



Yes, if you train quickly, you can become a **SWISS-PROT** annotator before the human proteome is done, but first eat your dinner!

databases

Database or databank?

Initially

- Databank (in UK)
- Database (in the USA)

Solution

- The abbreviation *db*

What is a Database?

A **structured collection** of data held in computer storage; *esp.* one that incorporates software to make it accessible in a variety of ways; *transf.*, any **large collection** of information.

OR

A *database* is a computerized archive used to store and organize data in such a way that information can be retrieved easily via a variety of search criteria.

Although data retrieval is the main purpose of all databases, biological databases often have a higher level of requirement, known as ***knowledge discovery***, which refers to the identification of connections between pieces of information that were not known when the information was first entered.

What is a database?

- A collection of data
 - structured
 - searchable (index) -> table of contents
 - updated periodically (release) -> new edition
 - cross-referenced ([hyperlinks](#)) -> links with other db
- Includes also associated tools (software) necessary for access, updating, information insertion, information deletion....
- Data storage management: flat files, relational databases...

Database: a flat file

Originally, databases all used a flat file format, which is a long text file that contains many entries separated by a *delimiter*

Within each entry are a number of fields separated by tabs or commas. Except for the raw values in each field, the entire text file does not contain any hidden instructions for computers to search for specific information or to create reports based on certain fields from each record. The text file can be considered a single table.

Thus, to search a flat file for a particular piece of information, a computer has to read through the entire file, an obviously inefficient process. This is manageable for a small database, but as database size increases or data types become more complex, this database style can become very difficult for information retrieval.

- **Relational databases** use a set of tables to organize data. Each table, also called a *relation*, is made up of columns and rows.
- The columns in a table are indexed according to a common feature called an *attribute*, so they can be cross-referenced in other tables.
- To execute a query in a relational database, the system selects linked data items from different tables and combines the information into one report.

Flat File

Name, States, Course number, Course name|John Smith, Texas, Biol 689, Bioinformatics|Jane Doe, Kansas, Bich 441, Biochemistry|William Brown, Illinois, Chem 289, Organic Chemistry|Jennifer Taylor, New York, Hort 201, Horticulture|Howard Douglas, Texas, Math 172, Calculus

Table A

Student #	Name	State
1	John Smith	Texas
2	Jane Doe	Kansas
3	William Brown	Illinois
4	Jennifer Taylor	New York
5	Howard Douglas	Texas

Table B

Student #	Course #
1	Biol 689
2	Bich 441
3	Chem 289
4	Hort 201
5	Math 172

Table C

Course #	Course name
Biol 689	Bioinformatics
Bich 441	Biochemistry
Chem 289	Organic chemistry
Hort 201	Horticulture
Math 172	Calculus

Figure 2.1: Example of constructing a relational database for five students' course information originally expressed in a flat file. By creating three different tables linked by common fields, data can be easily accessed and reassembled.

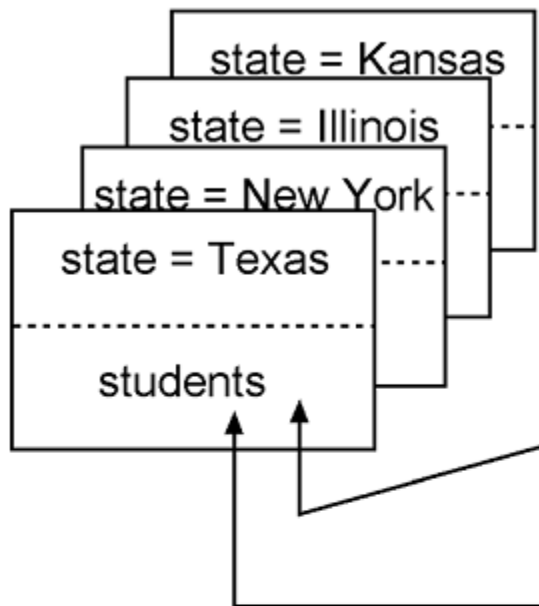
• Some databases in the field of molecular biology...

AATDB, AceDb, ACUTS, ADB, AFDB, AGIS, AMSdb,
ARR, AsDb, BBDB, BCGD, Beanref, Biolmage,
BioMagResBank, BIOMDB, BLOCKS, BovGBASE,
BOVMAP, BSORF, BTKbase, CANSITE, CarbBank,
CARBHYD, CATH, CAZY, CCDC, CD4OLbase, CGAP,
ChickGBASE, Colibri, COPE, CottonDB, CSNDB, CUTG,
CyanoBase, dbCFC, dbEST, dbSTS, DDBJ, DGP, DictyDb,
Picty_cDB, DIP, DOGS, DOMO, DPD, DPlInteract, ECDC,
ECGC, EC02DBASE, EcoCyc, EcoGene, EMBL, EMD db,
ENZYME, EPD, EpoDB, ESTHER, FlyBase, FlyView,
GCRDB, GDB, GENATLAS, Genbank, GeneCards,
Genline, GenLink, GENOTK, GenProtEC, GIFTS,
GPCRDB, GRAP, GRBase, gRNAsdb, GRR, GSDB,
HAEMB, HAMSTERS, HEART-2DPAGE, HEXadb, HGMD,
HIDB, HIDC, HIVdb, HotMolecBase, HOVERGEN, HPDB,
HSC-2DPAGE, ICN, ICTVDB, IL2RGbase, IMGT, Kabat,
KDNA, KEGG, Klotho, LGIC, MAD, MaizeDb, MDB,
Medline, Mendel, MEROPS, MGDB, MGI, MHCPEP5
Micado, MitoDat, MITOMAP, MJDB, MmtDB, Mol-R-Ur,
MPDB, MRR, MutBase, MycDB, NDB, NRSUB, O-lycBase,
OMIA, OMIM, OPD, ORDB, OWL, PAHdb, PatBase, PDB,
PDD, Pfam, PhosphoBase, PigBASE, PIR, PKR, PMD,
PPDB, PRESAGE, PRINTS, ProDom, Prolysis, PROSITE,
PROTOMAP, RatMAP, RDP, REBASE, RGP, SBASE,
SCOP, SeqAnaiRef, SGD, SGP, SheepMap, Soybase,
SPAD, SRNA db, SRPDB, STACK, StyGene, Sub2D,
SubtiList, SWISS-2DPAGE, SWISS-3DIMAGE, SWISS-
MODEL Repository, SWISS-PROT, TelDB, TGN, tmRDB,
TOPS, TRANSFAC, TRR, UniGene, URNADB, V BASE,
VDRR, VectorDB, WDCM, WIT, WormPep, YEPD, YPD,
YPM, etc !!!!

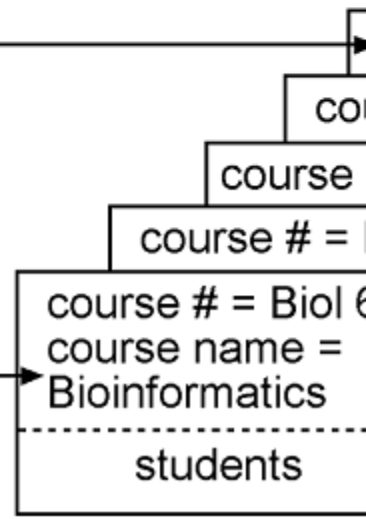
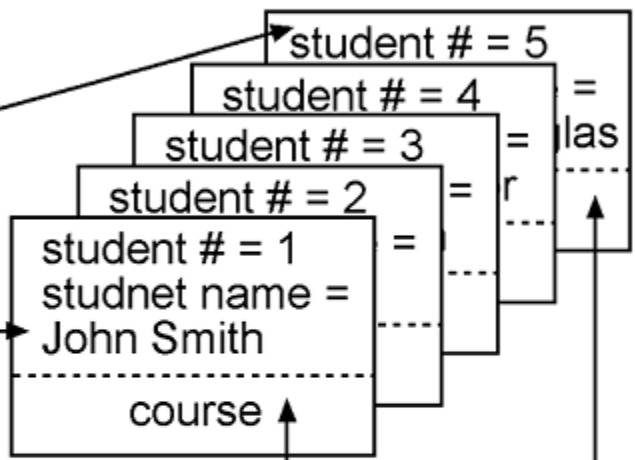
Object-Oriented Databases

- Store data as objects.
- An object can be considered as a unit that combines data and mathematical routines that act on the data.
- Structured such that the objects are linked by a set of pointers defining predetermined relationships b/w the objects.
- Programming languages like C++ are used to create object-oriented databases.
- OOD is more flexible; data can be structured based on hierarchical relationships.
- OOD lacks the rigorous mathematical foundation of the relational databases
- There is also a risk that some of the relationships between objects may be misrepresented

State Object



Student Object



Biological Databases:

Based on their contents, biological databases can be roughly divided into three categories:

Primary databases contain original biological data. They are archives of raw sequence or structural data submitted by the scientific community. GenBank and Protein Data Bank (PDB) are examples of primary databases.

Secondary databases contain computationally processed or manually curated information, based on original information from primary databases. Translated protein sequence databases containing functional annotation belong to this category. Examples are SWISS-Prot and Protein Information Resources (PIR).

Specialized databases are those that cater to a particular research interest. For example, Flybase, HIV sequence database, and Ribosomal Database Project are databases that specialize in a particular organism or a particular type of data.

TABLE 2.1. Major Biological Databases Available Via the World Wide Web

Databases and Retrieval Systems	Brief Summary of Content	URL
AceDB	Genome database for <i>Caenorhabditis elegans</i>	www.acedb.org
DDBJ	Primary nucleotide sequence database in Japan	www.ddbj.nig.ac.jp
EMBL	Primary nucleotide sequence database in Europe	www.ebi.ac.uk/embl/index.html
Entrez	NCBI portal for a variety of biological databases	www.ncbi.nlm.nih.gov/gquery/gquery
ExPASy	Proteomics database	http://us.expasy.org/
FlyBase	A database of the <i>Drosophila</i> genome	http://flybase.bio.indiana.edu/
FSSP	Protein secondary structures	www.bioinfo.biocenter.helsinki.fi:8080
GenBank	Primary nucleotide sequence database in NCBI	www.ncbi.nlm.nih.gov/Genbank
HIV databases	HIV sequence data and related immunologic information	www.hiv.lanl.gov/content/index
Microarray gene	DNA microarray data and analysis tools	www.ebi.ac.uk/microarray

Interconnection between Biological Databases

- There is a demand for linking different databases
- The main barrier is format incompatibility
- One solution to networking the databases is COBRA
- Works in a way similar to HTML labeling database entries using a set of common tags
- XML also helps in bridging databases. In this format, each biological record is broken down into small, basic components that are labeled with a hierarchical nesting of tags

PITFALLS OF BIOLOGICAL DATABASES

- Overreliance on sequence information and related annotations
- High levels of redundancy in the primary sequence databases
- The solution is RefSeq, SWISS-PROT, *Gene Ontology* etc.

INFORMATION RETRIEVAL FROM BIOLOGICAL DATABASES

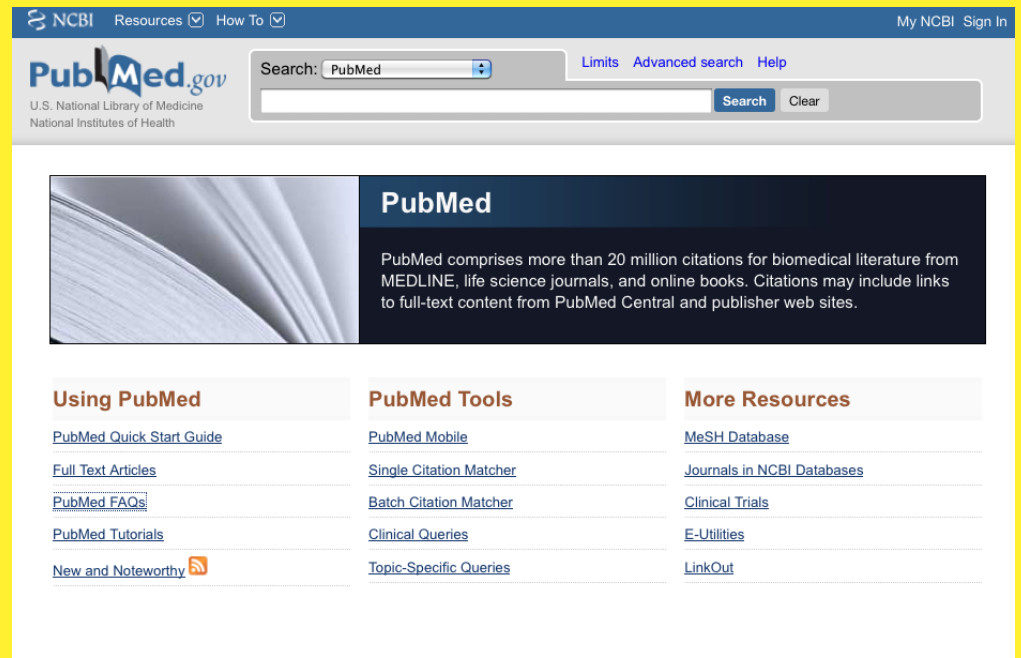
- Major goal in developing databases is to provide efficient and user friendly access to the data stored. There are a number of retrieval systems for biological data. The most popular retrieval systems for biological databases are Entrez and Sequence Retrieval Systems (SRS) that provide access to multiple databases for retrieval of integrated search results.

Entrez

- It is a gateway that allows text-based searches for a wide variety of data, including annotated genetic sequence information, structural information, as well as citations and abstracts, full papers, and taxonomic data.
- The key feature of Entrez is its ability to integrate information, which comes from cross-referencing between NCBI databases based on preexisting and logical relationships between individual entries

PubMed (Medline)

- MEDLINE covers the fields of medicine, nursing, dentistry, veterinary medicine, public health, and **preclinical sciences**
- Contains citations from approximately 5,200 worldwide journals in 37 languages; 60 languages for older journals.
- Contains over 20 million citations since 1948
- Contains links to biological db and to some journals
- New records are added to PreMEDLINE daily!



The screenshot shows the PubMed website interface. At the top, there is a navigation bar with "NCBI Resources" and "How To" menus, and a "My NCBI Sign In" link. Below this is the "PubMed.gov" logo, which includes the text "U.S. National Library of Medicine" and "National Institutes of Health". To the right of the logo is a search bar with the text "Search: PubMed" and a dropdown arrow. Below the search bar are "Limits", "Advanced search", and "Help" links. A "Search" button and a "Clear" button are also present. Below the search bar is a large banner with a blue background and a white text box. The banner features a close-up image of a book's pages on the left and the text "PubMed" in a large, bold font on the right. Below the banner is a section titled "Using PubMed" with a list of links: "PubMed Quick Start Guide", "Full Text Articles", "PubMed FAQs", "PubMed Tutorials", and "New and Noteworthy". To the right of this section is a section titled "PubMed Tools" with a list of links: "PubMed Mobile", "Single Citation Matcher", "Batch Citation Matcher", "Clinical Queries", and "Topic-Specific Queries". To the right of that is a section titled "More Resources" with a list of links: "MeSH Database", "Journals in NCBI Databases", "Clinical Trials", "E-Utilities", and "LinkOut".

Search PubMed for human HIV 1

Limits

Preview/Index

History

Clipboard

Details

- Use All Fields pull-down menu to specify a field.
- Boolean operators AND, OR, NOT must be in upper case.
- If search fields tags are used enclose in square brackets, e.g., rubella [ti].
- Search [limits](#) may exclude in process and publisher supplied citations.

Limited to:

All Fields
 All Fields
 Author
 Corporate Author
 EC/RN Number
 Entrez Date
 Filter
 First Author
 Full Author Name
 Grant Number
 Issue
 Journal

only items with abstracts

Languages

Humans or Animals

To
 month and day are optional.

Subsets
 Subsets
 AIDS
 Bioethics
 Cancer
 Complementary Medicine
 Core clinical journals
 Dental journals
 History of Medicine
 MEDLINE
 Nursing journals
 OLDMEDLINE for Pre1966

About Entrez

Text Version

Entrez PubMed

Overview

Help | FAQ

Tutorial

New/Noteworthy

E-Utilities

PubMed Services

Journals Database

MeSH Database

Single Citation

Matcher

Search PubMed for human HIV 1 Preview Go Clear

Limits **Preview/Index** History Clipboard Details

- Enter terms and click Preview to see only the number of search results.
- To combine searches use # before search number, e.g., (#2 OR #3) AND asthma.
- Click on query # to add to strategy

Search Most Recent Queries

[#2](#) Search human HIV 1

Add Term(s) to Query or View Index:

- Enter a term in the text box; use the pull-down menu to specify a search field.
- Click Preview to add terms to the query box and see the number of search results, or click Index to view terms within

All Fields Preview Index

Affiliation

All Fields add a term to the query box.

Author

Corporate Author

EC/RN Number

Entrez Date

Filter

First Author

Full Author Name

Grant Number

Issue

Search Field Descriptions and Tags

Affiliation [AD] All Fields [ALL] Author [AU] Comment Corrections Corporate Author [CN] EC/RN Number [RN] Entrez Date [EDAT] Filter [FILTER] First Author Name [1AU] Full Author Name [FAU] Full Investigator Name [FIR] Grant Number [GR] Investigator [IR]	Issue [IP] Journal Title [TA] Language [LA] Last Author [LASTAU] MeSH Date [MHDA] MeSH Major Topic [MAJR] MeSH Subheadings [SH] MeSH Terms [MH] NLM Unique ID [JID] Other Term [OT] Owner Pagination [PG] Personal Name as Subject [PS] Pharmacological Action MeSH Terms [PA]	Place of Publication [PL] Publication Date [DP] Publication Type [PT] Publisher Identifier [AID] Secondary Source ID [SI] Subset [SB] Substance Name [NM] Text Words [TW] Title [TI] Title/Abstract [TIAB] Transliterated Title [TT] UID [PMID] Volume [VI]
--	---	---

A search by authors:

“Esser” [au] AND “martin” [au]

NCBI Resources How To My NCBI Sign In

PubMed.gov
U.S. National Library of Medicine
National Institutes of Health

Search: PubMed
"Esser C" [au] AND "Martin W" [au] Search Clear

Display Settings: Summary, Sorted by Recently Added Send to:

Results: 4

- [Supertrees and symbiosis in eukaryote genome evolution.](#)
1. **Esser C, Martin W.**
Trends Microbiol. 2007 Oct;15(10):435-7. Epub 2007 Sep 19.
PMID: 17884500 [PubMed - indexed for MEDLINE]
[Related citations](#)
- [The origin of mitochondria in light of a fluid prokaryotic chromosome model.](#)
2. **Esser C, Martin W, Dagan T.**
Biol Lett. 2007 Apr 22;3(2):180-4.
PMID: 17251118 [PubMed - indexed for MEDLINE] **Free PMC Article**
[Free full text](#) [Related citations](#)
- [A genome phylogeny for mitochondria among alpha-proteobacteria and a predominantly eubacterial ancestry of yeast nuclear genes.](#)
3. **Esser C, Ahmadinejad N, Wiegand C, Rotte C, Sebastiani F, Gelius-Dietrich G, Henze K, Kretschmann E, Richly E, Leister D, Bryant D, Steel MA, Lockhart PJ, Penny D, Martin W.**
Mol Biol Evol. 2004 Sep;21(9):1643-60. Epub 2004 May 21.
PMID: 15155797 [PubMed - indexed for MEDLINE] **Free Article**
[Related citations](#)
- [Phylogenomics of the reproductive parasite Wolbachia pipientis wMel: a streamlined genome overrun by mobile genetic elements.](#)
4. Wu M, Sun LV, Vamathevan J, Riegler M, Deboy R, Brownlie JC, McGraw EA, **Martin W, Esser C**, Ahmadinejad N, Wiegand C, Madupu R, Beanan MJ, Brinkac LM, Daugherty SC, Durkin AS, Kolonay JF, Nelson WC, Mohamoud Y, Lee P, Berry K, Young MB, Utterback T, Weidman J, Nierman WC, Paulsen IT, Nelson KE, Tettelin H, O'Neill SL, Eisen JA.
PLoS Biol. 2004 Mar;2(3):E69. Epub 2004 Mar 16.
PMID: 15024419 [PubMed - indexed for MEDLINE] **Free PMC Article**
[Free full text](#) [Related citations](#)

Display Settings: Summary, Sorted by Recently Added Send to:

Filter your results:

All (4)
[Free Full Text \(3\)](#)
Review (0)
[Manage Filters](#)

Save Results in Collections Tutorial

My NCBI — Collections

Select	All	Name	0 items selected	Merge	Delete	Sharing	Last Modified	Type
<input type="checkbox"/>	<input type="checkbox"/>	My Bibliography				Public	last month	Standard
<input type="checkbox"/>	<input type="checkbox"/>	Other Clonings	0			Private	never	Standard
<input type="checkbox"/>	<input type="checkbox"/>	pancreatic cancer	1000			Private	last month	PubMed
<input type="checkbox"/>	<input type="checkbox"/>	p53 acetylation, reviews	95			Private	last month	PubMed
<input type="checkbox"/>	<input type="checkbox"/>	obstructive sleep apnea in children	356			Public	today	PubMed

0:00 / 2:32

See larger video at YouTube
See all NCBI YouTube video channel videos

2 free full-text articles in PubMed Central

The origin of mitochondria in light of a fluid prokaryotic chromosome model. [Biol Lett. 2007]
Phylogenomics of the reproductive parasite Wolbachia pipientis wMel: a stre [PLoS Biol. 2004]
See all (2)...

A search by title word:

“Wolbachia pipientis” [ti]

Entrez PubMed

http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?CMD=search&DB=pubmed

NCBI PubMed A service of the National Library of Medicine and the National Institutes of Health

Search PubMed for "Wolbachia pipientis" [ti] Go Clear Save Search

Display Summary Show 20 Sort by Send to

All: 29 Review: 3

Items 1 - 20 of 29 Page 1 of 2 Next

- 1:** [Makepeace BL, Rodgers L, Trees AJ.](#) Related Articles, Links
Rate of elimination of *Wolbachia pipientis* by doxycycline in vitro increases following drug withdrawal. *Antimicrob Agents Chemother.* 2006 Mar;50(3):922-7. PMID: 16495252 [PubMed - indexed for MEDLINE]
- 2:** [Casiraghi M, Bordenstein SR, Baldo L, Lo N, Beninati T, Wernegreen JJ, Werren JH, Bandi C.](#) Related Articles, Links
Phylogeny of *Wolbachia pipientis* based on *gltA*, *groEL* and *ftsZ* gene sequences: clustering of arthropod and nematode symbionts in the F supergroup, and evidence for further diversity in the *Wolbachia* tree. *Microbiology.* 2005 Dec;151(Pt 12):4015-22. PMID: 16339946 [PubMed - indexed for MEDLINE]
- 3:** [Mavingui P, Van VT, Labeyrie E, Rances E, Vavre F, Simonet P.](#) Related Articles, Links
Efficient procedure for purification of obligate intracellular *Wolbachia pipientis* and representative amplification of its genome by multiple-displacement amplification. *Appl Environ Microbiol.* 2005 Nov;71(11):6910-7. PMID: 16269725 [PubMed - indexed for MEDLINE]
- 4:** [Iturbe-Ormaetxe I, Burke GR, Riegler M, O'Neill SL.](#) Related Articles, Links
Distribution, expression, and motif variability of ankyrin domain genes in *Wolbachia pipientis*. *J Bacteriol.* 2005 Aug;187(15):5136-45. PMID: 16030207 [PubMed - indexed for MEDLINE]

Database Search Strategies

- General search principles - not limited to sequence (or to biology).
- Start with broad keywords and narrow the search using more specific terms.
- Try variants of spelling, numbers, etc.
- Search many databases.
- **Be persistent!!**

Searching PubMed

- Structureless searches
 - Automatic term mapping
- Structured searches
 - Tags, e.g. [au], [ta], [dp], [ti]
 - Boolean operators, e.g. AND, OR, NOT, ()
- Additional features
 - Subsets, limits
 - Clipboard, history

Start working:

Search PubMed

- 1. cuban cigars**
- 2. cuban OR cigars**
- 3. “cuban cigars”**
- 4. cuba* cigar***
- 5. (cuba* cigar*) NOT smok***
- 6. Fidel Castro**
- 7. “fidel castro”**
- 8. #6 NOT #7**

“Details” and “History” in PubMed

The screenshot displays the PubMed website interface. At the top left is the NCBI logo. The main header features the PubMed logo and the text "A service of the National Library of Medicine and the National Institutes of Health" with the URL "www.pubmed.gov". Below the header is a navigation bar with tabs for "All Databases", "PubMed", "Nucleotide", "Protein", "Genome", "Structure", "OMIM", "PMC", and "Journals". The search bar contains the text "PubMed" and "for castro j", with "Go", "Clear", and "Save Search" buttons. Below the search bar are tabs for "Limits", "Preview/Index", "History", "Clipboard", and "Details". The "Details" tab is selected. The interface shows "Display Summary" and "Show 20" items. The search results are summarized as "All: 1326" and "Review: 57". The first two items are listed:

- 1:** [Lindblade KA, Arana B, Zea-Flores G, Rizzo N, Porter CH, Dominguez A, Cruz-Ortiz N, Unnasch TR, Punkosdy GA, Richards J, Sauerbrey M, Castro J, Catu E, Oliva O, Richards FO Jr.](#)
Elimination of *Onchocercia volvulus* Transmission in the Santa Rosa Focus of Guatemala.
Am J Trop Med Hyg. 2007 Aug;77(2):334-341.
PMID: 17690408 [PubMed - as supplied by publisher]
- 2:** [Cook CB, Castro JC, Schmidt RE, Gauthier SM, Whitaker MD, Roust LR, Argueta R, Hull BP, Zimmerman RS.](#)
Diabetes care in hospitalized noncritically ill patients: More evidence for clinical inertia and negative therapeutic momentum.
J Hosp Med. 2007 Aug 7;2(4):203-211 [Epub ahead of print]
PMID: 17683100 [PubMed - as supplied by publisher]

“Details” and “History” in PubMed

The screenshot displays the PubMed interface. At the top, the NCBI logo is on the left, and the PubMed logo with the URL www.pubmed.gov and the text "A service of the National Library of Medicine and the National Institutes of Health" is on the right. Below the header, a navigation bar includes "All Databases", "PubMed", "Nucleotide", "Protein", and "Genome". The search bar contains "PubMed" in a dropdown menu, "for castro j" in the input field, and "Go" and "Clear" buttons. Below the search bar, a row of tabs includes "Limits", "Preview/Index", "History", "Clipboard", and "Details", with "Details" being the active tab. The main content area shows a "Query Translation:" section with a text box containing "castro j[Author]". Below this, there are "Search" and "URL" buttons. The "Result:" section shows a count of "1326". The "Translations:" section shows a table with two columns: "castro j" and "castro j[Author]". The "Database:" section shows "PubMed". The "User query:" section shows "castro j". On the left side of the page, there is a sidebar with various links including "About Entrez", "Text Version", "Entrez PubMed", "PubMed Services", and "Related Resources".

NCBI

PubMed
www.pubmed.gov
A service of the National Library of Medicine
and the National Institutes of Health

All Databases PubMed Nucleotide Protein Genome

Search PubMed for castro j Go Clear

Limits Preview/Index History Clipboard **Details**

Query Translation:
castro j[Author]

Search URL

Result:
1326

Translations:

castro j	castro j[Author]
----------	------------------

Database:
PubMed

User query:
castro j

About Entrez
Text Version
Entrez PubMed
Overview
Help | FAQ
Tutorials
New/Noteworthy
E-Utilities
PubMed Services
Journals Database
MeSH Database
Single Citation
Matcher
Batch Citation
Matcher
Clinical Queries
Special Queries
LinkOut
My NCBI
Related Resources
Order Documents
NLM Mobile
NLM Catalog

The **OMIM** (**O**nline **M**endelian **I**nheritance in **M**an)

- Genes and genetic disorders
- Edited by team at Johns Hopkins
- Updated daily

MIM Number Prefixes

- * gene with known sequence
- + gene with known sequence and phenotype
- # phenotype description, molecular basis known
- % mendelian phenotype or locus, molecular basis unknown
- no prefix other, mainly phenotypes with suspected mendelian basis

Searching OMIM

- Search Fields
 - Name of trait, e.g., hypertension
 - Cytogenetic location, e.g., 1p31.6
 - Inheritance, e.g., autosomal dominant
 - Gene, e.g., coagulation factor VIII

OMIM search tags

All Fields	[ALL]
Allelic Variant	[AV] or [VAR]
Chromosome	[CH] or [CHR]
Clinical Synopsis	[CS] or [CLIN]
Gene Map	[GM] or [MAP]
Gene Name	[GN] or [GENE]
Reference	[RE] or [REF]



All Databases

PubMed

Nucleotide

Protein

Genome

Structure

Search OMIM

for f8c

Go

Clear

Limits

Preview/Index

History

Clipboard

Details

Entrez

OMIM

Search OMIM

Search Gene Map

Search Morbid Map

Help

OMIM Help

How to Link

FAQ

Numbering System

Symbols

How to Print

Citing OMIM

Download

OMIM Facts

Statistics

Update Log

Restrictions on Use

Allied Resources

Genetic Alliance

Databases

HGMD

Locus-Specific

Model Organisms

MitoMap

Phenotype

- To Search all fields, leave the following boxes unchecked.
- To narrow the search, check the boxes with specific fields' names, or use [search field tags](#) enclosed in square brackets, e.g. aaa[title].
- [Boolean operators](#) AND, OR, NOT must be in upper case.

Search in Field(s):

clear

- Title MIM number Allelic Variants
 Text References Clinical Synopsis
 Gene Map Disorder Contributors

Chromosome(s):

clear

- 1 2 3 4 5 6 7 8
 9 10 11 12 13 14 15 16
 17 18 19 20 21 22 X Y
 mitochondrial unknown

MIM Number Prefix:

clear

- * gene with known sequence
 + gene with known sequence and phenotype
 # phenotype description, molecular basis known
 % mendelian phenotype or locus, molecular basis unknown
 ncbe other, mainly phenotypes with suspected mendelian basis

Only Records with:

clear

- Allelic Variants
 Clinical Synopsis
 Gene map locus

Creation Date From To

Last Modification From To

Use the format YYYY/MM/DD; month and day are optional.

Start working:

Search OMIM

How many types of hemophilia are there?

For how many is the affected gene known?

What are the genes involved in hemophilia A?

What are the mutations in hemophilia A?