

# Drive-Thru Data: Using NLM APIs to Access Information Fast

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National Library of Medicine

National Institutes of Health

U.S. Department of Health & Human Services



U.S. National Library of Medicine

# After this session, you should be able to...

- Explain...
  - what an API is,
  - how APIs can help you interact with systems, and
  - why users might choose to use APIs.
- Describe the basic mechanics of using an API
- Identify...
  - some of NLM's APIs, and
  - when a specific NLM API would be useful.



# The World of NLM

## Literature

- PubMed
- PMC
- Bookshelf

## Consumer Health

- MedlinePlus

## Terminology

- MeSH
- RxNorm
- UMLS



## Molecular Biology

- Nucleotide
- Protein
- SRA

## Drugs and Chemicals

- DailyMed
- PubChem

## Other

- ClinicalTrials.gov

And many more...

# Poll: Which categories of NLM products do you use?

- Literature
- Consumer Health
- Terminology
- Molecular Biology
- Drugs and Chemicals
- Other



# Example: Health info for patients in EHRs




Language English Region of care Maryland / Virginia / Washington, D.C. My Account

Health Summary Medical Record Message Center Appointments Pharmacy Coverage & Costs Health & Wellness

COVID-19 updates: Latest updates about the vaccine, booster shots, testing, how to protect yourself and get care.

Hello, Jane Smith

Your Health Summary – Conditions

Issue		Date
Acquired Cystic Kidney Disease		5/02/2022
Acute Sinusitis		09/10/2020
Influenza		04/19/2019

Appointments Medications Test Results Messages Insurance



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Home → Health Topics → Kidney Cysts

## Kidney Cysts

On this page

Basics <ul style="list-style-type: none"><li>Summary</li><li>Start Here</li><li>Diagnosis and Tests</li></ul>	Learn More <ul style="list-style-type: none"><li>Specifics</li><li>Genetics</li></ul>	See, Play and Learn <ul style="list-style-type: none"><li>Videos and Tutorials</li></ul>
Research <ul style="list-style-type: none"><li>Statistics and Research</li><li>Clinical Trials</li><li>Journal Articles</li></ul>	Resources <ul style="list-style-type: none"><li>Reference Desk</li><li>Find an Expert</li></ul>	For You <ul style="list-style-type: none"><li>Children</li><li>Patient Handouts</li></ul>

**Summary**

A cyst is a fluid-filled sac. You may get simple kidney cysts as you age; they are usually harmless. There are also some diseases which cause kidney cysts. One type is polycystic kidney disease (PKD). It runs in families. In PKD, many cysts grow in the kidneys. This can enlarge the kidneys and make them work poorly. About half of people with the most common type of PKD end up with kidney failure. PKD also causes cysts in other parts of the body, such as the liver.

Often, there are no symptoms at first. Later, symptoms include

- Pain in the back and lower sides
- Headaches
- Blood in the urine

Doctors diagnose PKD with imaging tests and family history. There is no cure. Treatments can help with symptoms and complications. They include medicines and lifestyle changes, and if there is kidney failure, dialysis or kidney transplants.

Acquired cystic kidney disease (ACKD) happens in people who have chronic kidney disease, especially

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**MEDICAL ENCYCLOPEDIA**

- Abdominal CT scan
- Abdominal MRI
- Medullary cystic kidney disease
- Polycystic kidney disease

# Example: Finding clinical trials for cancer patients

The screenshot shows the BioPortal Clinical Trial Search interface. At the top, the BioPortal logo and navigation links are visible. The patient profile is displayed as 'Testpatient, Mary Jane, Female, 60 years old, Breast Carcinoma, LIVING (12 months), Recurred/Progressed (4 months)'. Below this, there are tabs for 'Summary', 'Pathways', 'Clinical Data', 'MTB', and 'ClinicalTrialsGov'. A search bar is present with the text 'Search clinical trials'. The search results are displayed in a table with the following columns: Status, Matching Criteria, Study Title, Conditions, Interventions, Eligibility Criteria, and Locations. Three results are shown, each with a 'show' button and a 'show more' button.

Status	Matching Criteria	Study Title	Conditions	Interventions	Eligibility Criteria	Locations
Recruiting	Age is matching Gender is matching Condition is matching Found keywords: BRAF	AN OPEN-LABEL, MULTICENTER, RANDOMIZED PHASE 3 STUDY OF FIRST-LINE ENCORAFENIB PLUS CETUXIMAB WITH OR WITHOUT CHEMOTHERAPY VERSUS STANDARD OF CARE THERAPY WITH A SAFETY LEAD-IN OF ENCORAFENIB AND CETUXIMAB PLUS CHEMOTHERAPY IN PARTICIPANTS WITH METASTATIC BRAF V600E-MUTANT COLORECTAL CANCER	Neoplasms	Encorafenib Cetuximab Oxaliplatin Irinotecan Leucovorin <a href="#">show more</a>	<a href="#">show</a>	Phoenix   Mayo Clinic - Phoenix Oncology Pharmacy   Arizona Phoenix   Mayo Clinic Hospital   Arizona Scottsdale   Mayo Clinic in Arizona - Scottsdale   Arizona Beverly Hills   Tower Hematology Oncology Medical Group (THO)   California Los Angeles   Keck Hospital of USC   California <a href="#">show more</a>
Recruiting	Age is matching Gender is matching Condition is matching Found keywords: BRAF	An Open-label Phase 1 Study to Evaluate Drug-Drug Interactions of Agents Co-Administered With Encorafenib and Binimetinib in Patients With BRAF V600-mutant Unresectable or Metastatic Melanoma or Other Advanced Solid Tumors	Advanced Solid Tumors Metastatic Melanoma	losartan dextromethorphan caffeine omeprazole midazolam <a href="#">show more</a>	<a href="#">show</a>	Orange   UC Irvine Health   California Aurora   University of Colorado Hospital - Anschutz Cancer Pavilion (ACP)   Colorado Chicago   University of Illinois at Chicago   Illinois Saint Paul   Regions Cancer Care Center   Minnesota Saint Paul   HealthPartners Specialty Center-Eye Care   Minnesota <a href="#">show more</a>
Recruiting	Age is matching Gender is matching Condition is matching	Detection and Metabolic Characterization in DOPA PET/CT of ne Treated Brain Metastases of Lung	Brain Metastases MRI	F-DOPA PET/CT	<a href="#">show</a>	Angers   CHU Angers   Angers   Institut de Cancerologie de l'Ouest

# Example: Author nationality trends in PubMed

The screenshot shows a PubMed article page for "Bioanalytical strategies in drug discovery and development". The authors listed are Aarzo Thakur, Zhiyuan Tan, Tsubasa Kameyama, Eman El-Khateeb, Shakti Nagpal, Stephanie Malone, Rohitash Jamwal, Chukwunonso K Nwabufo, and their affiliations are listed with highlighted nationalities: Singapore, Singapore, China, USA, UK, Egypt, Singapore, USA, USA, and Canada.

**NIH National Library of Medicine**  
National Center for Biotechnology Information

**PubMed.gov** Search

Advanced User Guide

Search results Save Email Send to Display options

Review > Drug Metab Rev. 2021 Aug;53(3):434-458. doi: 10.1080/03602532.2021.1959606.  
Epub 2021 Aug 23.

### Bioanalytical strategies in drug discovery and development

Aarzo Thakur<sup>1,2</sup>, Zhiyuan Tan<sup>3</sup>, Tsubasa Kameyama<sup>4</sup>, Eman El-Khateeb<sup>5,6</sup>, Shakti Nagpal<sup>7</sup>, Stephanie Malone<sup>8</sup>, Rohitash Jamwal<sup>9</sup>, Chukwunonso K Nwabufo<sup>10</sup>

Affiliations: collapse

#### Affiliations

- 1 Innovations in Food and Chemical Safety, Agency for Science, Technology, and Research, Singapore, **Singapore**
- 2 Skin Research Institute of Singapore, Agency for Science, Technology, and Research, Singapore, **Singapore**
- 3 Department of Early Clinical Development, dMed-Clinipace, Shanghai, **China**
- 4 Department of Bioengineering and Therapeutic Sciences, Schools of Pharmacy and Medicine, University of California San Francisco, San Francisco, CA, **USA**
- 5 Centre for Applied Pharmacokinetic Research, University of Manchester, Manchester, **UK**
- 6 Clinical Pharmacy Department, Faculty of Pharmacy, Tanta University, Tanta, **Egypt**
- 7 Department of Pharmacy, Faculty of Science, National University of Singapore, Singapore, **Singapore**
- 8 Theravance Biopharma US, Inc., South San Francisco, CA, **USA**
- 9 College of Pharmacy, University of Rhode Island, Kingston, RI, **USA**
- 10 Gilead Alberta ULC, Edmonton, **Canada**

PREV RESULT 19 of 108 NEXT RESULT 21 of 108

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PAGE NAVIGATION Title & authors Abstract Similar articles Cited by Publication types MeSH terms



# Example: Author nationality trends in PubMed

The image displays two overlapping screenshots of the PubMed.gov website, illustrating author nationality trends. The top screenshot shows the search results for the article "Nickel in soil and water: Sources, biogeochemistry, and remediation using biochar". The authors listed are Ali El-Naggar, Nevool Ahmed, Alarod Mosa, Nabool Khan, Nihil, Bidal, Yousof, Anket Sharma, Binoy Sarkar, Yanjiang Cai, and Scott X Chang. The bottom screenshot shows the search results for the article "Universal health coverage and intersectoral action for health: key messages from Disease Control Priorities, 3rd edition". The authors listed include Dean J Jamison, Ala Awan, Charles N Mock, Rachel Nugent, David Watkins, Olugbo Adeyi, Shachi Anand, Rikat Altun, Stefano Bertozzi, Zulfiqar Bhutta, Ayman Binagwaho, Robert Black, Mark Blechen, Barry R Bloom, Elizabeth Brumway, Daniel A F Bruck, Dan Chhabra, Alvaro Cueva, Mark Cutler, Kousha Eshaghi, Niladri Das Saha, Haile T Debas, Peter Donorf, Tarun Das, Kenneth A Fleming, Mark Gillman, Patricia J Garcia, Atul Gawande, Thomas Gasiano, Helen Gelband, Roger Glasziou, Amanda Glasziou, Gienshi Gray, Demissa Halize, Sang K Hwang, Susan Horton, Guy Hutton, Prabhat Jha, Felicia M Knaul, Olive Kobusingye, Eric L Kokauer, Margaret E Krusk, Peter Lachmann, Ramanan Laminarayan, Carol Levin, Lu Meng Lou, Nika Madhav, Ajith Mahalingam, Jean Claude Mwanza, Anthony Measham, Maria Elena Medina Mora, Carol Mehta, Anne Mills, JudyAnne Mills, James Montoya, Ole Norheim, Zachary Olson, Indira Devi Oshrokhina, Iren Ojiambo, Judy Othman, Vikram Patel, George C Patton, Siles Pradyumna, Diwantha Puthanveedu, Jayraj C, Sanjiv Reddy, Saeed Razaee, Rengaswamy Sankaranarayanan, Arnie Sapolveda, Richard Skolnik, Kirk S Smith, Markon Tommerman, Stephen Tollman, Stephane Verguet, Damien G Walker, Neff Walker, Yangling Wu, and Xun Zhao.

8 Theravance biopharma US, Inc., South San Francisco, CA, USA.  
 9 College of Pharmacy, University of Rhode Island, Kingston, RI, USA.  
 10 Gilead Alberta ULC, Edmonton, Canada.





# Example: Author nationality trends in PubMed

This XML file does not appear to have any style information associated with it. The document tree is shown below.

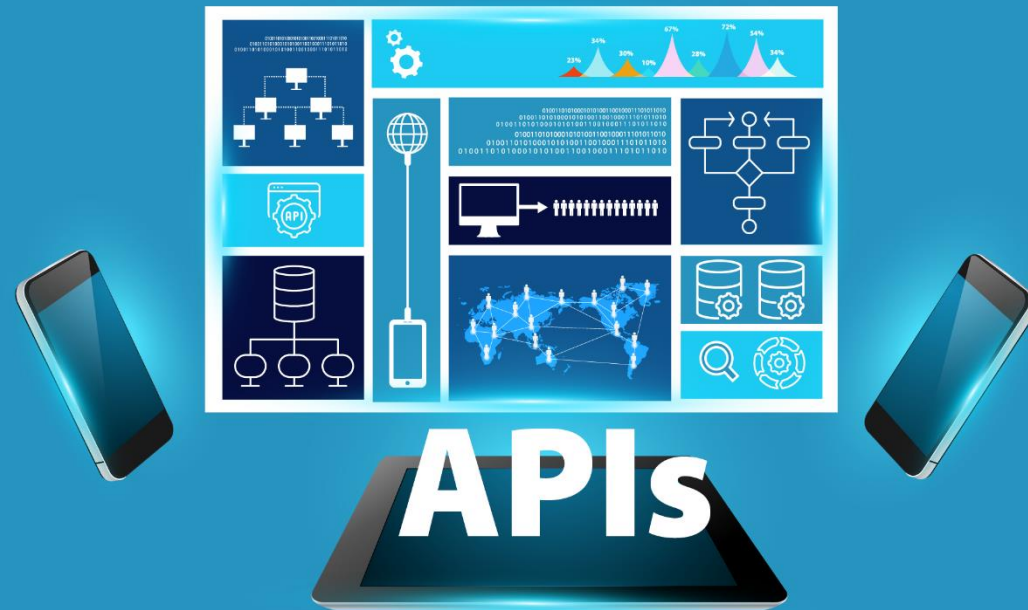
```
▼<PubmedArticleSet>
  ▼<PubmedArticle>
    ▼<MedlineCitation Status="MEDLINE" IndexingMethod="Curated" Owner="NLM">
      <PMID Version="1">34310243</PMID>
      ▼<DateCompleted>
        <Year>2022</Year>
        <Month>04</Month>
        <Day>04</Day>
      </DateCompleted>
      ▼<DateRevised>
        <Year>2022</Year>
        <Month>05</Month>
        <Day>31</Day>
      </DateRevised>
      ▼<Article PubModel="Print-Electronic">
        ▼<Journal>
          <ISSN IssnType="Electronic">1097-9883</ISSN>
          ▼<JournalIssue CitedMedium="Internet">
            <Volume>53</Volume>
            <Issue>3</Issue>
            ▼<PubDate>
              <Year>2021</Year>
              <Month>08</Month>
            </PubDate>
          </JournalIssue>
          <Title>Drug metabolism reviews</Title>
          <ISOAbbreviation>Drug Metab Rev</ISOAbbreviation>
        </Journal>
        <ArticleTitle>Bioanalytical strategies in drug discovery and development.</ArticleTitle>
        ▼<Pagination>
          <MedlinePgn>434-458</MedlinePgn>
        </Pagination>
        <ELocationID EIdType="doi" ValidYN="Y">10.1080/03602532.2021.1959606</ELocationID>
        ▼<Abstract>
          <AbstractText>A reliable, rapid, and effective bioanalytical method is essential for the determination of the pharmacokinetic, pharmacodynamic, and toxicokinetic parameters that inform the safety and efficacy profile of investigational drugs. The overall goal of bioanalytical method development is to elucidate the procedure and operating conditions under which a method can sufficiently extract, qualify, and/or quantify the analyte(s) of interest and/or their metabolites for the intended purpose. Given the difference in the physicochemical properties of small and large molecule drugs, different strategies need to be adopted for the development of an effective and efficient bioanalytical method. Herein, we provide an overview of different sample preparation strategies, analytical platforms, as well as procedures for achieving high throughput for bioanalysis of small and large molecule drugs.</AbstractText>
        </Abstract>
        ▼<AuthorList CompleteYN="Y">
          ▼<Author ValidYN="Y">
            <LastName>Thakur</LastName>
            <ForeName>Aarzo</ForeName>
            <Initials>A</Initials>
            ▼<AffiliationInfo>
              <Affiliation>Innovations in Food and Chemical Safety, Agency for Science, Technology, and Research, Singapore, Singapore
```



# What do these projects have in common?

- Each uses NLM information...
  - ...but **not** NLM websites!
- They need a different type of access:
  - Outside of a web browser
  - With limited (or zero) direct human interaction
  - To information in a specific format.
  - To information as data.

# The solution?



Application Programming Interfaces (APIs)

# Poll: What is your experience with APIs?

- Use them all the time!
- Use them periodically.
- Have used them in the past.
- Know about them, but haven't used them.
- This is all new to me!



# What is an API?

- A set of protocols for contacting a remote system and making requests.
- Designed to be used “programmatically,” not directly by humans.
- APIs typically include:
  - a server, and
  - a set of rules for making requests (or "calls") to that server

# A Drive Thru for Data



# Why are APIs useful?

- API calls can be built-in to programs/applications.
  - Data can be requested/retrieved much faster
  - Less need for human intervention
- Some APIs offer more options for data retrieval:
  - Specialized formats
  - Specialized data

# How (many) APIs work

- The way you access the API is via a URL
- The specific URL you use includes the address of the API you're using, plus the details of your request
- What information you get back depends on how you construct the URL.





# The two parts of (many) API requests

## The base URL

Indicates which API  
you're using

## Some parameters

The details of what  
you're asking for



# The Base URL

- The address of the API server
- Specific to each individual API
- Some examples:
  - MedlinePlus: <https://wsearch.nlm.nih.gov/ws/query>
  - E-utilities: <https://eutils.ncbi.nlm.nih.gov/entrez/eutils/>
  - MeSH RDF: <https://id.nlm.nih.gov/mesh>



# Parameters

- Parameter options are specific to the API in question
  - Actual parameters are specific to each request
- Can include things like:
  - Search strings
  - Results restrictions
  - Formatting options
  - etc.
- An example:
  - `db=pubmed&id=1602668&retmode=xml&rettype=full`



# Building an API URL: MedlinePlus

- Start with the Base URL for MedlinePlus API
  - <https://wsearch.nlm.nih.gov/ws/query>



# Building an API URL: Part Two

- Determine your parameters
  - Language: English or Spanish?
    - db=healthTopics
  - Search query: What are you looking for?
    - term=acid+reflux
  - Other options: How many results?
    - retmax=5

# Putting it all together: MedlinePlus

Base URL

<https://wsearch.nlm.nih.gov/ws/query>

Parameters

Database

db=healthTopics

Search Query

term=acid+reflux

# of  
Results

retmax=5

<https://wsearch.nlm.nih.gov/ws/query?db=healthTopics&term=acid+reflux&retmax=5>



# What we get

This XML file does not appear to have a title function associated with it. The document tree is shown below.

```
<nlmSearchResult>
  <term>acid reflux</term>
  <file>viv_i0hNNB</file>
  <server>pvlb7srch15</server>
  <count>12</count>
  <retstart>0</retstart>
  <retmax>5</retmax>
  <list num="12" start="0" per="5">
    <document rank="0" url="https://medlineplus.gov/gerd.h
      <content name="title">GERD</content>
      <content name="organizationName">National Library of Medicine</content>
      <content name="altTitle"><span class="qt0">Acid</span> <span class="qt1">Reflux</span></content>
      <content name="altTitle"><span class="qt2">Gastroesophageal </span><span class="qt1"><span class="qt2">Reflux</span></span></content>
      <content name="altTitle"><span class="qt2">Gastroesophageal </span><span class="qt1"><span class="qt2">reflux</span></span></span> disease</content>
      <content name="FullSummary"><p>Your esophagus is the tube that carries food from your mouth to your stomach. <span class="qt2">Gastroesophageal
        </span><span class="qt1"><span class="qt2">reflux</span></span></span> disease (GERD) happens when a muscle at the end of your esophagus does not
        close properly. This allows stomach contents to leak back, or <span class="qt1">reflux</span>, into the esophagus and irritate it. </p><p>You
        may feel a burning in the chest or throat called heartburn. Sometimes, you can taste stomach fluid in the back of the mouth. If you have these
        symptoms more than twice a week, you may have GERD. You can also have GERD without having heartburn. Your symptoms could include a dry cough,
        asthma symptoms, or trouble swallowing.</p><p>Anyone, including infants and children, can have GERD. If not treated, it can lead to more
        serious health problems. In some cases, you might need medicines or surgery. However, many people can improve their symptoms by:</p><ul>
        <li>Avoiding alcohol and spicy, fatty or acidic foods that trigger heartburn</li><li>Eating smaller meals</li><li>Not eating close to bedtime
        </li><li>Losing weight if needed </li><li>Wearing loose-fitting clothes</li></ul><p>NIH: National Institute of Diabetes and Digestive and
        Kidney Diseases</p></content>
      <content name="mesh"><span class="qt2">Gastroesophageal </span><span class="qt1"><span class="qt2">Reflux</span></span></content>
      <content name="groupName">Digestive System</content>
      <content name="snippet"> Your esophagus is the tube that carries food from your mouth to your stomach. <span class="qt2">Gastroesophageal
        </span><span class="qt1"><span class="qt2">reflux</span></span></span> disease (GERD) happens when a muscle at the end of your ... </content>
    </document>
    <document rank="1" url="https://medlineplus.gov/heartb
      <content name="title">Heartburn</content>
      <content name="organizationName">National Library of Medicine</content>
      <content name="altTitle"><span class="qt0">Acid</span> <span class="qt1">Reflux</span></content>
      <content name="altTitle"><span class="qt0">Acid</span> indigestion</content>
```

# You Need a Car





# What kind of car?



# What if I don't know how to drive?

Learn to drive...



...or find a driver!



# Poll: Any programming experience?

- R
- Python
- C++
- Shell scripting (Linux/Unix)
- PHP/JavaScript
- MatLab
- Other (tell us in chat)
- None yet!

# What's on the menu? NLM data!



# Choosing the right API

- Remember! Different APIs for different purposes!
- When deciding to use an API, first question: does it have what I need?
- If a resource has multiple APIs, may serve different data in different formats.

# MedlinePlus

- MedlinePlus Web Service
  - Retrieves MedlinePlus Health Topics in XML
  - Can help embed MedlinePlus content on a webpage
- MedlinePlus Connect
  - Integrated into Electronic Health Records
  - Used primarily by EHR vendors/developers



# PubMed

- E-Utilities
  - Access 35+ NCBI databases, including PubMed
  - Best way to access PubMed via API
- Literature Citation Exporter
  - Converts PMIDs into citation strings
- Citation Matcher
  - Converts citation strings to PMIDs



# PMC/Bookshelf

- E-utilities (again)
  - Access metadata and (some) full-text
- OAI-PMH
  - Full-text from PMC/Bookshelf Open Access subsets
  - Uses industry standard for digital repositories



# Medical Subject Headings (MeSH)

## E-utilities (yet again)

## MeSH RDF

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
<eSummaryResult>
  <DocSum>
    <Id>68056989</Id>
    <Item Name="DS_YearIntroduced" Type="String">2010</Item>
    <Item Name="DS_ScopeNote" Type="String">MYOCARDIAL INFARCTION in which the inferior wall of the heart is involved. It is often caused by occlusion of the right coronary artery.</Item>
    <Item Name="DS_RegistryNumber" Type="String"/>
    <Item Name="DS_HeadingMappedTo" Type="String"/>
    <Item Name="DS_MeshTerms" Type="List">
      <Item Name="string" Type="String">Inferior Wall Myocardial Infarction</Item>
      <Item Name="string" Type="String">Diaphragmatic Myocardial Infarction</Item>
      <Item Name="string" Type="String">Diaphragmatic Myocardial Infarctions</Item>
      <Item Name="string" Type="String">Infarction, Diaphragmatic Myocardial</Item>
      <Item Name="string" Type="String">Infarctions, Diaphragmatic Myocardial</Item>
      <Item Name="string" Type="String">Myocardial Infarction, Diaphragmatic</Item>
      <Item Name="string" Type="String">Myocardial Infarctions, Diaphragmatic</Item>
      <Item Name="string" Type="String">Myocardial Infarction, Inferior Wall</Item>
      <Item Name="string" Type="String">Inferior Myocardial Infarction</Item>
      <Item Name="string" Type="String">Infarction, Inferior Myocardial</Item>
      <Item Name="string" Type="String">Infarctions, Inferior Myocardial</Item>
      <Item Name="string" Type="String">Inferior Myocardial Infarctions</Item>
      <Item Name="string" Type="String">Myocardial Infarction, Inferior</Item>
      <Item Name="string" Type="String">Myocardial Infarctions, Inferior</Item>
      <Item Name="string" Type="String">Acute Inferior Myocardial Infarction</Item>
    </Item>
    <Item Name="DS_Subheading" Type="List">
      <Item Name="string" Type="String">analysis</Item>
      <Item Name="string" Type="String">anatomy and histology</Item>
      <Item Name="string" Type="String">blood</Item>
      <Item Name="string" Type="String">chemically induced</Item>
      <Item Name="string" Type="String">classification</Item>
      <Item Name="string" Type="String">complications</Item>
      <Item Name="string" Type="String">diagnosis</Item>
      <Item Name="string" Type="String">diagnostic imaging</Item>
      <Item Name="string" Type="String">drug therapy</Item>
      <Item Name="string" Type="String">epidemiology</Item>
      <Item Name="string" Type="String">ethnology</Item>
      <Item Name="string" Type="String">etiology</Item>
      <Item Name="string" Type="String">genetics</Item>
      <Item Name="string" Type="String">immunology</Item>
      <Item Name="string" Type="String">metabolism</Item>
      <Item Name="string" Type="String">mortality</Item>
      <Item Name="string" Type="String">pathology</Item>
      <Item Name="string" Type="String">physiology</Item>
      <Item Name="string" Type="String">physiopathology</Item>
      <Item Name="string" Type="String">prevention and control</Item>
      <Item Name="string" Type="String">statistics and numerical data</Item>
      <Item Name="string" Type="String">surgery</Item>
      <Item Name="string" Type="String">therapy</Item>
    </Item>
  </DocSum>
</eSummaryResult>
```

### MeSH RDF API <sup>1.0.1</sup>

[ Base URL: [id.nlm.nih.gov/mesh](http://id.nlm.nih.gov/mesh) ]  
<https://id.nlm.nih.gov/mesh/swagger/swagger.json>

SPARQL Endpoint and Lookup service for MeSH RDF  
[SPARQL API technical documentation](#)

Schemes

HTTPS

**sparql** The SPARQL 1.1 endpoint returns RDF results and graphs - see the [query page](#)

GET /sparql Perform SPARQL query

**lookup** The lookup API returns simple JSON - see the [lookup page](#)

GET /lookup/descriptor Search for Descriptors, also known as Headings.

GET /lookup/pair Search for Descriptor-Qualifier pairs, also known as Subheadings.

GET /lookup/term Search for Entry Terms

GET /lookup/qualifiers Return all allowed Qualifiers for a Descriptor.

GET /lookup/details Lookup some details for a descriptor

GET /lookup/years Returns the current status of various years in MeSH RDF

GET /lookup/label Return the label or labels for a Resource URI.



# RxNorm

The screenshot displays the RxNorm web application interface, which is part of the National Library of Medicine (NIH) ecosystem. The interface is titled "RxNorm" and features a header with the NIH logo and the text "National Library of Medicine". The main content area is divided into several sections:


- WORKFLOW:** A vertical flowchart showing a sequence of functions: RxNorm: findRxcuiByString, RXCUI, RxNorm: getRelatedByType, RXCUI, and RxNorm: getNDCs.
- BUILD:** A section for selecting a function, currently showing "No function selected".
- LOAD:** A section for loading a workflow, with options "From workflow library" and "From my workflows: Choose File" (No file chosen).
- INPUT:** A section for entering input values, with a text field labeled "name:" containing the value "simvastatin".
- OUTPUT:** A section for selecting the output format, with radio buttons for "TABLE" (selected) and "TEXT".
- Documentation and Output:** Two panels on the right side of the interface. The "Documentation" panel is currently empty. The "Output" panel displays a list of National Drug Codes (NDC) for simvastatin, including 00574171015, 73308035401, and many others.

Additional features include a "Basic Instructions" section with the following steps:

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

On the left side of the interface, there are two vertical buttons: "Interactive" and "Batch".

# ClinicalTrials.gov

 U.S. National Library of Medicine  
**ClinicalTrials.gov API**

**API Full Study Demo**

If you are looking for information about clinical studies, please visit [ClinicalTrials.gov](https://clinicaltrials.gov).

[API Home](#)

### Full Studies Request

Specify the [query parameters](#) for a [Full Studies query URL](#):

Query URL:

Search Expression:  
expr=

[\(See API Search Expressions and Syntax\)](#)

Minimum Rank: min\_rnk=

Maximum Rank: max\_rnk=

Format: fmt=

[Scroll up to access the request controls](#)

### Response

View a formatted [query response](#), including the query URL, for the Full Studies request:

URL: [https://clinicaltrials.gov/api/query/full\\_studies?expr=heart+attack&min\\_rnk=1&max\\_rnk=&fmt=xml](https://clinicaltrials.gov/api/query/full_studies?expr=heart+attack&min_rnk=1&max_rnk=&fmt=xml)

```
<FullStudiesResponse>
<APIVrs>1.01.05</APIVrs>
<DataVrs>2022:08:15 23:28:55.124</DataVrs>
<Expression>heart attack</Expression>
<NSTudiesAvail>424812</NSTudiesAvail>
<NSTudiesFound>9177</NSTudiesFound>
<MinRank>1</MinRank>
```



# Poll: Which API is most interesting?

- MedlinePlus Web Service/MedlinePlus Connect
- E-utilities (PubMed, MeSH, PMC)
- Other PubMed APIs
- OAI-PMH (PMC, Bookshelf)
- MeSH RDF
- RxNormAPI
- ClinicalTrials.gov
- Something else
- Still not sure why I would use an API...



# To recap: when should I use APIs?

- Working in a programming environment
- Need NLM data in a machine-readable format
- Need up-to-date data quickly/on-demand
- Have specific things to search for/request



# When should I not use APIs?

- When you're NOT programming!
- When APIs aren't an option
- When exploring/browsing a resource
- When you need **all** of the data

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<p><b>MEDLINE/PubMed</b></p> <p>Biomedical journal citations.</p> <p><a href="#">Terms and Conditions</a> <a href="#">FAQ</a></p>	<p><b>MeSH</b></p> <p>Medical Subject Headings</p> <p><a href="#">Terms and Conditions</a> <a href="#">Preview MeSH using MeSH Browser</a></p>
<p><b>VHP</b></p> <p>Visible Human Project: Three-dimensional representations of a human male body and a human female body.</p> <p><a href="#">Terms and Conditions</a> <a href="#">Sample Data</a></p>	<p><b>Pill Image</b></p> <p>This downloadable dataset contains approximately: 4,000 Reference Pill Images and 133,000 Consumer-Grade Pill Images.</p> <p><a href="#">Terms and Conditions</a> <a href="#">Sample Data</a></p>
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<p><b>CCRIS</b></p> <p>Chemical Carcinogenesis Research Information System: Fully referenced data bank containing chemical records with carcinogenicity, mutagenicity, tumor promotion, and tumor inhibition test results.</p>	<p><b>ChemIDplus</b></p> <p>The authority file used for the identification of chemical substances cited in other NLM databases.</p>

[https://www.nlm.nih.gov/databases/download/data\\_distrib\\_main.html](https://www.nlm.nih.gov/databases/download/data_distrib_main.html)



# Where to go next?

- Learn about programming or find a programmer
  - Online courses
  - Library Carpentry
  - Ask around!
- Think about your project
  - What do you know?
  - What do you need to know?
- Find the right API for you



# NLM Data Discovery

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# Learn more about NLM Resources!

- Training from NNLM
  - <https://www.nnlm.gov/training>
- Educational Resources (and more training) from NLM
  - <https://learn.nlm.nih.gov>
- Past and Upcoming FDLP Academy Webinars



# Read the documentation!

- Tells you what the API can and can't do
- Instructions on syntax, formatting requests
- Provide guidelines for usage
- May include example API calls

# Questions?

