



Medical University of Graz

Biomedical Databases

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Documentation

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Educational goals

- Understand basic concepts of databases
 - Database management systems
 - Database access
 - Database curation
 - Database semantics
 - Controlled vocabularies and databases
- Explore important databases for biomedical research
 - Literature databases: Pubmed / Medline / Web of Science / Google Scholar
 - Databases to support health care: UpToDate
 - Databases to support clinical research: ClinicalTrials.gov
 - Databases to support omics research: Uniprot, GeneBank, NCBI databases

Organization of Lecture

- Scope
 - Database Basics
 - General & Medical databases
 - OMICS databases
- Interactive
- Use you own device
- Ask questions – I'll try to answer them
- Give me feedback
- Language:

Austrians

ENGLISH

Germans

Others

What are databases?

- Represent real world objects and their dependencies in a data model
- A DBMS (Database Management System) is the “container” of a database. It provides a syntax for working with the database.
Typical DBMSs: Oracle, MS SQL Server, MySQL, MS Access
- Databases can be found in most IT systems that manage data
- Interfaces:
 - Database client application
 - Web interface
 - APIs (application program interfaces)

Typical database operations

Create database objects

Delete data

Search data

Selection / Projection

?

Insert new data

Change data

Example: hospital database

PatID	FallID	Vorname	Name	Titel	Sex	Geburts	SV-Nr	Straße	Ort	PLZ	Land	Aufnahm	Entlassda	Haupt	Hauptdiagnose (Te)
234508973	9829993923	Franz	Brunner		m	12.12.1945	7556121245	Kirchweg 26	Gratkorn	8101	Österreich	12.04.2013	22.04.2013	G20.1	Primäres Parkinson-Syndrom mit
549082235	2341221400	Konstantin	Luttenberger		m	31.08.1963	6643310893	Leibnitzer Str 15	Lebring	8403	Österreich	22.04.2013	04.05.2013	I21.1	Akuter transmuraler Myokardinfarkt der
683654353	2000977623	Elke	Schulze	Mag.	w	03.07.1968	9012030768	Anton-Kleinoscheg-Str 29	Graz	8051	Österreich	25.04.2013	30.07.2013	G82.1	Spastische Paraparese und
545454109	2466375743	Jessica	Strohriegl		w	04.10.1988	9970041088	Rudolfstraße 123	Graz	8010	Österreich	08.04.2013	11.04.2013	H66.0	Akute eitrige Otitis media
236519452	7655545877	Jaden	Klötzl		m	05.11.2009	4646051109	Hofstr 1	Hausmannstätten	8071	Österreich	05.04.2013	31.07.2013	S02.1	Schädelbasisfraktur
843656542	4478477543	Margitta	Schwarzenegger-Klötzl	Dr.	w	12.12.1972	5558121272	Hofstr 1	Hausmannstätten	8071	Österreich	05.04.2013	10.06.2013	S72.7	Multiple Frakturen des Femurs
340009212	7887900352	Bettina	Lammer	Mag.	w	14.02.1956	7823140256	Griesplatz 28	Graz	8020	Österreich	01.04.2013	24.07.2013	F30.2	Manie mit psychotischen
202040563	7578888254	Giuseppe	De Tomaso		m	04.10.1952	6542041052	Leitnergasse 11	Graz	8010	Österreich	02.04.2013	04.04.2013	C43.5	Bösartiges Melanom des Rumpfes
421545873	5847364332	Roman	Terbovc		m	05.01.1975	6684050175	Mladinska ulica 29	Šentilj	2212	Slowenien	13.04.2013	16.04.2013	H66.0	Akute eitrige Otitis media
118702653	8559754441	Maria das Neves	Pinheiro da Silva		w	31.12.1969	7546311269	Leitnergasse 23	Graz	8010	Österreich	16.04.2013	30.04.2013	I21.1	Akuter transmuraler Myokardinfarkt der
342444438	3554640992	Kim	Park		m	23.06.1955	4886230675	Wickenburgg 3	Graz	8010	Österreich	05.04.2013	12.04.2013	E11.1	Diabetes mellitus, Typ 2 mit
464346833	9758002454	Maria	Ehrenberger		w	02.02.1946	2399020246	Volksgartenstaße 3	Graz	8020	Österreich	02.04.2013	21.04.2013	C73	Bösartige Neubildung der
203332422	5450025454	Lisbeth	Puntigam		w	24.04.1971	4886240471	Annenstraße 44	Graz	8020	Österreich	17.04.2013	18.05.2013	I26.9	Lungenembolie ohne Angabe eines
210883233	9895576500	Gerhard	Müller		m	01.02.1918	4755010218	Am Arlandgrund 19	Graz	8045	Österreich	22.04.2013	25.04.2013	H25.2	Cataracta senilis, Morgagni-Typ
234094583	9075465823	Adolf	Brunner		m	21.04.1941	6654210441	Preißgasse 4	Hartberg	8230	Österreich	30.04.2013	23.05.2013	A15.2	Lungentuberkulose, histologisch gesichert
283610234	2002025224	Aise	Devici		w	11.11.1984	5788111184	Hochstadelweg 19	Nußdorf-Debant	9990	Österreich	10.04.2013	13.04.2013	H66.0	Akute eitrige Otitis media
567845242	5564659781	Klaus-Michael	Kohler		m	09.01.1966	7755010966	Müller-Guttenbrunn-Weg 23	Graz-Liebenau	8041	Österreich	21.04.2013	05.05.2013	I21.1	Akuter transmuraler Myokardinfarkt der
457789020	3112143202	Carmen	Meyr		w	03.07.1977	4432030777	Schilfgasse 15	Graz-Straßgang	8054	Österreich	14.04.2013	13.05.2013	S72.7	Multiple Frakturen des Femurs
500545723	5888729364	Muhammad	Üstün		m	06.07.1954	9700060794	Algersdorfer Straße 16	Graz	8020	Österreich	11.04.2013	20.04.2013	E11.1	Diabetes mellitus, Typ 2 mit
687875422	9009736772	Johanna	Hadlic		w	13.08.1929	6734130829	Afritschgasse 36	Graz	8020	Österreich	27.04.2013	03.05.2013	E11.1	Diabetes mellitus, Typ 2 mit
432443502	3434554645	Georg	Moser		m	05.05.1941	7773050541	Freihofanger 2	Graz	8043	Österreich	01.04.2013	30.08.2013	F31.3	Bipolare affektive Störung,
800050524	7676855645	Roberta	Eber		w	03.06.2002	1323030602	Dultstraße 58	Gratkorn	8101	Österreich	05.04.2013	17.06.2013	S02.1	Schädelbasisfraktur
988999523	5000527877	Christiane	Thomüller		w	12.06.1960	2544120690	Göstinger Str 182	Graz	8051	Österreich	12.04.2013	22.04.2013	I21.1	Akuter transmuraler Myokardinfarkt der

PatID	FallID	Vorname	Name	Titel		Geburts	SV-Nr	Straße	Ort	PLZ	Land	Aufnahm	Entlassda	Haupt	Hauptdiagnose (Te)
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549082235	2341221400	Konstantin	Luttenberger		m	31.08.1963	6643310893	Leibnitzer Str 15	Lebring	8403	Österreich	22.04.2013	04.05.2013	I21.1	Akuter transmuraler Myokardinfarkt der
683654353	2000977623	Elke	Schulze	Mag.	w	03.07.1968	9012030768	Anton-Kleinoscheg-Str 29	Graz	8051	Österreich	25.04.2013	30.07.2013	G82.1	Spastische Paraparese und
545454109	2466375743	Jessica	Strohriegl		w	04.10.1988	9970041088	Rudolfstraße 123	Graz	8010	Österreich	08.04.2013	11.04.2013	H66.0	Akute eitrige Otitis media
236519452	7655545877	Jaden	Klötzl		m	05.11.2009	4646051109	Hofstr 1	Hausmannstätten	8071	Österreich	05.04.2013	31.07.2013	S02.1	Schädelbasisfraktur
843656542	4478477543	Margitta	Schwarzenegger-Klötzl	Dr.	w	12.12									Multiple Frakturen des Femurs
340009212	7887900352	Bettina	Lammer	Mag.	w	14.02									Manie mit psychotischen
202040563	7578888254	Giuseppe	De Tomaso		m	04.10									Bösartiges Melanom des Rumpfes
421545873	5847364332	Roman	Terbovc		m	05.01									Akute eitrige Otitis media
118702653	8559754441	Maria das Neves	Pinheiro da Silva		w	31.12									Akuter transmuraler Myokardinfarkt der
342444438	3554640992	Kim	Park		m	23.06									Diabetes mellitus, Typ 2 mit
464346833	9758002454	Maria	Ehrenberger		w	02.02									Bösartige Neubildung der
203332422	5450025454	Lisbeth	Puntigam		w	24.04									Lungenembolie ohne Angabe eines
210883233	9895576500	Gerhard	Müller		m	01.02									Cataracta senilis, Morgagni-Typ
234094583	9075465823	Adolf	Brunner		m	21.04									Lungentuberkulose, histologisch gesichert
283610234	2002025224	Aise	Devici		w	11.11									Akute eitrige Otitis media
567845242	5564659781	Klaus-Michael	Kohler		m	09.01									Akuter transmuraler Myokardinfarkt der
457789020	3112143202	Carmen	Meyr		w	03.07									Multiple Frakturen des Femurs
500545723	5888729364	Muhammad	Üstün		m	06.07									Diabetes mellitus, Typ 2 mit
687875422	9009736772	Johanna	Hadlic		w	13.08.1929	6734130829	Afritschgasse 36	Graz	8020	Österreich	27.04.2013	03.05.2013	E11.1	Diabetes mellitus, Typ 2 mit
432443502	3434554645	Georg	Moser		m	05.05.1941	7773050541	Freihofanger 2	Graz	8043	Österreich	01.04.2013	30.08.2013	F31.3	Bipolare affektive Störung,
800050524	7676855645	Roberta	Eber		w	03.06.2002	1323030602	Dultstraße 58	Gratkorn	8101	Österreich	05.04.2013	17.06.2013	S02.1	Schädelbasisfraktur
988999523	5000527877	Christiane	Thomüller		w	12.06.1960	2544120690	Göstinger Str 182	Graz	8051	Österreich	12.04.2013	22.04.2013	I21.1	Akuter transmuraler Myokardinfarkt der

Relational database schema

- de-Facto-Standard
- Based on Tables:
 - **Rows** contain database records (Tuples, “Datensätze”)
 - **Columns** contain database fields (attributes)
 - **Values** constitute the content of a database

PatID	FallID	Vorname	Name	Titel	Sex	Geburts	SV-Nr	Straße	Ort	PLZ	Land	Aufnahm	Entlassda	Haupt	Hauptdiagnose (Te)
234508973	9829993923	Franz	Brunner		m	12.12.1945	7556121245	Kirchweg 26	Gratkorn	8101	Österreich	12.04.2013	22.04.2013	G20.1	Primäres Parkinson-Syndrom mit
549082235	2341221400	Konstantin	Luttenberger		m	31.08.1963	6643310893	Leibnitzer Str 15	Lebring	8403	Österreich	22.04.2013	04.05.2013	I21.1	Akuter transmuraler Myokardinfarkt der
683654353	2000977623	Elke	Schulze	Mag.	w	03.07.1968	9012030768	Anton-Kleinoscheg-Str 29	Graz	8051	Österreich	25.04.2013	30.07.2013	G82.1	Spastische Paraparese und
545454109	2466375743	Jessica	Strohriegl		w	04.10.1988	9970041088	Rudolfstraße 123	Graz	8010	Österreich	08.04.2013	11.04.2013	H66.0	Akute eitrige Otitis media
236519452	7655545877	Jaden	Klötzl		m	05.11.2009	4646051109	Hofstr 1	Hausmannstätten	8071	Österreich	05.04.2013	31.07.2013	S02.1	Schädelbasisfraktur
843656542	4478477543	Margitta	Schwarzengger-Klötzl	Dr.	w	12.12.1972	5558121272	Hofstr 1	Hausmannstätten	8071	Österreich	05.04.2013	10.06.2013	S72.7	Multiple Frakturen des Femurs
340009212	7887900352	Bettina	Lammer	Mag.	w	14.02.1956	7823140256	Griesplatz 28	Graz	8020	Österreich	01.04.2013	24.07.2013	F30.2	Manie mit psychotischen
202040563	7578888254	Giuseppe	De Tomaso		m	04.10.1952	6542041052	Leitnergasse 11	Graz	8010	Österreich	02.04.2013	04.04.2013	C43.5	Bösartiges Melanom des Rumpfes
421545873	5847364332	Roman	Terbovc		m	05.01.1975	66840501								Otitis
118702653	8559754441	Maria das Neves	Pinheiro da Silva		w	31.12.1969	75463112								uraler kt der
342444438	3554640992	Kim	Park		m	23.06.1955	48862306								itus,
464346833	9758002454	Maria	Ehrenberger		w	02.02.1946	23990202								er
203332422	5450025454	Lisbeth	Puntigam		w	24.04.1971	48862404								ie eines
210883233	9895576500	Gerhard	Müller		m	01.02.1918	47550102								lis,
234094583	9075465823	Adolf	Brunner		m	21.04.1941	66542104								ulose,
283610234	2002025224	Aise	Devici		w	11.11.1984	57881111								eschert
567845242	5564659781	Klaus-Michael	Kohler		m	09.01.1966	77550105								Otitis
457789020	3112143202	Carmen	Meyr		w	03.07.1977	44320307								uraler kt der
500545723	5888729364	Muhammad	Üstün		m	06.07.1954	97000607								uren
687875422	9009736772	Johanna	Hadlic		w	13.08.1929	67341308								itus,
432443502	3434554645	Georg	Moser		m	05.05.1941	77730505								itive
800050524	7676855645	Roberta	Eber		w	03.06.2002	13230306								raktur
988999523	5000527877	Christiane	Thomüller		w	12.06.1960	2544120690	Göstinger Str 182	Graz	8051	Österreich	12.04.2013	22.04.2013	I21.1	Akuter transmuraler Myokardinfarkt der

Database queries

Selection by rows

Projection by columns

SELECT **Name, Vorname** from
Patienten

WHERE **Ort = „Hausmannstätten“**

PatID	FallID	Vorname	Name	Titel	C	Geburts	SV-Nr	Straße	Ort	PLZ	Land	Aufnahm	Entlassda	Haupt	Hauptdiagnose (Te)
234508973	9829993923	Franz	Brunner		m	12.12.1945	7556121245	Kirchweg 26	Gratkorn	8101	Österreich	12.04.2013	22.04.2013	G20.1	Primäres Parkinson-Syndrom mit
549082235	2341221400	Konstantin	Luttenberger		m	31.08.1963	6643310893	Leibnitzer Str 15	Lebring	8403	Österreich	22.04.2013	04.05.2013	I21.1	Akuter transmuraler Myokardinfarkt der
683654353	2000977623	Elke	Schulze	Mag.	w	03.07.1968	9012030768	Anton-Kleinoscheg-Str 29	Graz	8051	Österreich	25.04.2013	30.07.2013	G82.1	Spastische Paraparese und
545454109	2466375743	Jessica	Strohriegl		w	04.10.1988	9970041088	Rudolfstraße 123	Graz	8010	Österreich	08.04.2013	11.04.2013	H66.0	Akute eitrige Otitis media
236519452	7655545877	Jaden	Klötzl		m	05.11.2009	4646051109	Hofstr 1	Hausmannstätten	8071	Österreich	05.04.2013	31.07.2013	S02.1	Schädelbasisfraktur
843656542	4478477543	Margitta	Schwarzenegger-Klötzl	Dr.	w	12.12									Multiple Frakturen des Femurs
340009212	7887900352	Bettina	Lammer	Mag.	w	14.02									Manie mit psychotischen
202040563	7578888254	Giuseppe	De Tomaso		m	04.10									Bösartiges Melanom des Rumpfes
421545873	5847364332	Roman	Terbovc		m	05.01									Akute eitrige Otitis media
118702653	8559754441	Maria das Neves	Pinheiro da Silva		w	31.12									Akuter transmuraler Myokardinfarkt der
342444438	3554640992	Kim	Park		m	23.06									Diabetes mellitus, Typ 2 mit
464346833	9758002454	Maria	Ehrenberger		w	02.02									Bösartige Neubildung der
203332422	5450025454	Lisbeth	Puntigam		w	24.04									Lungenembolie ohne Angabe eines
210883233	9895576500	Gerhard	Müller		m	01.02									Cataracta senilis, Morgagni-Typ
234094583	9075465823	Adolf	Brunner		m	21.04									Lungentuberkulose, histologisch gesichert
283610234	2002025224	Aise	Devici		w	11.11									Akute eitrige Otitis media
567845242	5564659781	Klaus-Michael	Kohler		m	09.01									Akuter transmuraler Myokardinfarkt der
457789020	3112143202	Carmen	Meyr		w	03.07									Multiple Frakturen des Femurs
500545723	5888729364	Muhammad	Üstün		m	06.07									Diabetes mellitus, Typ 2 mit
687875422	9009736772	Johanna	Hadlic		w	13.08.1929	6734130829	Afritschgasse 36	Graz	8020	Österreich	27.04.2013	03.05.2013	E11.1	Diabetes mellitus, Typ 2 mit
432443502	3434554645	Georg	Moser		m	05.05.1941	7773050541	Freihofanger 2	Graz	8043	Österreich	01.04.2013	30.08.2013	F31.3	Bipolare affektive Störung,
800050524	7676855645	Roberta	Eber		w	03.06.2002	1323030602	Dultstraße 58	Gratkorn	8101	Österreich	05.04.2013	17.06.2013	S02.1	Schädelbasisfraktur
988999523	5000527877	Christiane	Thomüller		w	12.06.1960	2544120690	Göstinger Str 182	Graz	8051	Österreich	12.04.2013	22.04.2013	I21.1	Akuter transmuraler Myokardinfarkt der

Database keys

- From one or more fields
- Speed up ordering and retrieval
- Primary keys are univocal keys that identify a record.
- Primary keys in daily life?

Table "Patienten"

SV-Nr	Straße	Ort	PLZ	Land	Aufnahm	Entlassda	Haupt
556121245	Kirchweg 26	Gratkorn	8101	Österreich	12.04.2013	22.04.2013	G20.1
643310893	Leibnitzer Str 15	Lebring	8403	Österreich	22.04.2013	04.05.2013	I21.1
012030768	Anton-Kleinoscheg-Str 29	Graz	8051	Österreich	25.04.2013	30.07.2013	G82.1
970041088	Rudolfstraße 123	Graz	8010	Österreich	08.04.2013	11.04.2013	H66.0
646051109	Hofstr 1	Hausmannstätten	8071	Österreich	05.04.2013	31.07.2013	S02.1
558121272	Hofstr 1	Hausmannstätten	8071	Österreich	05.04.2013	10.06.2013	S72.7
823140256	Griesplatz 28	Graz	8020	Österreich	01.04.2013	24.07.2013	F30.2
542041052	Leitnergasse 11	Graz	8010	Österreich	02.04.2013	04.04.2013	C43.5
684050175	Mladinska ulica 29	Šentilj	2212	Slowenien	13.04.2013	16.04.2013	H66.0
546311269	Leitnergasse 23	Graz	8010	Österreich	16.04.2013	30.04.2013	I21.1
886230675	Wickenburgg 3	Graz	8010	Österreich	05.04.2013	12.04.2013	E11.1
399020246	Volksgartenstraße 3	Graz	8020	Österreich	02.04.2013	21.04.2013	C73
886240471	Annenstraße 44	Graz	8020	Österreich	17.04.2013	18.05.2013	I26.9
755010218	Am Arlandgrund 19	Graz	8045	Österreich	22.04.2013	25.04.2013	H25.2
654210441	Preßlgasse 4	Hartberg	8230	Österreich	30.04.2013	23.05.2013	A15.2
788111184	Hochstadelweg 19	Nußdorf-Debant	9990	Österreich	10.04.2013	13.04.2013	H66.0
755010966	Müller-Guttenbrunn-Weg 23	Graz-Liebenau	8041	Österreich	21.04.2013	05.05.2013	I21.1
432030777	Schilfgasse 15	Graz-Straßgang	8054	Österreich	14.04.2013	13.05.2013	S72.7
700060794	Algersdorfer Straße 16	Graz	8020	Österreich	11.04.2013	20.04.2013	E11.1
734130829	Afritschgasse 36	Graz	8020	Österreich	27.04.2013	03.05.2013	E11.1
773050541	Freihofanger 2	Graz	8043	Österreich	01.04.2013	30.08.2013	F31.3
323030602	Dultstraße 58	Gratkorn	8101	Österreich	05.04.2013	17.06.2013	S02.1
544120690	Göstinger Str 182	Graz	8051	Österreich	12.04.2013	22.04.2013	I21.1

Table "ICD"

Code	Text
I21.1	Akuter transmuraler Myokardinfarkt der Hinterwand
C43.5	Bösartiges Melanom des Rumpfes
I26.9	Lungenembolie ohne Angabe eines akuten Cor pulmonale
H25.2	Cataracta senilis, Morgagni-Typ
A15.2	Lungentuberkulose, histologisch gesichert
G20.1	Primäres Parkinson-Syndrom mit mäßiger bis schwerer Beeinträchtigung
S02.1	Schädelbasisfraktur
H66.0	Akute eitrige Otitis media
F30.2	Manie mit psychotischen Symptomen
E11.1	Diabetes mellitus, Typ 2 mit Ketoazidose
F31.3	Bipolare affektive Störung, gegenwärtig leichte oder mittelgradige Episode
S72.7	Multiple Frakturen des Femurs
C73	Bösartige Neubildung der Schilddrüse
G82.1	Spastische Paraparese und Paraplegie

„Normalisation“

- Removal of redundant information and thus sources of error
- More compact representation of content
- Primary key of detail table is foreign key of main table

Database semantics

- Semantics
 - the meaning behind names, identifiers, values in a database
 - The way how they are related to the real world
 - Database content denotes (types of) entities in the real world
- Example
 - Field „AufnDia“; Value: „V.a. HWI“
 - Field „Hb“; Value: 13.3
 - What is the problem here?
- Datatypes
 - Numeric, Text, Yes/No
 - “Controlled vocabularies”: Coding systems / thesauri / ontologies

Examples for controlled vocabularies / ontologies

ICD-10

- I21** Acute myocardial infarction
- I21.0** Acute transmural myocardial infarction of anterior wall
- I21.1** Acute transmural myocardial infarction of inferior wall
- I21.2** Acute transmural myocardial infarction of other sites

SNOMED CT

Parents

- > Ischemic heart disease (disorder)
- > Myocardial disease (disorder)
- > Myocardial necrosis (finding)
- > Necrosis of anatomical site (disorder)

Myocardial infarction (disorder) ☆ ↗

SCTID: 22298006

22298006 | Myocardial infarction (disorder) |

en Myocardial infarction

en Infarction of heart

en Cardiac infarction

en Heart attack

en Myocardial infarction (disorder)

en MI - Myocardial infarction

en Myocardial infarct

Associated morphology →

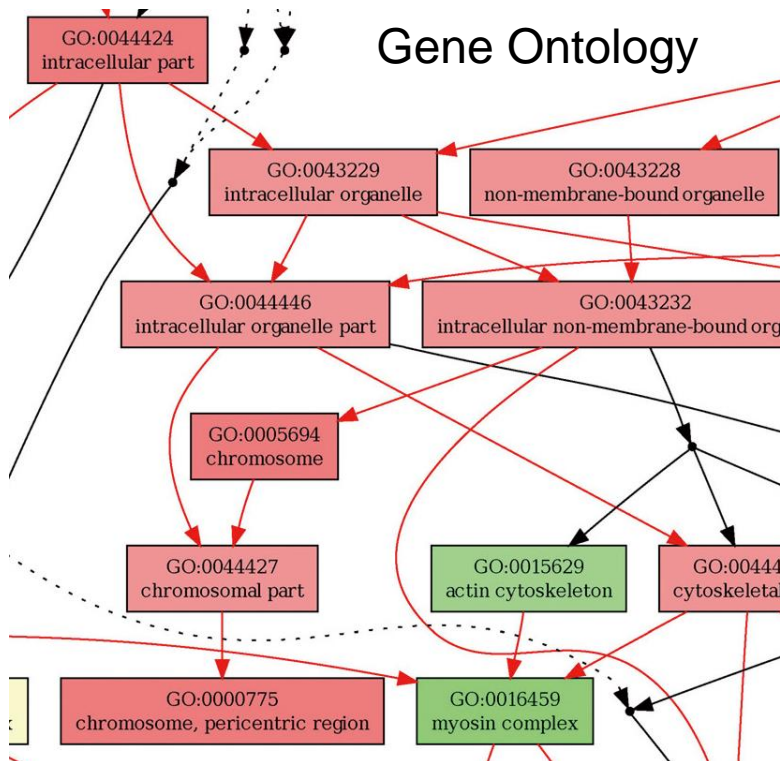
Infarct

Finding site → Myocardium structure

Children

- > Acute myocardial infarction (disorder)
- First myocardial infarction (disorder)
- Microinfarct of heart (disorder)

Gene Ontology



Controlled Vocabularies (CVs)

- Provide units of meaning, characterised by
 - unique codes
 - preferred terms
 - text definitions
 - AKA “terminologies”
- Thesauri, in addition, provide
 - Relations between terms:
synonymy / hypernymy / hyponymy
- (Formal) Ontologies provide:
 - Identifiers for classes of objects in the real world
 - Formal definitions / descriptions (using logics)
 - Invariant properties

ID D001241

Preferred term: Aspirin

Text definition: The prototypical analgesic used in the treatment of mild to moderate pain (...)

Synonym (Acetylsalicylic Acid, Aspirin)

Broader (Analgesic, Aspirin)

Broader (Salicylat, Aspirin)

AspirinMolecule subclassOf
hasPart some CarboxylGroup
hasPart some BenzeneRing
hasPart some AcetylResidue

CVs and Databases

- CVs provide standardised semantic identifiers
- Ontologies are limited to express context-independent truths about types of entities
- Databases express context-dependent assertions
- Ontologies ideally constitute the semantic building blocks for databases (like words that constitute a text)
 - Providing meaning to database tables
 - Providing meaning to database fields
 - Providing meaning
- The more databases are grounded in ontologies the more they fulfil the FAIR principles
 - Findable, Accessible, Interoperable, Reusable

[Wilkinson, Mark D., et al. "The FAIR Guiding Principles for scientific data management and stewardship." *Scientific data* 3 \(2016\).](#)

Database annotations

- The addition of IDs from CVs or ontologies is known as Annotation
- Annotations are normally done by domain experts, AKA curators
- Tools that do automated processing of natural language can assist curators and accelerate their work
- Fully automated annotations (without human review) raise quality issues, but are increasingly reliable once enough training data are available (big data / machine learning, “artificial intelligence”)
- Database content that only consists of CV IDs and numbers is known as “structured data”
- “Unstructured data” (text, images) nevertheless indispensable in most cases

Criteria to describe biomedical databases

- Access (free or subscription-based)
- Availability of database content (downloadable)
- Kind of interfaces (User, API)
- Transparency of used algorithms
- Human annotation effort
- Connection with other databases
- Structuredness
- Use of standards (terminologies, information models)

Literature databases

Medline & PubMed

<https://www.ncbi.nlm.nih.gov/pubmed/>

Medline & PubMed

- MEDLINE is the database, PubMed the search interface
 - 2020: approx. 26,461,788 million + 4,063,640 “in process”
 - 90% English-language articles
- 6,000 Publication organs (Journals, Proceedings)
- Beyond MEDLINE
 - IN-PROCESS (not yet tagged publications in "waiting position")
 - MeSH (Medical Subject Headings) : Keyword Thesaurus
- Indexing by NLM (manual)
 - MeSH headings / subheadings
 - Publication type
 - Substances, enzymes, organisms

Medical Subject Headings (MeSH)

- “Key” to MEDLINE
- 20,000 keywords, hierarchically structured:
 - Documents annotated with more specific keywords will also be found using more general keywords.
- Every MeSH term
 - Has a preferred term (“Hemorrhage”)
 - Has synonyms and hyponyms (Entry Terms): “Bleeding“, “Hemorrhage”.
 - Is in one or more "trees": "Tuberculosis, Pulmonary" both under "Lung Diseases" and "Bacterial Infections"
 - Can be further specified by "subheadings", e.g. Tuberculosis, Pulmonary / * drug therapy.

<https://www.ncbi.nlm.nih.gov/mesh/>

Fields

PMID- 25643895
 STAT- MEDLINE
 TI - Lower hazard ratio for death in women with cerebral hemorrhage.
 PG - 59-64
 LID - 10.1111/ane.12359 [doi]
 AB - OBJECTIVES: The aim of the study was to clarify the hazard ratio for death within 30 days after stroke comparing women to men. MATERIAL AND METHODS: We reviewed all stroke patients registered in the Kyoto Stroke Registry (from January 1999 to December 2009) in Japan. Hazard ratio (HR) for death and 95% confidence interval were calculated by the Cox regression in stroke and in each stroke subtype: cerebral infarction(...)
 CI - (c) 2015 John Wiley & Sons A/S. Published by John Wiley & Sons Ltd.
 FAU - Shigematsu, K
 AU - Shigematsu K
 AUID- ORCID: <http://orcid.org/0000-0003-3747-8115>
 AD - Department of Neurology, National Hospital Organization, Minami Kyoto Hospital, Kyoto, Japan.
 FAU - Watanabe, Y
 AU - Watanabe Y
 AD - Department of Epidemiology for Community Health and Medicine, Graduate School of Medical Science, Kyoto Prefectural University of Medicine, Kyoto, Japan.
 FAU - Nakano, H
 AD - Department of Neurosurgery, Kyoto Kidugawa Hospital, Kyoto, Japan.
 CN - Kyoto Stroke Registry Committee
 LA - eng
 PT - Journal Article
 TA - Acta Neurol Scand
 SB - IM
 MH - Adult
 MH - Aged
 MH - Cerebral Hemorrhage/etiology/*mortality
 MH - Female
 MH - *Sex Characteristics
 MH - Stroke/complications/*mortality
 MH - Subarachnoid Hemorrhage/etiology/mortality
 OT - cerebrovascular diseases
 OT - strokes
 EDAT- 2015/02/04 06:00
 MHDA- 2015/11/11 06:00
 CRDT- 2015/02/04 06:00
 PHST- 2014/11/11 00:00 [accepted]
 PHST- 2015/02/04 06:00 [pubmed]
 PHST- 2015/11/11 06:00 [medline]
 SO - Acta Neurol Scand. 2015 Jul;132(1):59-64. doi: 10.1111/ane.12359. Epub 2015 Feb

Values

Title

Abstract

Authors

Affiliation

Pub Type

MeSH

Dates

Source

Tuberculosis, Pulmonary

MYCOBACTERIUM infections of the lung.

Year introduced: TUBERCULOSIS IN CHILDHOOD was heading 1963-1989

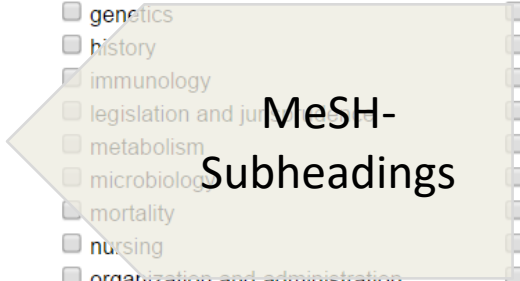
PubMed search builder options

Subheadings:

- analysis
- anatomy and histology
- blood
- blood supply
- cerebrospinal fluid
- chemically induced
- chemistry
- classification
- complications
- congenital
- cytology
- diagnosis
- diet therapy
- drug therapy
- economics
- embryology
- enzymology

- epidemiology
- ethnology
- etiology
- genetics
- history
- immunology
- legislation and jurisprudence
- metabolism
- microbiology
- mortality
- nursing
- organization and administration
- parasitology
- pathology
- pharmacology
- physiology

- physiopathology
- prevention and control
- psychology
- radiography
- radionuclide imaging
- radiotherapy
- rehabilitation
- statistics and numerical data
- surgery
- therapeutic use
- therapy
- transmission
- ultrasonography
- urine
- veterinary
- virology



[All MeSH Categories](#)

[Diseases Category](#)

[Bacterial Infections and Mycoses](#)

[Bacterial Infections](#)

[Gram-Positive Bacterial Infections](#)

[Actinomycetales Infections](#)

[Mycobacterium Infections](#)

[Tuberculosis](#)

Tuberculosis, Pulmonary

[Silicotuberculosis](#)

MeSH-Trees

[All MeSH Categories](#)

[Diseases Category](#)

[Respiratory Tract Diseases](#)

[Lung Diseases](#)

Tuberculosis, Pulmonary

[Silicotuberculosis](#)

MeSH Unique ID: D014397

Entry Terms:

- Tuberculoses, Pulmonary
- Pulmonary Tuberculoses
- Pulmonary Tuberculosis
- Pulmonary Consumption
- Consumption, Pulmonary
- Consumptions, Pulmonary
- Pulmonary Consumptions
- Pulmonary Phthisis
- Phthises, Pulmonary
- Phthisis, Pulmonary
- Pulmonary Phthises

MeSH in PubMed: Querying

- Search bar:
 - Search Article in PubMed
 - Search keywords in MeSH



- Complex Search: build from individual queries :

MeSH
[Create alert](#) [Limits](#) [Advanced](#)

Summary ▾ 20 per page ▾

Search results

Items: 1 to 20 of 263

<< First < Prev Page 1 of 14 Next >

- [Tuberculosis](#)
 1. Any of the infectious diseases of man and other animals caused by species of MYCOBACTERIUM.
Year introduced: **TUBERCULOSIS IMMUNITY** was heading 1963-1966
- [Latent Tuberculosis](#)

MeSH in PubMed: refine query

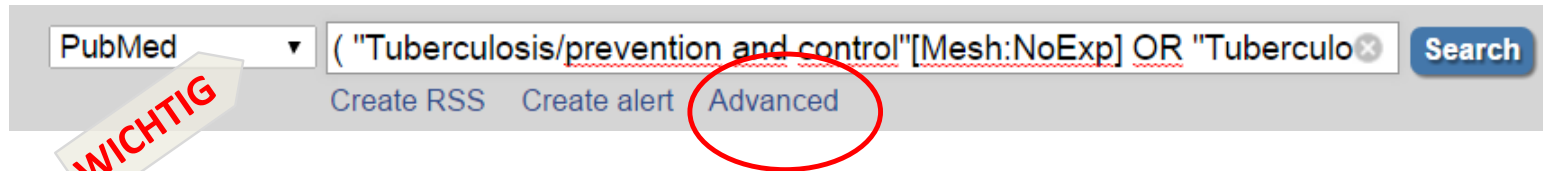
- If multiple hits: click correct one
- Restrict search:
 - By MeSH Subheadings
 - By "MeSH Major Topic" (*)
- Add to search builder

The screenshot shows the PubMed Search Builder interface. At the top, it says "PubMed Search Builder" with a small icon. Below that is a text input field containing the query: `("Tuberculosis/prevention and control"[Mesh:NoExp] OR "Tuberculosis/therapy"[Mesh:NoExp])`. Below the input field are two buttons: "Add to search builder" and "AND" with a dropdown arrow. At the bottom is a "Search PubMed" button.

MeSH-based query
using PubMed query
syntax

MeSH in PubMed: Complex Queries

- Division into individual search steps, each of which generated with the SearchBuilder.
- Use „Advanced“ for modularising complex PubMed queries



- In "History" each individual query is numbered for the creation of combined queries
- Complex searches may include all fields of a MEDLINE record, e.g. Authors, journals, time periods, etc. These are also selected in the "Builder".

MeSH in PubMed: Use of "Builder"

(#1) AND #3

[Edit](#) [Clear](#)

Builder

Combination of modular queries

Recent Query ▾ #1 -

AND ▾ Recent Query ▾ #3 -

AND ▾ All Fields ▾ - + [Show index list](#)

[Search](#) or [Add to history](#)

- Division into individual search steps, which one generates using SearchBuilder.
- Using the logical operators "OR" (disjunction, union), "AND" (conjunction, intersection), "NOT" (complement)

History [Download history](#) [Clear history](#)

History of modular queries

Search	Add to builder	Query	Items found	Time
#3	Add	Search "Africa"[Mesh]	213981	06:41:17
#1	Add	Search ("Tuberculosis/prevention and control"[Mesh:NoExp] OR "Tuberculosis/therapy"[Mesh:NoExp])	15007	06:38:21



PubMed: Free-text search

- Free text search as alternative / supplement:
 - Include articles not yet been indexed in MEDLINE
 - Not sufficiently accurate MeSH terms
 - Search in foreign language titles
 - Doubts about the completeness of MeSH index
- Automatic term mapping: produces a combination of free text and text search
 - Usually suboptimal result, but good entry

PubMed.gov
US National Library of Medicine
National Institutes of Health

PubMed ▼ Prevention of tuberculosis in North America |
Advanced

Query Translation:

```
("prevention and control"[Subheading] OR ("prevention"[All Fields] AND "control"[All Fields]) OR "prevention and control"[All Fields] OR "prevention"[All Fields]) AND ("tuberculosis"[MeSH Terms] OR "tuberculosis"[All Fields]) AND ("north america"[MeSH Terms] OR ("north"[All Fields] AND "america"[All Fields]) OR "north america"[All Fields])
```



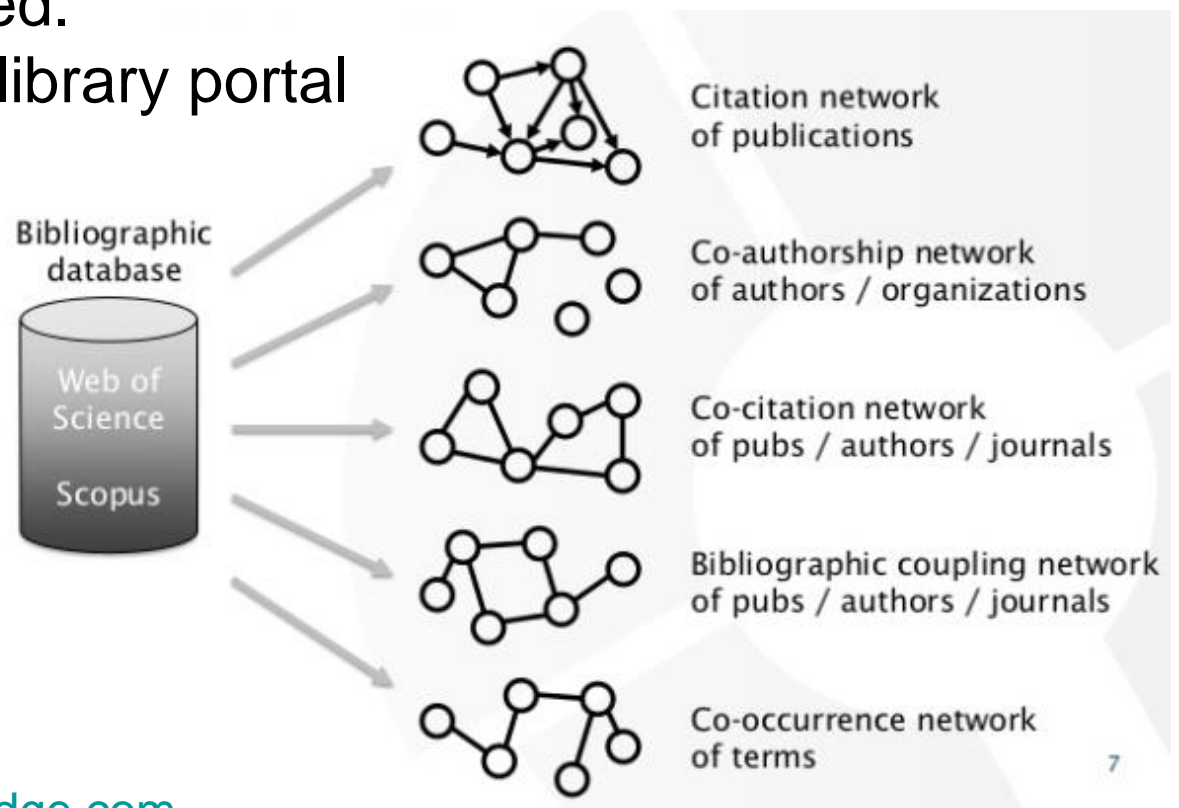
PubMed: Free text search principles

- Specify using "Field tags" Title [ti]; Title + Abstract [tiab]; Text Word [tw]
- Synonyms and hypernyms have to be added manually!
- Truncation operator (wildcard) "*":
 - `cholangio*` retrieves `cholangiohepatography`, `cholangiovenous`, ...
- Phrase search ("...")
 - `CD8 T cell memory` more but less specific hits compared to `"CD8 T cell memory"`.
- Disadvantage of free text search
 - Synonyms have to be considered and entered (OR-operator).
 - Spelling variants must be considered: `esophagus` (American) and `oesophagus` (British)
 - Ambiguous phrases: low precision.
 - Search only in the title leads: low recall.

PubMed / MEDLINE

- Before using it seriously: watch Tutorials
- Automatic Term mapping: suboptimal results but good for a first try
- MeSH search: captures only manually indexed content
- Free text query: captures also non-indexed content
 - Require manual addition of synonyms, hypernyms
 - Short free text searches are normally bad
- Both MeSH and Free text search require
 - Boolean operators
 - Parentheses (of more than one operator)
 - Field tags
- Article types only cover indexed content!
- Modularize your query
- Minor mistakes destroy your search!

- AKA ISI Web of Knowledge
- Producer: Clarivate Analytics
- Subscription-based.
Access via MUG library portal
- Citation index:
references
between articles
- Bibliometric
networks



<http://login.webofknowledge.com>

<https://www.slideshare.net/NeesJanvanEck/issi2015-tutorial-vosviewerandcitnetexplorer>

- Core Collection
 - 50,000 books; 12,000 journals; 160,000 Conference proceedings
 - No keywords – only free text search on title, author-assigned keywords, frequently used terms from the references
- Citation databases
 - Core collections (by discipline) & regional
 - Link publications by citations
 - Manually curated
- Journal impact factor
 - Selected journals
 - Not available for new journals
 - Not available for conference proceedings

Query in Web of Science

Use field tags, Boolean operators, parentheses, and query sets to create your query. Results will appear in the Search History table at the bottom of the page. (Learn more about Advanced Search)

Example: TS=(nanotub* AND carbon) NOT AU=Smalley RE
 #1 NOT #2 more examples | view the tutorial

(AU=Schulz S) AND (AU=Smith B) AND (TS=ontolog*)

Booleans: AND, OR, NOT, SAME, NEAR

Field Tags:

TS= Topic	SO= Publication Name [Index]
TI= Title	DO= DOI
AU= Author [Index]	PY= Year Published
AI= Author Identifiers	AD= Address
GP= Group Author [Index]	SU= Research Area
ED= Editor	IS= ISSN/ISBN

Search

Search History:

Set	Results	<input type="button" value="Save History"/> <input type="button" value="Open Saved History"/>		Combine Sets <input type="radio"/> AND <input type="radio"/> OR <input type="button" value="Combine"/>	Delete Sets <input type="button" value="Select All"/> <input type="button" value="Delete"/>
# 1	6 (AU=Schulz S) AND (AU=Smith B) AND (TS=ontolog*) Databases=WOS, KJD, MEDLINE, RSCI, SCIELO Timespan=All years Search language=Auto	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Select Page

 5K



- 1. **Strengths and limitations of formal ontologies in the biomedical domain.**
 By: Schulz, Stefan; Stenzhorn, Holger; Boeker, Martin; et al.
 Revista electronica de comunicacao, informacao & inovacao em saude : RECIIS Volume: 3 Issue: 1 Pages: 31-45 Published: 2009-Mar-01
- 2. **The Role of Ontologies for Sustainable, Semantically Interoperable and Trustworthy EHR Solutions**
 By: Blobel, Bernd; Kalra, Dipak; Koehn, Marc; et al.
 MEDICAL INFORMATICS IN A UNITED AND HEALTHY EUROPE Book Series: Studies

Times Cited: 30
(from All Databases)
 Usage Count ▾


Times Cited: 4
(from All Databases)
 Usage Count ▾

Ontologies for information organization in digital transformation processes

By: Mendonca, Fabricio Martins; Zaidan, Fernando Hadad
EM QUESTAO Volume: 25 Issue: 1 Pages: 295-320 Published: JAN-APR 2019



 [Free Full Text from Publisher](#) [View Abstract](#) 

Times Cited: 0
(from All Databases)

Usage Count 

Towards a semantic approach to numerical tree inference in phylogenetics

By: Vogt, Lars
CLADISTICS Volume: 34 Issue: 2 Pages: 200-224 Published: APR 2018



 [Full Text from Publisher](#) [View Abstract](#) 

Times Cited: 2
(from All Databases)

Usage Count 

Effectiveness of web-based social sensing in health information dissemination A review

By: Sharma, Pallavi; Kaur, Pankaj Deep
TELEMATICS AND INFORMATICS Volume: 34 Issue: 1 Pages: 194-219
Published: FEB 2017



 [Full Text from Publisher](#) [View Abstract](#) 

Times Cited: 8
(from All Databases)

Usage Count 

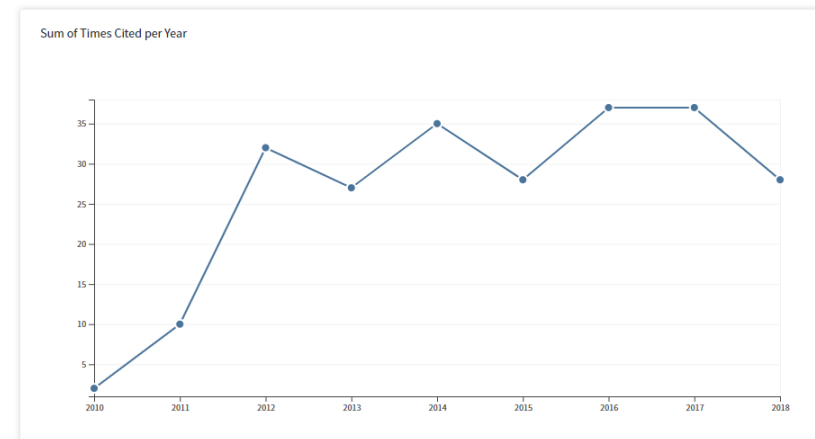
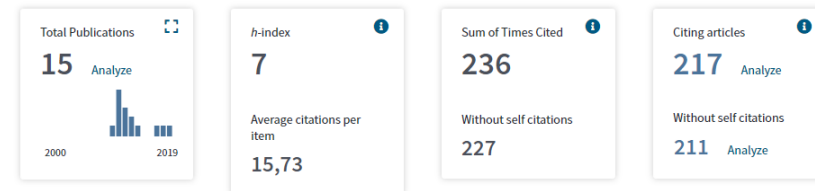
Clinical modeling-A critical analysis

By: Blobel, Bernd; Goossen, William; Brochhausen, Mathias
INTERNATIONAL JOURNAL OF MEDICAL INFORMATICS Volume: 83 Issue: 1
Pages: 57-69 Published: JAN 2014

 [Full Text from Publisher](#) [View Abstract](#) 

Times Cited: 7
(from All Databases)

Usage Count 



Journal Citation Reports

- Journal impact factors: number of citations received / number of articles (per year)

NEW ENGLAND JOURNAL OF MEDICINE

ISSN: 0028-4793

MASSACHUSETTS MEDICAL SOC

WALTHAM WOODS CENTER, 860 WINTER ST, WALTHAM, MA 02451-1413

USA

Titles

ISO: N. Engl. J. Med.

JCR Abbrev: NEW ENGL J MED

Categories

MEDICINE, GENERAL & INTERNAL - SCIE

Key Indicators

Year ▼	Total Cites Graph	Journal Impact Factor Graph	Impact Factor Without Journal Self Cites Graph	5 Year Impact Factor Graph	Immediacy Index Graph	Citable Items Graph	Cited Half-Life Graph	Citing Half-Life Graph	Eigenfactor Score Graph	Article Influence Score Graph	% Articles in Citable Items Graph	Normalized Eigenfactor Graph	Average JIF Percentile Graph
2017	332,...	79.260	78.538	67.513	15.727	326	8.5	4.8	0.70...	29.439	84.05	81.9...	99.677
2016	315,...	72.406	71.699	64.201	16.637	328	8.3	4.7	0.69...	27.775	85.98	80.3...	99.677
2015	283,...	59.558	58.912	56.170	20.012	342	8.3	5.0	0.68...	25.710	87.43	77.7...	99.677
2014	268,...	55.873	55.192	54.390	13.844	353	8.4	5.1	0.67...	24.284	86.69	75.7...	99.675
2013	257,...	54.420	53.682	52.426	14.747	348	8.2	4.7	0.65...	22.412	89.37	72.5...	99.679
2012	245,...	51.658	50.955	50.807	12.667	360	8.0	5.0	0.65...	21.642	88.89	Not ...	99.677
2011	232,...	53.298	52.414	50.075	11.484	349	7.8	4.8	0.66...	21.304	88.83	Not ...	99.677
2010	227,...	53.486	52.774	52.363	10.675	345	7.5	4.7	0.68...	21.349	89.86	Not ...	99.673
2009	216,...	47.050	46.403	51.410	14.557	352	7.5	4.5	0.67...	19.868	90.91	Not ...	99.624
2008	205,...	50.017	49.212	49.011	12.225	356	7.2	4.4	0.68...	18.762	88.76	Not ...	99.522

- Rather Search engine than database
 - Look & feel of Web search engines
 - Content not downloadable
 - “Black box”
 - No manual annotation / curation
- Coverage: all kinds of scientific publications
 - That are available online
 - Of which bibliographic records are available online
 - Estimation: 400 Million documents

Filter by time

Filter by relevance

Citation reports

Full texts, including preprints

query

Google Scholar

rofecoxib cardiovascular

Ungefähr 28.200 Ergebnisse (0,12 Sek.)

Mein Profil Meine Bibli

Beliebige Zeit

Seit 2019

Seit 2018

Seit 2015

raum wählen...

Nach Relevanz sortieren

Nach Datum sortieren

Beliebige Sprache

Seiten auf Deutsch

Patente einschließen

Zitate einschließen

Alert erstellen

[HTML] **Cardiovascular** events associated with **rofecoxib** in a colorectal adenoma chemoprevention trial
 RS Bresalier, RS Sandler, H O... - England Journal of ..., 2005 - Mass Medical Soc
 Background Selective inhibition of cyclooxygenase-2 (COX-2) may be associated with an increased risk of thrombotic events, but only limited long-term data have been available for analysis. We report on **cardiovascular** outcomes associated with the use of the selective ...
 ☆ 99 Zitiert von: 2882 Ähnliche Artikel Alle 19 Versionen

[HTML] nejm.org

Risk of **cardiovascular** events and **rofecoxib**: cumulative meta-analysis
 P Jüni, L Nartey, S Reichenbach, R Sterchi, PA Dieppe... - The lancet, 2004 - Elsevier
 Background The cyclo-oxygenase 2 inhibitor **rofecoxib** was recently withdrawn because of **cardiovascular** adverse effects. An increased risk of myocardial infarction had been observed in 2000 in the Vioxx Gastrointestinal Outcomes Research study (VIGOR), but was ...
 ☆ 99 Zitiert von: 1016 Ähnliche Artikel Alle 14 Versionen

[PDF] tripod.com

[ZITATION] **Cardiovascular** thrombotic events in controlled, clinical trials of **rofecoxib**
 MA Konstam, MR Weir, A Reicin, D Shapiro... - Circulation, 2001 - Am Heart Assoc
 ☆ 99 Zitiert von: 484 Ähnliche Artikel Alle 8 Versionen

Cardiovascular events associated with **rofecoxib**: final analysis of the APPROVe trial
 JA Baron, RS Sandler, RS Bresalier, A Lanas... - The Lancet, 2008 - Elsevier
 Background Selective inhibition of cyclo-oxygenase-2 has been associated with an increased risk of **cardiovascular** events in several clinical trials. The Adenomatous Polyp Prevention on Vioxx (APPROVe) study assessed the effect of 3-year treatment with a cyclo ...
 ☆ 99 Zitiert von: 224 Ähnliche Artikel Alle 10 Versionen

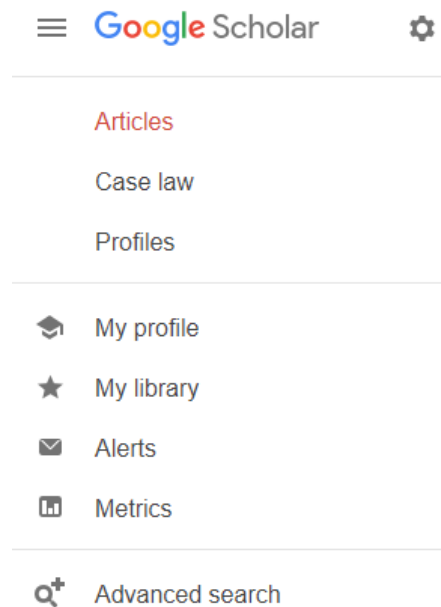
Comparison of **cardiovascular** thrombotic events in patients with osteoarthritis treated with **rofecoxib** versus nonselective nonsteroidal anti-inflammatory

Google Scholar pros and cons

- Pro
 - Highest coverage
 - Ordering by relevance (complex calculations)
 - „Cited by“ competes with subscription-based databases (WOS)
 - Access to free texts (40 – 60%)
- Con
 - Not transparent
 - Few searchable database fields
 - Detection errors
 - Sorting by relevance penalises new articles („Matthew effect“)

Google Scholar advanced search

- Phrase search
- Inclusion, exclusion
- Author
- Publication data
- Boolean operators unreliable!



The image shows the "Advanced search" interface. At the top, there is a close button (X) and a search button (magnifying glass). The main content area is titled "Find articles" and contains several search criteria with corresponding input fields:

- with all of the words**: [input field]
- with the exact phrase**: [input field]
- with at least one of the words**: [input field]
- without the words**: [input field]
- where my words occur**: anywhere in the article
 in the title of the article
- Return articles authored by**: [input field]
e.g., "PJ Hayes" or McCarthy
- Return articles published in**: [input field]
e.g., J Biol Chem or Nature
- Return articles dated between**: [input field] — [input field]
e.g., 1996

Medical databases

- UpToDate as one example for database support at the doctor's workplace
- ClinicalTrials.gov as one example for clinical trials
- Just to mention: also clinical or epidemiological registries are databases

- Ressource for evidence based clinical knowledge
 - Databases, guidelines, clinical calculators
- Lexi-comp drug-drug interaction knowledge

Lexicomp® Drug Interactions

Add items to your list by searching below.

Enter item name

ITEM LIST

Clear List Analyze

36 Results

Item	Interaction
<input type="radio"/> Aspirin	X MetroNIDAZOLE (Systemic) Alcohol (Ethyl)
<input type="radio"/> Mebendazole	X MetroNIDAZOLE (Systemic) (Antibiotics) BCG (Intravesical)
<input type="radio"/> MetroNIDAZOLE (Systemic)	X MetroNIDAZOLE (Systemic) (Antibiotics) Cholera Vaccine
<input type="radio"/> Cefaclor	X MetroNIDAZOLE (Systemic) Disulfiram
<input type="radio"/> Vitamin K1 (SYN)	X MetroNIDAZOLE (Systemic) Mebendazole
<input type="radio"/> NIFEdipine	X MetroNIDAZOLE (Systemic) Products Containing Propylene Glycol
<input type="radio"/> PROzac	X MetroNIDAZOLE (Systemic) Ritonavir
<input type="radio"/> Furosemide	D MetroNIDAZOLE (Systemic) Busulfan
<input type="radio"/> Furosemide	D MetroNIDAZOLE (Systemic) Dronabinol
<input type="radio"/> Furosemide	D MetroNIDAZOLE (Systemic) Lopinavir

Display complete list of interactions for an individual item by clicking item name.

<https://www.uptodate.com>

- Database of clinical studies
- Maintained by the U.S. National Library of Medicine
- Nearly 300,000 records in 2019
- Important fields:
 - Dates, locations
 - Primary outcome (e.g. success of treatment)
 - Secondary outcome (e.g. costs, complication, morbidity)
 - Text description
 - Study type and design (e.g. RCT)
 - Population, inclusion, exclusion criteria
 - Intervention (drug, surgery, ...)
 - Publications
 - Recruitment information
 - Sponsor
- No use of index terms
- Synonym matching in the background

Descriptive Information	
Brief Title <small>ICMJE</small>	Appendicectomy Versus Antibiotics in the Treatment of Acute Uncomplicated Appendicitis
Official Title <small>ICMJE</small>	Study of Surgical Treatment (Open Appendicectomy) Versus Antibiotic Treatment (Ertapenem) in the Treatment of Acute Uncomplicated Appendicitis
Brief Summary	<p>Appendicectomy has been the treatment of acute appendicitis for over a hundred years. Appendicectomy, however, includes operative and postoperative risks despite being a "routine" operation. At the same time other similar intra-abdominal infections, such as diverticulitis, are treated with antibiotics. There have been some encouraging reports on successful treatment of appendicitis with antibiotics and it has been estimated that operative treatment might be necessary for only 15 - 20 % of patients with acute appendicitis.</p> <p>The aim of this randomized prospective study is to compare operative treatment (open appendicectomy) with conservative treatment with antibiotics (ertapenem, Invanz). Before randomization acute uncomplicated appendicitis is diagnosed with a CT scan. The hypothesis of the study is that the majority of patients with uncomplicated acute appendicitis can be treated successfully with antibiotics and unnecessary appendicectomies can be avoided.</p>
Detailed Description	<i>Not Provided</i>
Study Type <small>ICMJE</small>	Interventional
Study Phase	Not Applicable
Study Design <small>ICMJE</small>	Allocation: Randomized Intervention Model: Parallel Assignment Masking: None (Open Label) Primary Purpose: Treatment
Condition <small>ICMJE</small>	Acute Appendicitis
Intervention <small>ICMJE</small>	<ul style="list-style-type: none"> Procedure: Appendicectomy Standard appendicectomy Drug: Ertapenem ertapenem 1g x 1 i.v. for three days + after discharge levofloxacin 500 mg 1 x 1 + metronidazole 500 mg 1x3 for 7 days p.o.
Study Arms	<ul style="list-style-type: none"> Active Comparator: Operative treatment Regular open appendicectomy Intervention: Procedure: Appendicectomy Active Comparator: Antibiotic treatment Ertapenem 1 g i.v. x 1 three days Intervention: Drug: Ertapenem

Tracking Information	
First Submitted Date <small>ICMJE</small>	November 30, 2009
First Posted Date <small>ICMJE</small>	December 1, 2009
Results First Submitted Date	August 21, 2016
Results First Posted Date	February 23, 2017
Last Update Posted Date	June 28, 2018
Study Start Date <small>ICMJE</small>	November 2009
Actual Primary Completion Date	June 2012 (Final data collection date for primary outcome measure)
Current Primary Outcome Measures <small>ICMJE</small> (submitted: January 2, 2017)	The Success of Antibiotic and Surgical Treatment in the Treatment of Acute Uncomplicated Appendicitis [Time Frame: Up to 10 years] A successful treatment is determined by resolution of the appendicitis by means of the assigned treatment.
Original Primary Outcome Measures <small>ICMJE</small> (submitted: November 30, 2009)	The success of antibiotic treatment in patients with acute uncomplicated appendicitis [Time Frame: 1.-3. days, 1 week, 2 months, 1 year, 3,5,10 y]
Change History	Complete list of historical versions of study NCT01022567 on ClinicalTrials.gov Archive Site
Current Secondary Outcome Measures <small>ICMJE</small> (submitted: January 2, 2017)	<ul style="list-style-type: none"> The Possible Complications, Morbidity and Mortality of Operative and Conservative Treatment [Time Frame: 1 year] The Direct and Indirect Costs of Both Treatment Arms [Time Frame: 1 year] The Recurrence of Conservatively Treated Appendicitis [Time Frame: up to 10 years]
Original Secondary Outcome Measures <small>ICMJE</small> (submitted: November 30, 2009)	<ul style="list-style-type: none"> The Possible Complications, Morbidity and Mortality of Operative and Conservative Treatment [Time Frame: Same as primary outcome measure] The Direct and Indirect Costs of Both Treatment Arms [Time Frame: Same as primary outcome measure] The Recurrence of Conservatively Treated Appendicitis [Time Frame: Same as primary outcome measure]
Current Other Outcome Measures <small>ICMJE</small>	<i>Not Provided</i>
Original Other Outcome Measures <small>ICMJE</small>	<i>Not Provided</i>

Tracking Information	
First Submitted Date <small>ICMJE</small>	November 30, 2009
First Posted Date <small>ICMJE</small>	December 1, 2009
Results First Submitted Date	August 21, 2016
Results First Posted Date	February 23, 2017
Last Update Posted Date	June 28, 2018
Study Start Date <small>ICMJE</small>	November 2009
Actual Primary Completion Date	June 2012 (Final data collection date for primary outcome measure)
Current Primary Outcome Measures <small>ICMJE</small> (submitted: January 2, 2017)	The Success of Antibiotic and Surgical Treatment in the Treatment of Acute Uncomplicated Appendicitis [Time Frame: Up to 10 years] A successful treatment is determined by resolution of the appendicitis by means of the assigned treatment.
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Original Secondary Outcome Measures <small>ICMJE</small> (submitted: November 30, 2009)	<ul style="list-style-type: none"> The Possible Complications, Morbidity and Mortality of Operative and Conservative Treatment [Time Frame: Same as primary outcome measure] The Direct and Indirect Costs of Both Treatment Arms [Time Frame: Same as primary outcome measure] The Recurrence of Conservatively Treated Appendicitis [Time Frame: Same as primary outcome measure]
Current Other Outcome Measures <small>ICMJE</small>	<i>Not Provided</i>
Original Other Outcome Measures <small>ICMJE</small>	<i>Not Provided</i>

Recruitment Information	
Recruitment Status ^{ICMJE}	Active, not recruiting
Actual Enrollment ^{ICMJE} (submitted: December 1, 2014)	530
Original Actual Enrollment ^{ICMJE} (submitted: November 30, 2009)	600
Estimated Study Completion Date	December 2025
Actual Primary Completion Date	June 2012 (Final data collection date for primary outcome measure)
Eligibility Criteria ^{ICMJE}	<p>Inclusion Criteria:</p> <ul style="list-style-type: none"> • Age range from 18 to 60 years • CT scan diagnosed uncomplicated acute appendicitis <p>Exclusion Criteria:</p> <ul style="list-style-type: none"> • Age under 18 years or age over 60 years • Pregnancy or breast-feeding • Allergy to contrast media or iodine • Renal insufficiency • metformin medication (DM) • Peritonitis (a perforated appendix) • Lack of co-operation (unable to give consent) • A severe other medical condition • CT-scan: other diagnosis, fecal lithiasis in appendix, perforation, abscess, suspicion of a tumour
Sex/Gender	Sexes Eligible for Study: All
Ages	18 Years to 60 Years (Adult)
Accepts Healthy Volunteers	Yes
Contacts ^{ICMJE}	<i>Contact information is only displayed when the study is recruiting subjects</i>
Listed Location Countries ^{ICMJE}	Finland

Biological Databases

- Increasing amount of partly overlapping Databases
- Huge amount of data
 - Sequences
 - Annotations (Gene ontology, organisms, ...)
- In-built visualization tools
- In-built sequence alignment tools
- Heavy curation effort
- Heavily interlinked
- Linked with original sources (PMID)
- Due to public funding (EU, US)

[Wheeler, David L., et al. "Database resources of the national center for biotechnology information." *Nucleic acids research* 35.suppl_1 \(2006\): D5-D12.](#)



[Toomula, Nishant, et al. "Biological databases-integration of life science data." *J. Comput. Sci. Syst. Biol* 4 \(2012\): 87-92.](#)



Uniprot

- Huge protein database for organisms and viruses
- Two components of UniProtKB:
TrEMBL and Swiss-Prot
- TrEMBL: computationally analysed records + automatic annotations
- UniProtKB/Swiss-Prot: manual annotations about all known relevant information about a protein from literature and sequence data.
 - One database record per gene and species
 - Location, biological processes, catalytic activity
 - Protein-protein interactions
 - Domains, binding sites
 - Expression patterns
 - Variant forms

<https://www.uniprot.org/>

UniProtKB	
UniProt Knowledgebase	
Swiss-Prot (558,898)	 Manually annotated and reviewed.
TrEMBL (137,213,158)	 Automatically annotated and not reviewed.

UniProtKB - Q71M42 (PC11X_1)

Display

- [Entry](#)
- [Publications](#)
- [Feature viewer](#)
- [Feature table](#)

- None
- Function
 - Names & Taxonomy
 - Subcell. location
 - Pathol./Biotech
 - PTM / Processing
 - Expression
 - Interaction
 - Structure
 - Family & Domains
 - Sequence (2)

[BLAST](#)
[Align](#)
[Format](#)
[Add to basket](#)

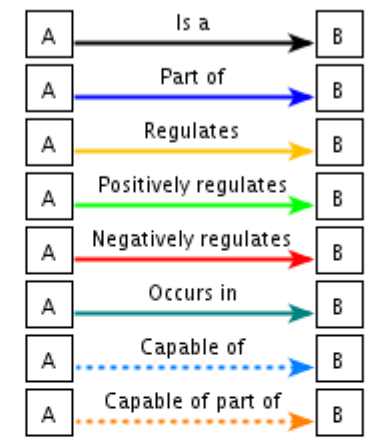
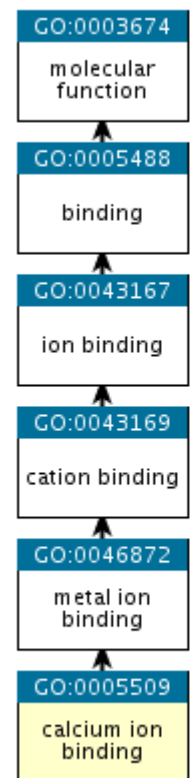
Protein | **Protocadherin-11 X-linked**
Gene | **PCDH11X**
Organism | *Pan troglodytes (Chimpanzee)*
Status | Reviewed - Annotation score:

Functionⁱ

Potential calcium-dependent cell-adhesion prote

- GO - Molecular functionⁱ**
- calcium ion binding Source: InterPro
- [View the complete GO annotation on QuickGO](#)

- GO - Biological processⁱ**
- cell adhesion Source: GO_Central
 - homophilic cell adhesion via plasma membrane adhesion molecules Source: InterPro
 - negative regulation of phosphatase activity Source: UniProtKB
- [View the complete GO annotation on QuickGO ...](#)



QuickGO - <https://www.ebi.ac.uk/QuickGO>

- Genome database for selected species (Homo sapiens and key model organisms)
- Important features
 - Graphical views
 - Gene Tree
 - Orthologues
 - Gene Variants
- Annotations
 - Gene Ontology: Biological Process, Molecular Function, Cellular Component
 - Phenotypes
 - Sources (PMIDs)

Gene: **BRCA2** ENSG00000139618

Description BRCA2, DNA repair associated [Source:HGNC Symbol;Acc:HGNC:1101]

Gene Synonyms BRCC2, FACD, FAD, FAD1, FANCD, FANCD1, XRCC11


Location [Chromosome 13: 32,315,474-32,400,266](#) forward strand.
GRCh38:CM000675.2

About this gene This gene has 7 transcripts ([splice variants](#)), [132 orthologues](#), is a member of [1 Ensembl protein family](#) and is associated with [128 phenotypes](#).

Transcripts [Show transcript table](#)

Phenotypes

Phenotypes, diseases and traits associated with this gene ENSG00000139618

Show All entries		Filter	
Phenotype, disease and trait	Source	Study	Allelic requirement
Acute myeloid leukemia	Cancer Gene Census	-	-
Adamantinomatous Craniopharyngioma	Cancer Gene Census	PMID:24413733	-
adrenocortical adenoma	Cancer Gene Census	PMID:28481359	-
Alveolar rhabdomyosarcoma	Cancer Gene Census	PMID:24332040 , PMID:24793135	-
Ampulla of Vater Carcinoma	Cancer Gene Census	PMID:26806338	-
Anal Squamous Cell Carcinoma	Cancer Gene Census	PMID:27852700 , PMID:28481359	-



- NCBI databases (“Entrez”)
 - Using platform known from Pubmed
 - Interlinked
- Important domains
 - Protein sequences
 - Genes
 - Gene expression maps
 - Complete genomes
 - Human genetic disorders (OMIM)
 - Chemicals (substance, Compound, BioAssay)



Nucleotide / Gene bank

- Open-access repository at NCBI (National Center for Biotechnology Information), U.S.
- Nucleotide sequences + protein translations
- > 100,000 organisms
286 billion bases, 211 million sequences (Dec 2018)
- Submission from individual labs



Browser address bar: <https://www.ncbi.nlm.nih.gov/nucleotide/advanced>

Navigation: NCBI Resources How To

Account: steschu@gmail.com My NCBI Sign Out

Message: The Nucleotide database will include EST and GSS sequences in early 2019. [Read more.](#)

Buttons: Nucleotide Home Help

Nucleotide Advanced Search Builder

Search query: "abrahamia littoralis"[Organism]

[Edit](#) [Clear](#)

Builder

Organism: "abrahamia littoralis"[Organism] [Hide index list](#)

- 'abelmoschus esculentus' bunchy top phytoplasma (1) [Previous 200](#)
- 'abrahamia elongata' (3) [Next 200](#)
- 'abrahamia lenticellata' (2)
- 'abrahamia littoralis' (6)
- 'abrahamia phillipsonii' (1)
- 'abrahamia suarezensis' (1)
- 'abrahamia' (80)
- 'acacia melanoxydon' phytoplasma (1)
- 'acacia salicina' little leaf phytoplasma (1)
- 'acalypha indica' phytoplasma (1) [Refresh index](#)

AND All Fields [Show index list](#)

[Search](#) or [Add to history](#)

Abrahamia littoralis isolate 305 external transcribed spacer, partial sequence

GenBank: AY594400.1

[FASTA](#) [Graphics](#)

Go to:

LOCUS AY594400 303 bp DNA linear PLN 02-APR-2010

DEFINITION Abrahamia littoralis isolate 305 external transcribed spacer, partial sequence.

ACCESSION AY594400

VERSION AY594400.1

KEYWORDS .

SOURCE Abrahamia littoralis

ORGANISM [Abrahamia littoralis](#)

Eukaryota; Viridiplantae; Streptophyta; Embryophyta; Tracheophyta; Spermatophyta; Magnoliophyta; eudicotyledons; Gunneridae; Pentapetalae; rosids; malvids; Sapindales; Anacardiaceae; Abrahamia.

REFERENCE 1 (bases 1 to 303)

AUTHORS Pell,S.K.

TITLE Out of Africa: Taxonomic Split of the Madagascan and African Species of Protorhus (Anacardiaceae)

JOURNAL Unpublished

REFERENCE 2 (bases 1 to 303)

AUTHORS Pell,S.K.

TITLE Direct Submission

JOURNAL Submitted (07-APR-2004) Cullman Program for Molecular Systematics Studies, New York Botanical Garden, 200th St. and Kazimiroff Blvd., Bronx, NY 10458, USA

FEATURES Location/Qualifiers

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                 /mol_type="genomic DNA"
                 /isolate="305"
                 /specimen_voucher="Randrianasolo 467a"
                 /db_xref="taxon:289789"
                 /country="Madagascar"

misc RNA       complement(<1..>303)
                 /product="external transcribed spacer"
  
```

ORIGIN

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61 ggggtgggacg ccaggcagc tacgtgttcc tcgcatgcct tgcctcgttg cgacgctggt
121 gaggcccatg gagctgttg tcgttccctc ggatgcggaa tgcgatgcat ggggtcgggg
181 tctcggcctc tgcttgccca agctatgcat ttgtcccttg acacgaacga ctgtcgcggc
241 cgtcttgatc ccgtcgtagc acacgtgctc gatggggctc atacgatcgt tggcgtcgtc
301 gag
..
  
```

Links to other databases and resources

■ [Homo sapiens erb-b2 receptor tyrosine kinase 3 \(ERBB3\), transcript variant 1, mRNA](#)

1. 5,765 bp linear mRNA

Accession: NM_001982.3 GI: 317171925

[Protein](#) [PubMed](#) [Taxonomy](#)

[GenBank](#) [FASTA](#) [Graphics](#)

- Proteins
- Organisms
- Taxonomy of organisms
- Genome viewer
- BLAST alignment tool

```

1 mrandalqvl gllfslargs evgnsqavcp gtlnglsvtg daenqyqtly klyercevvm
61 gnleivltgh nadlsflqwi revtgyvlva mnefstlplp nlrvvrgtqv ydgkfaifvm
121 lnyntnssha lrqlrltqlt eilsggyvie kndklchmdt idwrdivrdr daeivvkdng
181 rscppchevc kgrcwpggse dcqtltktic apqcngchfg pnpnqcchde caggcsgppd
241 tdcfacrhfn dsgacvprcp qplvynkltf qllepnhpty kyggvcvasc phnfvvdqts
301 cvracppdkm evdknglkmc epcggglcpka cegtsgsgrf qtvdsnidg fvnctkilgn
361 ldflitgling dpwhkipald peklnvfrtv reitgylniq swpphmhns vfsnlttigg
421 rsllyngfsl limknlvts lgfrslkeis agriyisanr qlcyhslnw tkvlrgptee
481 rldikhnrpr rdcvaegkvc dplcssggcw gpgpgqclsc rnysrggv cv thcnflngep
541 refaheaecf schpecqpm e gtatcngsgs dtcaqcahfr dgphcvsscp hgvlgakgpi
601 ykypdvq nec rpchenctqg ckgpelqdcl gqtlvligkt hltmaltvia glvvifmmlg
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901 vwelmtfgae pyagrlaev pdllekgerl aqqqictidv ymvmvkcwmi denirptfke
961 laneftrmar dpprylvikr esgpgiapgp ephgltnkkl eevelepeld lddleaeed
1021 nlatttlgsa lslpvgtlnr prgsqslisp ssgympmng nlgescquesa vsgssercpr
1081 pvslhpmprg clasessegh vtgseaelqe kvsmcrrsr srsprprgds ayhsqrhsl1
1141 tpvtpplsppg leeedvngyv mpdthlkgtp ssregtlssv glssvlgte e ededeeyeym
1201 nrrrrhspph pprpsleel gyeymdvgsd lsaslgstqs cplhpvpimp tagttdedy
1261 eymnrqrdgg gpggdyamg acpaseqgye emrafqgpg h qaphvhyarl ktlrsleatd
1321 safdnpywh srlfpkanaq rt

```


Other important databases

- OMIM (<https://omim.org/>):
 - database of human genes and genetic disorders and traits, with focus on the molecular relationship between genetic variation and phenotypic expression
- PubChem (<https://pubchem.ncbi.nlm.nih.gov/>)
 - a database of chemically characterised compounds and substances
- OrphaNet
(<https://www.orpha.net/consor/cgi-bin/index.php>)
 - Database of rare diseases and orphan drugs