E-utils Quick Start

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Release Notes

Please see our Release Notes for details on recent changes and updates.

Introduction

This chapter provides a brief overview of basic E-utility functions along with examples of
URL calls. Please see Chapter 2 for a general introduction to these utilities and Chapter 4 for
a detailed discussion of syntax and parameters.

Examples include live URLs that provide sample outputs.

All E-utility calls share the same base URL:


Searching a Database

Basic Searching

esearch.fcgi?db=<database>&term=<query>

Input: Entrez database (&db); Any Entrez text query (&term)

Output: List of UIDs matching the Entrez query

Example: Get the PubMed IDs (PMIDs) for articles about breast cancer published in Science
in 2008

  db=pubmed&term=science[journal]+AND+breast+cancer+AND+2008[pdat]

Storing Search Results

esearch.fcgi?db=<database>&term=<query>&usehistory=y

Input: Any Entrez text query (&term); Entrez database (&db); &usehistory=y

Output: Web environment (&WebEnv) and query key (&query_key) parameters specifying
the location on the Entrez history server of the list of UIDs matching the Entrez query

Example: Get the PubMed IDs (PMIDs) for articles about breast cancer published in Science
in 2008, and store them on the Entrez history server for later use
Associating Search Results with Existing Search Results

esearch.fcgi?db=<database>&term=<query1>&usehistory=y

# esearch produces WebEnv value ($web1) and QueryKey value ($key1)

esearch.fcgi?db=<database>&term=<query2>&usehistory=y&WebEnv=$web1

# esearch produces WebEnv value ($web2) that contains the results of both searches ($key1 and $key2)

Input: Any Entrez text query (&term); Entrez database (&db); &usehistory=y; Existing web environment (&WebEnv) from a prior E-utility call

Output: Web environment (&WebEnv) and query key (&query_key) parameters specifying the location on the Entrez history server of the list of UIDs matching the Entrez query

For More Information

Please see ESearch In-Depth for a full description of ESearch.

Sample ESearch Output

```xml
<?xml version="1.0" ?>
<eSearchResult>
  <Count>255147</Count>   # total number of records matching query
  <RetMax>20</RetMax>   # number of UIDs returned in this XML; default=20
  <RetStart>0</RetStart>   # index of first record returned; default=0
  <QueryKey>1</QueryKey>   # QueryKey, only present if &usehistory=y
  <WebEnv>013yIKBjM60UBxvBvfF1q8-9n11dXuA0huuMh-8GjC7F_Dz1XL6@897033B29A81FB01_0038SID</WebEnv>
    # WebEnv; only present if &usehistory=y
  <IdList>
    <Id>229486465</Id>   # list of UIDs returned
    <Id>229486321</Id>
    <Id>229485738</Id>
    <Id>229470359</Id>
    <Id>229463047</Id>
    <Id>229463037</Id>
    <Id>229463022</Id>
    <Id>229463019</Id>
    <Id>229463007</Id>
    <Id>229463002</Id>
    <Id>229463000</Id>
    <Id>229462974</Id>
    <Id>229462961</Id>
    <Id>229462956</Id>
    <Id>229462921</Id>
  </IdList>
</eSearchResult>
```
Searching PubMed with Citation Data

`ecitmatch.cgi?db=pubmed&rettype=xml&bdata=<citations>`

Input: List of citation strings separated by a carriage return (%0D), where each citation string has the following format:

`journal_title|year|volume|first_page|author_name|your_key|`

Output: A list of citation strings with the corresponding PubMed ID (PMID) appended.

Example: Search PubMed for the following citations:


`db=pubmed&retmode=xml&bdata=proc+natl+acad+sci+u+s+a|1991|88|3248|mann+bj|Art1|%0Dscience|1987|235|182|palmenberg+ac|Art2|`

Sample Output (the PMIDs appear in the rightmost field):

`proc natl acad sci u s a|1991|88|3248|mann bj|Art1|2014248`  
`sxence|1987|235|182|palmenberg ac|Art2|3026048`

Please see ECitMatch In-Depth for a full description of ECitMatch.
Uploading UIDs to Entrez

Basic Uploading

epost.fcgi?db=<database>&id=<uid_list>

Input: List of UIDs (&id); Entrez database (&db)

Output: Web environment (&WebEnv) and query key (&query_key) parameters specifying the location on the Entrez history server of the list of uploaded UIDs

Example: Upload five Gene IDs (7173,22018,54314,403521,525013) for later processing.


Associating a Set of UIDs with Previously Posted Sets

epost.fcgi?db=<database1>&id=<uid_list1>

# epost produces WebEnv value ($web1) and QueryKey value ($key1)

epost.fcgi?db=<database2>&id=<uid_list2>&WebEnv=$web1

# epost produces WebEnv value ($web2) that contains the results of both posts ($key1 and $key2)

Input: List of UIDs (&id); Entrez database (&db); Existing web environment (&WebEnv)

Output: Web environment (&WebEnv) and query key (&query_key) parameters specifying the location on the Entrez history server of the list of uploaded UIDs

For More Information

Please see EPost In-Depth for a full description of EPost.

Sample EPost Output

<?xml version="1.0"?>
<ePostResult>
<QueryKey>1</QueryKey>
<WebEnv>NCID_01_268116914_130.14.18.47_9001_1241798628</WebEnv>
</ePostResult>

Downloading Document Summaries

Basic Downloading

esummary.fcgi?db=<database>&id=<uid_list>

Input: List of UIDs (&id); Entrez database (&db)

Output: XML DocSums
Example: Download DocSums for these protein GIs:
6678417,9507199,28558982,28558984,28558988,28558990

db=protein&id=6678417,9507199,28558982,28558984,28558988,28558990

Downloading Data From a Previous Search

esearch.fcgi?db=<database>&term=<query>&usehistory=y

# esearch produces WebEnv value ($web1) and QueryKey value ($key1)
esummary.fcgi?db=<database>&query_key=$key1&WebEnv=$web1

Input: Web environment (&WebEnv) and query key (&query_key) representing a set of
Entrez UIDs on the Entrez history server

Output: XML DocSums

Sample ESummary Output

The output of ESummary is a series of XML “DocSums” (Document Summaries), the
format of which depends on the database. Below is an example DocSum for Entrez Protein.

<?xml version="1.0"?><!DOCTYPE eSummaryResult PUBLIC "-//NLM//DTD eSummaryResult, 29 October 2004//EN" "https://www.ncbi.nlm.nih.gov/entrez/query/DTD/eSummary_041029.dtd"><eSummaryResult><DocSum><Id>15718680</Id><Item Name="Caption" Type="String">NP_005537</Item><Item Name="Title" Type="String">IL2-inducible T-cell kinase [Homo sapiens]</Item><Item Name="Extra" Type="String">gi|15718680|ref|NP_005537.3|15718680</Item><Item Name="Gi" Type="Integer">15718680</Item><Item Name="CreateDate" Type="String">1999/06/09</Item><Item Name="UpdateDate" Type="String">2009/04/05</Item><Item Name="Flags" Type="Integer">512</Item><Item Name="TaxId" Type="Integer">9606</Item><Item Name="Length" Type="Integer">620</Item><Item Name="Status" Type="String">live</Item><Item Name="ReplacedBy" Type="String"></Item><Item Name="Comment" Type="String"><![CDATA[ ]]> </Item></DocSum></eSummaryResult>

Sample ESummary version 2.0 Output

Version 2.0 of ESummary is an alternate XML presentation of Entrez DocSums. To retrieve
version 2.0 DocSums, the URL should contain the &version parameter with an assigned
value of ‘2.0’. Each Entrez database provides its own unique DTD for version 2.0 DocSums,
and a link to the relevant DTD is provided in the header of the version 2.0 XML.
Below is an example version 2.0 DocSum from Entrez Protein (the same record as shown above in the default DocSum XML).

```xml
<?xml version="1.0"?>
<eSummaryResult>
  <DocumentSummarySet status="OK">
    <DocumentSummary uid="15718680">
      <Caption>NP_005537</Caption>
      <Title>tyrosine-protein kinase ITK/TSK [Homo sapiens]</Title>
      <Extra>gi|15718680|ref|NP_005537.3|</Extra>
      <Gi>15718680</Gi>
      <CreateDate>1999/06/09</CreateDate>
      <UpdateDate>2011/10/09</UpdateDate>
      <Flags>512</Flags>
      <TaxId>9606</TaxId>
      <Slen>620</Slen>
      <Biomol/>
      <MolType>aa</MolType>
      <Topology>linear</Topology>
      <SourceDb>refseq</SourceDb>
      <SegSetSize>0</SegSetSize>
      <ProjectId>0</ProjectId>
      <Genome>genomic</Genome>
      <SubType>chromosome|map</SubType>
      <SubName>5|5q31-q32</SubName>
      <AssemblyGi>399658</AssemblyGi>
      <AssemblyAcc>D13720.1</AssemblyAcc>
      <Tech/>
      <Completeness/>
      <GeneticCode>1</GeneticCode>
      <Strand/>
      <Organism>Homo sapiens</Organism>
      <Statistics>
        <Stat type="all" count="8"/>
        <Stat type="blob_size" count="16154"/>
        <Stat type="cdregion" count="1"/>
        <Stat type="cdregion" subtype="CDS" count="1"/>
        <Stat type="gene" count="1"/>
        <Stat type="gene" subtype="Gene" count="1"/>
        <Stat type="org" count="1"/>
        <Stat type="prot" count="1"/>
        <Stat type="prot" subtype="Prot" count="1"/>
        <Stat type="pub" count="14"/>
      </Statistics>
    </DocumentSummary>
  </DocumentSummarySet>
</eSummaryResult>
```
Downloading Full Records

Basic Downloading

`efetch.fcgi?db=<database>&id=<uid_list>&rettype=<retrieval_type>&retmode=<retrieval_mode>`

Input: List of UIDs (&id); Entrez database (&db); Retrieval type (&rettype); Retrieval mode (&retmode)

Output: Formatted data records as specified
Example: Download nuccore GIs 34577062 and 24475906 in FASTA format

db=nuccore&id=34577062,24475906&rettype=fasta&retmode=text

Downloading Data From a Previous Search

esearch.fcgi?db=<database>&term=<query>&usehistory=y

# esearch produces WebEnv value ($web1) and QueryKey value ($key1)

efetch.fcgi?db=<database>&query_key=$key1&WebEnv=$web1&rettype=
<retrieval_type>&retmode=<retrieval_mode>

Input: Entrez database (&db); Web environment (&WebEnv) and query key (&query_key) representing a set of Entrez UIDs on the Entrez history server; Retrieval type (&rettype); Retrieval mode (&retmode)

Output: Formatted data records as specified

Downloading a Large Set of Records

Please see Application 3 in Chapter 3

Input: Entrez database (&db); Web environment (&WebEnv) and query key (&query_key) representing a set of Entrez UIDs on the Entrez history server; Retrieval start (&retstart), the first record of the set to retrieve; Retrieval maximum (&retmax), maximum number of records to retrieve

Output: Formatted data records as specified

For More Information

Please see EFetch In-Depth for a full description of EFetch.

Finding Related Data Through Entrez Links

Basic Linking

Batch mode – finds only one set of linked UIDs

elink.fcgi?dbfrom=<source_db>&db=<destination_db>&id=<uid_list>

Input: List of UIDs (&id); Source Entrez database (&dbfrom); Destination Entrez database (&db)

Output: XML containing linked UIDs from source and destination databases

Example: Find one set of Gene IDs linked to nuccore GIs 34577062 and 24475906

dbfrom=nuccore&db=gene&id=34577062,24475906

‘By Id’ mode – finds one set of linked UIDs for each input UID

elink.fcgi?dbfrom=<source_db>&db=<destination_db>&id=<uid1>&id=
<uid2>&id=<uid3>...

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Example: Find separate sets of Gene IDs linked to nuccore GIs 34577062 and 24475906

dbfrom=nuccore&db=gene&id=34577062&id=24475906

Note: &db may be a comma-delimited list of databases, so that elink returns multiple sets of linked UIDs in a single call

Finding Links to Data from a Previous Search

esearch.fcgi?db=<source_db>&term=<query>&usehistory=y

# esearch produces WebEnv value ($web1) and QueryKey value ($key1)

elink.fcgi?dbfrom=<source_db>&db=<destination_db>&query_key=$key1&WebEnv=$web1&cmd=neighbor_history

Input: Source Entrez database (&dbfrom); Destination Entrez database (&db); Web environment (&WebEnv) and query key (&query_key) representing the set of source UIDs on the Entrez history server; Command mode (&cmd)

Output: XML containing Web environments and query keys for each set of linked UIDs

Note: To achieve ‘By Id’ mode, one must send each input UID as a separate &id parameter in the URL. Sending a WebEnv/query_key set always produces Batch mode behavior (one set of linked UIDs).

Finding Computational Neighbors Limited by an Entrez Search

elink.fcgi?dbfrom=<source_db>&db=<source_db>&id=<uid_list>&term=<query>&cmd=neighbor_history

Input: Source Entrez database (&dbfrom); Destination Entrez database (&db); List of UIDs (&id); Entrez query (&term); Command mode (&cmd)

Output: XML containing Web environments and query keys for each set of linked UIDs

Example: Find protein UIDs that are rat Reference Sequences and that are sequence similar to GI 15718680

dbfrom=protein&db=protein&id=15718680&term=rat[orgn]+AND+srcdb+refseq[prop]&cmd=neighbor_history

For More Information

Please see ELink In-Depth for a full description of ELink.

Getting Database Statistics and Search Fields

einfo.fcgi?db=<database>

Input: Entrez database (&db)

Output: XML containing database statistics
Note: If no database parameter is supplied, einfo will return a list of all valid Entrez databases.

Example: Find database statistics for Entrez Protein.


For More Information

Please see EInfo In-Depth for a full description of EInfo.

Sample EInfo Output

<?xml version="1.0"?>
<eInfoResult>
  <DbInfo>
    <DbName>protein</DbName>
    <MenuName>Protein</MenuName>
    <Description>Protein sequence record</Description>
    <Count>26715092</Count>
    <LastUpdate>2009/05/12 04:39</LastUpdate>
    <FieldList>
      <Field>
        <Name>ALL</Name>
        <FullName>All Fields</FullName>
        <Description>All terms from all searchable fields</Description>
        <TermCount>133639432</TermCount>
        <IsDate>N</IsDate>
        <IsNumerical>N</IsNumerical>
        <SingleToken>N</SingleToken>
        <Hierarchy>N</Hierarchy>
        <IsHidden>N</IsHidden>
      </Field>
      ...
      <Field>
        <Name>PORG</Name>
        <FullName>Primary Organism</FullName>
        <Description>Scientific and common names of primary organism, and all higher levels of taxonomy</Description>
        <TermCount>673555</TermCount>
        <IsDate>N</IsDate>
        <IsNumerical>N</IsNumerical>
        <SingleToken>Y</SingleToken>
        <Hierarchy>Y</Hierarchy>
        <IsHidden>N</IsHidden>
      </Field>
    </FieldList>
    <LinkList>
      <Link>
        <Name>protein_biosystems</Name>
        <Menu>BioSystem Links</Menu>
        <Description>BioSystems</Description>
      </Link>
    </LinkList>
  </DbInfo>
</eInfoResult>
Performing a Global Entrez Search

egquery.fcgi?term=<query>

Input: Entrez text query (&term)

Output: XML containing the number of hits in each database.

Example: Determine the number of records for mouse in Entrez.


For More Information

Please see EGQuery In-Depth for a full description of EGQuery.

Sample EGQuery Output

<?xml version="1.0"?>
<!--
$Id: egquery_template.xml 106311 2007-06-26 14:46:31Z osipov $
-->
<!-- ================================================================= -->
<Result>
	<Term>mouse[orgn]</Term>
	<eGQueryResult>
		<ResultItem>
			<DbName>pubmed</DbName>
			<MenuName>PubMed</MenuName>
			<Count>0</Count>
			>Status>Term or Database is not found</Status>
		</ResultItem>
		<ResultItem>
			<DbName>pmc</DbName>
			<MenuName>PMC</MenuName>
			<Count>3823</Count>
			>Status>Ok</Status>
		</ResultItem>
	...</ResultItem>
</eGQueryResult>
</Result>
<ResultItem>
    <DbName>nucore</DbName>
    <MenuName>Nucleotide</MenuName>
    <Count>1739903</Count>
    <Status>Ok</Status>
</ResultItem>

<ResultItem>
    <DbName>nucgss</DbName>
    <MenuName>GSS</MenuName>
    <Count>2264567</Count>
    <Status>Ok</Status>
</ResultItem>

<ResultItem>
    <DbName>nucest</DbName>
    <MenuName>EST</MenuName>
    <Count>4852140</Count>
    <Status>Ok</Status>
</ResultItem>

<ResultItem>
    <DbName>protein</DbName>
    <MenuName>Protein</MenuName>
    <Count>255212</Count>
    <Status>Ok</Status>
</ResultItem>

...  

<ResultItem>
    <DbName>proteinclusters</DbName>
    <MenuName>Protein Clusters</MenuName>
    <Count>13</Count>
    <Status>Ok</Status>
</ResultItem>

</eGQueryResult>

Retrieving Spelling Suggestions

espell.fcgi?term=<query>&db=<database>

Input: Entrez text query (&term); Entrez database (&db)

Output: XML containing the original query and spelling suggestions.

Example: Find spelling suggestions for the PubMed Central query ‘fiberblast cell growth’.


For More Information

Please see ESpell In-Depth for a full description of EGQuery.
Sample ESpell Output

<?xml version="1.0"?>
<eSpellResult>
  <Database>pmc</Database>
  <Query>fiberblast cell grwth</Query>
  <CorrectedQuery>fibroblast cell growth</CorrectedQuery>
  <SpelledQuery>
    <Replaced>fibroblast</Replaced>
    <Original> cell </Original>
    <Replaced>growth</Replaced>
  </SpelledQuery>
  <ERROR/>
</eSpellResult>

Demonstration Programs

EBot

EBot is an interactive web tool that first allows users to construct an arbitrary E-utility analysis pipeline and then generates a Perl script to execute the pipeline. The Perl script can be downloaded and executed on any computer with a Perl installation. For more details, see the EBot page linked above.

Sample Perl Scripts

The two sample Perl scripts below demonstrate basic E-utility functions. Both scripts should be copied and saved as plain text files and can be executed on any computer with a Perl installation.

ESearch-EFetch demonstrates basic search and retrieval functions.

```perl
#!/usr/local/bin/perl -w
# =======================================================================
#
#                            PUBLIC DOMAIN NOTICE
#               National Center for Biotechnology Information
#
# This software/database is a "United States Government Work" under the
# terms of the United States Copyright Act. It was written as part of
# the author's official duties as a United States Government employee and
# thus cannot be copyrighted. This software/database is freely available
# to the public for use. The National Library of Medicine and the U.S.
# Government have not placed any restriction on its use or reproduction.
#
# Although all reasonable efforts have been taken to ensure the accuracy
# and reliability of the software and data, the NLM and the U.S.
# Government do not and cannot warrant the performance or results that
# may be obtained by using this software or data. The NLM and the U.S.
# Government disclaim all warranties, express or implied, including
# warranties of performance, merchantability or fitness for any particular
# purpose.
```
# Please cite the author in any work or product based on this material.
# ---------------------------------------------------------------------
# Author: Oleg Khovayko
# File Description: eSearch/eFetch calling example
# ---------------------------------------------------------------------
# Subroutine to prompt user for variables in the next section

sub ask_user {
    print "$_[0] [$_[1]]: ";
    my $rc = <>;
    chomp $rc;
    if($rc eq "") { $rc = $_[1]; }
    return $rc;
}

# ---------------------------------------------------------------------
# Define library for the 'get' function used in the next section.
# $utils contains route for the utilities.
# $db, $query, and $report may be supplied by the user when prompted;
# if not answered, default values, will be assigned as shown below.

use LWP::Simple;


my $db     = ask_user("Database", "Pubmed");
my $query  = ask_user("Query", "zanzibar");
my $report = ask_user("Report", "abstract");

# ---------------------------------------------------------------------
# $esearch contains the PATH & parameters for the ESearch call
# $esearch_result contains the result of the ESearch call
# the results are displayed and parsed into variables $Count, $QueryKey, and $WebEnv for later use and then displayed.

my $esearch = "$utils/esearch.fcgi?" .
    "db=$db&retmax=1&usehistory=y&term=";

my $esearch_result = get($esearch . $query);

print "\nESEARCH RESULT: $esearch_result\n";

$esearch_result =~
    m|<Count>(\d+)</Count>.*<QueryKey>(\d+)</QueryKey>.*<WebEnv>(\S+)</WebEnv>|s;

my $Count    = $1;

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my $QueryKey = $2;
my $WebEnv   = $3;

print "Count = $Count; QueryKey = $QueryKey; WebEnv = $WebEnv\n";

# this area defines a loop which will display $retmax citation results from
# Efetch each time the the Enter Key is pressed, after a prompt.

my $retstart;
my $retmax=3;

for($retstart = 0; $retstart < $Count; $retstart += $retmax) {
    my $efetch = "$utils/efetch.fcgi?"
        "rettype=$report&retmode=text&retstart=$retstart&retmax=
        $retmax&"
        "db=$db&query_key=$QueryKey&WebEnv=$WebEnv";

    print "\nEF_QUERY=$efetch\n";
    my $efetch_result = get($efetch);
    print "---------\nEFETCH RESULT(\n(".
    ($retstart + 1) . "." . ($retstart + $retmax) . ": ".
    "[$efetch_result]\n-----PRESS ENTER!!!\n";
    <>>;
}

EPost-E Summary demonstrates basic uploading and document summary retrieval.

#!/usr/local/bin/perl -w
# =======================================================================
#                            PUBLIC DOMAIN NOTICE
#               National Center for Biotechnology Information
#  This software/database is a "United States Government Work" under the
#  terms of the United States Copyright Act. It was written as part of
#  the author's official duties as a United States Government employee and
#  thus cannot be copyrighted. This software/database is freely available
#  to the public for use. The National Library of Medicine and the U.S.
#  Government have not placed any restriction on its use or reproduction.
#  Although all reasonable efforts have been taken to ensure the accuracy
#  and reliability of the software and data, the NLM and the U.S.
#  Government do not and cannot warrant the performance or results that
#  may be obtained by using this software or data. The NLM and the U.S.
#  Government disclaim all warranties, express or implied, including
#  warranties of performance, merchantability or fitness for any particular
#  purpose.
#  Please cite the author in any work or product based on this material.
my $ePost_url = "$eutils_root/epost.fcgi";
my $eSummary_url = "$eutils_root/esummary.fcgi";
my $db_name = "PubMed";

use strict;
use LWP::UserAgent;
use LWP::Simple;
use HTTP::Request;
use HTTP::Headers;
use CGI;

# Read input file into variable $file
# File name - first argument $ARGV[0]

open IF, $ARGV[0] || die "Can't open for read: $!
";
my $file = <IF>;
close IF;
print "Loaded file: [$file]\n";

# Prepare file - substitute all separators to comma
$file =~ s/\s+/,/gs;
print "Prepared file: [$file]\n";

# Create CGI param line
my $form_data = "db=$db_name&id=$file";

# Create HTTP request
my $headers = new HTTP::Headers(  
    Accept        => "text/html, text/plain",  
    Content_Type  => "application/x-www-form-urlencoded"
);

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my $request = new HTTP::Request("POST", $ePost_url, $headers);
$request->content($form_data);

# Create the user agent object
my $ua = new LWP::UserAgent;
$ua->agent("ePost/example");

# send file to ePost by HTTP
my $response = $ua->request($request);

# Parse response->content and extract QueryKey & WebEnv
$response->content =~
m|<QueryKey>(\d+)</QueryKey>.*<WebEnv>(\S+)</WebEnv>|s;
my $QueryKey = $1;
my $WebEnv = $2;

print "\nEXTRACTED:\nQueryKey = $QueryKey;\nWebEnv = $WebEnv\n";

# Retrieve DocSum from eSummary by simple::get method and print it
print "\neSummary result: [" .
get("$eSummary_url?db=$db_name&query_key=$QueryKey&WebEnv=$WebEnv") .
"]\n";

For More Information

Announcement Mailing List

NCBI posts general announcements regarding the E-utils to the utilities-announce announcement mailing list. This mailing list is an announcement list only; individual subscribers may not send mail to the list. Also, the list of subscribers is private and is not shared or used in any other way except for providing announcements to list members. The list receives about one posting per month. Please subscribe at the above link.

Getting Help

Please refer to the PubMed and Entrez help documents for more information about search queries, database indexing, field limitations and database content.

Suggestions, comments, and questions specifically relating to the EUtility programs may be sent to eutilities@ncbi.nlm.nih.gov.

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