

# 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
  - know 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?

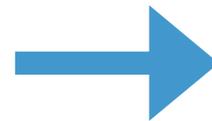
- Literature
- Consumer Health
- Terminology
- Molecular Biology
- Drugs and Chemicals
- Other



# Example: Health info for patients in EHRs

The screenshot shows a patient's health summary page. At the top, there's a navigation bar with 'Health Summary' selected. Below it, a 'COVID-19 updates' banner is visible. The main content area features a patient profile for Jane Smith and a table titled 'Your Health Summary – Conditions'. The table lists three conditions: Acquired Cystic Kidney Disease (dated 5/02/2022), Acute Sinusitis (dated 09/10/2020), and Influenza (dated 04/19/2019). Each condition has an information icon (i) next to it. A red box highlights the information icon for Acquired Cystic Kidney Disease. On the left side, there are buttons for 'Appointments', 'Medications', 'Test Results', 'Messages', and 'Insurance'.

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



The screenshot shows the MedlinePlus website page for 'Kidney Cysts'. The page has a search bar at the top right and navigation links for 'Health Topics', 'Drugs & Supplements', and 'Videos & Tools'. The main content area is titled 'Kidney Cysts' and includes a 'Summary' section. The summary text states: '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.' Below the summary, there are bullet points for symptoms: 'Pain in the back and lower sides', 'Headaches', and 'Blood in the urine'. On the right side, there is an anatomical illustration of a kidney with cysts, a 'Stay Connected' section with a newsletter sign-up form, and a 'MEDICAL ENCYCLOPEDIA' section with links to 'Abdominal CT scan', 'Abdominal MRI', 'Medullary cystic kidney disease', and '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 the profile, 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 the paper "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 below. Nationalities are highlighted in red boxes: Singapore, Singapore, China, USA, UK, Egypt, Singapore, USA, USA, and Canada.

NIH National Library of Medicine  
National Center for Biotechnology Information

PubMed.gov Search

Search results

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**

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

# Example: Author nationality trends in PubMed (cont.-1)

The image displays a sequence of overlapping screenshots from the PubMed website, illustrating author nationality trends. The screenshots are arranged in two columns, showing the progression of search results for two different queries.

**Left Column (Nickel in soil and water):**

- Search results for "Nickel in soil and water: Sources, biogeochemistry, and remediation using biochar".
- Authors listed include: Ali Ichiyegge, Naveed Ahmad, Muneed Muneed, Naveed Khan Naveed, Sahar Yousef, Anwar Shams, Tracy Sarker, Yongqing Cai, Scott X. Chang.
- Affiliations listed include:
  - 1. The University of Rhode Island, Kingston, RI, USA.
  - 2. College of Pharmacy, University of Rhode Island, Kingston, RI, USA.
  - 3. Gilead Alberta ULC, Edmonton, Canada.

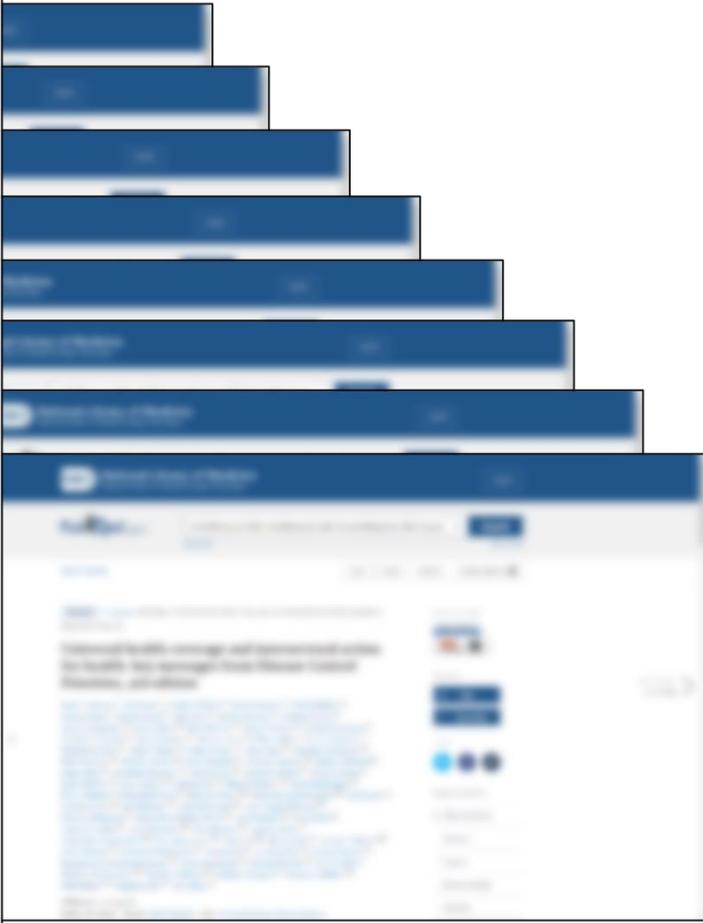
**Right Column (Universal health coverage):**

- Search results for "Universal health coverage and intersectoral action for health: key messages from Disease Control Priorities, 3rd edition".
- Authors listed include: Dean T. Jamison, Ala Alwan, Charles N. Moku, Rachel Nugent, David Watkins, Chinyere Akpaka, Sherif Ahmad, Saeed Ahmad, Stefano Bertozzi, Zulfiqar Bhutta, Agnes Binagwaho, Robert Black, Mark Blecher, Barry R. Bloom, Elizabeth Brachmann, Ibrahim A. Brouky, David Dabalen, Mervyn C. Carr, Mark C. Cohen, Krishna Dasgupta, Naveed Khan Naveed, Huda T. Dettan, Peter Dondos, Susan Dool, Kenneth A. Fleming, Mark Gillman, Patricia J. Garcia, Araf Gewa, Thomas G. Gebo, Helen Gelband, Roger Glasziou, Amanda Glasziou, Glenda Gray, Denise Haber, King K. Holmes, Susan Horton, Guy Hutton, Prabhat Jha, Felicia M. Knaul, Olive Kobayashi, Eric L. Kibuka, Margaret E. Kuhn, Peter Luchinskas, Ramesh Lakshminarayanan, Carol Linn, Lai Meng Lo, Nisa Madhav, Abdul Muhaimin, Jean M. Muscatelli, Anthony Measham, Maria Elena Medina Mora, Carol McMillin, Anne Mills, Jody Anne Mills, Javier Montoya, Chit. Nandhini, Zachary Olson, Ishwari Devi Oshroobadi, Ilan D. Paneth, Ruby D. Patel, Vikram Patel, George C. Patton, John Pridemore, Dinesh Prabhakaran, Arjunan Qureshi, Iori Reynolds, Svetlana Ruzicka, Ranganarany Santhanarayanan, Jaime Sepulveda, Richard S. Smith, Kiran R. Smith, Melissa Tenover, Stephen Tollman, Stephanie Vanderschueren, Daman G. Walker, Nefti Walker, Yangsheng Wu, Kurt Zhao.
- Affiliations listed include:
  - 1. The University of Rhode Island, Kingston, RI, USA.
  - 2. College of Pharmacy, University of Rhode Island, Kingston, RI, USA.
  - 3. Gilead Alberta ULC, Edmonton, Canada.

# Example: Author nationality trends in PubMed (cont.-2)

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

```
<?xml version="1.0" encoding="UTF-8" />
<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>
      </Article>
      <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</Affiliation>
          </AffiliationInfo>
        </Author>
      </AuthorList>
    </MedlineCitation>
  </PubmedArticle>
</PubmedArticleSet>
```

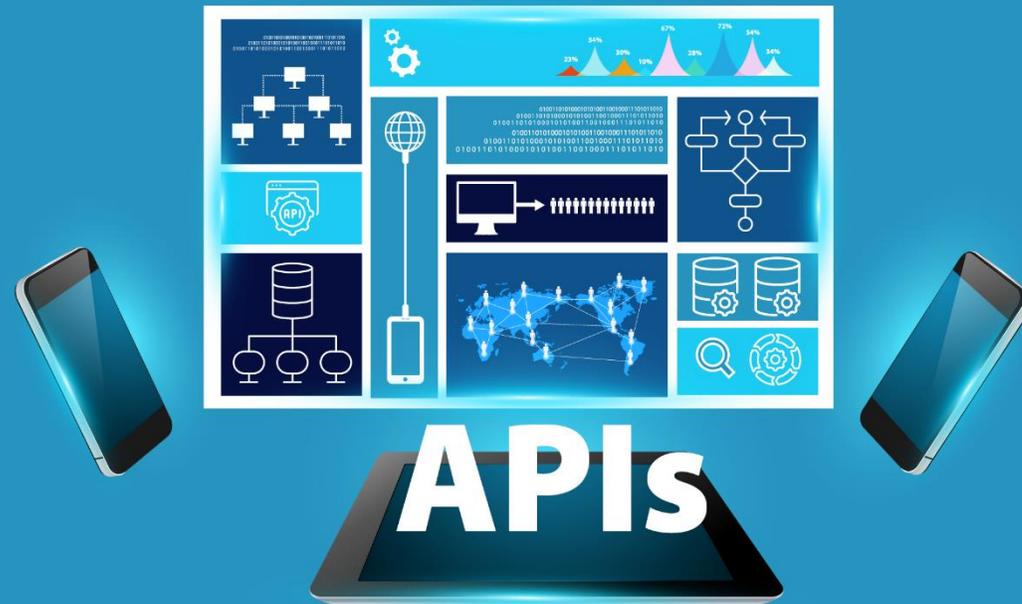


# What do these projects have in common?

- 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.
  - Retrieval in specialized formats
  - Retrieval of otherwise unavailable 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 or description 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> 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> 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> 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/PMCIDs into citation strings
- Citation Matcher
  - Programmatic access to PubMed Citation Matcher



# PMC/Bookshelf

- E-utilities (again)
  - Access metadata and (some) full-text
  - Uses same syntax as E-utilities for PubMed
- OAI-PMH/OAI-PMH LitArch
  - Full-text from PMC/Bookshelf Open Access subsets
  - Uses industry standard for online 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 application interface, which is part of the R-Mix suite for creating applications from NLM Drug APIs. The interface is organized into several functional areas:

- WORKFLOW:** A visual flowchart showing a sequence of functions: RxNorm: findRxcuiByString, RXCUI, RxNorm: getRelatedByType, RXCUI, and RxNorm: getNDCs.
- BUILD:** A section for selecting functions, currently showing "No function selected".
- LOAD:** Options to load a workflow from a library or from local workflows. The "From my workflows" section shows "Choose File" and "No file chosen".
- INPUT:** A text field for entering a drug name, with "simvastatin" entered. Below it are "Remove Last" and "Save" buttons.
- OUTPUT:** A section for selecting the output format, with "TABLE" selected and "TEXT" as an alternative.
- Documentation and Output:** Two scrollable panels on the right. The "Documentation" panel is currently empty. The "Output" panel displays a list of National Drug Codes (NDCs) for simvastatin, including 00574171015, 73308035401, and many others.

At the bottom of the interface, there are instructions for building and running workflows:

**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

# 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



# Bulk Downloads

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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>
<p><b>Clinical Questions Collection</b></p> <p>The Clinical Questions Collection is a downloadable dataset of questions that have been collected between 1991 – 2003 from healthcare providers in clinical settings across the country.</p> <p><a href="#">Terms and Conditions</a></p>	<p><b>NLM Meeting Abstracts</b></p> <p>The Meeting Abstracts database contains selected abstracts from meetings and conferences in the subject areas of: AIDS, Health Services Research, and Space Life Sciences, published between 1990 – 2010.</p> <p><a href="#">Terms and Conditions</a></p>
<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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## Data Discovery

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### NLM Products and Services

A comprehensive listing of products and services at the National Library of Medicine

### Featured: PubMed Citations

A baseline set of MEDLINE/PubMed citation records in XML format for download on an annual and daily basis.

**About Data Discovery at the NLM**  
Data Discovery is a platform providing access to datasets from selected NLM resources, as well as information and links to other NLM resources. Users can explore, filter, visualize, and export data in a variety of formats, including Excel, JSON,

**Terms and Conditions**  
Most datasets on Data Discovery follow the NLM Terms and Conditions for reuse. Individual datasets may have specific licenses or additional terms of use. Contact the NLM Help Desk for questions about specific datasets.



# 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



# Poll: What else do you need?

- More examples of APIs in action
- More info on available NLM APIs
- Help with programming
- Something else? – In the chat!



# Questions?

