy,
Practice & Policy

RxNorm

Why Should Pharmacists Care?

Olivier Bodenreider

National Library of Medicine, NIH, DHHS

Disclaimers

- No relationships with commercial interest
- The views and opinions expressed do not necessarily state or reflect those of the U.S. Government, and they may not be used for advertising or product endorsement purposes



Learning objectives

- 1- Explain the key elements, benefits, and limitations of RxNorm
- 2- Practice accessing RxNorm (RxNorm dataset, RxNav, APIs)
- 3- Identify companion resources linked to RxNorm
- 4- Identify issues with analyzing drugs in observational datasets





ashp[®]

Pharmacy,
Practice & Policy

Self-Assessment Questions

Question 1: Which type of information is in scope for RxNorm?

Question 2: Which use cases are covered by RxNorm?

Self-Assessment Question 1

- Which type of information is in scope for RxNorm?
 - A. Drug names
 - B. Drug codes
 - C. Pricing information
 - D. Drug-drug interactions
 - E. Indications



Self-Assessment Question 2

- Which use cases are covered by RxNorm?
 - A. E-prescribing
 - B. Information exchange
 - C. Formulary development
 - D. Reference value sets
 - E. Analytics



National Library of Medicine (NLM)

- World's largest biomedical library
- Maintains and makes available a vast print collection
- Produces electronic information resources on a wide range of topics that are searched billions of times each year by millions of people around the globe
- Supports and conducts research, development, and training in biomedical informatics and health information technology

<https://www.nlm.nih.gov/about/>



NLM strategic plan (2006-2016)*

- **Goal 1.** Seamless, Uninterrupted Access to Expanding Collections of Biomedical Data, Medical Knowledge, and Health Information
- **Goal 2.** Trusted Information Services that Promote Health Literacy and the Reduction of Health Disparities Worldwide
- **Goal 3.** Integrated Biomedical, Clinical, and Public Health Information Systems that Promote Scientific Discovery and Speed the Translation of Research into Practice
- **Goal 4.** A Strong and Diverse Workforce for Biomedical Informatics Research, Systems Development, and Innovative Service Delivery

<https://www.nlm.nih.gov/pubs/plan/lrpdocs.html>



Overview

- RxNorm basics
- Applications for using RxNorm
 - RxNav, RxClass, RxMix
- Follow-along examples
- Analyzing observational data with RxNorm



RxNorm – *Why Should Pharmacists Care?*
Part 1

RxNorm basics

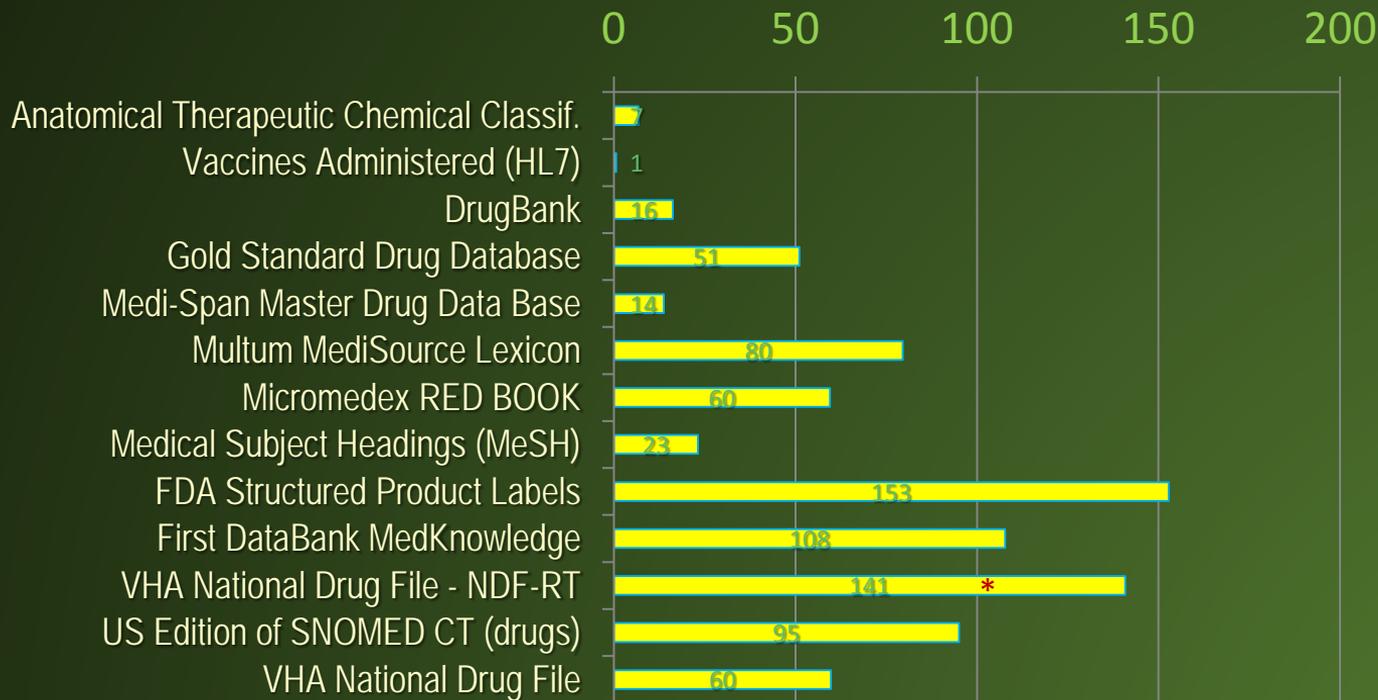


Interoperability among drug vocabularies

- 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



Source vocabularies in RxNorm



(terms in thousands, as of March 2017)



Normalization **Lexical level**

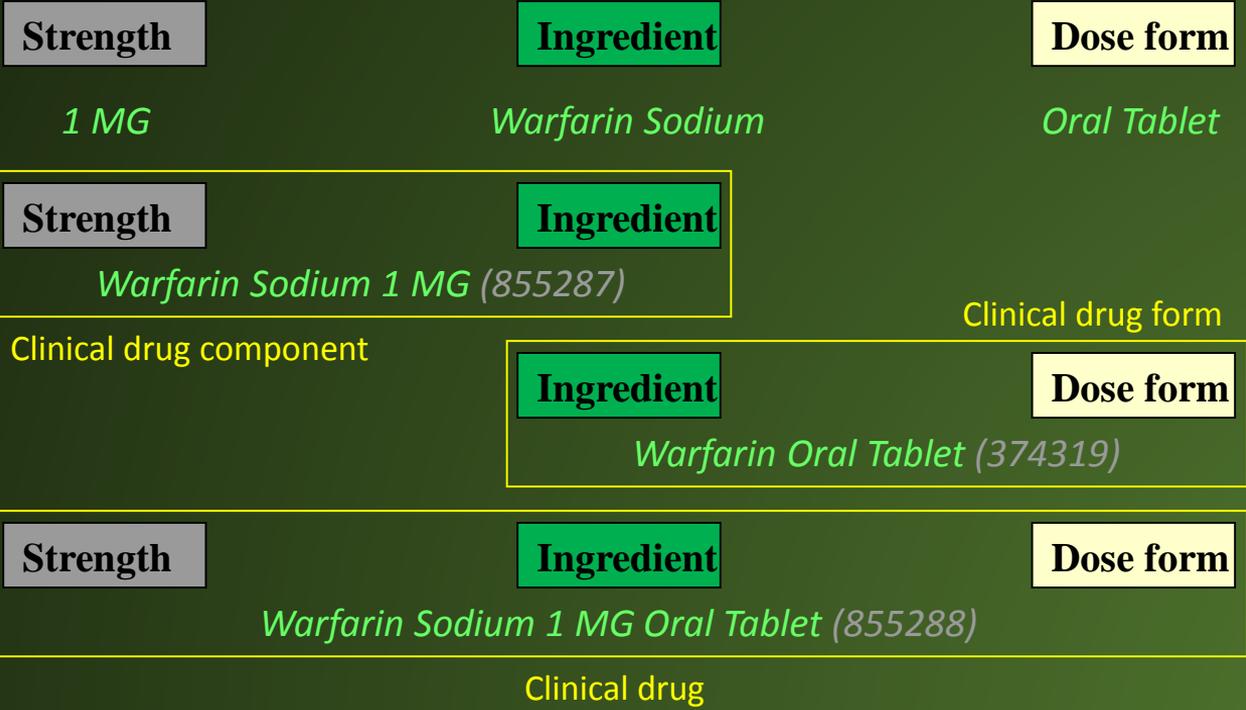
Name	Code	Source
WARFARIN (COUMADIN) NA 1MG TAB	4005203	VANDF
warfarin 1 mg oral tablet	3617	MMSL
WARFARIN NA 1MG TAB,UD	4014039	VANDF
WARFARIN NA 1MG TAB,UD [VA Product]	N0000161787	NDFRT
WARFARIN SODIUM 1 mg ORAL TABLET	14198	NDDF
WARFARIN SODIUM 1 mg ORAL TABLET	60429-784	MTHSPL
Warfarin Sodium 1 MG Oral Tablet	104045	MMX
WARFARIN SODIUM 1 mg ORAL TABLET	63629-4017	MTHSPL
WARFARIN SODIUM 1 mg ORAL TABLET [Warfarin Sodium]	53808-0985	MTHSPL
Warfarin Sodium 1 MILLIGRAM In 1 TABLET ORAL TABLET	15330-100	MTHSPL
WARFARIN SODIUM 1.09 MG ORAL TABLET	281572	MTHFDA
Warfarin Sodium 1mg Oral tablet	933	GS
Warfarin sodium 1mg tablet (product)	319733000	SNOMEDCT_US
Warfarin Sodium Tab 1 MG	6749	MDDB
Warfarin Sodium, 1 mg oral tablet	3617	MMSL
WARFARIN SODIUM@1 mg@ORAL@TABLET	14198	NDDF
[...]		



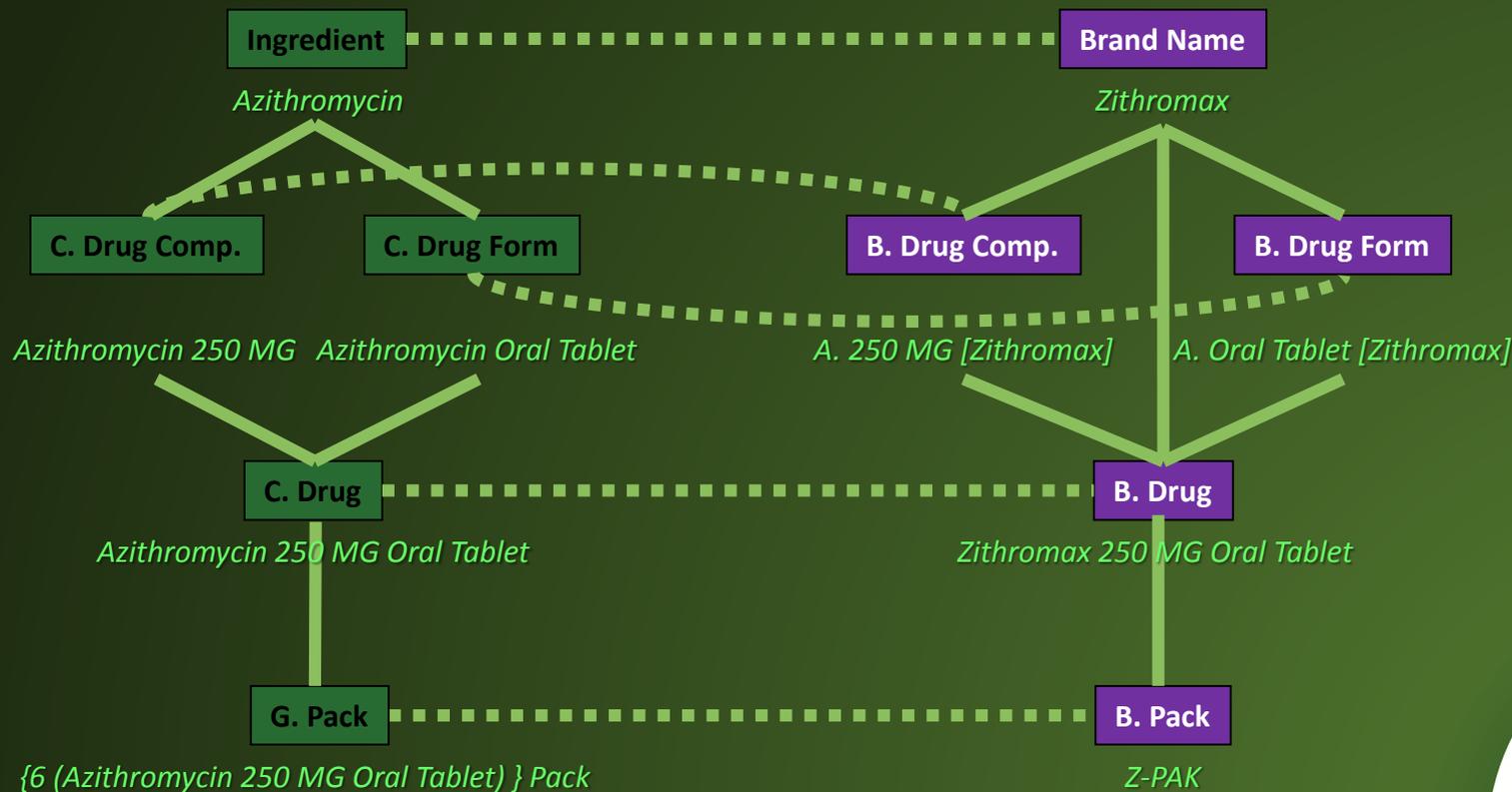
Warfarin Sodium 1 MG Oral Tablet (855288)



Normalized form



Relations among drug entities



What RxNorm does NOT contain

- Non-prescription drugs (limited coverage of OTC drugs)
- Non-drug entities (e.g., supplies)
- Drug classes / drug-class membership
- Indications, adverse events
- Drug-drug interactions
- Pricing information
- Dosing information

Available through
services (APIs)



RxNorm – *Why Should Pharmacists Care?*
Part 2

RxNorm in action



Example Mapping NDCs to ATC drug classes

- NDCs are attached to a clinical drug (SCD) or a branded (drug)
- Branded drugs are mapped to clinical drugs
- Clinical drugs are linked to their ingredient
- Many drug classification systems link classes to ingredient-level drugs (e.g., ATC, NDF-RT, EPC, MeSH pharmacologic action)



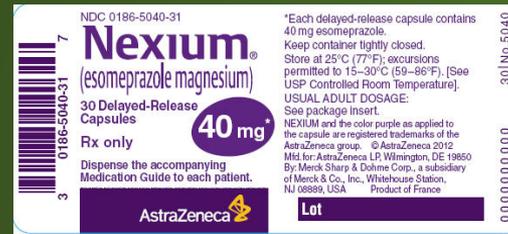
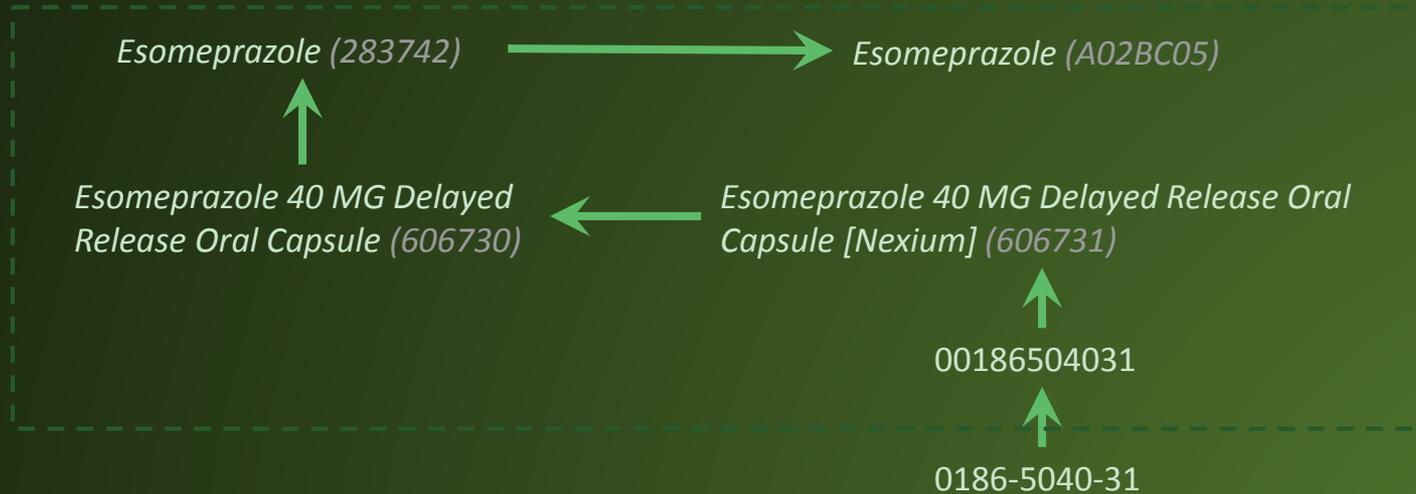
A **ALIMENTARY TRACT AND METABOLISM**

A02 **DRUGS FOR ACID RELATED DISORDERS**

A02B **DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)**

A02BC **Proton pump inhibitors**

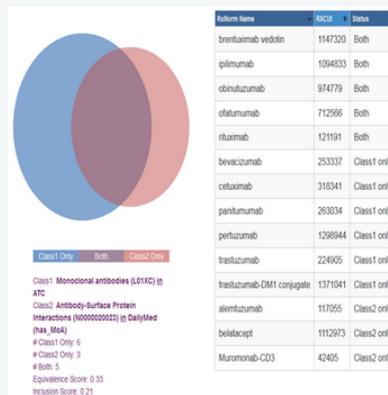
ATC code	Name	DDD	U	Adm.R	Note
A02BC05	<u>esomeprazole</u>	30	mg	O	
		30	mg	P	



A new RxNav web application has replaced the java version.
Please help us to improve your site experience by providing us feedback at this [link](#)

RxClass

The RxClass Browser is a web application for exploring and navigating through the class hierarchies to find the RxNorm drug members associated with each class.



RxNav

APIs

RxMix

RxClass

News

Statistics

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

RxNav brand names

Recent brand names added

Arymo	Corphedra
Daxbia	DayQuil HBP

High Priority Drug-Drug Interactions Added

A set of high priority drug-drug interactions have been added to the Interactions API and displayable in RxNav. The source is named...

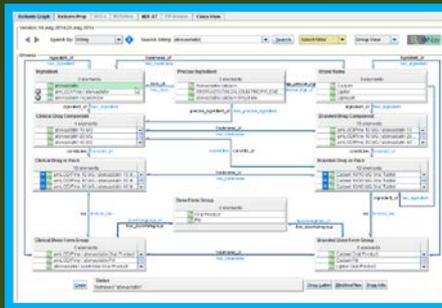
RxNav web version is here!

The RxNav web application is now available, replacing the RxNav java version. Check out the new design and responsiveness. [More](#)



RxNav

- Drug-centric browser
 - RxNorm
 - Prescribable subset
 - RxTerms
 - NDF-RT
 - Pill images
 - Drug-drug interactions
- Supports navigation to the rich RxNorm and NDF-RT graphs
- Links to other drug resources
 - DailyMed, MedlinePlus, NLM Drug Information Portal
- Drug-centric “class view”
- Leverages the drug APIs



RxClass

- **Class-centric** browser for RxNorm drugs
 - ATC
 - DailyMed (Mechanism of action, Physiologic effect, Chemical structure, FDA classes)
 - MeSH (Pharmacologic actions)
 - NDF-RT (VA classes, Diseases for indications/contra-indications)
- Supports search by drug or by class
- Features
 - Display and navigation
 - All the drugs for a class
 - All the classes for a drug
 - Compute similarity among drug classes (based on shared drug members)

The screenshot shows the RxClass web application interface. The main content area displays a search result for '7 Future generic drugs in ATC'. The results are presented in a table with columns for Drug, ATC, Mechanism, and other details. The table lists several drugs, including '7 Future generic drugs in ATC', with their respective ATC codes and mechanisms of action.

Drug	ATC	Mechanism	Other details
7 Future generic drugs in ATC			
7 Future generic drugs in ATC			
7 Future generic drugs in ATC			
7 Future generic drugs in ATC			
7 Future generic drugs in ATC			
7 Future generic drugs in ATC			
7 Future generic drugs in ATC			

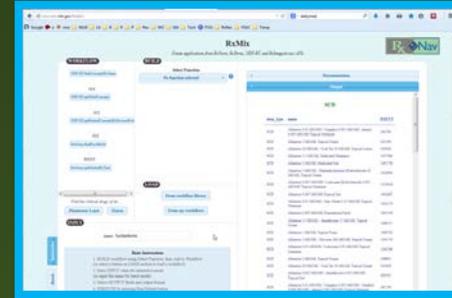


Application programming interfaces (APIs)

- Expose the content of RxNorm, RxTerms and NDF-RT (and other resources)
 - Logical structure, not storage format
 - Up-to-date information (monthly updates of RxNorm)
 - Additional features
 - Normalized and approximate matching; spelling correction
 - Drug-drug interactions checking (from DrugBank)
 - Link to drug classes (from ATC, DailyMed, MeSH, NDF-RT)
 - Archive of NDCs since 2007
 - Optimized graph traversal (pre-computed)
- For use in applications
 - Web services
 - SOAP, REST (XML, JSON)
 - Independent of any programming language



RxMix



- Graphical interface to the drug APIs
 - RxNorm, NDF-RT, RxTerms, RxImageAccess, Interactions, RxClass, MedEx, DailyMed
- Handles interoperability between functions
- Helps users compose complex queries
 - *Find all the NDC codes for a given allergy class (e.g., barbiturates)*
- Supports batch execution



RxNorm use cases

- E-prescribing
 - *NCPDP SCRIPT standard for e-prescribing requires RxNorm*
- Information exchange
 - *DoD and VA rely on RxNorm to mediate drug information across their electronic medical record systems*
- Formulary development
 - *CMS uses RxNorm in their Formulary Reference File, as part of the guideline for Medicare drug benefits*
- Reference value sets
 - *The drug value sets used in clinical quality measures for Meaningful Use are defined in reference to RxNorm*
- Analytics
 - *OHDSI, the Observational Health Data Sciences and Informatics research group, uses RxNorm to analyze prescription data*



RxNorm – *Why Should Pharmacists Care?*
Part 3

Follow-along examples



Follow-along examples

- Using ***RxNav***
 - Find the ATC class for NDC 0186-5040-31 (Nexium 40 mg delayed-released capsule)
 - NDC → RxNorm branded drug → RxNorm ingredient → ATC ingredient → ATC class
- Using ***RxClass***
 - Find all RxNorm ingredients from the same class as *esomeprazole*
 - Search classes by ingredient (or just click on a class in RxNav)
 - Find other classes with similar ingredients
 - Similar classes feature
- Using ***RxMix*** (Complete workflow)



Web applications

- Documentation
 - <https://rxnav.nlm.nih.gov/>
- RxNav
 - <https://mor.nlm.nih.gov/RxNav/>
- RxClass
 - <https://mor.nlm.nih.gov/RxClass/>
- RxMix
 - <https://mor.nlm.nih.gov/RxMix/>



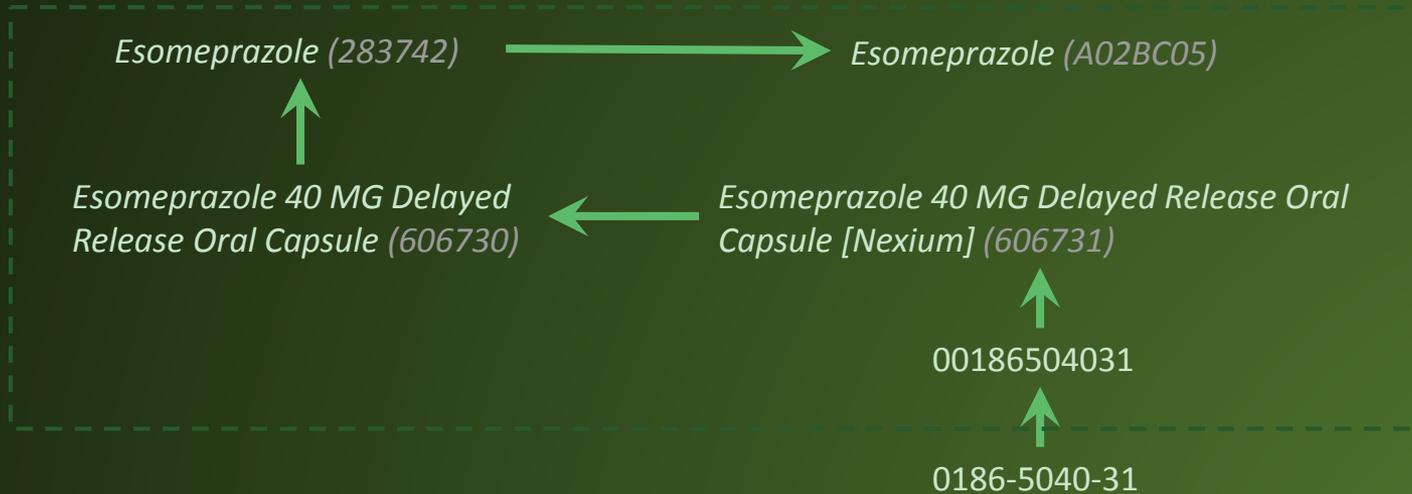
A **ALIMENTARY TRACT AND METABOLISM**

A02 **DRUGS FOR ACID RELATED DISORDERS**

A02B **DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)**

A02BC **Proton pump inhibitors**

ATC code	Name	DDD	U	Adm.R	Note
A02BC05	<u>esomeprazole</u>	30	mg	O	
		30	mg	P	



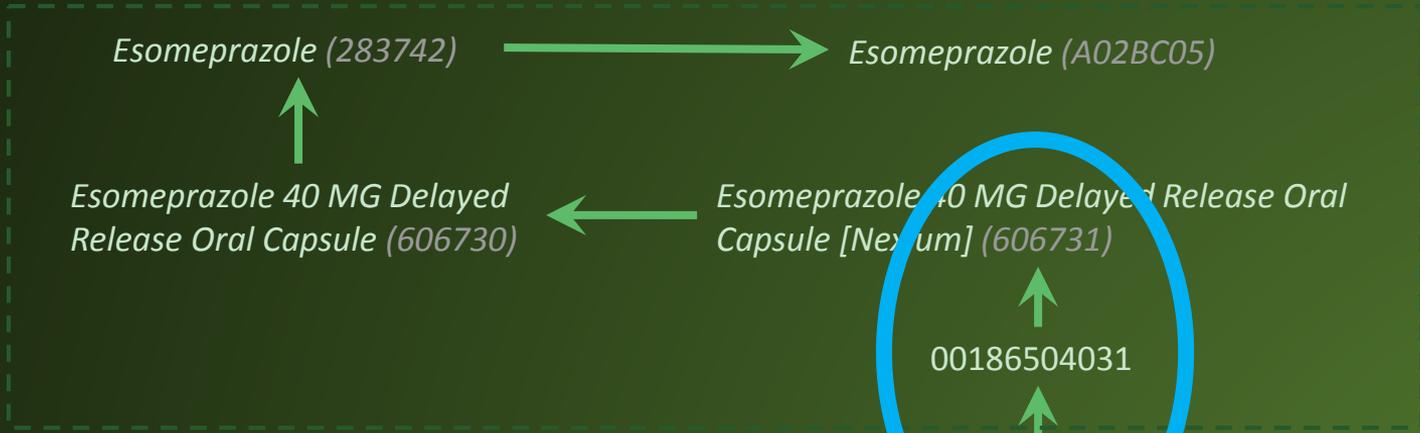
A ALIMENTARY TRACT AND METABOLISM

A02 DRUGS FOR ACID RELATED DISORDERS

A02B DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)

A02BC Proton pump inhibitors

ATC code	Name	DDD	U	Adm.R	Note
A02BC05	<u>esomeprazole</u>	30	mg	O	
		30	mg	P	





NextIUM 40 MG Delayed Release Oral Capsule [RxCUI = 606731]

- RxNorm Graph
- RxNorm Properties
- NDC
- RxTerms
- NDF-RT
- Pill Images
- Class View
- Interaction View

Views

- Classic
- Simple
- Table

Filters

H V Rx S

Group Form

Links

Legend

- MIN
- Pack
- Multi

IN/MIN	Ingredient (1)
H Rx S	Esomeprazole

PIN	Precise Ingredient (0)
-----	------------------------

BN	Brand Name (1)
H Rx S	NextIUM

SCDC	Clinical Drug Component (1)
H Rx S	Esomeprazole 40 MG



SBDC	Branded Drug Component (1)
H Rx S	Esomeprazole 40 MG [NextIUM]

SCD/GPCK	Clinical Drug or Pack (1)
H Rx S	Esomeprazole 40 MG Delayed Release Oral Capsule

SBD/BPCK	Branded Drug or Pack (1)
H Rx S	NextIUM 40 MG Delayed Release Oral Capsule

SCDG	Clinical Dose Form Group (2)
H Rx S	Esomeprazole Oral Product
H Rx S	Esomeprazole Pill

DFG	Dose Form Group (2)
hvRx S	Oral Product
hvRx S	Pill

SBDG	Branded Dose Form Group (2)
H Rx S	NextIUM Oral Product
H Rx S	NextIUM Pill

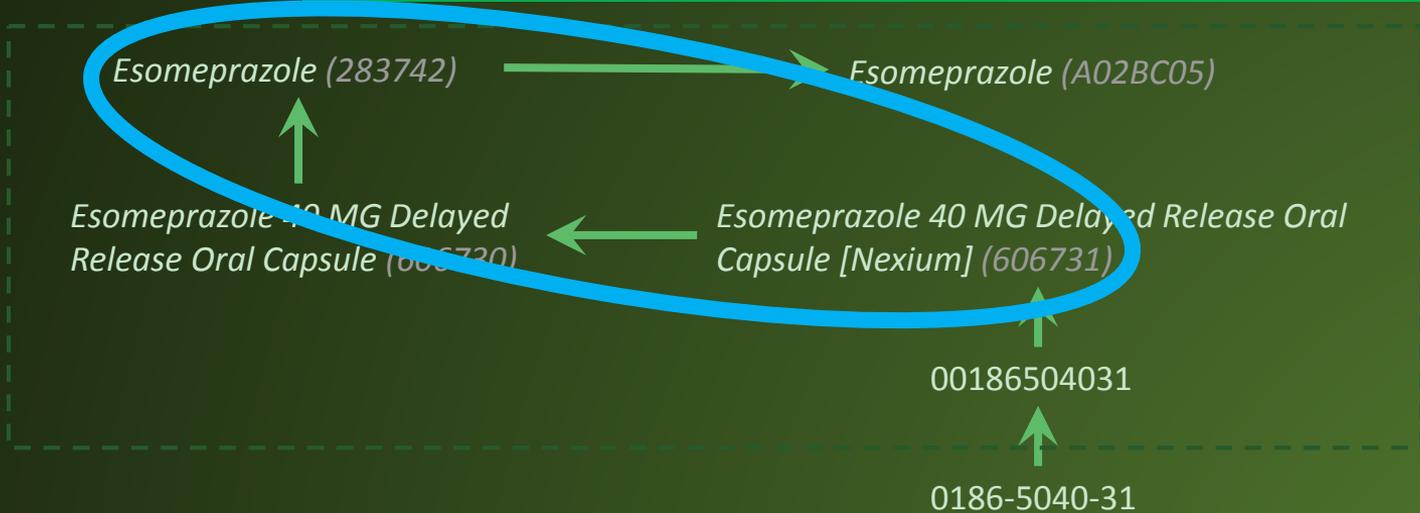
A ALIMENTARY TRACT AND METABOLISM

A02 DRUGS FOR ACID RELATED DISORDERS

A02B DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)

A02BC Proton pump inhibitors

ATC code	Name	DDD	U	Adm.R	Note
A02BC05	<u>esomeprazole</u>	30	mg	O	
		30	mg	P	





Search bar containing 'Esomeprazole' and a search icon.



Esomeprazole [RxCUI = 283742]

- RxNorm Graph
- RxNorm Properties**
- NDC
- RxTerms
- NDF-RT
- Pill Images
- Class View
- Interaction View

- Views
- Classic
 - Simple
 - Table

- Filters
- H
 - V
 - Rx
 - S

Group Form

- Links
- -
 -

- Legend
- MIN
 - Pack
 - Multi

Download

IN/MIN	Ingredient (2)
H Rx S	Esomeprazole
H Rx M	Esomeprazole / Naproxen

PIN	Precise Ingredient (4)
Rx S	Esomeprazole magnesium
Rx S	esomeprazole magnesium dihydrate
Rx S	esomeprazole sodium
H Rx S	Esomeprazole Strontium

BN	Brand Name (2)
H Rx S	NexIUM
H Rx M	Vimovo

SCDC	Clinical Drug Component (7)
H Rx S	Esomeprazole 10 MG
H Rx S	Esomeprazole 2.5 MG
H Rx SM	Esomeprazole 20 MG
H Rx S	Esomeprazole 40 MG
H Rx S	Esomeprazole 5 MG
H Rx S	Esomeprazole Strontium 24.65 MG



SBDC	Branded Drug Component (7)
H Rx S	Esomeprazole 10 MG [NexIUM]
H Rx S	Esomeprazole 2.5 MG [NexIUM]
H Rx M	Esomeprazole 20 MG / Naproxen 375 MG [Vimovo]
H Rx M	Esomeprazole 20 MG / Naproxen 500 MG [Vimovo]
H Rx S	Esomeprazole 20 MG [NexIUM]
H Rx S	Esomeprazole 40 MG [NexIUM]

SCD/GPCK	Clinical Drug or Pack (18)
H Rx S	Esomeprazole 10 MG Granules for Oral Suspension
H Rx S	Esomeprazole 2.5 MG Granules for Oral Suspension
H Rx M	Esomeprazole 20 MG / Naproxen 375 MG Delayed Release Oral Tablet
H Rx M	Esomeprazole 20 MG / Naproxen 500 MG Delayed Release Oral Tablet
H Rx S	Esomeprazole 20 MG Delayed Release Oral Capsule
H Rx S	Esomeprazole 20 MG Delayed Release Oral Tablet

SBD/BPCK	Branded Drug or Pack (12)
H Rx S	NexIUM 10 MG Granules for Delayed Release Oral Suspension
H Rx S	NexIUM 2.5 MG Granules for Delayed Release Oral Suspension
H Rx S	NexIUM 20 MG Delayed Release Oral Capsule
H Rx S	NexIUM 20 MG Delayed Release Oral Tablet

SCDG	Clinical Dose Form Group (6)
H Rx M	Esomeprazole / Naproxen Oral Product
H Rx M	Esomeprazole / Naproxen Pill
H Rx S	Esomeprazole Granule Product
H Rx S	Esomeprazole Injectable Product
H Rx S	Esomeprazole Oral Product
H Rx S	Esomeprazole Pill

DFG	Dose Form Group (4)
HvRx S	Granule Product
HvRx S	Injectable Product
HvRx S	Oral Product
HvRx S	Pill

SBDG	Branded Dose Form Group (6)
H Rx S	NexIUM Granule Product
H Rx S	NexIUM Injectable Product
H Rx S	NexIUM Oral Product
H Rx S	NexIUM Pill
H Rx M	Vimovo Oral Product
H Rx M	Vimovo Pill

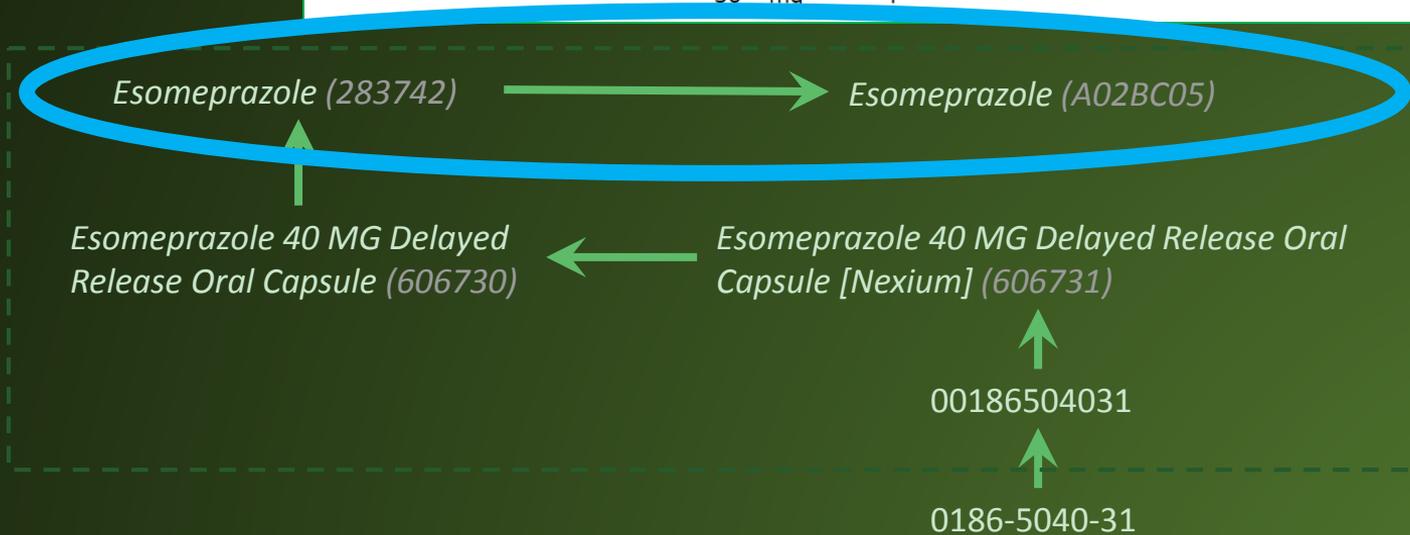
A ALIMENTARY TRACT AND METABOLISM

A02 DRUGS FOR ACID RELATED DISORDERS

A02B DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)

A02BC Proton pump inhibitors

ATC code	Name	DDD	U	Adm.R	Note
A02BC05	<u>esomeprazole</u>	30	mg	O	
		30	ma	P	





Show RxNorm Properties Information

String



Esomeprazole [RxCUI = 283742]

- RxNorm Graph
- RxNorm Properties**
- NDC
- RxTerms
- NDF-RT
- Pill Images
- Class View
- Interaction View

Views

- Attributes
- **Codes**
- Names
- Sources

Download

Property	Value
ATC	A02BC05
MMSL_CODE	GNd04749
NUI	N0000148700
NUI	N0000189434
RxCUI	283742
SPL_SET_ID	069d7015-a2e4-4dbb-8255-2172e22a6300
SPL_SET_ID	0907236c-786f-4e36-b360-6c499986fe9a
SPL_SET_ID	0a4e27bd-151c-462f-ac47-4d0a1105aa9d
SPL_SET_ID	0eea6d43-db1e-471c-ba0a-1f8321c6293b
SPL_SET_ID	15023261-51c8-2388-3439-48dace49ec02
SPL_SET_ID	1f0ba9c8-e5f2-4d65-a0e3-19a6541a03b5
SPL_SET_ID	31ec2d55-9a3e-4150-8a98-a2895a4174b7
SPL_SET_ID	3a65d9b7-7a8d-4fc6-a290-50c3543dc485
SPL_SET_ID	3c916d32-f9e9-1d15-e054-00144ff88e88
SPL_SET_ID	3cdfcf9-b5fa-4622-9e83-ce29eccc93
SPL_SET_ID	42b67915-43ca-4119-8f66-ed449b445f7c
SPL_SET_ID	4332634f-fde0-4b98-8735-d3ab865189c3
SPL_SET_ID	4513934d-0cf0-40fc-a348-b4e75a33b094
SPL_SET_ID	45a15ba2-2aae-4edc-beaa-4a2357d87f32
SPL_SET_ID	477cfda2-44cf-4d0e-bdc4-e30bf16bfea9
SPL_SET_ID	4a9fe897-db08-4e14-b243-d2124a07d1d1
SPL_SET_ID	4b6c6f3c-fbd3-4eeb-a6fe-17eeb4a51cfa
SPL_SET_ID	4d5e0d44-4a23-4445-0a20-aa07a4610a20

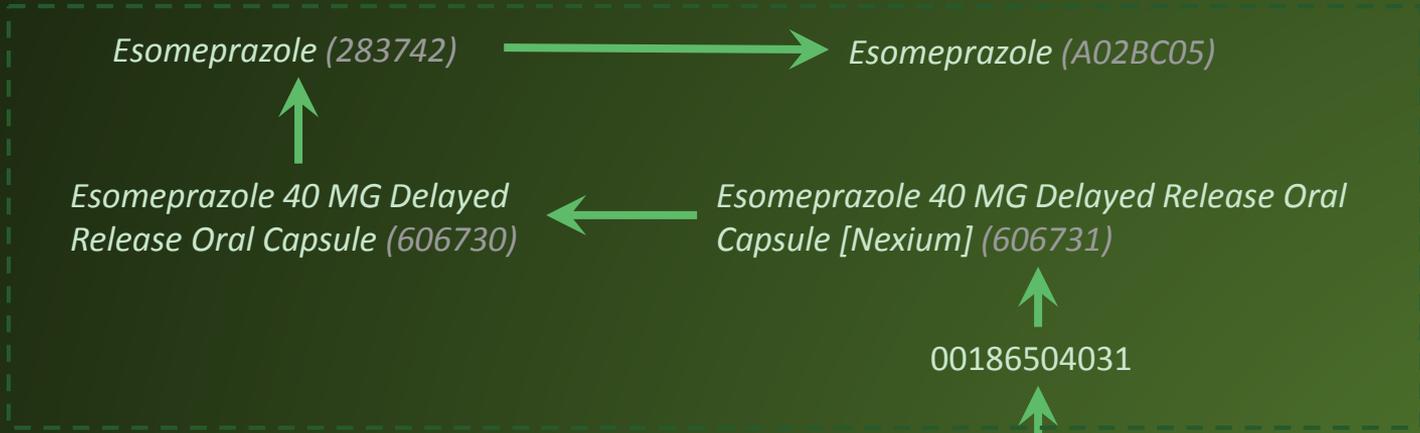
A **ALIMENTARY TRACT AND METABOLISM**

A02 **DRUGS FOR ACID RELATED DISORDERS**

A02B **DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)**

A02BC **Proton pump inhibitors**

ATC code	Name	DDD	U	Adm.R	Note
A02BC05	<u>esomeprazole</u>	30	mg	O	
		30	mg	P	





String [dropdown] Esomeprazole [search icon] [refresh icon]



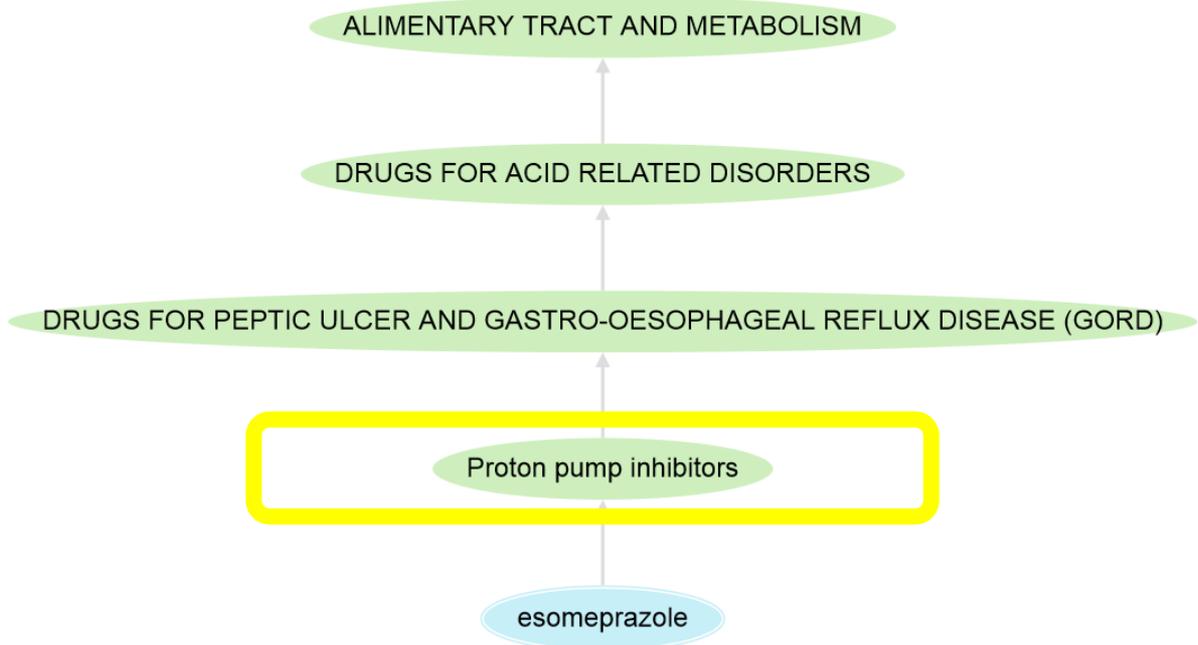
Show Drug's Relation to Drug Class
Esomeprazole [RxCUI = 283742]

- RxNorm Graph
- RxNorm Properties
- NDC
- RxTerms
- NDF-RT
- Pill Images
- Class View**
- Interaction View

Views

- **ATC**
- MESH
- Drug
- Disease
- DF
- CHEM
- MoA
- PK
- PE

Hide Legend



Legend





News

ATC/DDD Index

Updates included in the ATC/DDD Index

ATC/DDD methodology

ATC

DDD

ATC/DDD alterations, cumulative lists

ATC/DDD Index and Guidelines

Use of ATC/DDD

Courses

Meetings/open session

Deadlines

Links

Postal address: WHO Collaborating Centre for Drug Statistics Methodology Norwegian Institute of Public Health P.O.Box 4404 Nydalen 0403 Oslo Norway

Visiting/delivery address: Marcus Thranes gate 6 0473 Oslo Norway

Tel: +47 21 07 81 60 E-mail: whocc@fhi.no

Copyright/Disclaimer

New search Show text from Guidelines

A ALIMENTARY TRACT AND METABOLISM
A02 DRUGS FOR ACID RELATED DISORDERS
A02B DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)
A02BC Proton pump inhibitors

Table with columns: ATC code, Name, DDD, U, Adm.R, Note. Rows include omeprazole, pantoprazole, lansoprazole, rabeprazole, esomeprazole, dexlansoprazole, dexrabeprazole*, lansoprazole, combinations, rabeprazole, combinations.

List of abbreviations

Last updated: 2016-12-19

Finding all PPI drugs in ATC

dexrabeprazole not on the U.S. market

https://www.whocc.no/atc_ddd_index/



Class Browser

- ▼ Anatomical Therapeutic Chemical (ATC1-4)
 - ▼ ALIMENTARY TRACT AND METABOLISM (370)
 - ANABOLIC AGENTS FOR SYSTEMIC USE (9)
 - ANTIDIARRHEALS, INTESTINAL ANTIINFLAMMATORY/ANTIINFECTIVE AGENTS (42)
 - ANTIEMETICS AND ANTINAUSEANTS (13)
 - ANTIObESITY PREPARATIONS, EXCL. DIET PRODUCTS (12)
 - APPETITE STIMULANTS (0)
 - BILE AND LIVER THERAPY (13)
 - DIGESTIVES, INCL. ENZYMES (7)
 - ▼ DRUGS FOR ACID RELATED DISORDERS (35)
 - ANTACIDS (14)
 - ▼ DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD) (21)
 - Combinations for eradication of *Helicobacter pylori* (1)
 - H2-receptor antagonists (5)
 - Other drugs for peptic ulcer and gastro-oesophageal reflux disease (GORD) (8)
 - Prostaglandins (1)
 - Proton pump inhibitors (6)
 - OTHER DRUGS FOR ACID RELATED DISORDERS (0)
 - DRUGS FOR CONSTIPATION (35)
 - DRUGS FOR FUNCTIONAL GASTROINTESTINAL DISORDERS (44)
 - DRUGS USED IN DIABETES (61)
 - MINERAL SUPPLEMENTS (30)
 - OTHER ALIMENTARY TRACT AND METABOLISM PRODUCTS (32)

RxClass

Exploring drug classes and their RxNorm drug members

Search...

by class name/id
 by RxNorm drug name/id
 ingredient drug only

Proton pump inhibitors

class: Proton pump inhibitors / id: A02BC / class type: ATC1-4 / [show context](#)

Print

6 RxNorm generic drugs in ATC / [similar classes](#)

Type	RXCUI	RxNorm Name	Relation	All classes
IN	816346	dexlansoprazole	DIRECT	<input type="button" value="Show"/>
IN	283742	Esomeprazole	DIRECT	<input type="button" value="Show"/>
IN	17128	lansoprazole	DIRECT	<input type="button" value="Show"/>
IN	7646	Omeprazole	DIRECT	<input type="button" value="Show"/>
IN	40790	pantoprazole	DIRECT	<input type="button" value="Show"/>
IN	114979	rabeprazole	DIRECT	<input type="button" value="Show"/>



WHO Collaborating Centre for
Drug Statistics Methodology

News

ATC/DDD Index

Updates included in
the ATC/DDD Index

ATC/DDD methodology

ATC

DDD

ATC/DDD alterations,
cumulative lists

ATC/DDD Index and
Guidelines

Use of ATC/DDD

Courses

Meetings/open sessions

Deadlines

Links

Postal address:
WHO Collaborating
Centre for Drug Statistics
Methodology
Norwegian Institute of
Public Health
P.O.Box 4404 Nydalen
0403 Oslo
Norway

Visiting/delivery
address:
Marcus Thranes gate 6
0473 Oslo
Norway

Tel: +47 21 07 81 60
E-mail: whocc@fhi.no

[Copyright/Disclaimer](#)

A **ALIMENTARY TRACT AND METABOLISM**
A02 **DRUGS FOR ACID RELATED DISORDER**
A02B **DRUGS FOR PEPTIC ULCER AND GAST**
A02BC **Proton pump inhibitors**

ATC code	Name
A02BC01	omeprazole
A02BC02	pantoprazole
A02BC03	lansoprazole
A02BC04	rabeprazole
A02BC05	esomeprazole
A02BC06	dexlansoprazole
A02BC07	dexrabeprazole
A02BC53	lansoprazole, combinations
A02BC54	rabeprazole, combinations

[List of abbreviations](#)

Last updated: 2016-12-19



Classes in other
drug classification
systems



Class Browser

- ▼ Anatomical Therapeutic Chemical (ATC1-4)
 - ▼ ALIMENTARY TRACT AND METABOLISM (370)
 - ANABOLIC AGENTS FOR SYSTEMIC USE (9)
 - ANTIDIARRHEALS, INTESTINAL ANTIINFLAMMATORY/ANTIINFECTIVE AGENTS (42)
 - ANTIEMETICS AND ANTINAUSEANTS (13)
 - ANTIObESITY PREPARATIONS, EXCL. DIET PRODUCTS (12)
 - APPETITE STIMULANTS (0)
 - BILE AND LIVER THERAPY (13)
 - DIGESTIVES, INCL. ENZYMES (7)
 - ▼ DRUGS FOR ACID RELATED DISORDERS (35)
 - ANTACIDS (14)
 - ▼ DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD) (21)
 - Combinations for eradication of *Helicobacter pylori* (1)
 - H2-receptor antagonists (5)
 - Other drugs for peptic ulcer and gastro-oesophageal reflux disease (GORD) (8)
 - Prostaglandins (1)
 - Proton pump inhibitors (6)
 - OTHER DRUGS FOR ACID RELATED DISORDERS (0)
 - DRUGS FOR CONSTIPATION (35)
 - DRUGS FOR FUNCTIONAL GASTROINTESTINAL DISORDERS (44)
 - DRUGS USED IN DIABETES (61)
 - MINERAL SUPPLEMENTS (30)
 - OTHER ALIMENTARY TRACT AND METABOLISM PRODUCTS (32)

RxClass

Exploring drug classes and their RxNorm drug members

Search...

by class name/id
 by RxNorm drug name/id
 ingredient drug only

Proton pump inhibitors 

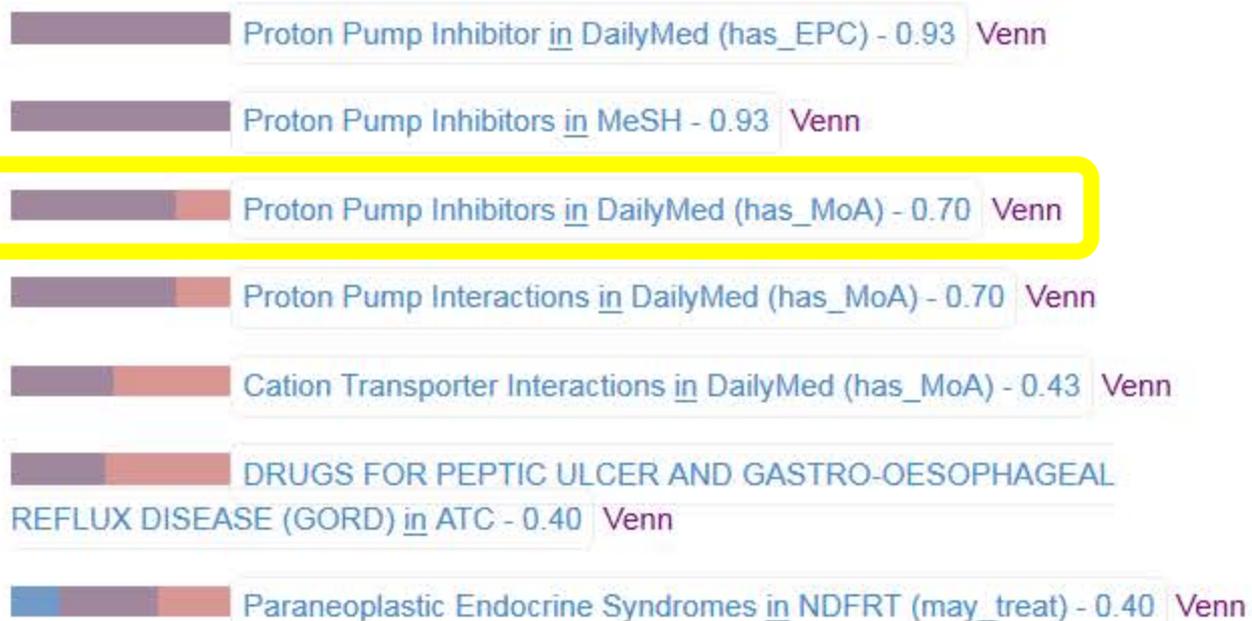
class: Proton pump inhibitors / id: A02BC / class type: ATC1-4 / [show context](#)

 Print

6 RxNorm generic drugs in ATC similar classes

Type	RXCUI	RxNorm Name	Relation	All classes
IN	816346	dexlansoprazole	DIRECT	<input type="button" value="Show"/>
IN	283742	Esomeprazole	DIRECT	<input type="button" value="Show"/>
IN	17128	lansoprazole	DIRECT	<input type="button" value="Show"/>
IN	7646	Omeprazole	DIRECT	<input type="button" value="Show"/>
IN	40790	pantoprazole	DIRECT	<input type="button" value="Show"/>
IN	114979	rabeprazole	DIRECT	<input type="button" value="Show"/>

67 classes similar to class 'Proton pump inhibitors' ✕

- 
- | | | |
|---|---|--------|
|  | Proton Pump Inhibitor <u>in</u> DailyMed (has_EPC) - 0.93 Venn | |
|  | Proton Pump Inhibitors <u>in</u> MeSH - 0.93 Venn | |
|  | Proton Pump Inhibitors <u>in</u> DailyMed (has_MoA) - 0.70 Venn | |
|  | Proton Pump Interactions <u>in</u> DailyMed (has_MoA) - 0.70 Venn | |
|  | Cation Transporter Interactions <u>in</u> DailyMed (has_MoA) - 0.43 Venn | DIRECT |
|  | DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD) <u>in</u> ATC - 0.40 Venn | DIRECT |
|  | Paraneoplastic Endocrine Syndromes <u>in</u> NDFRT (may_treat) - 0.40 Venn | DIRECT |

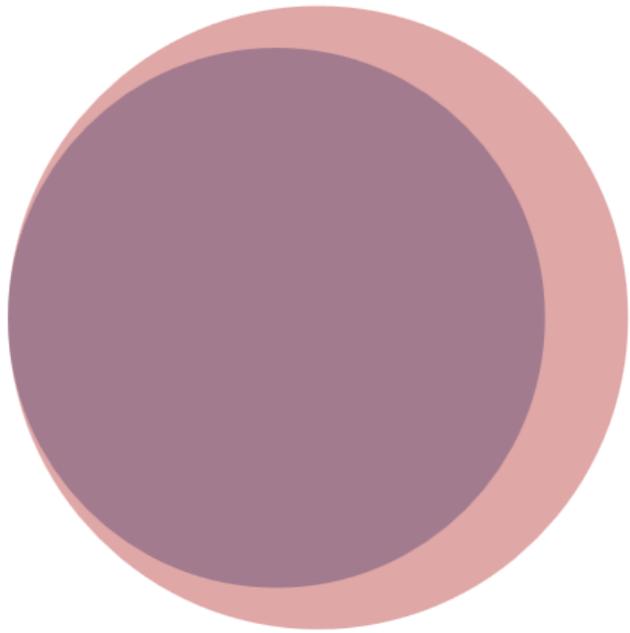
Relation

DIRECT

DIRECT

DIRECT

DIRECT



Class1 Only Both Class2 Only

Class1: **Proton pump inhibitors (A02BC) in ATC**

Class2: **Proton Pump Inhibitors (N0000000147) in DailyMed (has_MoA)**

Class1 Only: 0

Class2 Only: 2

Both: 6

Equivalence Score: 0.70

Inclusion Score: -1.0

RxNorm Name	RXCUI	Status
dexlansoprazole	816346	Both
Esomeprazole	283742	Both
lansoprazole	17128	Both
Omeprazole	7646	Both
pantoprazole	40790	Both
rabeprazole	114979	Both
Amantadine	620	Class2 only
Rimantadine	9386	Class2 only



Class Browser

- > Anatomical Therapeutic Chemical (ATC1-4)
- > Established Pharmacologic Classes (EPC) [from DailyMed]
- > MeSH Pharmacologic Actions (MESHPA)
- > Disease
- > Chemical Structure (Chem) [from DailyMed]
- > Mechanism of Action (MoA) [from DailyMed]
 - > Antibody Interactions (37)
 - > Biological Macromolecular Activity (0)
 - > Enzyme Interactions (297)
 - > Immunologic and Biological Factor Interactions (46)
 - > Membrane Transporter Interactions (90)
 - > ATP-Binding Cassette (ABC) Transporter Interactions (40)
 - > Fatty Acid Transporter Interactions (1)
 - > Ion Channel Interactions (24)
 - > Ion Transporter Interactions (39)
 - > Anion Transporter Interactions (9)
 - > Antiporter Interactions (1)
 - > Cation Transporter Interactions (14)
 - > Organic Cation Transporter Interactions (6)
 - > Proton Pump Interactions (8)
 - > Proton Pump Inhibitors (8)
 - M2 Protein Inhibitors (2)
 - > Symporter Interactions (16)
 - > Monosaccharide Transporter Interactions (3)
 - > Neurotransmitter Transporter Interactions (14)
 - > Physiochemical Activity (121)
 - > Receptor Interactions (382)
 - Unknown Cellular or Molecular Interaction (0)
 - > Physiologic Effect (PE) [from DailyMed]
 - > Pharmacokinetics (PK)
 - > VA Classes (VA)

Exploring drug classes and their RxNorm drug members

Q

by class name/id
 by RxNorm drug name/id
 ingredient drug only
[Edit Drug Sources](#)

Proton Pump Inhibitors

class: **Proton Pump Inhibitors** / id: N0000000147 / class type: **MOA** / [show context](#)

Print

8 RxNorm generic drugs for **has_MoA** in DailyMed / [similar classes](#)

Type	RXCUI	RxNorm Name	Relation	All classes
IN	620	Amantadine	INDIRECT	Show
IN	816346	dexlansoprazole	DIRECT	Show
IN	283742	Esomeprazole	DIRECT	Show
IN	17128	lansoprazole	DIRECT	Show
IN	7646	Omeprazole	DIRECT	Show
IN	40790	pantoprazole	DIRECT	Show
IN	114979	rabeprazole	DIRECT	Show
IN	9386	Rimantadine	INDIRECT	Show

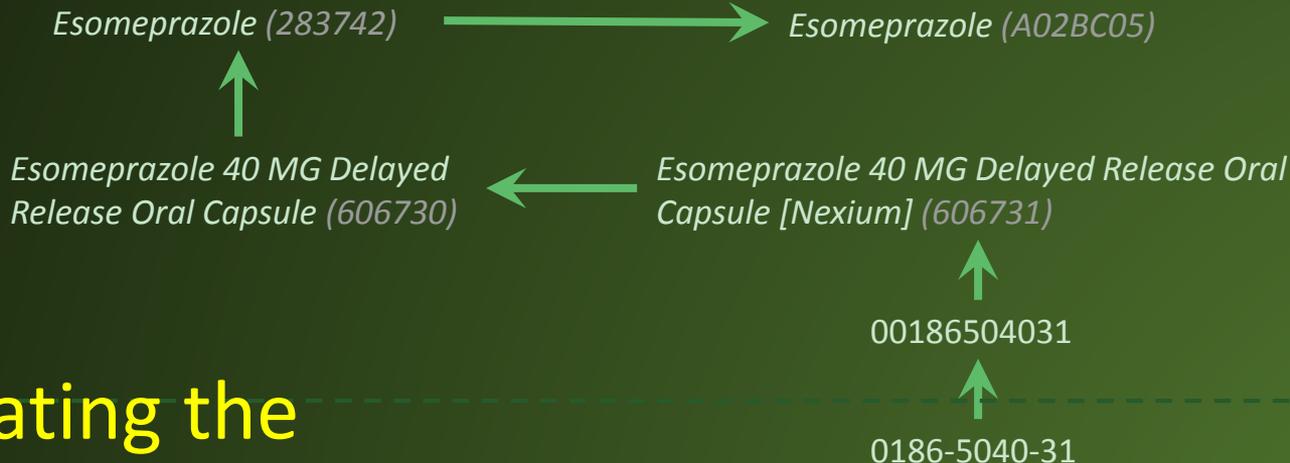
A ALIMENTARY TRACT AND METABOLISM

A02 DRUGS FOR ACID RELATED DISORDERS

A02B DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)

A02BC Proton pump inhibitors

ATC code	Name	DDD	U	Adm.R	Note
A02BC05	<u>esomeprazole</u>	30	mg	O	
		30	mg	P	



Automating the mapping from NDC to ATC using RxMix





WORKFLOW

No Workflow Defined

BUILD

Select Function

No function selected



LOAD

From workflow library

From my workflows

INPUT

Input:

Basic Instructions

1. BUILD workflow using Select Function, then Add to Workflow (or select a button in LOAD section to load a workflow)
2. Enter INPUT value for interactive mode (or input file name for batch mode)

Documentation

Introduction

RxMix is an interface for building applications that allows users to combine functions of the RxNorm, RxTerms, NDF-RT, RxClass, Interactions and RxImageAccess APIs. It allows users to run either interactively or in batch mode.

Sample RxMix configurations

Find drug interaction brands for Morphine (RXCU = 7052)

Find allergy drugs for Proton Pump Inhibitors (NUI = N0000000147)

APIs

- > RxNorm
- > NDF-RT
- > RxTerms
- > RxImageAccess
- > Interaction
- > RxClass
- > DailyMed
- > MedEx

References

TAG	DEFINITION
acqDate	The physical sample acquisition date
...	0=only return an RXCUI if it contains an RXNORM vocabulary term, 1=return

A **ALIMENTARY TRACT AND METABOLISM**

A02 **DRUGS FOR ACID RELATED DISORDERS**

A02B **DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)**

A02BC **Proton pump inhibitors**

ATC code	Name	DDD	U	Adm.R	Note
A02BC05	<u>esomeprazole</u>	30	mg	O	
		30	mg	P	

Esomeprazole (283742)

Esomeprazole (A02BC05)

Esomeprazole 40 MG Delayed
Release Oral Capsule (606730)

Esomeprazole 40 MG Delayed Release Oral
Capsule [Nexium] (606731)

rxnorm:findRxcuiById
("NDC", "0186-5040-31", 0)
→ 606731

00186504031

0186-5040-31



WORKFLOW

No Workflow Defined

BUILD

Select Function

findRxcuiById 

Optional Parameters

id_string: NDC

ansources tag:

0

Add to Workflow

LOAD

Add the selected function to workflow (Add)

From workflow library

From my workflows

INPUT

NDC:

Basic Instructions

1. BUILD workflow using Select Function, then Add to Workflow (or select a button in LOAD section to load a workflow)
2. Enter INPUT value for interactive mode (or input file name for batch mode)

Documentation

Introduction

RxMix is an interface for building applications that allows users to combine functions of the RxNorm, RxTerms, NDF-RT, RxClass, Interactions and RxImageAccess APIs. It allows users to run either interactively or in batch mode.

Sample RxMix configurations

[Find drug interaction brands for Morphine \(RXCUI = 7052\)](#)[Find allergy drugs for Proton Pump Inhibitors \(NUI =N000000147\)](#)

APIs

- > Norm
- > NDF-RT
- > RxTerms
- > RxImageAccess
- > Interaction
- > RxClass
- > DailyMed
- > MedEx

References

TAG	DEFINITION
acqDate	The physical sample acquisition date
...	0=only return an RXCUI if it contains an RXNORM vocabulary term. 1=return

WORKFLOW

RxNorm.findRxcuiById

BUILD

Select Function

No function selected



LOAD

From workflow library

From my workflows

Remove Last

Save

INPUT

NDC: 0186-5040-31

Basic Instructions

1. BUILD workflow using Select Function, then Add to Workflow (or select a button in LOAD section to load a workflow)
2. Enter INPUT value for interactive mode (or input file name for batch mode)

EXECUTE

Clear

Run Interactive

Documentation

Output

RXCUI

606731

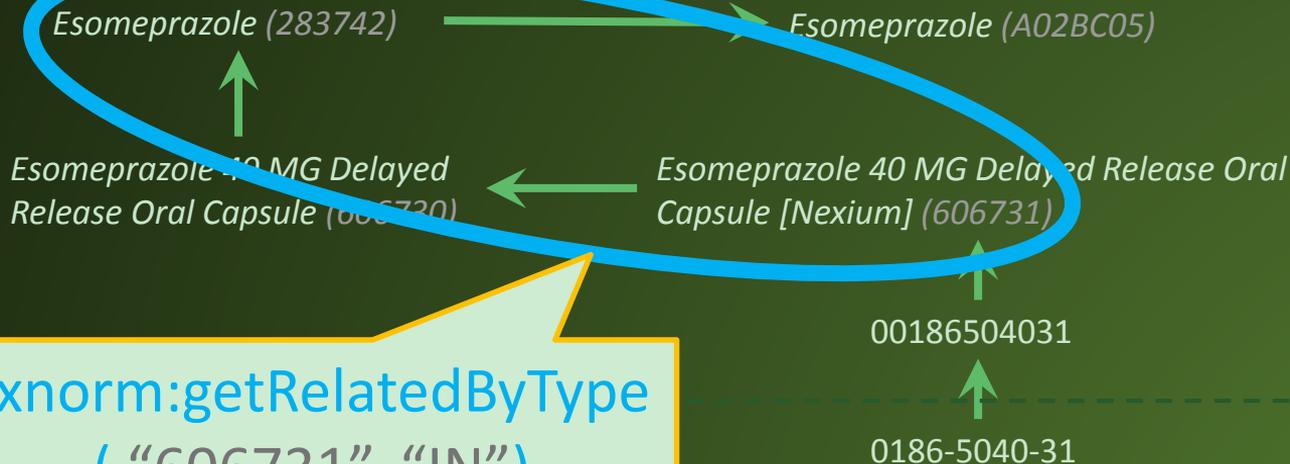
A ALIMENTARY TRACT AND METABOLISM

A02 DRUGS FOR ACID RELATED DISORDERS

A02B DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)

A02BC Proton pump inhibitors

ATC code	Name	DDD	U	Adm.R	Note
A02BC05	<u>esomeprazole</u>	30	mg	O	
		30	mg	P	



rxnorm:getRelatedByType
("606731", "IN")
→ 283742



WORKFLOW

RxNorm.findRxcuiById

BUILD

Select Function

getRelatedByType

Optional Parameters

term_type: 1 selected

Check all Uncheck all

- BN
- BPCK
- DF
- DFG
- GPCK

IN

Add to Workflow

LOAD

From workflow library

From my workflows

Remove Last

Save

INPUT

NDC: 0186-5040-31

Basic Instructions

1. BUILD workflow using Select Function, then Add to Workflow (or select a button in LOAD section to load a workflow)
2. Enter INPUT value for interactive mode (or input file name for batch mode)

EXECUTE

Clear

Run Interactive

Documentation

Output

RXCUI

606731

WORKFLOW

RxNorm:findRxcuiById

RXCUI

RxNorm:getRelatedByType

BUILD

Select Function

No function selected



LOAD

From workflow library

From my workflows

Remove Last

Save

INPUT

NDC: 0186-5040-31

Basic Instructions

1. BUILD workflow using Select Function, then Add to Workflow (or select a button in LOAD section to load a workflow)
2. Enter INPUT value for interactive mode (or input file name for batch mode)

Documentation

Output

IN

UMLSCUI	term_type	name	RXCUI
C0937846	IN	Esomeprazole	283742

A **ALIMENTARY TRACT AND METABOLISM**
 A02 **DRUGS FOR ACID RELATED DISORDERS**
 A02BC **DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)**
 A02BC **Proton pump inhibitors**

ATC code	Name	DDD	U	adm.R	Note
A02BC05	<u>esomeprazole</u>	30	mg	O	
		30	mg	P	

Esomeprazole (283742)

Esomeprazole (A02BC05)

Esomeprazole 40 MG Delayed Release Oral Capsule (606731)

Esomeprazole 40 MG Delayed Release Oral Capsule [Nexium] (606731)

00186504031

0186-5040-31

rxclass:getClassByRxNormDrugId
 ("283742", "ATC", "ALL")
 → A02BC, Proton pump inhibitors



WORKFLOW

RxNorm.findRxcuiById

RXCUI

RxNorm.getRelatedByType

BUILD

Select Function

No function selected

RxImageAccess

getPillImageInfo

Interaction

findDrugInteractions

RxClass

findClassByName

findSimilarClassesByDrugList

getClassByRxNormDrugId

getClassByRxNormDrugName

getClassSpellingSuggestions

LOAD

From workflow library

From my workflows

Remove Last

Save

INPUT

NDC: 0186-5040-31

Basic Instructions

1. BUILD workflow using Select Function, then Add to Workflow (or select a button in LOAD section to load a workflow)
2. Enter INPUT value for interactive mode (or input file name for batch mode)

Documentation

Output

IN

UMLSCUI	term_type	name	RXCUI
C0937846	IN	Esomeprazole	283742

WORKFLOW

RxNorm.findRxcuiById

RXCUI

RxNorm.getRelatedByType

BUILD

Select Function

getClassByRxNormDrugId

Optional Parameters

relaSource: **ATC**

re

- ALL
- ATC**
- DAILYMED
- FDASPL
- MESH
- NDFRT

Add to Workflow

LOAD

From workflow library

From my workflows

Remove Last

Save

INPUT

NDC: 0186-5040-31

Basic Instructions

1. BUILD workflow using Select Function, then Add to Workflow (or select a button in LOAD section to load a workflow)
2. Enter INPUT value for interactive mode (or input file name for batch mode)

Documentation

Output

IN

UMLSCUI	term_type	name	RXCUI
C0937846	IN	Esomeprazole	283742

EXECUTE

Clear

Run Interactive

WORKFLOW

RxNorm:findRxcuiById

RXCUI

RxNorm:getRelatedByType

RXCUI

RxClass:getClassByRxNormDrugId

Remove Last

Save

BUILD

Select Function

No function selected

LOAD

From workflow library

From my workflows

INPUT

NDC:

Basic Instructions

1. BUILD workflow using Select Function, then Add to Workflow (or select a button in LOAD section to load a workflow)
2. Enter INPUT value for interactive mode (or input file name for batch mode)

Documentation

Output

relaSource	term_type	drugName	RXCUI	rela	classId	name	classType
ATC	IN	Esomeprazole	283742	-	A02BC	Proton pump inhibitors	ATC1-4
ATC	MIN	Esomeprazole / Naproxen	994202	-	M01AE	Propionic acid derivatives	ATC1-4

A **ALIMENTARY TRACT AND METABOLISM**
 A02 **DRUGS FOR ACID RELATED DISORDERS**
 A02B **DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)**
 A02BC **Proton pump inhibitors**

ATC code	Name	DDD	U	Adm.R	Note
A02BC05	esomeprazole	30	mg	O	
		30	mg	P	

Esomeprazole (28374)

Esomeprazole (A02BC05)

Esomeprazole 40 MG
Release Oral Capsule

Esomeprazole 40 MG Delayed Release Oral
Capsule [Nexium] (606731)

00186504031

0186-5040-31

`rxclass:getClassGraph("A02BC")`

→ **A02B, DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD);**
A02, DRUGS FOR ACID RELATED DISORDERS;
A, ALIMENTARY TRACT AND METABOLISM



WORKFLOW

RxNorm:findRxcuiById

RXCUI

RxNorm:getRelatedByType

RXCUI

RxClass:getClassByRxNormDrugId

BUILD

Select Function

getClassGraph

Add to Workflow

LOAD

From workflow library

From my workflows

Remove Last

Save

INPUT

NDC: 0186-5040-31

Basic Instructions

1. BUILD workflow using Select Function, then Add to Workflow (or select a button in LOAD section to load a workflow)
2. Enter INPUT value for interactive mode (or input file name for batch mode)

Documentation

Output

relaSource	term_type	drugName	RXCUI	rela	classId	name	classType
ATC	IN	Esomeprazole	283742	-	A02BC	Proton pump inhibitors	ATC1-4
ATC	MIN	Esomeprazole / Naproxen	994202	-	M01AE	Propionic acid derivatives	ATC1-4

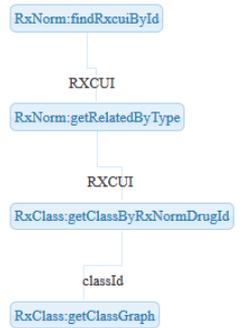
EXECUTE

Clear

Run Interactive



WORKFLOW



BUILD

Select Function

No function selected

LOAD

From workflow library

From my workflows

Remove Last

Save

INPUT

NDC:

Basic Instructions

1. BUILD workflow using Select Function, then Add to Workflow (or select a button in LOAD section to load a workflow)
2. Enter INPUT value for interactive mode (or input file name for batch mode)
3. Select OUTPUT fields and output format
4. EXECUTE by pressing Run/Submit button

Documentation

Output

Node(s)

dataType	classId	name	classType
node	A02B	DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)	ATC1-4
node	A02BC	Proton pump inhibitors	ATC1-4
node	A	ALIMENTARY TRACT AND METABOLISM	ATC1-4
node	0	Anatomical Therapeutic Chemical (ATC1-4)	ATC1-4
node	A02	DRUGS FOR ACID RELATED DISORDERS	ATC1-4
node	M01	ANTIINFLAMMATORY AND ANTIRHEUMATIC PRODUCTS	ATC1-4
node	0	Anatomical Therapeutic Chemical (ATC1-4)	ATC1-4
node	M01A	ANTIINFLAMMATORY AND ANTIRHEUMATIC PRODUCTS, NON-STEROIDS	ATC1-4
node	M01AE	Propionic acid derivatives	ATC1-4
node	M	MUSCULO-SKELETAL SYSTEM	ATC1-4

Edge(s)

dataType	classId1	rela	classId2
edge	A02BC	isa	A02B
edge	A02	isa	A
edge	A	isa	0
edge	A02B	isa	A02

Interactive

Batch

RxNorm – *Why Should Pharmacists Care?*

Part 4

Analyzing observational data with RxNorm



Source of observational data (drugs)

- Surescripts transactions
- Data from payers
 - Medicaid
 - Medicare Part D
- Commercial health analytics companies
 - Truven (120M patients)
 - PharMetrics Plus (100M patients)
 - Ambulatory EMR (35M patients)
 - Open Claims (250M patients)
- Networks of clinical data warehouses
 - PCORnet, OHDSI, Health Facts, ...
- Reagan-Udall Foundation for the FDA
 - IMEDS Research Lab (temporarily suspended)



Common use cases

- Pharmacology-epidemiology
 - Assess exposure to drugs (by ingredient or class)
 - Assess prescribed daily dose
 - Identify potentially inappropriate medications
 - Elderly (Beers)
 - Pregnant women (Briggs)
- Outcomes research
 - Comparative effectiveness
 - Pharmacovigilance and drug safety
- “Learning Health System”



Prescribed vs. defined daily dose

- Dataset
 - Surescripts feed
 - All prescriptions to ER patients
 - For 3 months in 2011 in a Bethesda hospital
- Reference for defined daily dose: ATC
- Methods
 - RxNorm clinical drug → RxNorm ingredient ↔ ATC ingredient → ATC defined daily dose ↔ prescribed daily dose
 - Restricted to systemic drugs (based on dose form)
- Findings
 - Confirmed feasibility
 - 25% of the prescriptions exactly match the ATC DDD
 - 50% of the prescriptions within 66-150% of the ATC DDD
 - 75% of the prescriptions within 50-200% of the ATC DDD

[Bodenreider, AMIA, 2014]



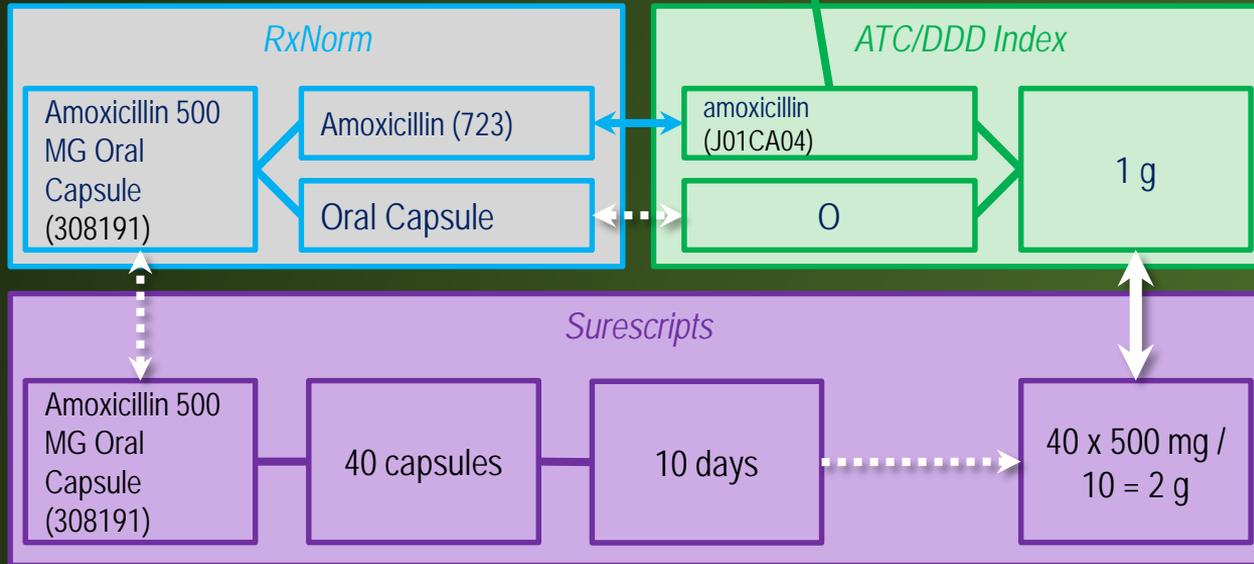
Methods Example

J ANTIINFECTIVES FOR SYSTEMIC USE

J01 ANTIBACTERIALS FOR SYSTEMIC USE

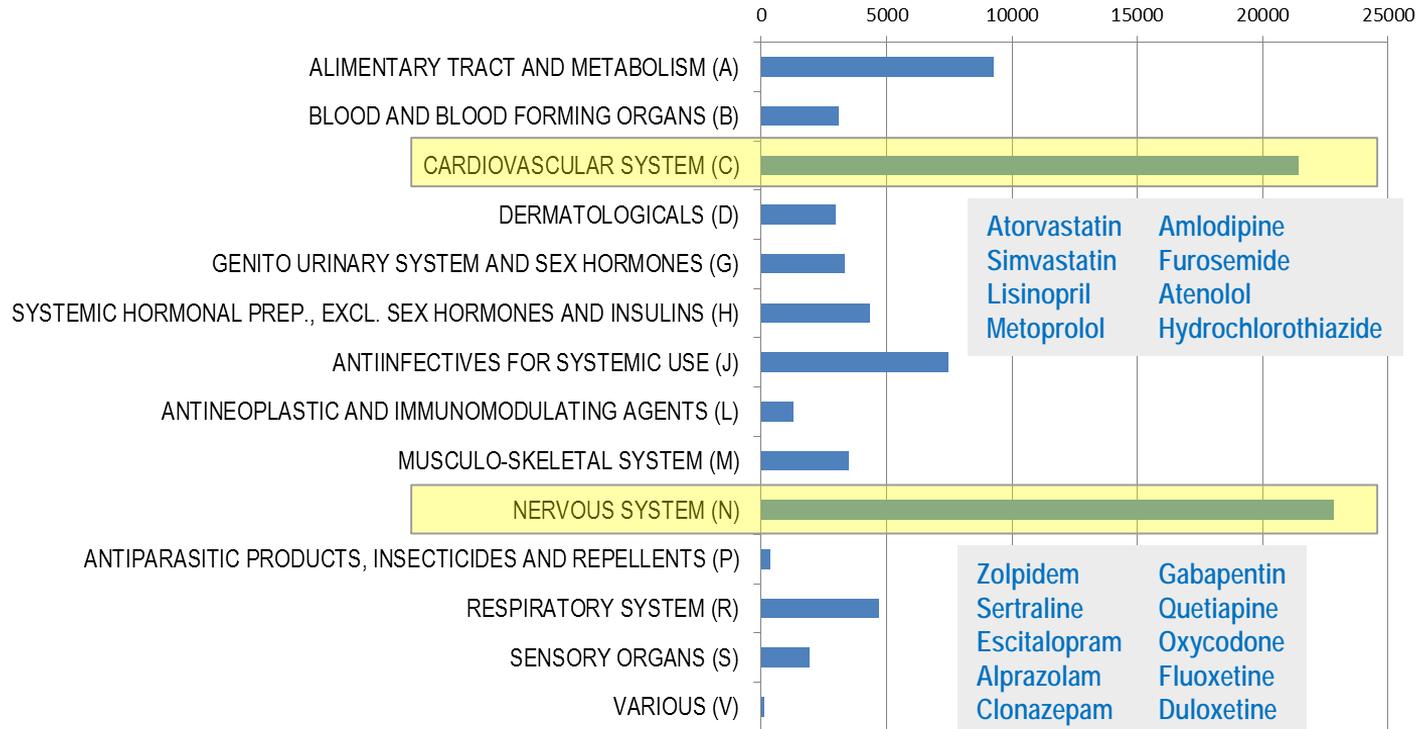
J01C BETA-LACTAM ANTIBACTERIALS, PENICILLINS

J01CA Penicillins with extended spectrum

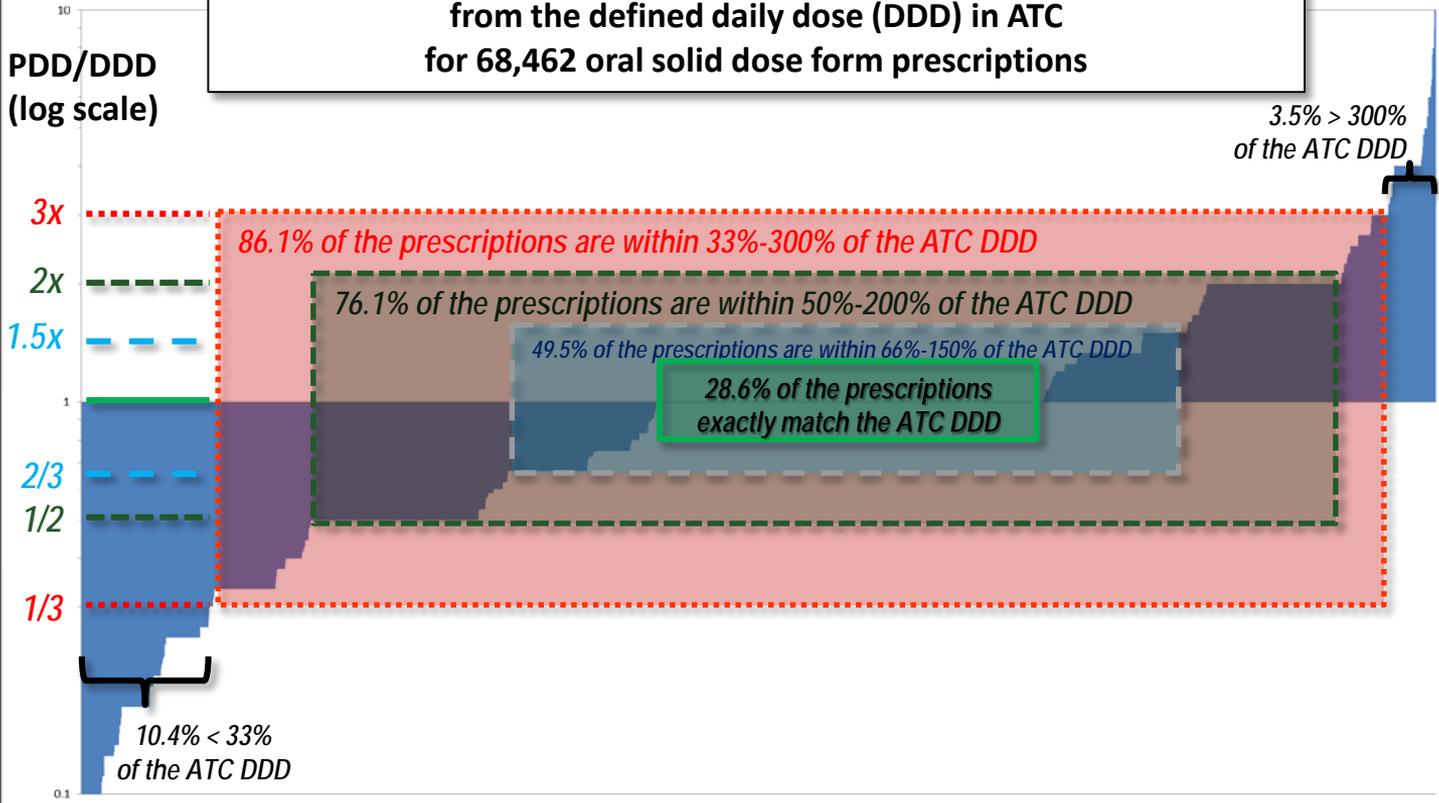


Results Prescription classification

Frequency of drugs by level-1 ATC group in the Surescripts prescription dataset N=86,578



**Deviation of the prescribed daily dose (PDD) in Surescripts
from the defined daily dose (DDD) in ATC
for 68,462 oral solid dose form prescriptions**



Issues

- No normalization of drugs in claims data
- NDCs contain clinically irrelevant details and need to be aggregated
- Many NDCs are obsolete and need to be mapped to current drugs for analysis
- Many drug classification systems link ingredients to classes, leading to ambiguous associations



Wrap-up



Key Takeaways

- **Use standards!**
 - Because it is a standard drug terminology (in the U.S.), RxNorm can help integrate, exchange and analyze prescription data
- **Try it ay home!**
 - RxNav and RxClass are useful tools for exploring RxNorm drugs and classes from several drug classification systems
 - RxMix helps automate mapping across drug entities for non-programmers
- **Participate in research activities!**
 - Pharmacists are increasingly involved in research, especially with observational data from claims and electronic health records



Self-Assessment Question 1

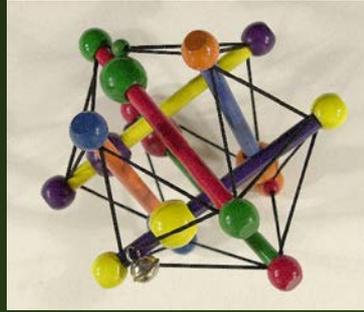
- Which type of information is in scope for RxNorm?
 - A. Drug names
 - B. Drug codes
 - C. Pricing information
 - D. Drug-drug interactions
 - E. Indications



Self-Assessment Question 2

- Which use cases are covered by RxNorm?
 - A. E-prescribing
 - B. Information exchange
 - C. Formulary development
 - D. Reference value sets
 - E. Analytics





Medical Ontology Research

Contact: olivier@nlm.nih.gov

Web: <https://mor.nlm.nih.gov>



Olivier Bodenreider

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



U.S. National Library of Medicine

