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# The RxNorm Time Machine

## *Issues in using RxNorm for analytics*

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# Disclaimer

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# Analytics use cases

- Example
  - Evolution of the prescription of opioid drugs over time
- Implementation
  - Claims databases (e.g., Medicare VRDC, Truven)
    - NDC ↔ RxCUI [↔ drug class]
  - Clinical data warehouses
    - [Compendia ID ↔] RxCUI [↔ drug class]
- Requires to make sense of obsolete codes
  - Obsolete NDCs mapped to current drugs
  - Identity criteria for obsolete RxCUIs (ingredient + strength + dose form)

# NDCs and RxCUIs turnover rate

- NDC
  - High
  - Changes in
    - Manufacturer
    - Packaging
- RxCUI
  - Low
  - Changes in normal forms (ingredient / strength / dose form [+ QnF, QlD])
  - *Terminology updates (code changes due to editorial policies)*

# E-prescribing vs. analytics

- E-prescribing
  - Restrict to currently marketed drugs
  - Restrict to drugs marketed in a given region

- Analytics
  - All drugs ever marketed
  - All drugs marketed in all regions

RxNorm

RxNorm APIs

- *Terminology updates (code changes due to editorial policies)*

# RxNorm dataset (Full monthly)

- Limited support for analytics
- Obsolete RxNorm concepts and relations still present in the RxNorm dataset
  - Concepts marked obsolete
    - SUPPRESS=Y and SUPPRESS=O
  - Non-prescribable entities (unquantified forms)
    - SUPPRESS=E
- Obsolete NDCs are removed from the set of NDCs curated by RxNorm (SAB=RXNORM)
- No cumulative history metadata
  - With start and end data for each RxCUI and NDC
- Retired RxCUI data (File = RXNCUI.RRF)
  - Used as the basis for remapping RxCUIs

# RxNav

- Biased towards e-prescribing
  - Until very recently
- Only active RxNorm concepts and NDCs can be retrieved
  - Support for remapped concepts
- Only active concepts can be linked to other concepts

RxNav

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

NIH U.S. National Library of Medicine

About Disclaimer FAQ

mor.nlm.nih.gov says:

RXCUI = 351772 is obsolete and has been remapped to RXCUI = 1668240

OK Cancel

RxNav Navigating RxNorm Drugs

RXC

# Welcome to RxNav

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

Views

- Classic
- Simple
- Table

Filters

H
V
Rx
S

Group
Form

Links

Legend

MIN
Pack
Multi

Download

| IN/MIN | Ingredient | PIN | Precise Ingredient | BN | Brand Name |
|---|---|---|---|---|---|
| | | | | | |

| SCDC | Clinical Drug Component | SBDC | Branded Drug Component |
|---|---|---|---|
| | | | |

RxNav Navigating RxNorm Drugs

| SCD/GPCK | Clinical Drug or Pack | SBD/BPCK | Branded Drug or Pack |
|---|---|---|---|
| | | | |

| SCDG | Clinical Dose Form Group | DFG | Dose Form Group | SBDG | Branded Dose Form Group |
|---|---|---|---|---|---|
| | | | | | |

# RxNorm API support for analytics

- NDC
  - *getNDCStatus*(**NDC**, startDate, endDate, latest_only)
    - Indicate if an NDC is Active, Obsolete, Alien, or Unknown
      - Optionally restricted to a given time interval
    - RxNorm versions when the NDC was active
    - Original RxCUI(s) the NDC was associated with
      - All RxCUIs vs. latest RxCUI
  - *getAllHistoricalNDCs*(**RxCUI**, active_only)
    - Return all NDCs ever associated with a given RxCUI
      - Optionally restricted to active NDCs
    - RxNorm versions when the NDC was active

- *getNDCStatus*(00364666854)


```
{
    "ndcStatus": {
        "status": "Obsolete",
        "comment": "RxCUI (312656) is still active",
        "ndcHistory": [{
            "activeRxcui": "312656",
            "originalRxcui": "312656",
            "startDate": "200706",
            "endDate": "201101"
        }]
    }
}
```


312656
Promazine 50 MG/ML
Injectable Solution

- *getNDCStatus*(00143314501)


```
{
    "ndcStatus": {
        "status": "Active",
        "comment": "",
        "ndcHistory": [{
            "activeRxcui": "1116191",
            "originalRxcui": "1116191",
            "startDate": "201108",
            "endDate": "201709"
        },
        {
            "activeRxcui": "1116191",
            "originalRxcui": "198918",
            "startDate": "200706",
            "endDate": "201107"
        }]
    }
}
```


1116191
ePHEDrine sulfate 25 MG
Oral Capsule

*RXCUI = 198918 is obsolete and has been remapped to RXCUI = 1116191*

## ◆ *getAllHistoricalNDCs*(1668240)


```
{
    "historicalNdcConcept": {
        "historicalNdcTime": [{
            "status": "indirect",
            "rxcui": "351772",
            "ndcTime": [
            { "ndc": ["00069040001" ], "startDate": "201401", "endDate": "201510"},
            { "ndc": ["00069040010" ], "startDate": "201401", "endDate": "201510"},
            { "ndc": ["00069315014" ], "startDate": "200706", "endDate": "201510"},
            { "ndc": ["00069315083" ], "startDate": "200706", "endDate": "201510"},
            { "ndc": ["00069315084" ], "startDate": "201304", "endDate": "201510"},
            { "ndc": ["54569468100" ], "startDate": "200706", "endDate": "201101"},
            { "ndc": ["54868452700" ], "startDate": "200810", "endDate": "201510"},
            { "ndc": ["55154271505" ], "startDate": "200706", "endDate": "201206"},
            { "ndc": ["61947315000" ], "startDate": "200708", "endDate": "201206"},
            { "ndc": ["61947315001" ], "startDate": "200706", "endDate": "201206"},
            { "ndc": ["61947315003" ], "startDate": "200706", "endDate": "201206"}]
        },
        {
            "status": "direct",
            "rxcui": "1668240",
            "ndcTime": [
            { "ndc": ["00069040001" ], "startDate": "201511", "endDate": "201709"},
            { "ndc": ["00069040010" ], "startDate": "201511", "endDate": "201709"},
            { "ndc": ["00069315014" ], "startDate": "201511", "endDate": "201709"},
            { "ndc": ["00069315083" ], "startDate": "201511", "endDate": "201709"},
            { "ndc": ["00069315084" ], "startDate": "201511", "endDate": "201709"},
            { "ndc": ["54868452700" ], "startDate": "201511", "endDate": "201709"}]
        }]
    }
}
```


*RXCUI = 351772 is obsolete and has been remapped to RXCUI = 1668240*

1668240
Zithromax 500 MG Injection

# RxNorm API support for analytics

- RxCUI
  - *getRxcuiStatus*(**RxCUI**)
    - Indicate if an RxCUI is Active, Alien, Quantified, Remapped, Retired, or Unknown
    - Last RxNorm versions when active (for Remapped RxCUIs)
    - RxCUI, name and type of the current active RxNorm concept
  - *RxcuiHistory**(**RxCUI**)
    - Indicate if an RxCUI is Active, Retired, Never Active, Non-RxNorm, Unknown
    - Return the canonical representation of any RxNorm concept
      - Identity: ingredient, strength, dose form (+ QnF, QlD)
      - Metadata: source, start and end date

- *getRxcuiStatus*(198918)


```
{
    "rxcuiStatus": {
        "status": "Remapped",
        "remappedDate": "110705F",
        "minConceptGroup": {
            "minConcept": [{
                "rxcui": "1116191",
                "name": "Ephedrine sulfate 25 MG Oral Capsule",
                "tty": "SCD"
            }]
        }
    }
}
```


*RXCUI = 198918 is obsolete and has been remapped to RXCUI = 1116191*

- *getRxcuiStatus*(1805014)

*RxCUI = 1805014 has been quantified and is remapped to multiple concepts*


```
{
    "rxcuiStatus": {
        "status": "Quantified",
        "remappedDate": "",
        "minConceptGroup": {
            "minConcept": [{
                "rxcui": "1805012",
                "name": "2 ML bendamustine hydrochloride 90 MG/ML Injection [Treanda]",
                "tty": "SBD"
            },
            {
                "rxcui": "1805016",
                "name": "0.5 ML bendamustine hydrochloride 90 MG/ML Injection [Treanda]",
                "tty": "SBD"
            }]
        }
    }
}
```

# New RxNav support for obsolete concepts

- New Status tab in RxNav
  - Displays the canonical representation and metadata of all active and inactive RxNorm concepts
  - Powered by the *RxcuiHistory* API

RxNav
Navigating RxNorm Drugs

RXCUI 1805014

# Zithromax 500 MG Injection [RxCUI = 1668240]



## Active Concept

### Properties

| Title | Value |
|---|---|
| RxCUI | 1668240 |
| Concept Name | Azithromycin 500 MG Injection [Zithromax] |
| Pack Alias | |
| Term Type | SBD |
| Dose Form | Injection |
| Dose Form RxCUI | 1649574 |
| Multiple Ingredient | No |
| Branded | Yes |
| Quantity Factor | |
| Quality Distinction | |
| SCD | Azithromycin 500 MG Injection |

### Ingredients

Active Ingredient(AI) & Active Moiety(AM), as well as non-normalized numerator and denominator values, will be available in the future.

| Base | AI | AM | BoSS | Numerator Value | Numerator Units | Denominator Value | Denominator Units |
|---|---|---|---|---|---|---|---|
| Azithromycin | | | Azithromycin | 500 | MG | | |

### Metadata

| Title | Value |
|---|---|
| Status | Active |
| Source | RXNORM |
| Start Date | 11-2015 |
| End Date | |
| Is Current | True |

RxNav
Navigating RxNorm Drugs

RXCUI 857094

# Acetaminophen 325 MG / Hydrocodone Bitartrate 5 MG Oral Tablet [Procet 5/325] [RxCUI = 857094]



## Retired Concept

### Properties

| Title | Value |
|---|---|
| RxCUI | 857094 |
| Concept Name | Acetaminophen 325 MG / Hydrocodone Bitartrate 5 MG Oral Tablet [Procet 5/325] |
| Pack Alias | |
| Term Type | SBD |
| Dose Form | Oral Tablet |
| Dose Form RxCUI | 317541 |
| Multiple Ingredient | Yes |
| Branded | Yes |
| Quantity Factor | |
| Quality Distinction | |
| SCD | Acetaminophen 325 MG / Hydrocodone Bitartrate 5 MG Oral Tablet |

### Ingredients

Active Ingredient(AI) & Active Moiety(AM), as well as non-normalized numerator and denominator values, will be available in the future.

| Base | AI | AM | BoSS | Numerator Value | Numerator Units | Denominator Value | Denominator Units |
|---|---|---|---|---|---|---|---|
| Hydrocodone | | | Hydrocodone Bitartrate | 5 | MG | | |
| Acetaminophen | | | Acetaminophen | 325 | MG | | |

### Metadata

| Title | Value |
|---|---|
| Status | Retired |
| Source | RXNORM |
| Start Date | 08-2009 |
| End Date | 02-2013 |
| Is Current | False |

RxNav
Navigating RxNorm Drugs

RXCUI 1023000

# Hyperlipemia [RxCUI = 1023000]



## Non-RxNorm Concept

### Properties

| Title | Value |
|---|---|
| RxCUI | 1023000 |
| Concept Name | Hyperlipemia |
| SCD | |

### Metadata

| Title | Value |
|---|---|
| Status | Non-RxNorm |
| Source | NDFRT |
| Start Date | 11-2010 |
| End Date | 09-2017 |
| Is Current | False |

# Summary

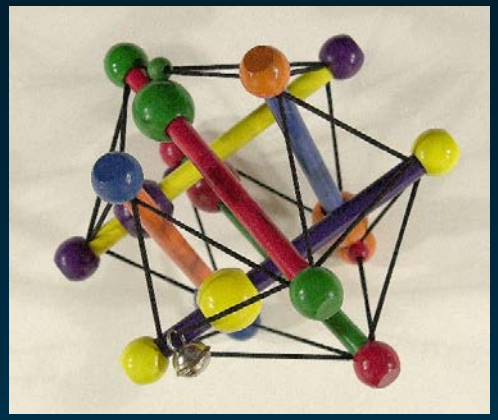
- The update model of the RxNorm dataset is biased towards e-prescribing, and does not fully support analytics
  - Obsolete NDCs are removed from the set of NDCs curated by RxNorm
  - Obsolete RxCUIs and relations persist
    - No metadata for obsolete RxCUIs

# Summary

- Support for analytics ("Time Machine") built through the RxNorm API
  - NDC
    - NDC → RxCUI(s) + metadata
      - For each NDC ever curated by RxNorm
    - RxCUI → all NDCs ever associated with this RxCUI
      - Including through remapping of RxCUIs
  - RxCUI
    - RxCUI → status (including remapping)
    - RxCUI → definitional properties and metadata (for all active and obsolete RxNorm concepts)
- Displayed in RxNav (new Status tab)
- Canonical representation of RxNorm drugs
  - Can also support a similarity function for drugs

# Acknowledgments


- RxNav team (development)
  - Lee Peters
  - Richard Rice
- External collaborators (use cases)
  - *getRxcuiStatus*
    - Indian Health Service
    - Value Set Authority Center
  - *getNDCStatus*
    - Boston Children's Hospital/Harvard Medical School (Dr. Ken Mandl)
  - *getAllHistoricalNDCs*, *RxcuiHistory*
    - Greater Plains Collaborative PCORnet (Dr. Jim Campbell)



# Medical Ontology Research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