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AMIA 2017 – Washington, D.C.
S54 – System Demonstrations – Systems for Knowledge Representation
November 6, 2017

RxMix

Use of NLM drug APIs by non-programmers

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Lister Hill National Center for
Biomedical Communications

Disclosure

- 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.
- No relationships with commercial interest

Learning Objectives

- List the NLM drug APIs available through RxMix
- Explain how to create a complex workflow of API functions with RxMix
- Explain how to execute a batch query with RxMix
- List use cases that can be addressed with RxMix

Outline

- Motivation
- NLM drug APIs and applications
- APIs integrated in RxMix
- RxMix
  - Batch functionality
  - Function composition
- Use cases

MOTIVATION

Motivation

- RxNorm
  - Drug vocabulary developed at NLM
  - RxNav
    - Helps users navigate RxNorm drugs
      - E.g., map codes from the NDC registry to RxNorm
    - Does not support automation or composition
  - RxNorm application programming interface (API)
    - Helps programmers integrate RxNorm in their applications
    - Remains difficult to use by non-programmers

Use case 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	esomeprazole	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)

00186504031

0186-5040-31

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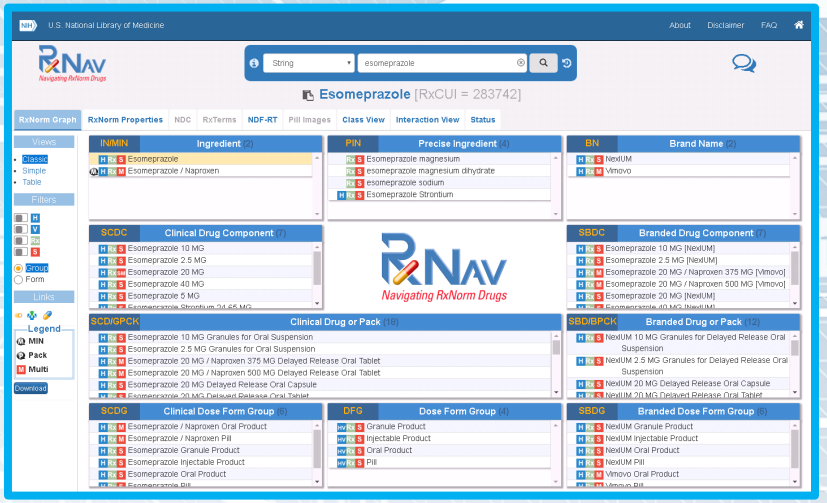
NLM DRUG APIS AND APPLICATIONS

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”
- Access to obsolete codes (“Status”)
- Leverages several of the drug APIs

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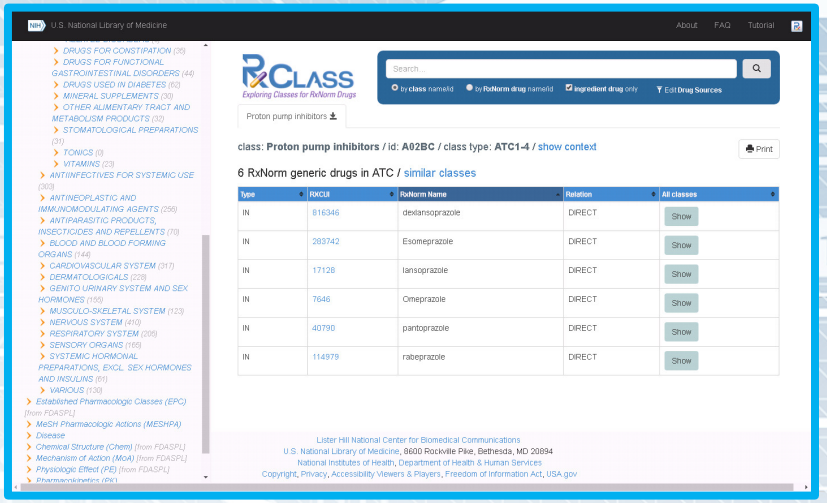
https://mor.nlm.nih.gov/RxNav/

RxClass



- Class-centric browser for RxNorm drugs
  - ATC
  - MeSH (Pharmacologic actions)
  - DailyMed (Mechanism of action, Physiologic effect, Chemical structure, FDA classes)
  - 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)
- Leverages several the RxClass APIs

https://mor.nlm.nih.gov/RxClass/

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
    - Archive of RxCUIs since 2005
  - Optimized graph traversal (pre-computed)
- For use in applications
  - Web services
  - SOAP, REST (XML, JSON)
  - Independent of any programming language

https://rxnav.nlm.nih.gov/APIsOverview.html

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 drug class (e.g., barbiturates)*
- Supports batch execution

https://mor.nlm.nih.gov/RxMix/

APIS INTEGRATED IN RXMIX

APIs integrated in RxMix

- RxNorm
  - Resolve drug codes and names to RxNorm (e.g., NDC to RxNorm)
  - Navigate across RxNorm drug entities (e.g., brand to generic)
- RxTerms
  - Physician-friendly names for e-prescription systems
- RxImageAccess
  - NLM collection of pill images
- Drug-drug interactions
  - DDIs from DrugBank and high-priority DDIs from ONC
- RxClass
  - Drug-class relations (mechanism of action; physiologic effect; chemical structure; FDA's EPCs; VA legacy classes)
- MedEx
  - NLP system for extracting drug information from clinical narratives
- DailyMed
  - Repository of Structured Product Labels

RXMIX - BATCH FUNCTIONALITY

Follow-along examples

- Using ***RxNav***:
  - Map NDC 0186-5040-31 (Nexium 40 mg delayed-released capsule) to RxNorm
    - NDC → RxNorm branded drug

No automation

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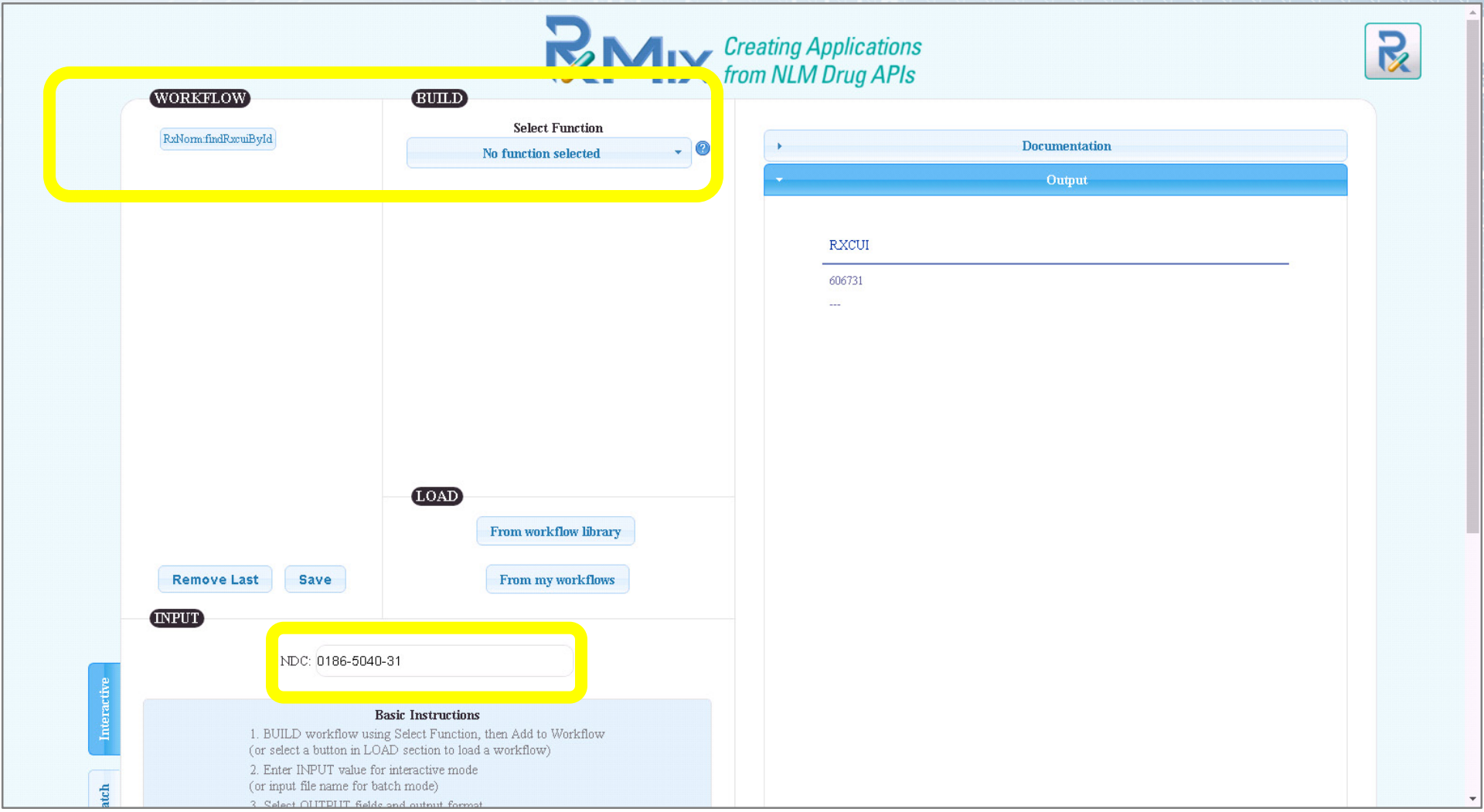
https://mor.nlm.nih.gov/RxNav/

Follow-along examples

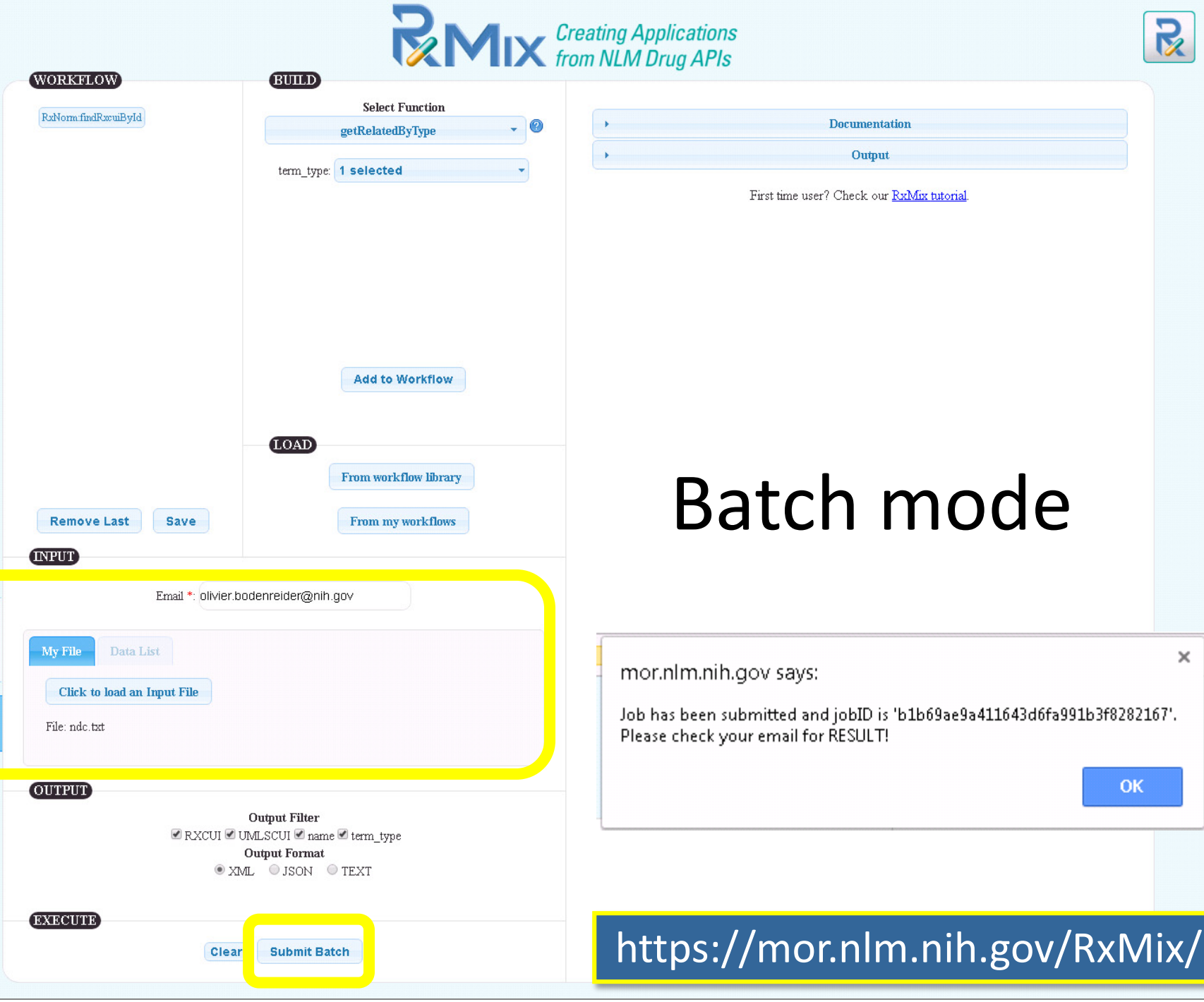
- Using ***RxMix (interactive mode)***:
  - Map NDC 0186-5040-31 to RxNorm
    - RxNorm:findRxcuiById(id_string=NDC; allSourcesFlag=0)
    - Returns: 606731 (NexIUM 40 MG Delayed Release Oral Capsule)
- Using ***RxMix (batch mode)***:
  - Map NDC 0186-5040-31 to RxNorm
    - RxNorm:findRxcuiById(id_string=NDC; allSourcesFlag=0)
    - Returns: 606731 (NexIUM 40 MG Delayed Release Oral Capsule)
  - Batch tab
    - Load input file (text file; one NDC per line)
  - Enter email address
  - Click “Submit batch”
  - Monitor email for results

0496-0741-65
13668-184-90
36987-1738-1
43353-656-60
51991-795-05

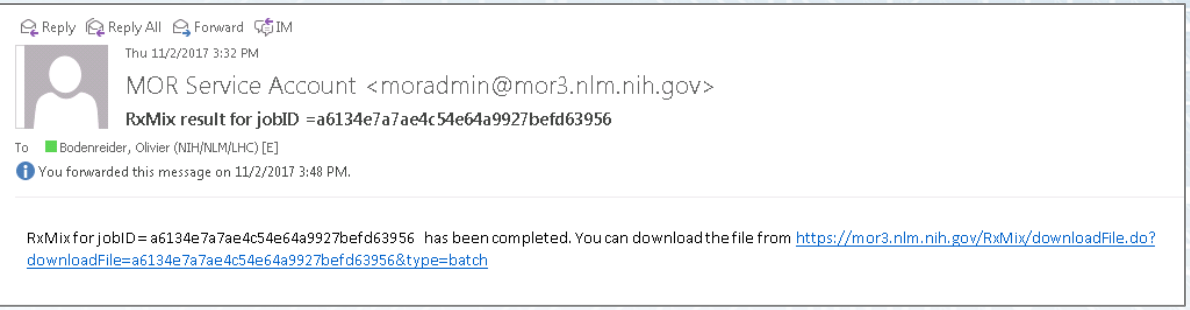
Interactive mode



https://mor.nlm.nih.gov/RxMix/


RxMix Creating Applications from NLM Drug APIs
WORKFLOW
RxNorm:findRxcuiById
BUILD
Select Function
getRelatedByType
term_type: 1 selected
Add to Workflow
LOAD
From workflow library
From my workflows
Remove Last
Save
Documentation
Output
First time user? Check our RxMix tutorial.
Batch mode
INPUT
Email *: olivier.bodenreider@nih.gov
Interactive
Batch
My File
Data List
Click to load an Input File
File: ndc.txt
mor.nlm.nih.gov says:
Job has been submitted and jobID is 'b1b69ae9a411643d6fa991b3f8282167'.
Please check your email for RESULT!
OK
OUTPUT
Output Filter
RXCUI UMLSCUI name term_type
Output Format
XML JSON TEXT
EXECUTE
Clear
Submit Batch
https://mor.nlm.nih.gov/RxMix/

Batch mode – Results


Reply Reply All Forward IM

Thu 11/2/2017 3:32 PM

MOR Service Account <moradmin@mor3.nlm.nih.gov>

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To Bodenreider, Olivier (NIH/NLM/LHC) [E]

You forwarded this message on 11/2/2017 3:48 PM.

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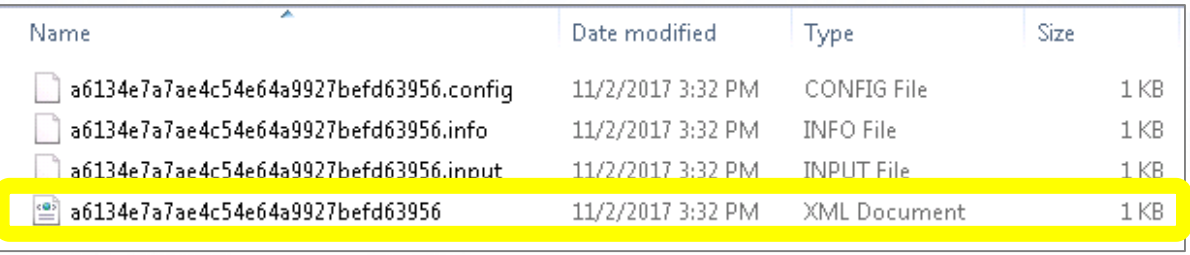

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a6134e7a7ae4c54e64a9927befd63956.info	11/2/2017 3:32 PM	INFO File	1 KB
a6134e7a7ae4c54e64a9927befd63956.input	11/2/2017 3:32 PM	INPUT File	1 KB
a6134e7a7ae4c54e64a9927befd63956	11/2/2017 3:32 PM	XML Document	1 KB

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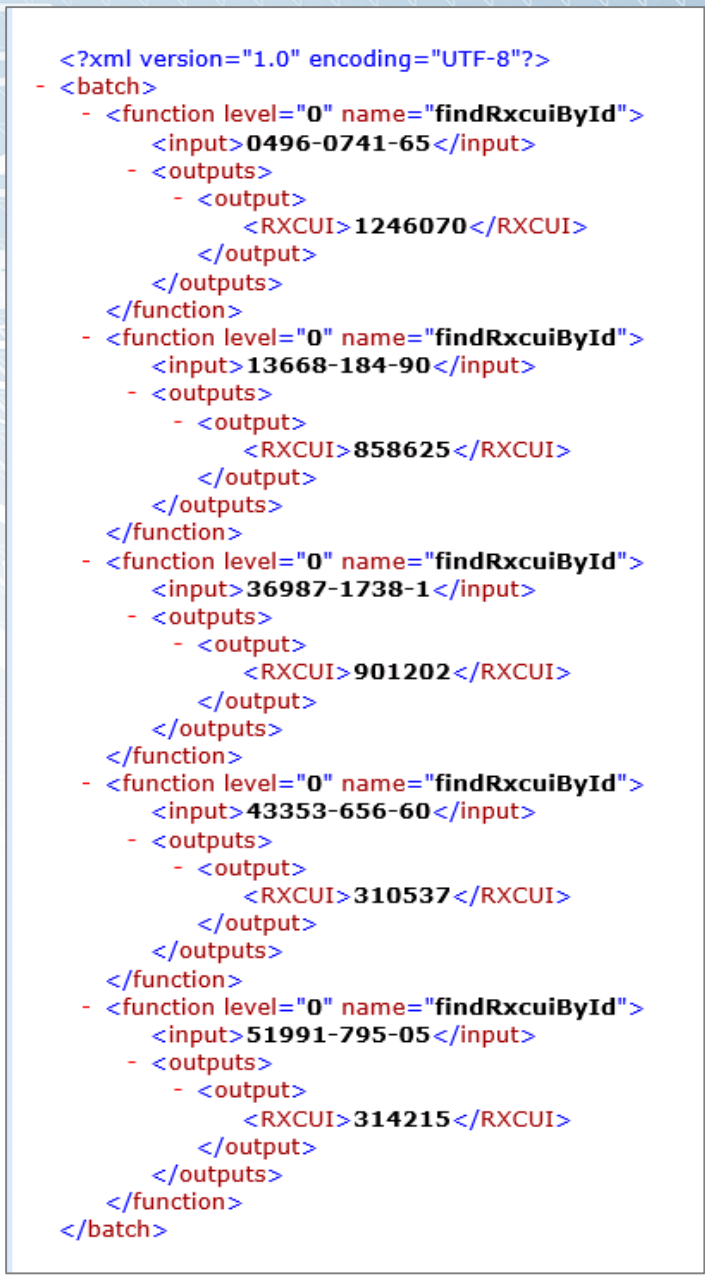

https://mor.nlm.nih.gov/RxMix/

Additional considerations

- Multiple functions available for mapping NDCs to RxNorm
  - RxNorm:findRxcuiById
    - Only current NDCs are mapped, not obsolete NDCs
  - RxNorm:getNDCStatus
    - Both current and obsolete NDCs are mapped
    - *Useful for analytics*

RXMIX - FUNCTION COMPOSITION

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)

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A02BC **Proton pump inhibitors**

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Esomeprazole (283742) → *Esomeprazole (A02BC05)*

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↑

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https://mor.nlm.nih.gov/RxNav/

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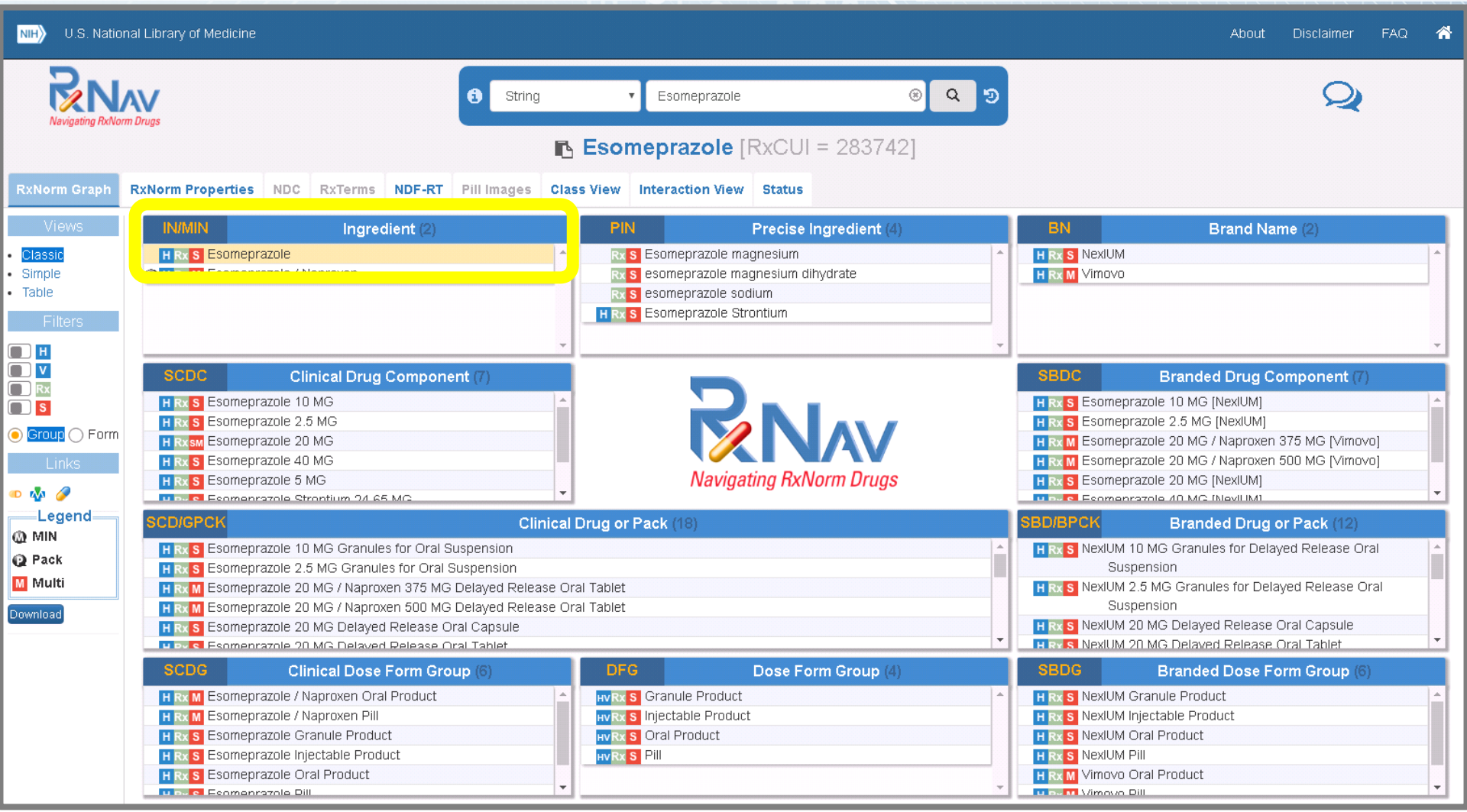

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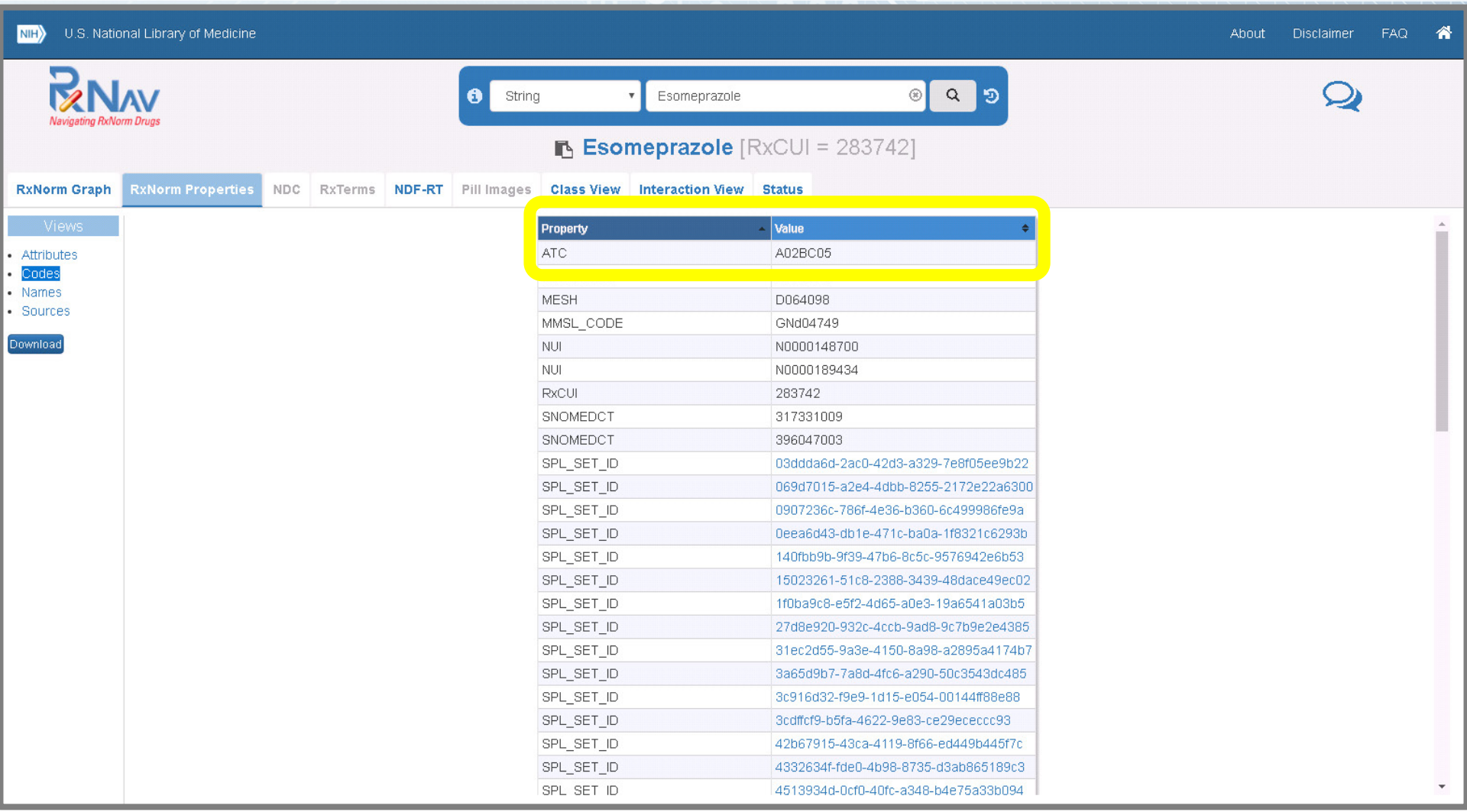

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		30	mg	P	

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↑

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↑

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↑

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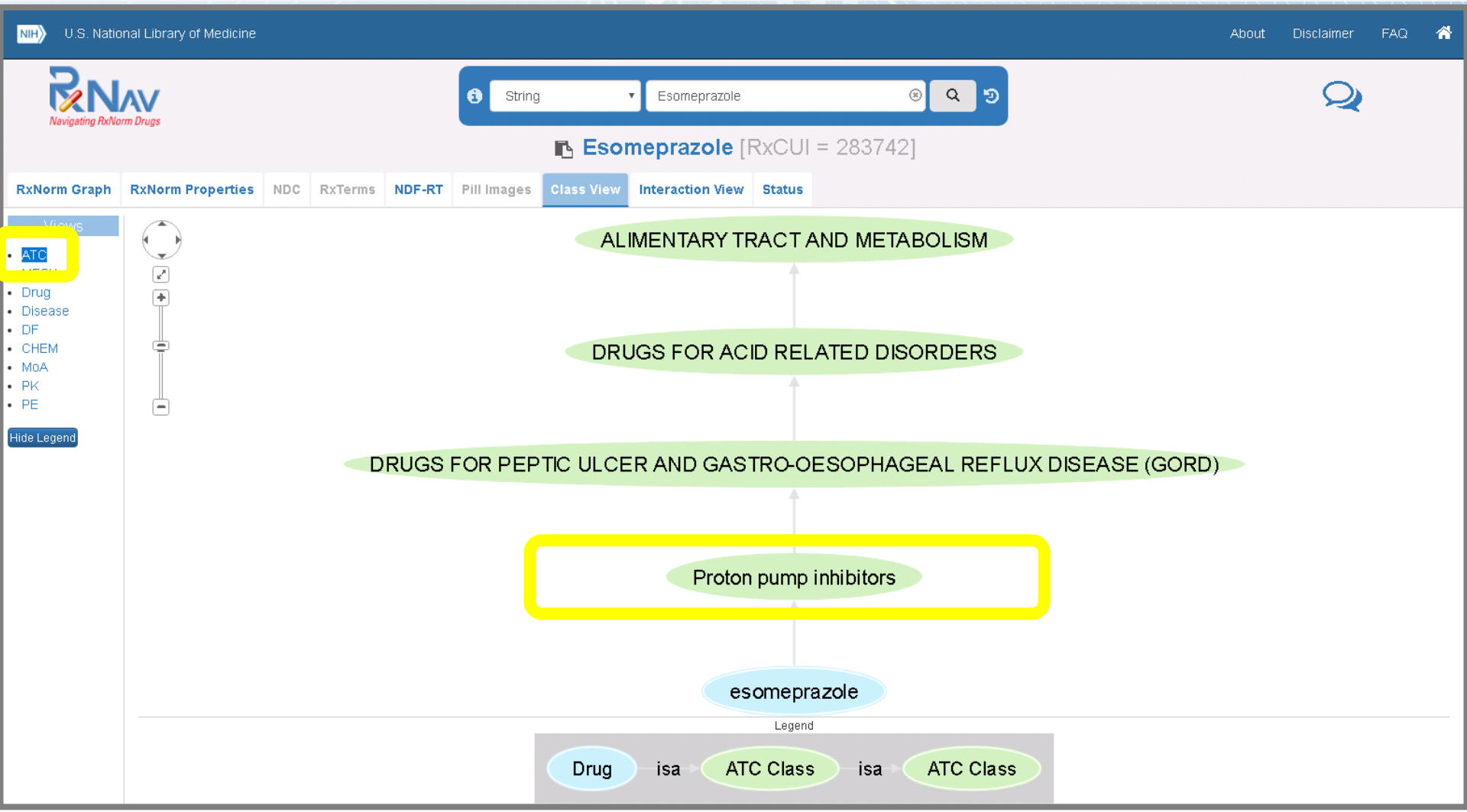

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https://mor.nlm.nih.gov/RxNav/

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A02B DRUGS FOR PEPTIC ULCER AND GASTRO-OESOPHAGEAL REFLUX DISEASE (GORD)
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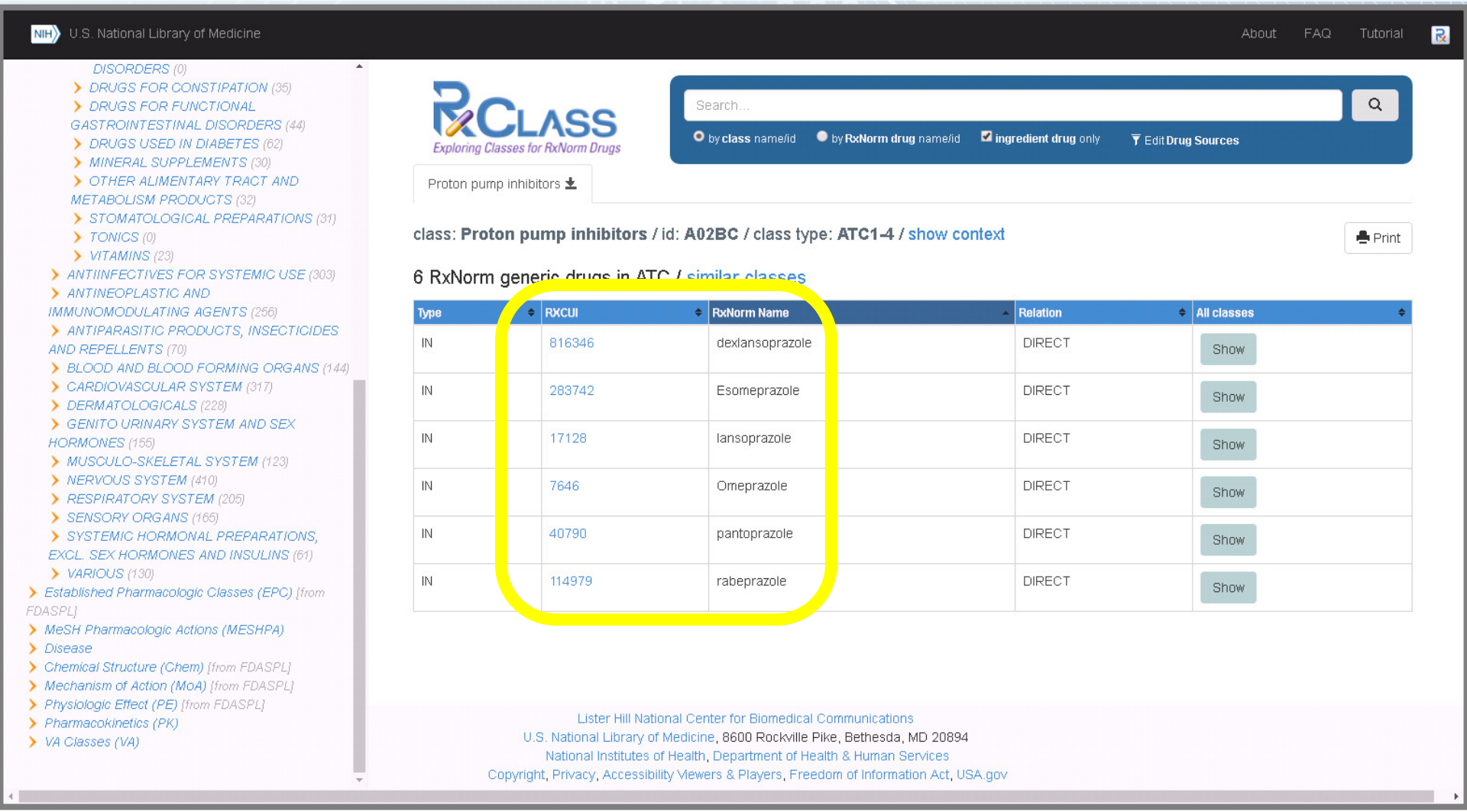
ATC code	Name	DDD	U	Adm.R	Note
A02BC01	omeprazole	20	mg	O	
		20	mg	P	
A02BC02	pantoprazole	40	mg	O	
		40	mg	P	
A02BC03	lansoprazole	30	mg	O	
A02BC04	rabeprazole	20	mg	O	
A02BC05	esomeprazole	30	mg	P	
		30	mg	O	
A02BC06	dexlansoprazole	30	mg	O	
A02BC07	dexrabeprazole*				
A02BC53	lansoprazole, combinations				
A02BC54	rabeprazole, combinations				

List of abbreviations

Last updated: 2016-12-19

dexrabeprazole not on the U.S. market

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



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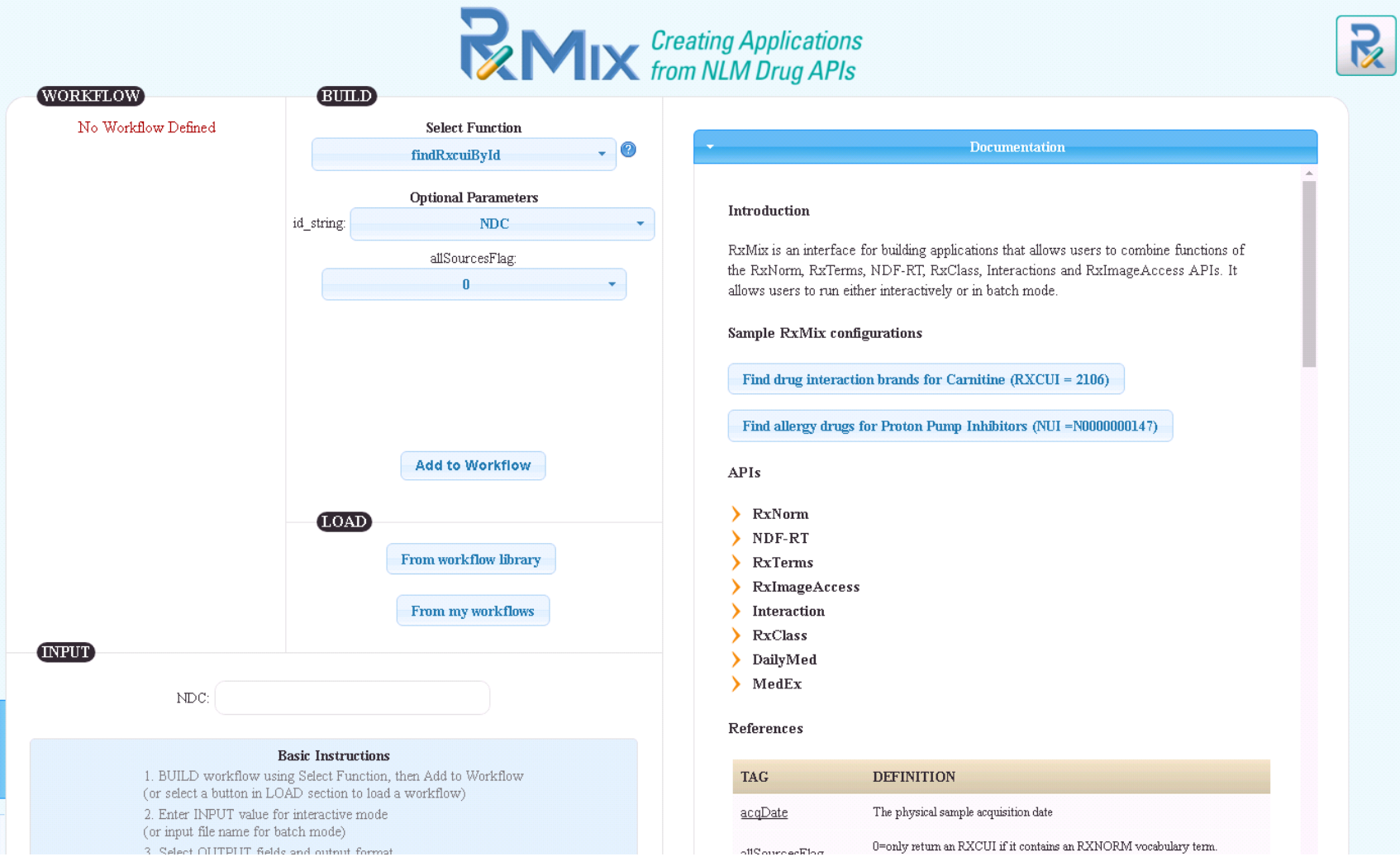
https://mor.nlm.nih.gov/RxClass/

Follow-along examples

- Using ***RxMix***:
  - Map NDC 0186-5040-31 to RxNorm
    - RxNorm:findRxcuiById(id_string=NDC; allSourcesFlag=0)
    - Returns: 606731 (NexIUM 40 MG Delayed Release Oral Capsule)
  - Find ingredient for RxNorm 606731
    - RxNorm:getRelatedByType(term_type=IN)
    - Returns: 283742 (Esomeprazole)
  - Find ATC class for RxNorm 283742
    - RxClass:getClassByRxNormDrugId(relaSource=ATC)
    - Returns: A02BC (Proton pump inhibitors)

Step 1 – Map NDC 0186-5040-31 to RxNorm



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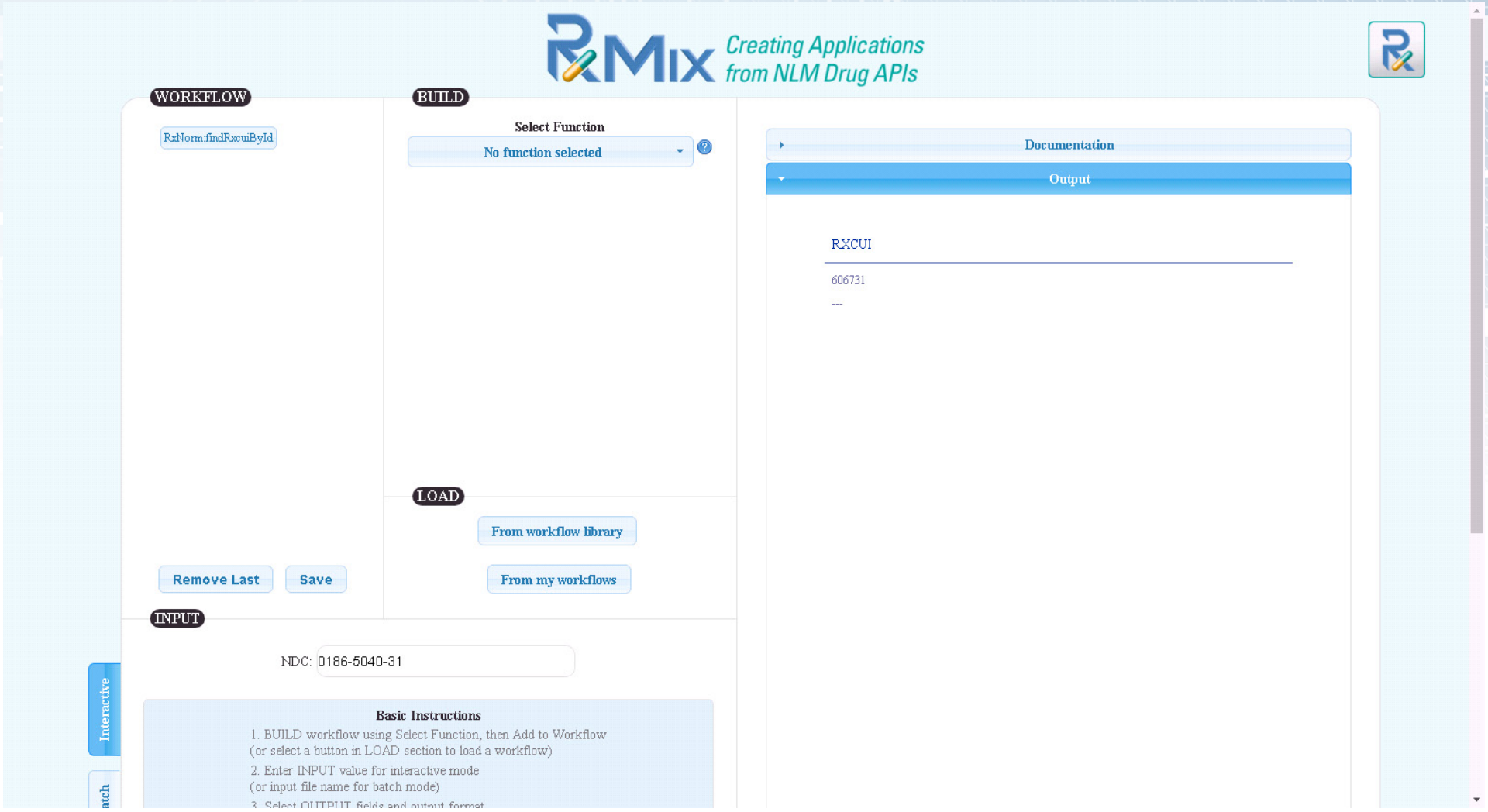
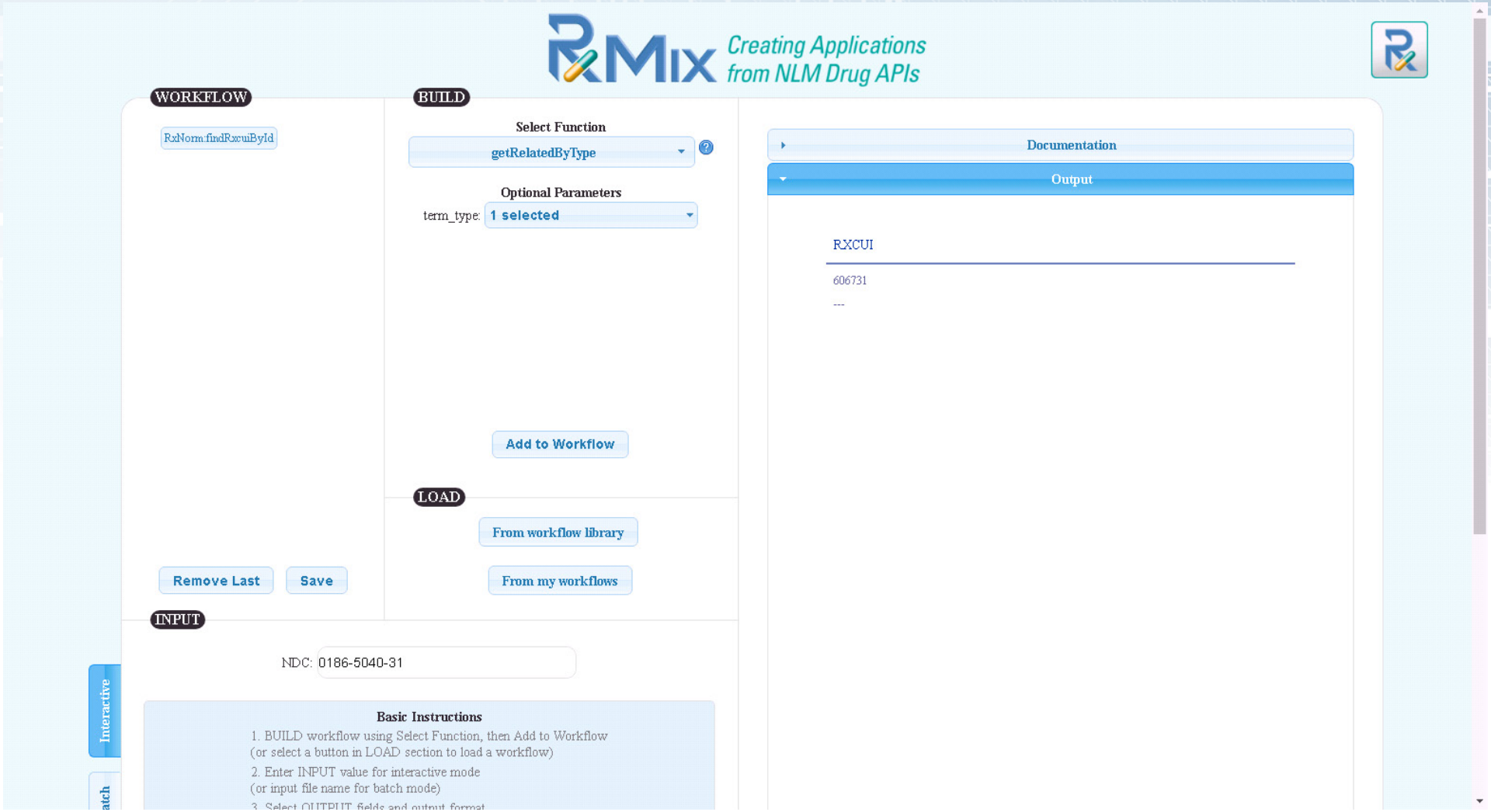
Step 1 – Map NDC 0186-5040-31 to RxNorm



https://mor.nlm.nih.gov/RxMix/

Step 2 – Find ingredient for RxNorm 606731 (from previous step)



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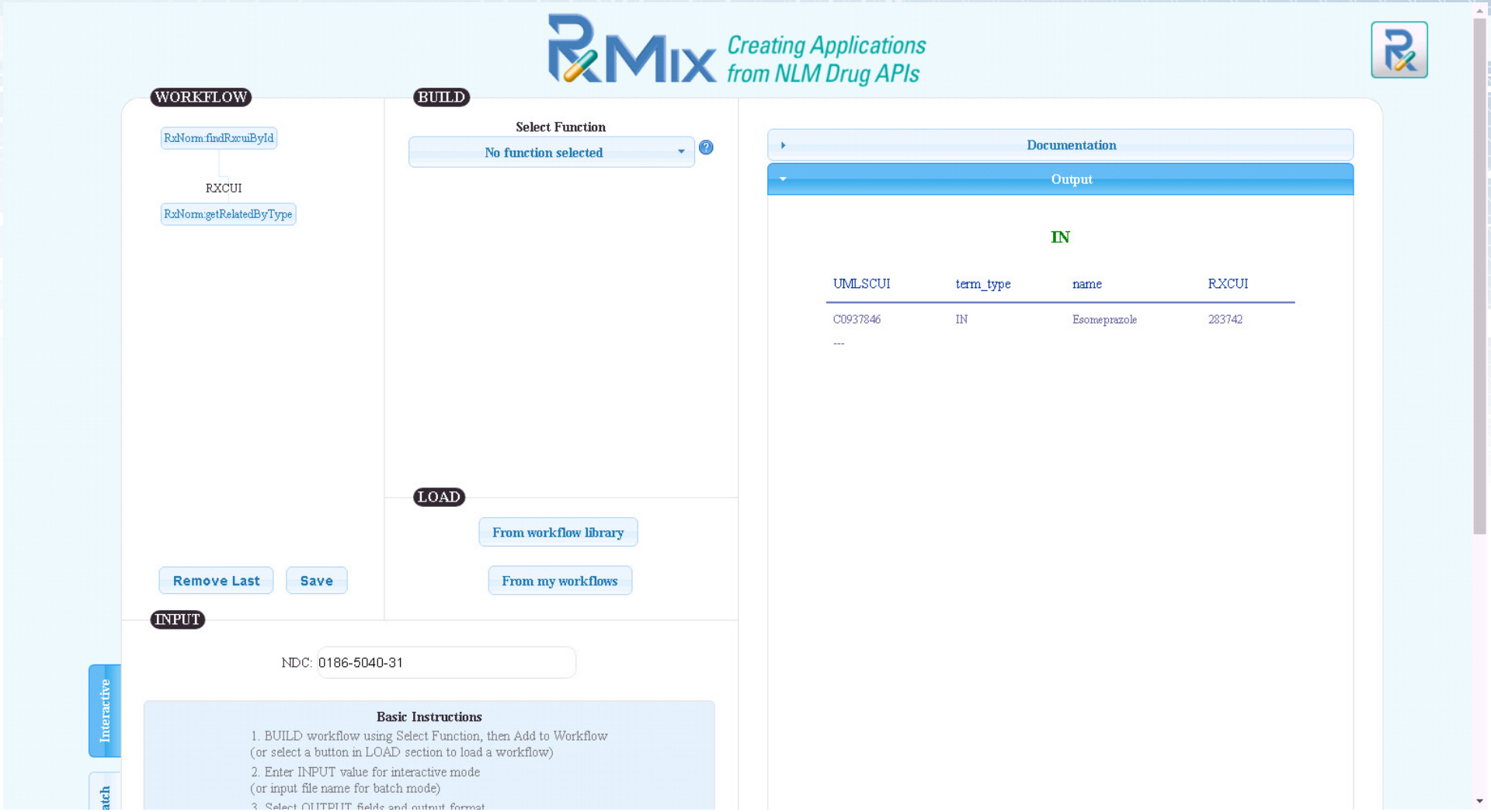
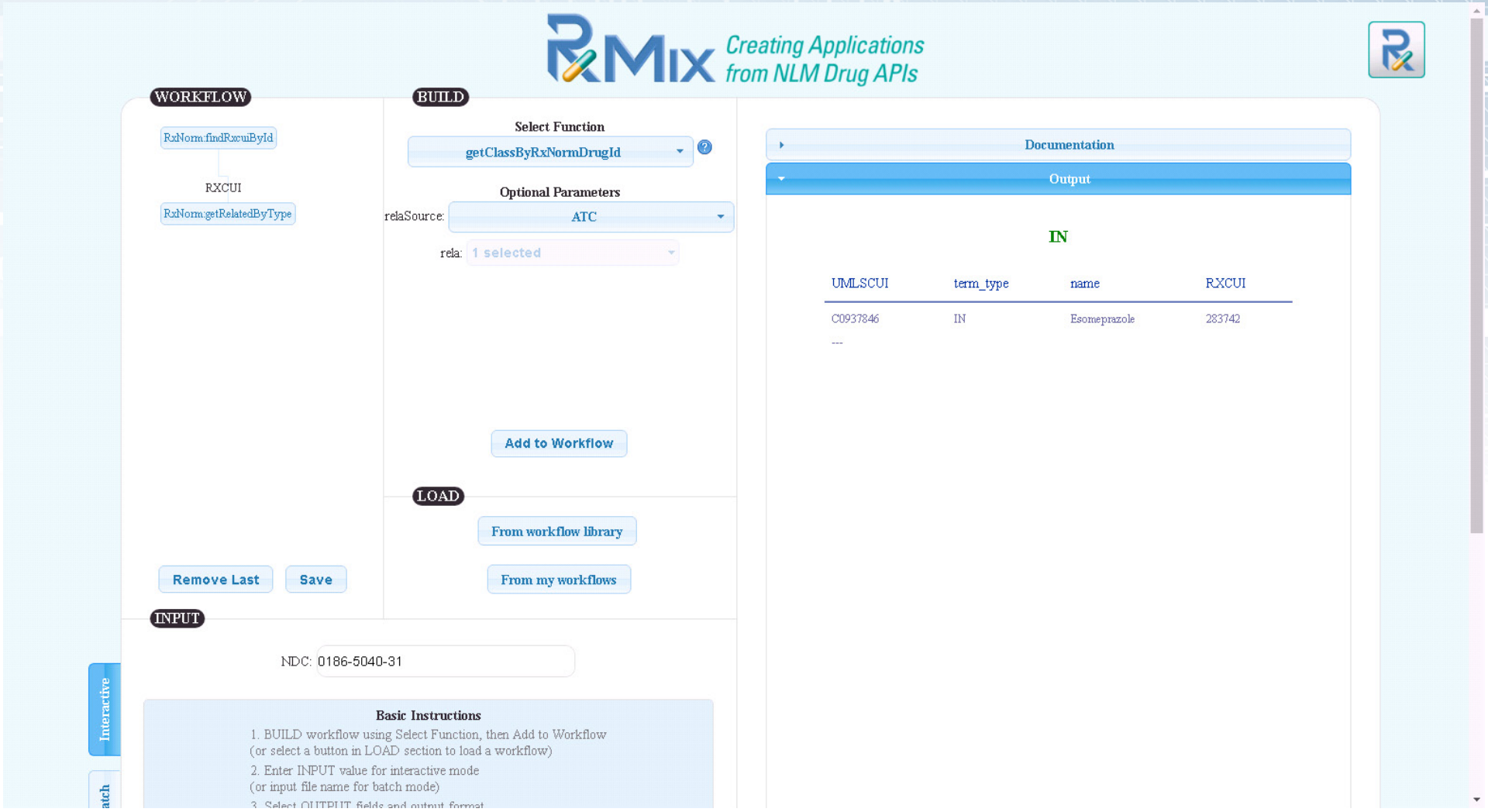
Step 2 – Find ingredient for RxNorm 606731 (from previous step)



https://mor.nlm.nih.gov/RxMix/

Step 3 – Find ATC class for RxNorm 283742 (from previous step)



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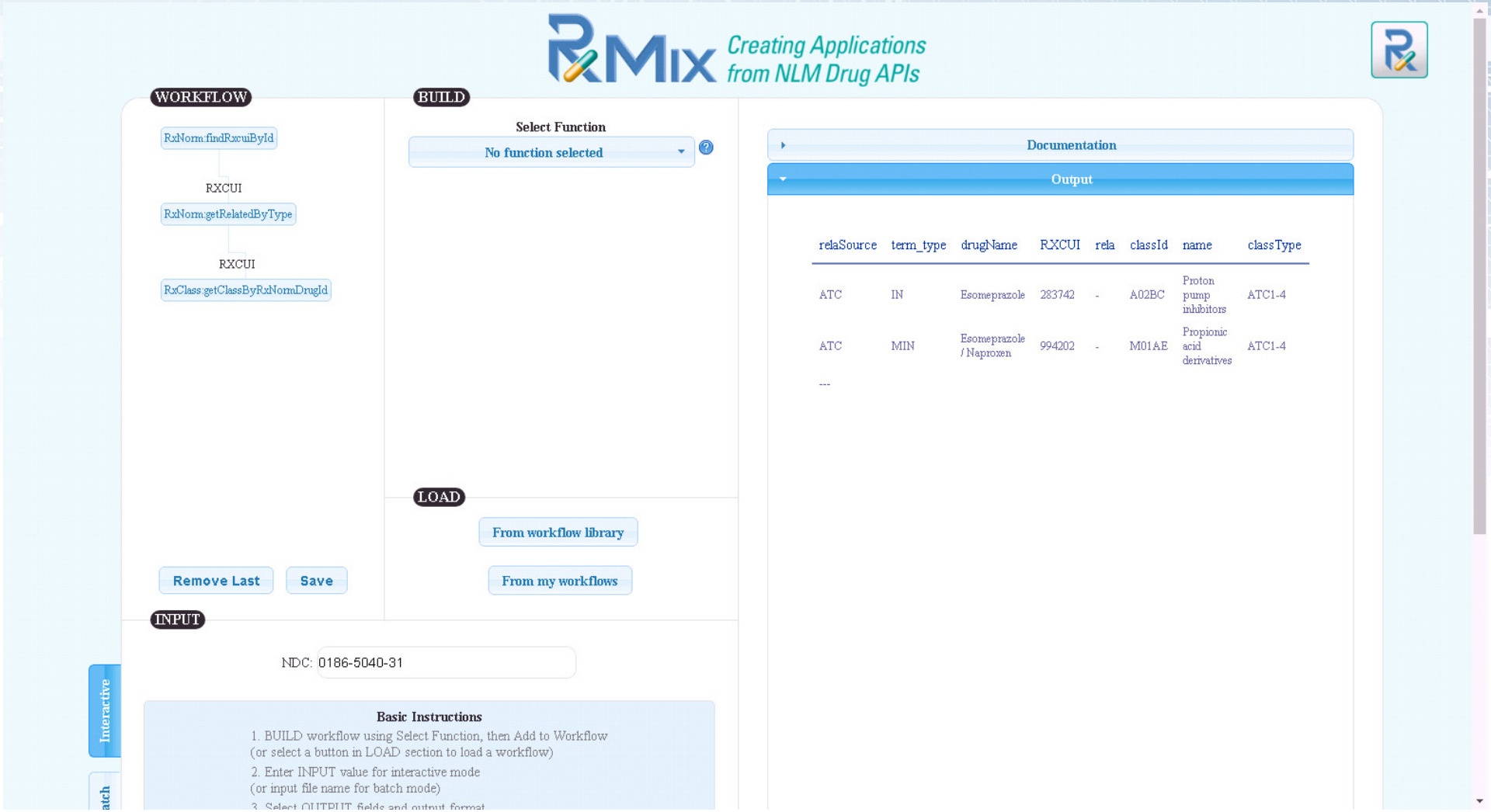
Step 3 – Find ATC class for RxNorm 283742 (from previous step)



https://mor.nlm.nih.gov/RxMix/

USE CASES

Common use cases

- Map drug identifiers to RxNorm
  - NDC → RxNorm; RxNorm → NDC
- Map branded drugs to generic drugs
  - Lipitor → Atorvastatin
- Map branded drugs or generic drugs to their active ingredients
  - Vimovo 375/20 Delayed Release Oral Tablet → Esomeprazole + Naproxen
- Map drugs to drug classes
  - NexIUM 40 MG Delayed Release Oral Capsule → **Proton pump inhibitors**

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