Pharma & Biotech Patent Searching in Public Scientific Databases

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OVERVIEW

INTRODUCTION

PUBMED & PATENT-CITING SCIENTIFIC LITERATURE

SEARCHING PATENT-CITED SCIENTIFIC LITERATURE

COMPOUND CODING ACROSS PATENT & SCIENTIFIC LITERATURE

FINAL OBSERVATIONS

Introduction:
(Broken) Links Between Patent & Scientific Literature

- A complete, patent-relevant search in pharma & biotech requires checking the content of scientific literature beyond patent databases, looking for:
  - ✓ Text-/table-based based disclosures
  - ✓ Details over biological sequences, chemical structures, technologies
  - ✓ Features identified in graphs, photographs, raw data

  that may be absent or hard to find in patent literature

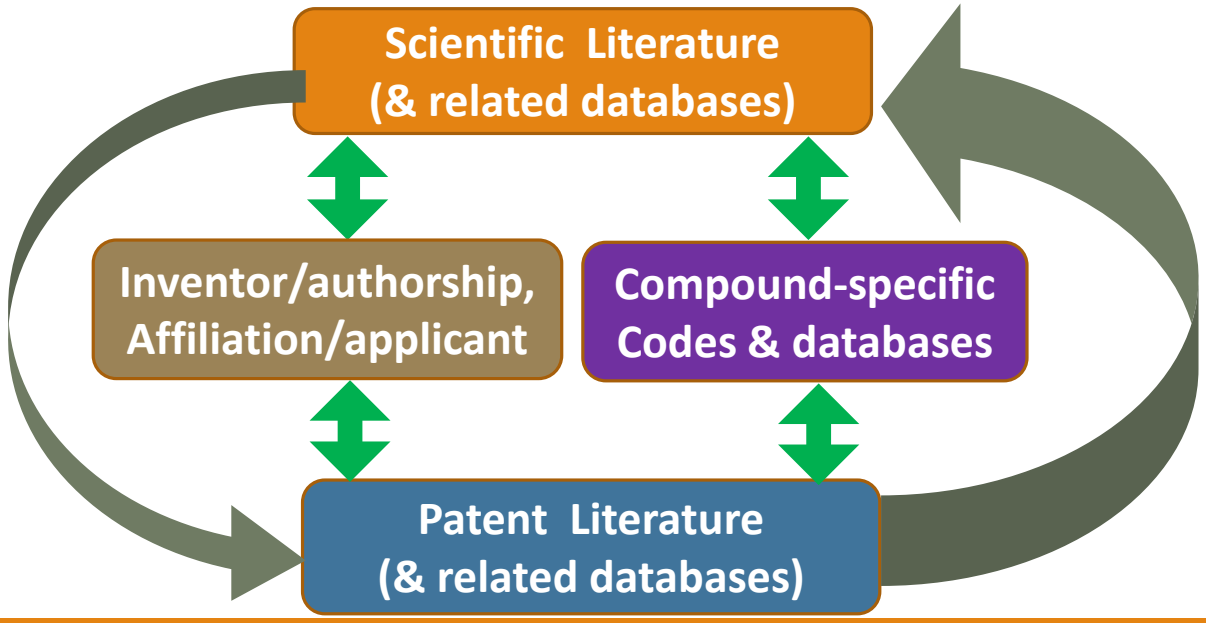
- Non-patent scientific databases & literature rarely refer to patent-originated or patent-related information, and often in a incomplete and/or inconsistent manner due to
  - ✓ Poor understanding of patent system
  - ✓ Qualitatively/quantitatively Incomplete coverage of patent information

  Limiting the possibilities to identify and consolidate the best of the two “worlds”

Introduction:
(In)directly Cross-citing Patent & Scientific Literature

- The citation flow is uneven between patent and scientific literature
  - ✓ Still a limited number of articles cites patent documentation at all or properly
  - ✓ Scope/format of scientific literature cited in patent documentation is uneven

- The information that is actually ”shared” between these two types of disclosure may be based on identity of names of people, organization, and/or compounds but other means may facilitate this task or expanding the scope



Pubmed & Patent-Citing Scientific Literature: Introduction

- Pubmed is a major entry point for searching scientific literature in life sciences, and beyond, that present some major advantages, eg:
  - ✓ High number of covered journals & books, with high frequency of update
  - ✓ Complex search & field features, MeSH indexing (Medical Subject Headings)
  - ✓ Links to full-text, similar articles, & records in other NIH databases

- At the same time, some general limitations need to be acknowledged:
  - ✓ Dependency from provider's formats & policy for adding new entries
  - ✓ Inconsistent/unclear own policy on when/how entries are updated & indexed
  - ✓ No links/search features to citations from/to a given entry ("similar" feature)

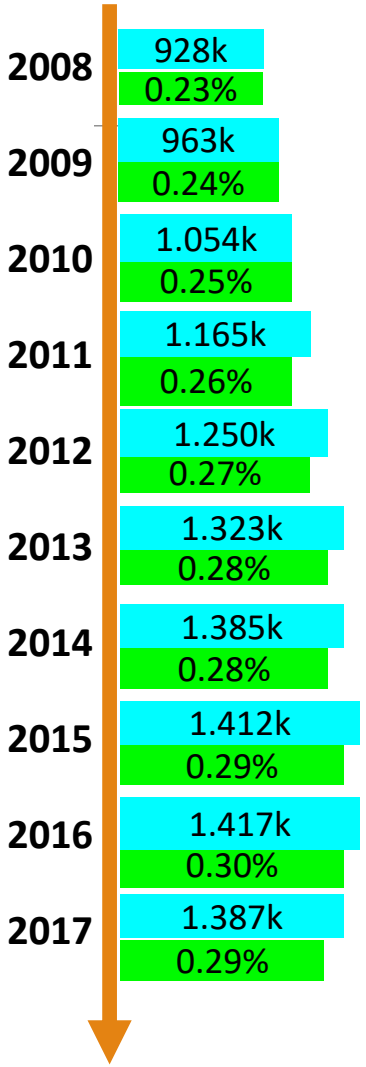
- When dealing with patent-related topics, other limitations appear in Pubmed:
  - ✓ No distinction between entries on economical/social/political matters about patent system and those about technical/legal content of patent documents
  - ✓ Confusion over the actual use and meaning of "patent" across entries

Pubmed & Patent-Citing Scientific Literature: Patent-related content & Pubmed Searching

- A quick search in Pubmed shows that, over the last 10 years:
  - ✓ Number of Pubmed entries has regularly increased
  - ✓ Percentage of entries including *patent** over this period is 0.27% but increasing somehow over the years

- By browsing these entries, a quite large variety of patent-related topics appears covered in such articles, but a substantive fraction of them appears having nothing to do with any patent matter (quite confusing/discouraging)

- Truly/falsely patent information in Pubmed can be more directly identified by "deconstructing" how Pubmed actually present and use such entries
  - ✓ Four "search levels" can be defined
  - ✓ The outcome of those alternative search approaches can be then combined with technical keywords



Pubmed & Patent-Citing Scientific Literature : Journals Covering Patent Literature (Level 1; I/II)

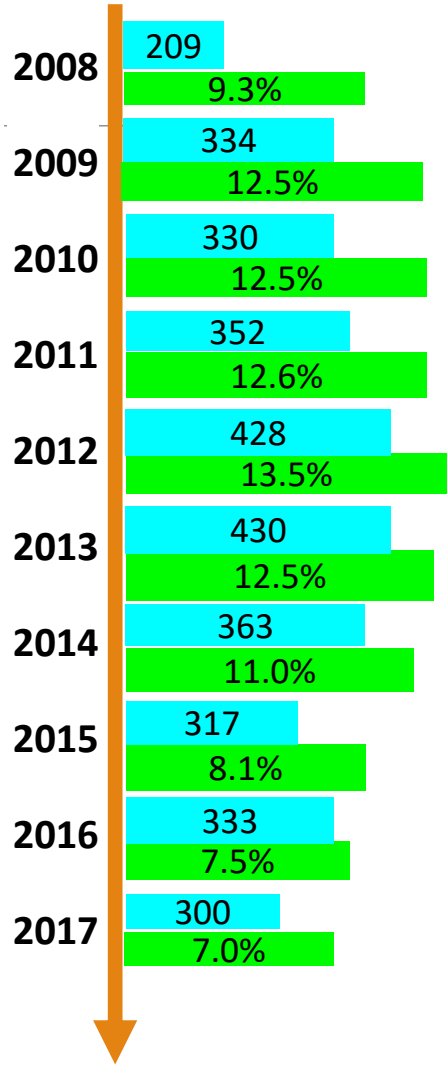
- Pubmed indexes articles a series of journals explicitly covering patent matters information is available in a variety of formats:
  - ✓ Expert opinion on therapeutic patents
  - ✓ Pharmaceutical patent analyst
  - ✓ "Recent Patents" series (14 distinct titles among the whole series, but some of them are discontinued)
  - ✓ Some, but limited, entries from legal journals
  - ✓ Other potentially relevant journals (such as World Patent Inf., J. Tech. Transf., Technovation, Scientometrics) are **not** indexed in Pubmed

- General observations:
  - ✓ Possibly the level providing the highest percentage of patent-related technical content since authors & audience are mainly people working regularly on patent matters in academia or companies
  - ✓ High article / subscription cost, inversely proportional to Impact Factor

Pubmed & Patent-Citing Scientific Literature: Journals Covering Patent Literature (Level 1; II/II)

- Pubmed search in these journals requires considering:
  - ✓ The [Journal] field need to be fully written according to Pubmed format (no truncation or limited search criteria), that is, the initial search using *patent** does **not** find their articles not including *patent** elsewhere in the entry
  - ✓ Incomplete year coverage and irregular update (eg coverage of Exp. Opin. Ther. Pat. starts from 2004,vol.14)

- However,
  - ✓ These journals provide a number of entries that is uneven and does not contribute to most recent increase but still substantial in terms of percentage over *Patent** entries
  - ✓ If a topic of a search is fully new for a searcher, and an article in these journals covers such a topic, maybe worth getting it at least as a starting point for keywords, etc.
  - ✓ Search can be pursued also at publisher's website



Pubmed & Patent-Citing Scientific Literature: Articles with *Patent** in Original Title/Abst. (Level 2; I/II)

- The *"patent*"* search can be limited to Pubmed entries in which authors made use of this wording in title and/or abstract (*as patents, patenting, patentee(s), patented, "patent landscape", "drug patent(s)", "patent expiration", "patent pending", "patent review(s)", "patent protected", "patent application(s)", "patent literature", "patent survey", "patent search", "patent protection", patentab*, "patent value", "us patent", "patent office", "patent citations", "patent citation", "patent system",* etc.*)* but there are two main source of false hits:
  - ✓ The typo patient / patients is not corrected, with the result of selecting many articles of clinical research and summaries of medical case studies
  - ✓ The regular use of "patent" as adjective in medical and/or older English indicating "*unobstructed, obvious, readily visible, exposed*" eg

Patent medicine	Patent foramen ovale	Patent fistula	Patently
Patent anastomosis	Patent ductus arteriosus	Patent shunt	Patent urachus

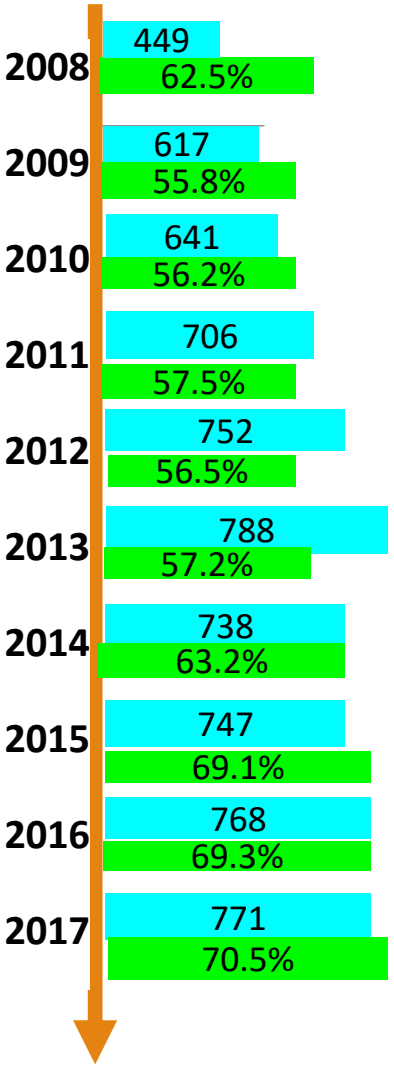
- If alternative search approaches may allow finding entries that present the desired "patent" anyway, the recall/precision of Pubmed search in title/abstract is improved by using more appropriate phrases or variants

Pubmed & Patent-Citing Scientific Literature : Articles with *Patent** in Original Title/Abst.(Level 2;II/II)

- A complex but still not fully “clean” search strategy can be

(patenta*[Title/Abstract] OR patente*[Title/Abstract] OR patenti*[Title/Abstract] OR patents[Title/Abstract] OR "new patent"[Title/Abstract] OR patents[Title/Abstract] OR patenting[Title/Abstract] OR patente*[Title/Abstract] OR “patent landscape”[Title/Abstract] OR “drug patent”[Title/Abstract] OR “drug patents”[Title/Abstract] OR “patent expiration”[Title/Abstract] OR ”patent pending”[Title/Abstract] OR “patent review"[Title/Abstract] OR “patent reviews"[Title/Abstract] OR “patent protected” [Title/Abstract] OR “patent application”[Title/Abstract] OR “patent applications”[Title/Abstract] OR “patent literature”[Title/Abstract] OR “patent survey”[Title/Abstract] OR “patent search”[Title/Abstract] OR “patent protection”[Title/Abstract] OR “patent value ”[Title/Abstract] OR “us patent”[Title/Abstract] OR “patent office”[Title/Abstract] OR “patent citations”[Title/Abstract] OR “patent citation”[Title/Abstract] OR “patent system”[Title/Abstract])

- This search provides with a total number of entries that has grown and now is stabilized but percentage of those not present in *Patents* journals has continued increasing
  - ✓ Contributing at least in part to recent growth of patent information-related technical content in Pubmed
  - ✓ Showing the higher interest in publishing about patent matters and/or referring to patent documentation in generally non-patent-oriented journals



Pubmed & Patent-Citing Scientific Literature: Articles with Patent-Related MeSH (Level 3)

- MeSH indexing provides:
  - ✓ A single “patents as topic”[MeSH Terms]
  - ✓ Some “patent”[MeSH Terms] related to the medical use of adjective (eg “patent medicines”, “patent ductus”)

- However:
  - ✓ “patents as topic”[MeSH Terms] covers less than half of the hits found using journal-based/Level 1 or title&abstract-based/Level 2 strategies
  - ✓ “patents as topic”[MeSH Terms]-only hits increase the total number of patent-related hits by 10%-15% each year
  - ✓ A large majority of such “patents as topic”[MeSH Terms]-only hits refers to articles covering economical, social, and/or legal topics rather than technical contents of patent documents

- The “patents as topic”[MeSH Terms] search is worth to be used but always completed with technically focused, patent term- based search strategies

Pubmed & Patent-Citing Scientific Literature: Articles with Patent Originator Info (Level 4; I/IV)

- Once that a list of companies and/or authors is available for comparing patent publications and scientific publications, it is a common practice to use these names in Pubmed but worth reminding some search features:
  - ✓ Both [Author] and [Affiliation] fields can be searched using the truncation operator * and all other usual operators
  - ✓ However [Affiliation] field is neither standardized, nor always provided by publisher in a complete format, but more importantly, Pubmeb tutorial clearly indicates "*before 2014, only the **first** author's affiliation is included*"

- This limitation is quite important, especially with the growing number of authors and entities involved in each publications but there is a further, subtler manner to associate Pubmed entries to (un)published patent documents

Pubmed & Patent-Citing Scientific Literature: Articles with Patent Originator Info (Level 4; II/IV)

- In recent years, some publishers and journals (eg PLOSone, PNAS) have strengthened obligations of disclosing any commitment/relationship linking an author with a company having any potential interest in the content of the article

- Pubmed has followed up by introducing a specific search field [Conflict of Interest Statements] **since 2016** that contains a free text including:
  - ✓ Authors and/or their employer being inventor or applicant in (un)published, (un)related patent application
  - ✓ Grants, shares, fees, involvement as founder/consultant/officer, or other financial interests that an author declares with respect to a company
  - ✓ Name of companies somehow involved in the data generated for the article and/or in other activities of an author

  That is even retroactively added for entries prior to 2016 by some journals

- A search focused on this field, in association to technical criteria and/or specific name of authors/affiliation, may provide some unexpected insights

Pubmed & Patent-Citing Literature : Articles with Patent & Originator Info (Level 4; III/IV)

- Some examples of relevant text on [Conflict of Interest Statements]:

  ABC and DE are also co-inventors on patent applications that include aspects of device that was used in the clinical trial

  LN and RS are co-inventors of an Australian provisional patent application No. 2017nnnnnn [title] filed by Univ. NNNN that includes the present work

  SH owns the following patents: US5nnnnnn, US7nnnnnn, US9nnnnnn

  GA and TB have filed patents in the field of anti-CDnn therapy

  AS and SR-J are shareholders of NNN Inc., and both are inventors of patents owned by NNN Inc.

  The technology has been patented by Hosp. ABC and an exclusive license signed with NNN Ther.. Dr. AB has Founders shares in NNN Ther.

- There are also quite a number of "negative", irrelevant statements

  AS is co-applicant for NIH grant No. nnnnnn

  There are no patents, products in development or marketed products to declare

Pubmed & Patent-Citing Literature : Articles with Patent & Originator Info (Level 4; IV/IV)

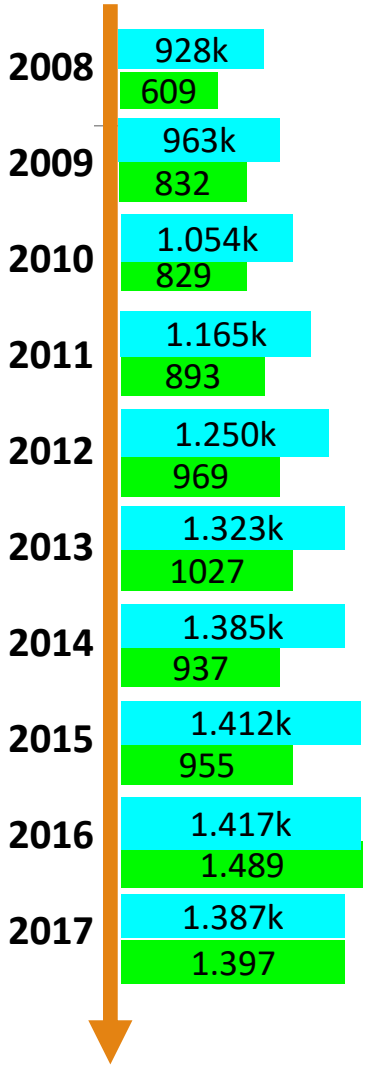
- The [Conflict of Interest Statements] field search by using criteria such as *invent*, coinvent*, coapplicant*, applicant*, patent*, provisional** may be used:
  - ✓ To disambiguate the general *patent** search
  - ✓ To expand what other search levels (or even other databases) may hardly provide in a clear manner

- Indeed:
  - ✓ More than 1200 Pubmed entries in 2017 and (in Aug. 2018) more than 1100 entries in 2017 have some type of patent-relevant text in this field
  - ✓ Less than 50 of them are found by using any of previous approaches (even though a substantial percentage may present "negative statements")
  - ✓ *By* combining *invent*, coinvent*, fili*, file*, licens*, licenc*, coapplicant*, applicant**, with *patent*, provisional**, approx. 50% of initial hits not found with level 1-3 searches are selected

Pubmed & Patent-Citing Literature : Take-home messages

- Pubmed may be searched for identifying patent-relevant and/or patent-originated information in scientific literature but:
  - ✓ Using the appropriate approach(es)
  - ✓ When the scope can justify spending some time and/or some names and other keywords are available for a search

- The search strategy below covering search level **1, 2, 3, or 4** is still not fully "clean" but provides a more limited, but more relevant, list of hits in Pubmed that is clearly growing over the years when compared to the total content of Pubmed



"Pharmaceutical patent analyst"[Journal] OR "Recent patents on anti-cancer drug discovery"[Journal] OR "Recent patents on anti-infective drug discovery"[Journal] OR "Recent patents on biotechnology"[Journal] OR "Recent patents on inflammation & allergy drug discovery"[Journal] OR "Recent patents on drug delivery & formulation"[Journal] OR "Recent patents on nanotechnology"[Journal] OR "Recent patents on cardiovascular drug discovery"[Journal] OR "Recent patents on food, nutrition & agriculture"[Journal] OR "Recent patents on CNS drug discovery"[Journal] OR "Recent patents on DNA & gene sequences"[Journal] OR "Recent patents on endocrine, metabolic & immune drug discovery"[Journal] OR "Recent patents on nanomedicine"[Journal] OR "Recent patents on biomarkers"[Journal] OR "Recent patents on biomedical engineering"[Journal] OR "Recent patents on regenerative medicine"[Journal] OR "Recent patents on space technology"[Journal] OR "Expert opinion on therapeutic patents"[Journal]) OR ((patenta*[Title/Abstract] OR patente*[Title/Abstract] OR patenti*[Title/Abstract] OR patents[Title/Abstract] OR "new patent"[Title/Abstract] OR patents[Title/Abstract] OR patenting[Title/Abstract] OR patente*[Title/Abstract] OR "patent landscape"[Title/Abstract] OR "drug patent"[Title/Abstract] OR "drug patents"[Title/Abstract] OR "patent expiration"[Title/Abstract] OR "patent pending"[Title/Abstract] OR "patent review"[Title/Abstract] OR "patent reviews"[Title/Abstract] OR "patent protected" [Title/Abstract] OR "patent application"[Title/Abstract] OR "patent applications"[Title/Abstract] OR "patent literature"[Title/Abstract] OR "patent survey"[Title/Abstract] OR "patent search"[Title/Abstract] OR "patent protection"[Title/Abstract] OR patents as topic[MeSH Terms] OR ((fili*[Conflict of Interest Statements] OR file*[Conflict of Interest Statements] OR invent*[Conflict of Interest Statements] OR coinvent*[Conflict of Interest Statements] OR coapplicant*[Conflict of Interest Statements] OR applicant*[Conflict of Interest Statements] OR licenc*[Conflict of Interest Statements] OR licens*[Conflict of Interest Statements]) AND (patent*[Conflict of Interest Statements] OR provisiona*[Conflict of Interest Statements]))) AND ("2008/01/01"[Date - Publication] : "2018/01/01"[Date - Publication])

Searching Patent-cited Scientific Literature Introduction

- The citation of scientific literature in patent proceedings is particularly important in pharma & biotech patent proceedings across:
  - ✓ The text of the patent application
  - ✓ In official search report by patent offices
  - ✓ During examination or post-grant proceedings

- Various tools are available for identifying cross-citing scientific literature, less opportunities are available for searching scientific literature according to their use in patent literature

- These searches may be particularly relevant for competitive intelligence and post-grant proceedings but require taking into account the lack of consistency on how available tools identify and link patent and scientific literature
  - ✓ Different format of article citation by different patent attorneys/offices
  - ✓ Coverage limited to the literature in the patent application, in the search report, in the IDS, and any of their combinations

Searching Patent-cited Scientific Literature : Lens.org Contents & Searches

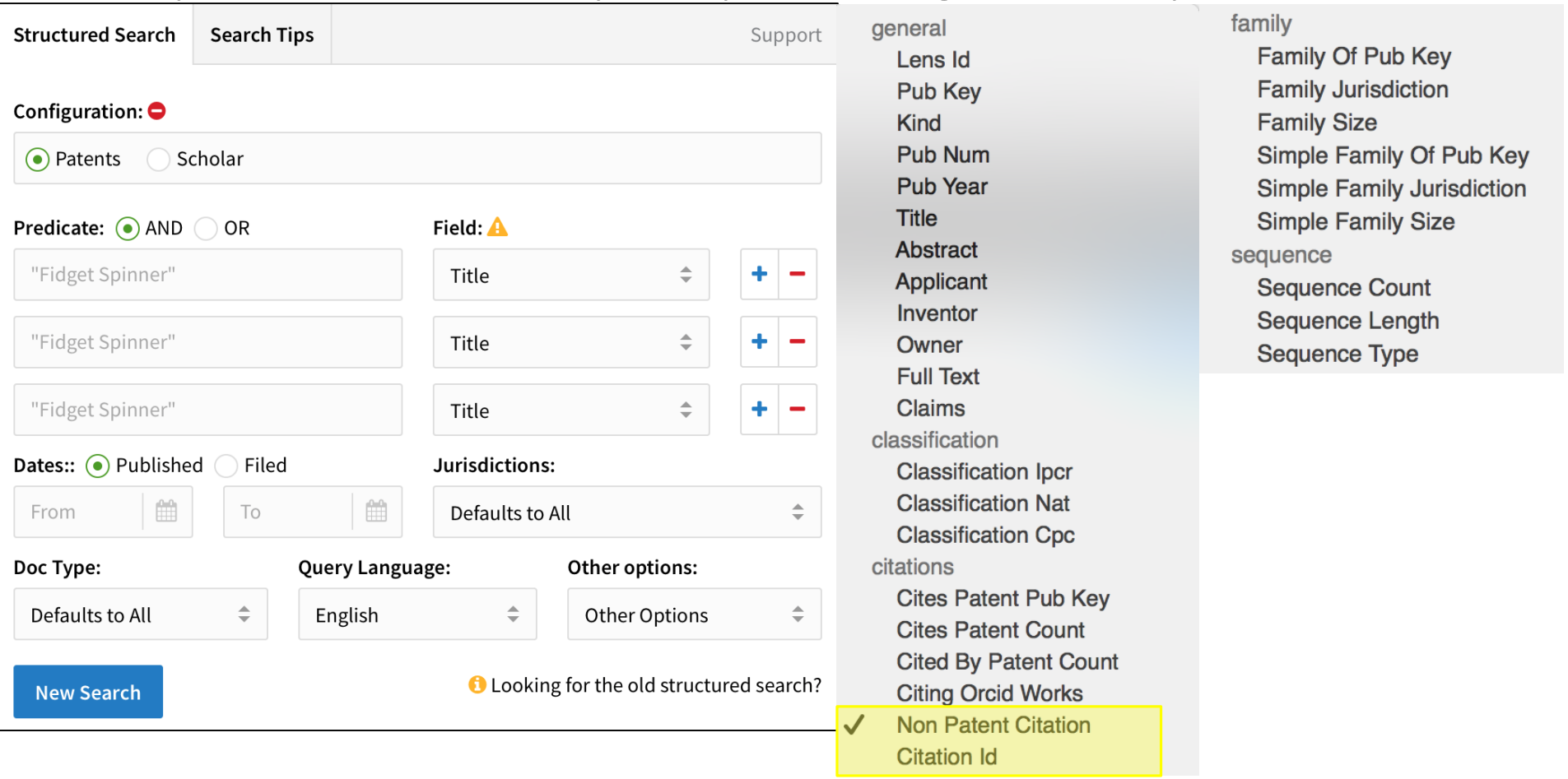
- Lens.org provides a quite unique double database and double search interface covering scientific literature and patent information with links to:
  - ✓ PDF version of patent documents
  - ✓ Article official indexing
  - ✓ Cross-citing frequency & other metadata

- In addition, the PatSeq section provides different access to DNA & Protein cited into patent documentation with links to:
  - ✓ Specific webpage for each sequence in the official sequence listing
  - ✓ Corresponding patent documents

- Lens.org provides users with large datasets, several layers of linked information, and different search approaches, but not clear if/how the content and links are actually validated for update, completeness, and precision, eg:
  - ✓ Incomplete coverage for older documents
  - ✓ IDS only often used for US patents

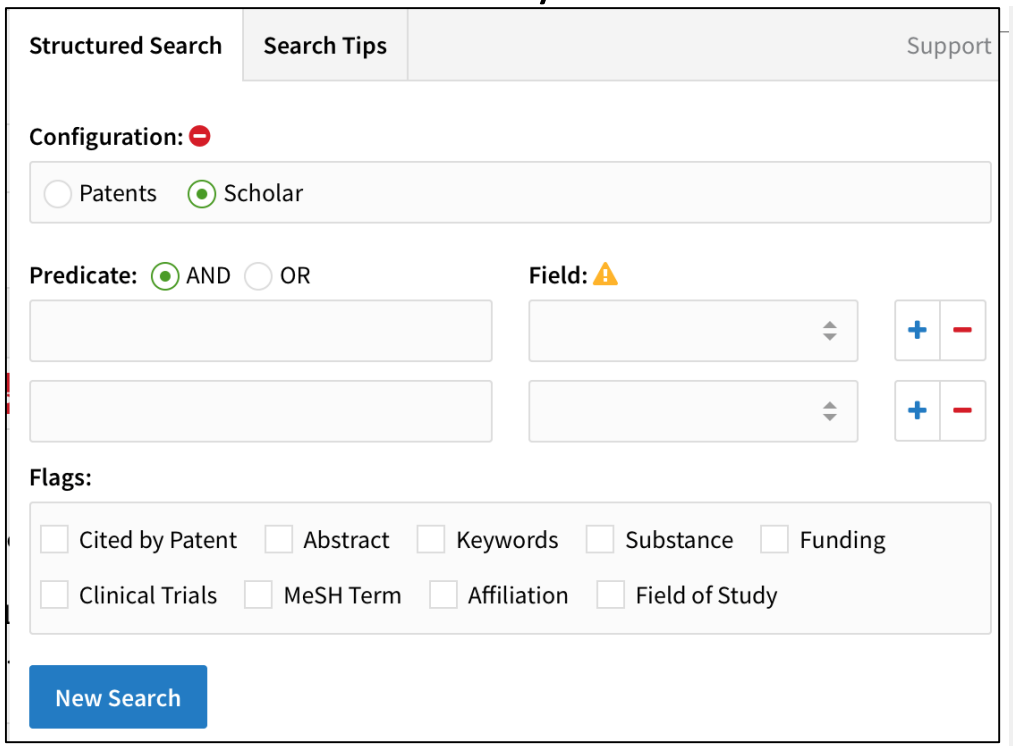
Searching Patent-cited Scientific Literature: Lens.org Patent Structured Search Interface

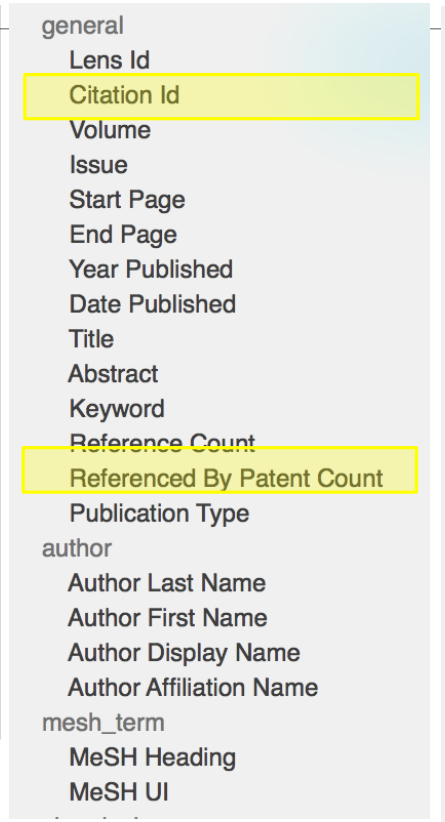
- The Structured Search interface for patent literature covers both DNA/protein sequence content (but only as sequence listings) and (non)patent citations

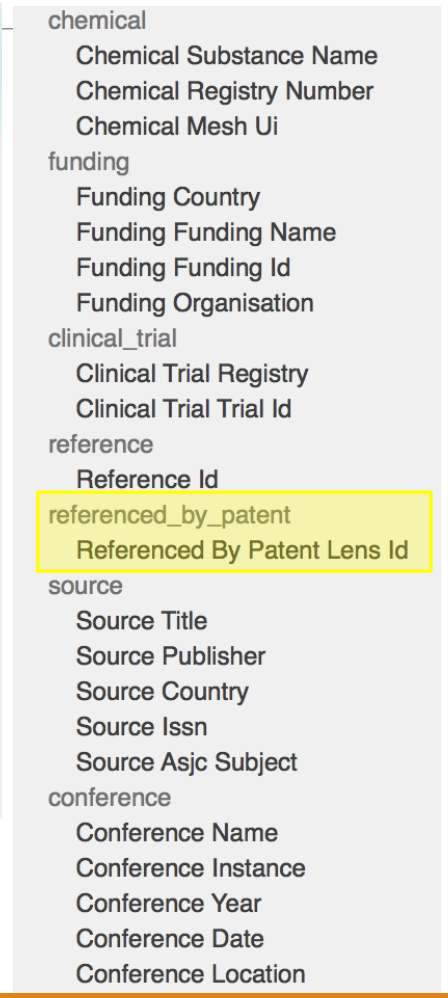


Searching Patent-cited Scientific Literature: Lens.org Scientific Literature Search Interface

- The Structured Search interface for scientific literature is even more complete but unclear if actually all indexed literature is searchable with all listed criteria







Searching Patent-cited Scientific Literature: Lens.org Patent Literature Search Language

- The Lens.org help pages provide a number of examples and details also for constructing long, complex patent searches combining criteria and operators

Index Fields

The following are all of the fields indexed on The Lens.

- **lens_id** – e.g. `186-488-232-022-055`
- **pub_key** e.g. `US_2013_0227762_A1`
- **jurisdiction** e.g. `US`
- **kind** e.g. `A1`
- **pub_num** e.g. `2013/0227762`
- **pub_date** e.g. `20170905` – yyyymmdd
- **pub_year** e.g. `2018`
- **filing_date** e.g. `20000519`
- **earliest_priority_date** e.g. `20000519`
- **title** e.g. `"Fidget Spinner"`
- **abstract** e.g. `"Super Conductor"`
- **applicant** e.g. `"Smith David"`
- **inventor** e.g. `Sally`
- **owner** e.g. `"Sony Ltd"`
- **has_full_text** e.g. `true`
- **full_text** e.g. `robot`
- **claims** e.g. `semiconductor`
- **classification_ipcr** e.g. `"H01L21/768"`
- **classification_nat** e.g. `"221/220"` (US classifications)
- **classification_cpc** e.g. `H01L2924\/*`
- **cites_patent_pub_key** e.g. `US_7128866_B1` – docs citing US_7128
- **cites_patent_count** e.g. `5`
- **cited_by_patent_count** e.g. `10`
- **non_patent_citation** e.g. `(health OR medicine)`
- **citation_id** e.g. `10.1038\/NATURE03090`
- **family_of_pub_key** e.g. `US_6408520_B1`
- **family_jurisdiction** e.g. `(US OR EP)`
- **family_size** e.g. `[4 TO 6]`
- **simple_family_of_pub_key** e.g. `US_6408520_B1`
- **simple_family_jurisdiction** e.g. `US`
- **simple_family_size** e.g. `3`
- **sequence_count** e.g. `[2 TO 3]`
- **sequence_length** e.g. `[1 TO 100]`
- **sequence_type** e.g. `N` – nucleotide, `P` – peptide

- To search for a value in an indexed field you type the name of the field followed by a colon and then the value you wish to search. For example:
  - **title**:`malaria`
  - **pub_date**:`[20070101 TO 20070631]`
- When you want to search on multiple fields you can use boolean operators which all must be upper case. For example:
  - `rice AND pesticide`
  - `malaria OR mosquito`
  - `printing NOT inkjet`
- Lucene supports `AND`, `OR`, `NOT` as well as "must" `+` and "must not" `-` as Boolean operators
- For more information on how boolean logic works, see this tutorial (/support/help-resources/other-articles/boolean-logic-tutorial/).
- Other operators available include:
  - term grouping: Lucene supports using parentheses `( )` to group terms into sub queries e.g. `(red AND yellow) OR (blue and green)`
  - Field grouping: Lucene supports using parentheses to group multiple clauses to a single field e.g. `title:(car OR truck)`
  - `*` and `?` for wildcard searches. Note that wildcard search terms are not stemmed and therefore may not work as expected for searches where "*Stemming*" (located in "*Query Tools*") is turned on. This is because when stemming is turned on, search terms are matched against stemmed values in the index. For example the terms `valve` and `valves` will be stemmed to `valv` and both match the stemmed value *valv* in the index. The term `valve*` will not be stemmed and therefore won't match `valv` in the index. Read more about stemming on wikipedia (http://en.wikipedia.org/wiki/Stemming).
  - `~` for fuzzy/proximity searches. `"foo bar"~4` searches for `foo` and `bar` within 4 words from each other. Exact matches are proximity zero and word transpositions `(bar foo)` are proximity 2.
  - `TO` for range searches
  - `^` to boost the relevance of a value in a search, affects the result order eg. `car abstract:coke^2`
  - `\` to escape the following special query syntax characters in a search term that are not inside quotes: `(+ - && || ! ( ) { } [ ] ^ ~ * ? : \ /)`

Searching Patent-cited Scientific Literature: Lens.org Scientific Literature Search Language

- The Lens.org help pages are less complete and precise about literature coverage and search criteria and operators

Scholarly Search

23/02/2018

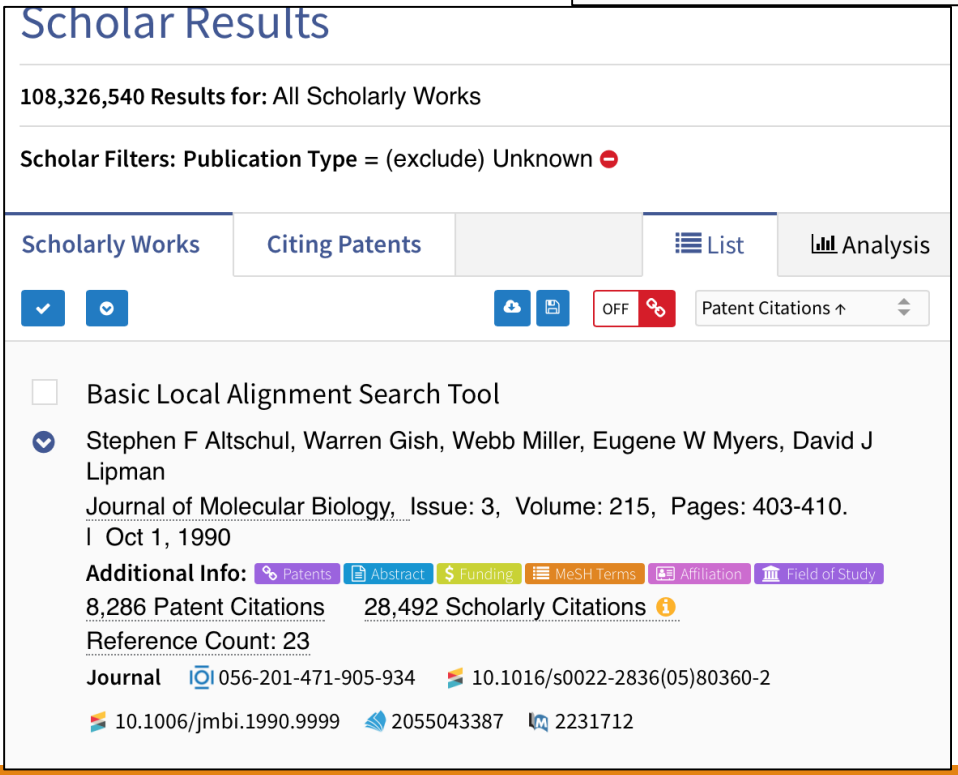
Since 2014, the Lens has begun o! ering scholarly works that are disclosed in the global patent literature and in partnership with NIH PubMed, USA and Crossref, UK, the Lens team managed to resolve 47% of such non-patent literature (NPL) by open persistent identifiers, such as DOIs, PMIDs, and PMCID and ma tch them to NPLs in the patent corpus.

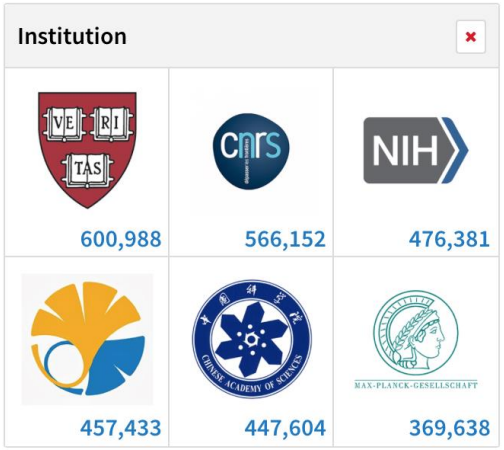
Currently, the Lens hosts and serves scholarly records from PubMed (27,860,556), Crossref (17,889.848), and PubMed Central (4,155,640) with the f ollowing brief list of the matched and merged granular metadata:

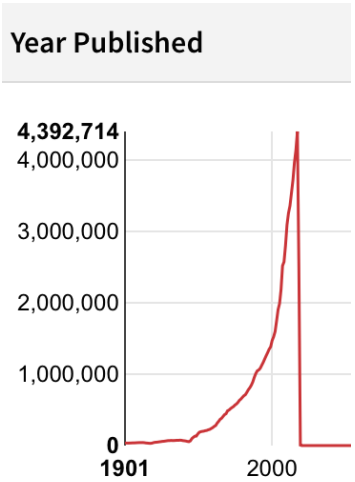
- citation identifiers
- title
- publication date
- publication type
- authors (first and last name, order, a! iliation)
- start end pages, volume, issue
- journal
- abstract
- references (string with identifiers if available)
- funding/grant information
- keywords (PubMed only)
- mesh_term (PubMed only)
- chemicals (PubMed only)
- clinical_trial data (PubMed only)
- citing patents

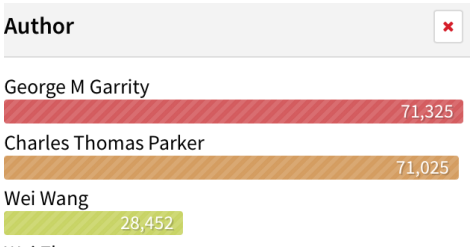
Searching Patent-cited Scientific Literature: Lens.org Scientific Literature Overview & Metadata

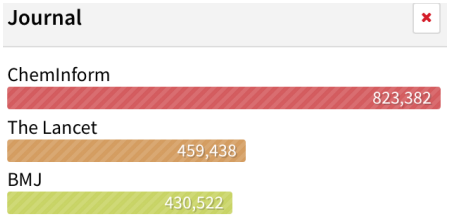
- Examples and data overview clearly show the focus in life science but also on some journals









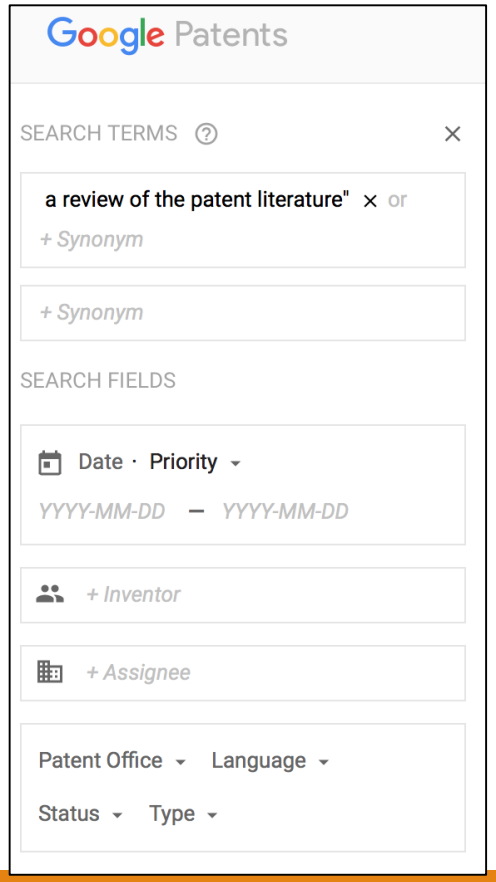


Searching Patent-cited Scientific Literature: Lens.org Scientific Article Presentation

- Each article is presented with links to the external sources (with own metrics…)

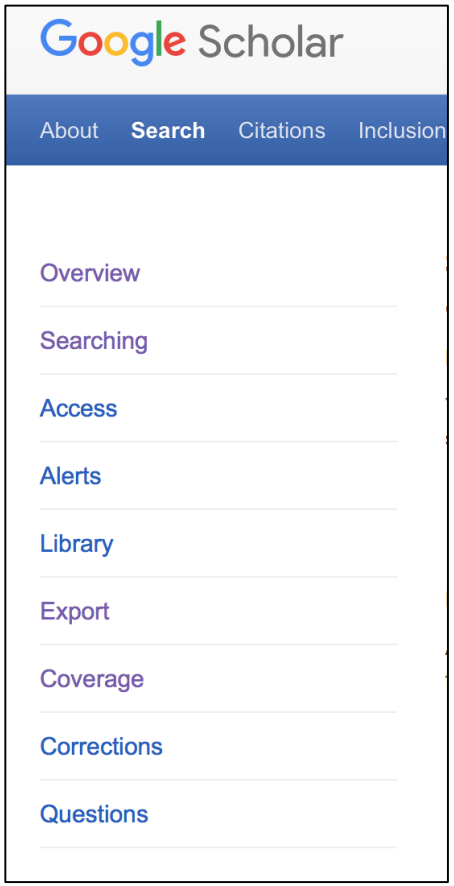
Searching Patent-cited Scientific Literature: Google Scholar/Patents Advanced Search Interfaces

- Google also provides its own double database and double search interface covering scientific literature (Google Scholar, which covers also thesis and not-so-often indexed journals) and patent information (Google Patents) with links to external providers and citation metrics but seemingly:
  - ✓ Less indexed / searchable fields
  - ✓ Less cross-indexed information, metadata



Searching Patent-cited Scientific Literature: Google Scholar /Patents Advanced Search Operators

- Google Patents Help page explains how to build quite complex searches (but not so much with Google Scholar)



About Google Patents

Searching

Next: Search results page

From the homepage, you can begin your search in a few ways:

- Enter a patent publication or application number, such as `[US9014905B1]`, `[9014905]`, or `[US 14/166,502]`

Searching by metadata (inventor, assignee, date, etc)

1. From the homepage, enter one of the following field names (without the [brackets]). Press ENTER to search after typing:
   a. Search inventors `[inventor:bell]` or `[inventor:"Alexander Graham Bell"]`
   b. Search assignees `[assignee:google]` or `[assignee:"Google Inc"]`
   c. Search before or after filing date (can be changed to priority or publication date after the search) `[before:2010]`, `[after:"Jan 2006"]`, `[before:"1/2/2006"]`
   d. Search patents by country `[country:US]`
   e. Search patents by status `[status:grant]`
   f. Search patents by language `[language:english]`

Proximity: You can use proximity operators to boost the score of documents if they contain expressions near each other. *Note*: proximity operators only change ranking, not retrieval. `NEAR`, `NEARx`, `NEAR/x`, or `/xw` means matches are a maximum of `x` words away, in *any* order. `WITH` means 20 words away, any order, and `SAME` means 200 words away, any order. `AJD`, `AJDx`, `ADJ/x`, or `+xw` are the same as `NEAR`, but

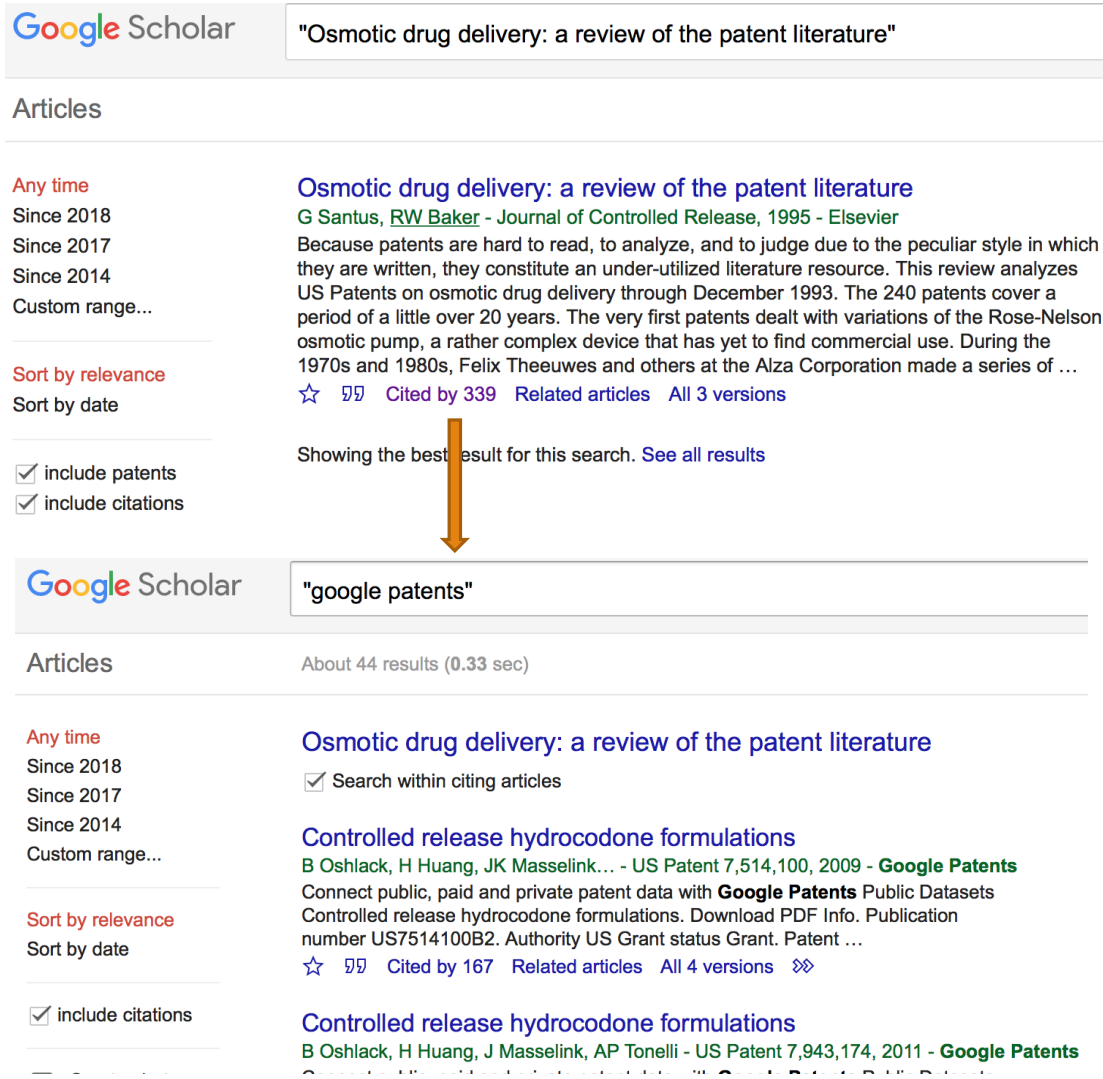
Example: `(safety ADJ/5 belt) NEAR/10 (baby OR child) SAME vehicle`.

Searching in title, abstract, claims, CPC: You can search inside a specific field using field names. Use `TI=(safety belt)` to search in the title, `AB=` for the abstract and `CL=` for the claims. For CPCs, `CPC=B60R22` will match documents with exactly this CPC, `CPC=B60R22/low` matches documents with this CPC or a child classification of this CPC. CPCs can also be used without a field prefix (see Searching by keywords and classifications above).

Wildcards, truncation: Although we automatically generate plurals, you can instead specify wildcard patterns of words to search. Wildcards only work on single words. The top 25 most common matches will be ORed together. *Note:* wildcards only work on English words. The wildcards are `?` (zero or one character), `*` or `$` (zero or more characters), `$x` (zero to x characters), and # (exactly one character). You can include more than one wildcard symbol per word.
Examples: `*saccharide?` and `hydroxy*phenyl*`.

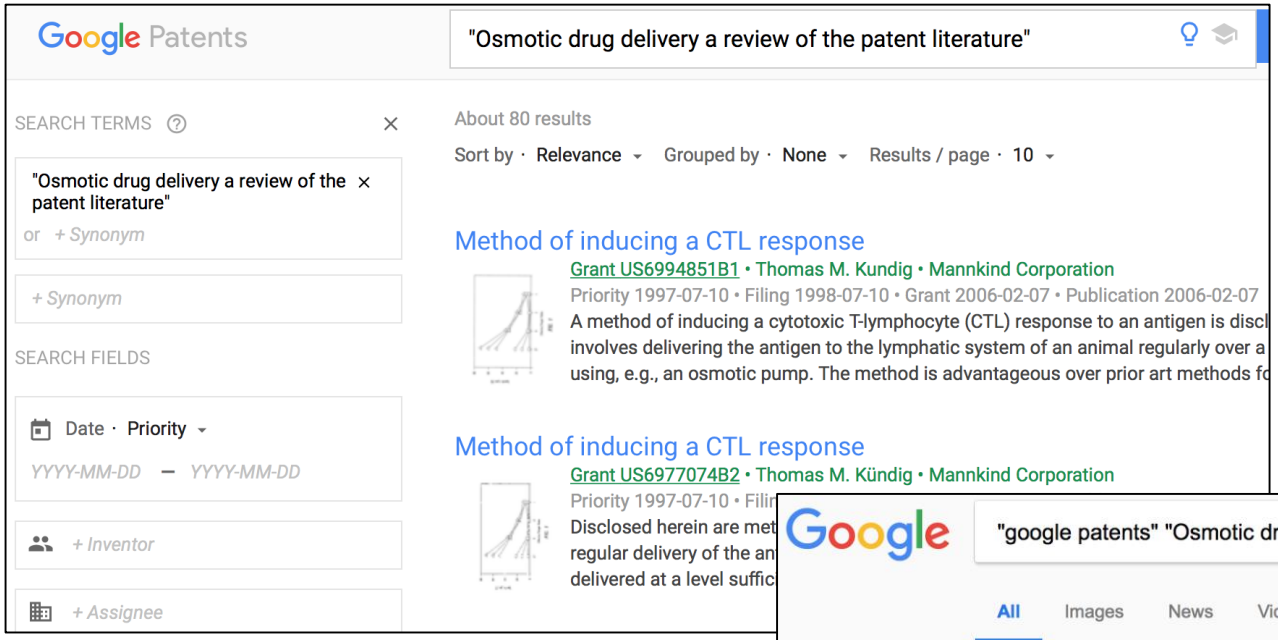
Searching Patent-cited Scientific Literature: Google Scholar Actual Search Opportunities

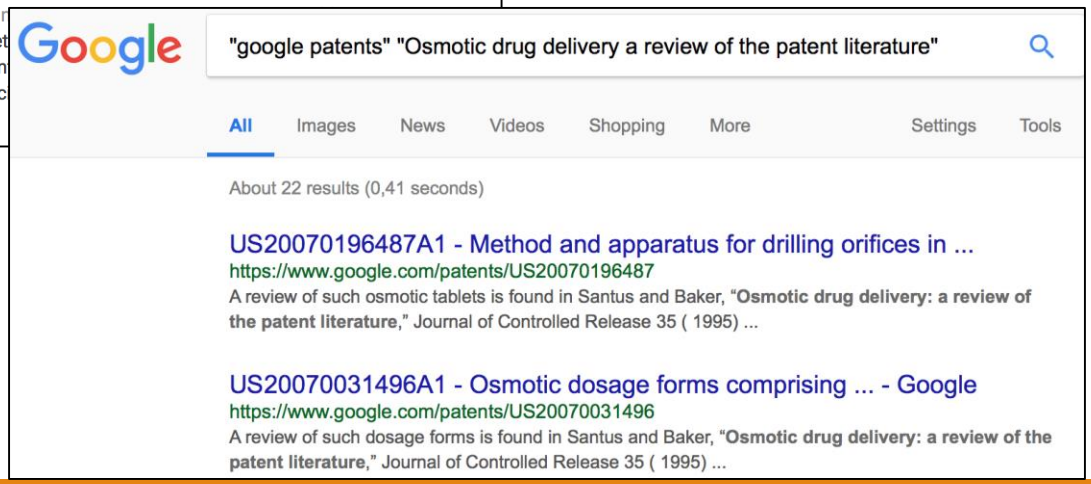
- However Google Scholar can be also searched for the citations of a given article in patent literature according to “Google Patents” by searching:
  - ✓ an article by the title, then
  - ✓ the linked list of citing references by limiting with “Google Patents”



Searching Patent-cited Scientific Literature: Google Patents Actual Search Opportunities

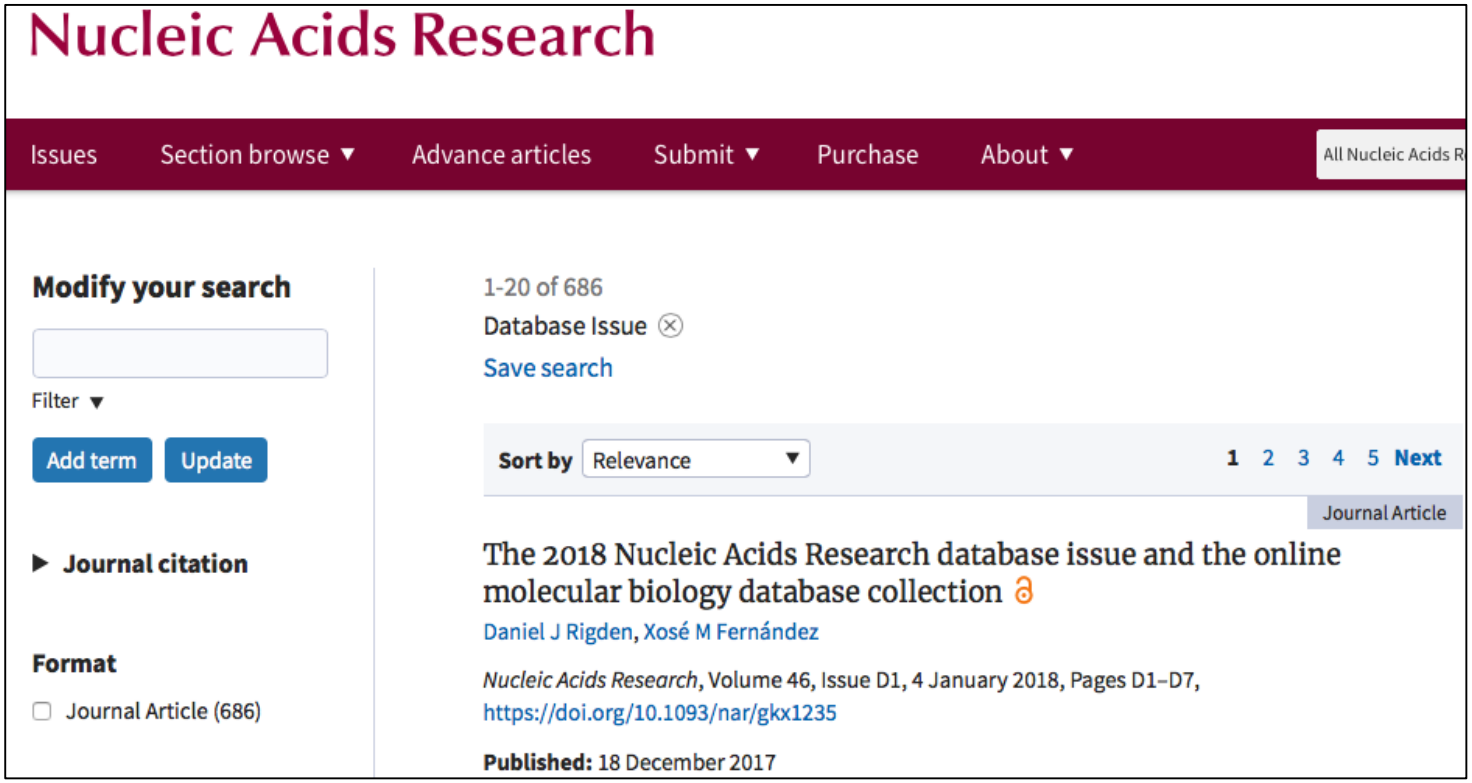
- Google Patents can be then also searched with the article by title, but citation data do not correspond neither with Google Scholar nor with “pure” Google…





Compound Coding across Patent & Scientific Literature: Nucl. Acid Res. Database of Databases (Introduction)

- The first stop for identifying scientific biotech/pharma databases that refer to and/or collect data from patent documentation is the section of *Nucleic Acid Research* journal covering the annual, free "*database issue*" published each January and searchable using the dedicated advanced search tool by using "patent", "database" and the relevant keywords for a topic:



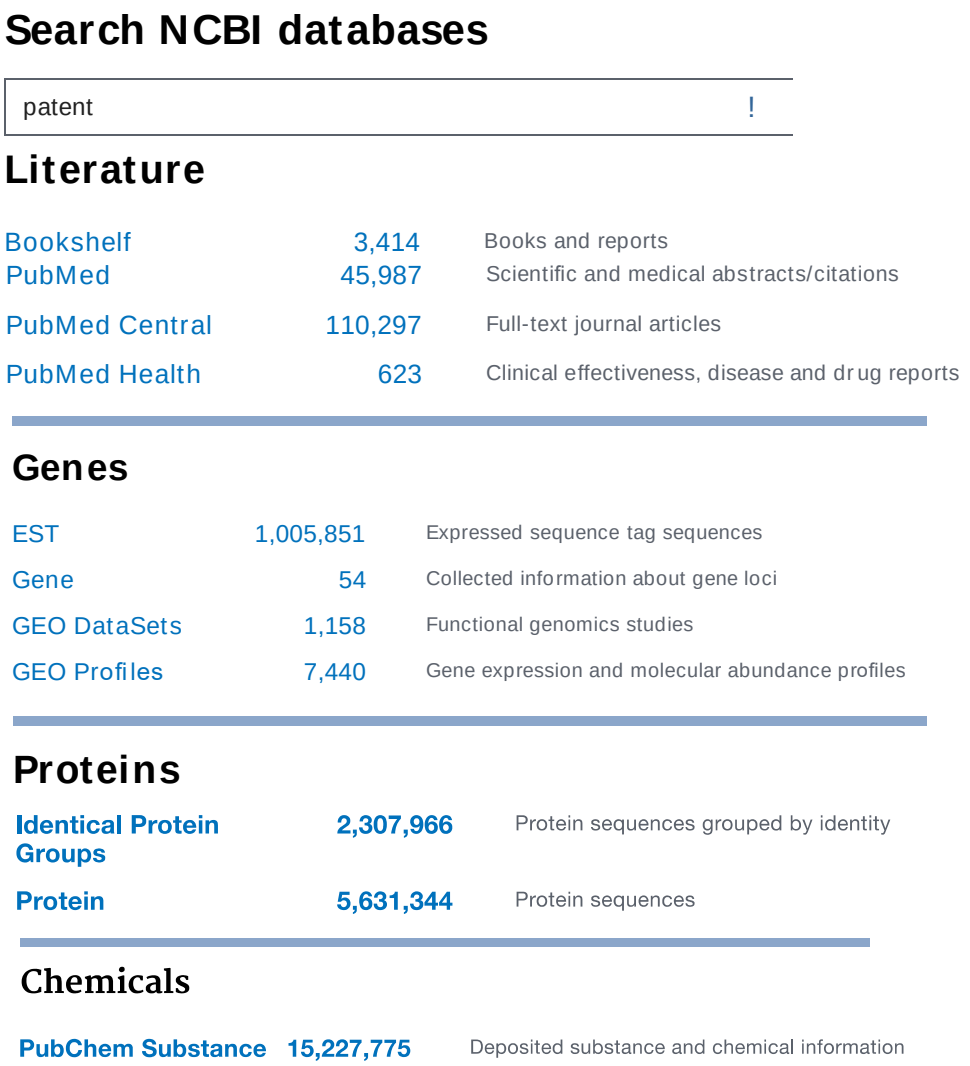
Compound Coding across Patent & Scientific Literature: Nucl. Acid Res. Database of Databases (Commentaries)

- This separate section of NAR website covers only from 2014 but prior that date such issue was simply the one of Jan. 1st every year, going back until 1996, but
  - ✓ Still more detailed for patent information on chemicals/drug than biological compounds (having a very diverse, not always consistent coding)
  - ✓ Authors of these articles are generally database originators, being mostly academics who do not provide with a fully objective / complete report

- The databases can cover very specific topics but with no guarantee about the selection criteria and database records are actually correct/updated/complete:
  - ✓ Indeed, many reported databases are "one-off" result of a project and may be not updated since their first release (or are even no more available)
  - ✓ The more reliable authors and databases are those affiliated to main bioinformatic institutions such as EBI/EMBL (Europe) and NCBI/NIH (USA)
  - ✓ Redundancy problems since the same database can be covered in more than one article, during its development over the years and/or the same codes/patent information are cross-referenced across databases

Compound Coding across Patent & Scientific Literature NCBI Databases & Patent Information (introduction)

- NCBI web site provide a global view of a number of literature-based, compound-based, and other scientific databases of interest for biotech/pharma searches



Compound Coding across Patent & Scientific Literature: NCBI Databases & Patent Information (Protein/DNA)

- However their indexing is limited as content and/or sources (mainly USPTO), with redundancy across republished WO/US/EP documents and codes poorly used elsewhere (in particular within scientific publications)

Nucleotide | (patent[Text Word]) AND homo[Organism]

Items: 1 to 20 of 7379073

1. Sequence 1 from **Patent** WO2013068413
   2,011 bp linear DNA
   Accession: JB393413.1 GI: 549038390
   GenBank FASTA Graphics

2. Sequence 216 from **Patent** EP2722395
   36 bp linear DNA
   Accession: JC559089.1 GI: 684925391
   GenBank FASTA Graphics

3. H.sapiens gene for B cell differentiation factor I
   3,230 bp linear DNA
   Accession: X12706.1 GI: 29392
   GenBank FASTA Graphics

4. H.sapiens mRNA for endothelial plasminogen activator inhibitor PAI
   1,482 bp linear mRNA
   Accession: X12701.1 GI: 31146
   GenBank FASTA Graphics

5. H.sapiens mRNA for protein S
   3,344 bp linear mRNA
   Accession: X12892.1 GI: 35692
   GenBank FASTA Graphics

Protein | (patent) AND homo[Organism]

3. protein histidine phosphatase interacting partner, PHPIP-180, partial [**Homo** sapi
   571 aa protein
   Accession: CAE11964.1 GI: 32954229
   GenPept Identical Proteins FASTA Graphics

4. unnamed protein product [**Homo** sapiens]
   362 aa protein
   Accession: CAJ44921.1 GI: 83410955
   GenPept Identical Proteins FASTA Graphics

5. unnamed protein product, partial [**Homo** sapiens]
   232 aa protein
   Accession: CAK95595.1 GI: 109715524
   GenPept Identical Proteins FASTA Graphics

6. binding protein [**Homo** sapiens]
   328 aa protein
   Accession: CAA00862.1 GI: 412023
   GenPept Identical Proteins FASTA Graphics

7. unnamed protein product [**Homo** sapiens]
   353 aa protein
   Accession: CAH69774.1 GI: 55581783
   GenPept Identical Proteins FASTA Graphics

8. Tpr1 [**Homo** sapiens]
   726 aa protein
   Accession: CAD86491.1 GI: 29370785
   GenPept Identical Proteins FASTA Graphics

Compound Coding across Patent & Scientific Literature: NCBI Databases & Patent Information (PubChem)

- This NCBI/NIH database provides "*a public repository for small-molecule and RNAi data*" associating information from many sources, including own unpublished assays, with a code that is cited present in articles and links to other NCBI databases (including PubMed/MeSH) but:
  - ✓ Patent information is generally US only, with title only
  - ✓ NO specific filter/keyword for patent information
  - ✓ Confusing code (only a number)

STRUCTURE VENDORS DRUG INFO PHARMACOLOGY LITERATURE PATENTS BIOACTIVITIES

PubChem CID:	3415
Chemical Names:	Foscarnet; Phosphonoformic acid; Phosphonoformate; Carboxyphosphonic acid; Foscarmet; 4428-95-9
Molecular Formula:	CH_3O_5P
Molecular Weight:	126.004 g/mol
InChI Key:	ZJAOAACCNHFJAH-UHFFFAOYSA-N

Drug Information: Drug Indication | Therapeutic Uses | Clinical Trials | FDA UNII

1 to 5 of 6,247 **1** 2 3 ... 1,250 Relevance

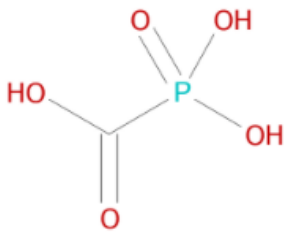
Patent ID	Title	Submitted Date	Granted Date
US8367701	Crystalline pharmaceutical and methods of preparation and use thereof	2011-11-04	2013-02-05
US7820660	N-Substituted hydroxypyrimidinone carboxamide inhibitors of HIV integrase	2008-11-06	2010-10-26

Compound Coding across Patent & Scientific Literature: EBI Databases & Patent Information (ChEmbl)

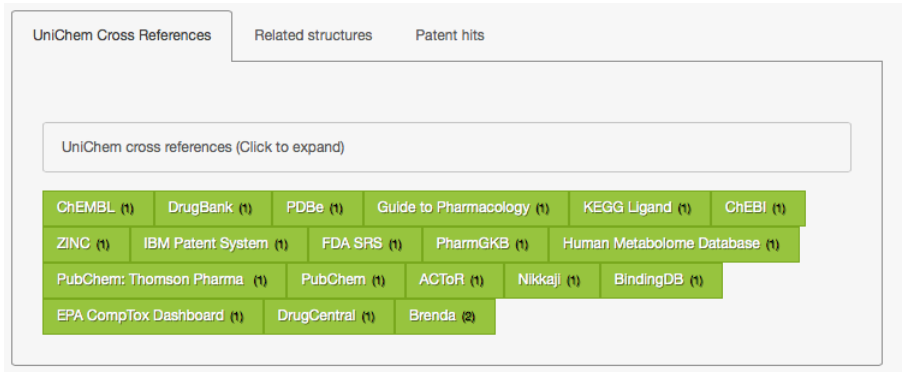
- This EBI database provides *"an open large-scale bioactivity database"* associating information from many sources, with a code that is cited/present in articles and links to many other databases including the parallel EBI chemical patent databases SureChembl (also searchable by structure, patent no., keywords, and other numerical range/similarity criteria) but still NO specific filter/keyword for patent information

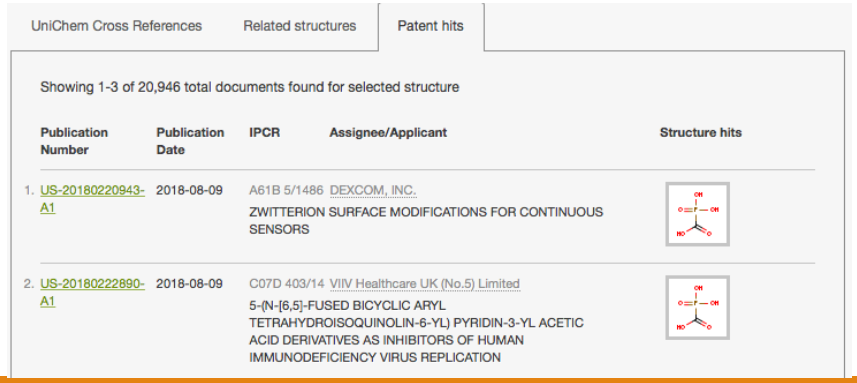
Compound Name and Classification

Compound ID	CHEMBL666
Compound Name	FOSCARNET
ChEMBL Synonyms	Foscavir | FOSCARNET SODIUM | EHB 776 | Dihydroxyphosphinecarboxylic Acid Oxide | Foscarnet
Max Phase	4 (Approved)
Trade Names	FOSCARNET SODIUM | FOSCAVIR
Molecular Formula	CH3O5P



PharmGKB	PA449706
PubChem	3415
PubChem: Thomson Pharma	15194456
SureChEMBL	SCHEMBL23633
ZINC	ZINC000008101109



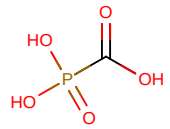


Compound Coding across Patent & Scientific Literature: Drug Databases & Patent Information (DrugBank)

- This Canadian database provides "*molecular information about drugs, their mechanisms, their interactions and their targets*" associating information from many sources in a single record for both chemical and biological drugs, with a code (general format DBnnnnn) that is cited present in many articles but:
  - ✓ Patent information is generally CA/US only, not specifying if each cited patent covers composition-of-matter, specific use, production process, etc.
  - ✓ NO specific filter/keyword for patent information (embedded into Pharmacoeconomics" super-field, but not systematically completed)
  - ✓ Recent move towards a "commercial" model

Name	Foscarnet
Accession Number	DB00529 (APRD00669)
Type	Small Molecule
Groups	Approved
Description	An antiviral agent used in the treatment of cytomegalovirus retinitis. Foscarnet also shows activity against human herpesviruses and HIV. [PubChem]
Patents	Not Available

Structure



3D | Download | Similar Structures

Synonyms	Carboxyphosphonic acid
	Foscarmet
	Phosphonoformate
	Phosphonoformic acid
	Phosphonomethanoic acid

Compound Coding across Patent & Scientific Literature: Drug Databases & Patent Information (IUPHAR-DB)

- This database provides "*expert-curated molecular interactions between successful and potential drugs and their targets in the human genome*" but:
  - ✓ Patent information is unevenly completed and embedded in specific fields that cannot be specifically searched using a code / field
  - ✓ Actual interest is how the information is assembled from various sources

Summary | Biological activity | Clinical data | Structure | Similar ligands

Classification	
Compound class	Synthetic organic
Approved drug?	Yes (FDA (1991))

IUPAC Name
phosphonoformic acid

International Nonproprietary Names	
INN number	
4712	foscarnet sodium

Synonyms
carboxyphosphonic acid | Foscavir® | phosphonocarboxylic acid | phosphonoformic acid

Comments
Foscarnet is an antiviral medication.

Database Links	
CAS Registry No.	4428-95-9
ChEBI	CHEBI:127780
ChEMBL Ligand	CHEMBL666
DrugBank Ligand	DB00529
GtoPdb PubChem SID	178102144
PubChem CID	3415
RCSB PDB Ligand	PPF
Search Google for chemical match using the InChIKey	ZJAOAACCNHFJAH-UHFFFAOYSA-N
Search Google for chemicals with the same backbone	ZJAOAACCNHFJAH
Search PubMed clinical trials	foscarnet sodium
Search PubMed titles	foscarnet sodium
Search PubMed titles/abstracts	foscarnet sodium
Search UniChem for chemical match using the InChIKey	ZJAOAACCNHFJAH-UHFFFAOYSA-N
Search UniChem for chemicals with the same backbone	ZJAOAACCNHFJAH
Wikipedia	Foscarnet

Compound Coding across Patent & Scientific Literature: Enhanced Use & Access in Scientific Literature

- Aside from reviews summarizing patent literature, patent references are still unevenly, rarely present in scientific literature, especially for drugs

- Compound-specific, patent-related codes from scientific databases are now more commonly used in articles, especially for chemical compounds, due to:
  - ✓ Greater, simpler experimental access to chemical libraries with patent-related codes by public institutions for large compound screening
  - ✓ Greater, simpler in silico access to chemical information through databases such as DrugBank, Pubchem, Chembl, SureChembl
  - ✓ More interest in translating the findings from pharmaceutical, commercial research in more basic, public research context with screening equipment
  - ✓ More common use of (large) supplementary information files in web version of scientific articles for providing full access to original “raw data”

- However neither scientific literature nor compound databases index which articles refer to compounds by means of corresponding patent-related codes

Compound-related Patent Information: (Advanced) Google Search & Scientific Literature

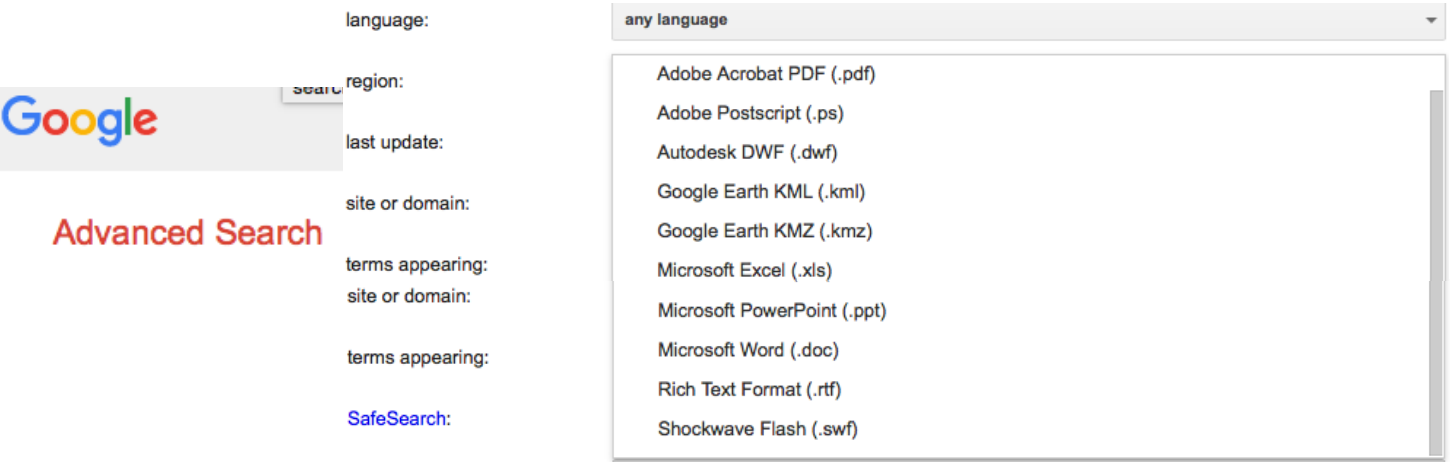
- Patent-related and other compound coding and commercial names can be made available through scientific literature (where such compounds are tested and compared) in a variety of formats summarized in two main categories:
  - ✓ Within text, figures, or tables of the PDF of the article
  - ✓ Within supplementary files of an article (available in PDF or other formats, in particular .xls, .txt, .xlsx, .doc, .tsv, .csv, or .sdf)

- Such files are indexed by Google in an uneven manner, depending from the publisher's policy, but, when they are actually available, they require:
  - ✓ Identifying the relevant database compound codes (by prior searches)
  - ✓ Making use of Advanced Google functions, in particular for file extension

- The coverage of information about a drug or other compounds, in particular for evaluating evidence with respect to specific assays/uses, can be evaluated in a more complete manner, also in view of experiments that have been performed by others than drug originators/ licensees

Compound-related Patent Information: Advanced Google Search Main Info

- Google search page (by using “filetype:” or “ext:” search operator) can be used for finding references to database and database codes in freely available files
- Regular Advanced Google search page suggests a series of ten available formats



- However, other file extensions are actually supported, as many of those used in the supplementary files associated to scientific articles available for downloading and analysis, and also to some databases and websites, including:
  - ✓ Generic formats (filetype:txt filetype:sql filetype:csv filetype:tsv)
  - ✓ Scientific format (filetype:tex filetype:sdf filetype:dat filetype:xml)

Compound-related Patent Information: Advanced Google Search Additional Info

- Using the keyword *"drug"* and no limitation, Google indexes 550 millions and 99.5 millions with filetype:pdf, but other filetype limitations can be applied

filetype:doc 440.000	filetype:xml 406.000	filetype:txt 386.000
filetype:ppt 101.000	filetype:rtf 80.300	filetype:xls 79.900
filetype:dat 27.500	filetype:tex 10.800	filetype:csv 9.960
filetype:sql 567	filetype:tsv 26	filetype:sdf 18

- Such "deep" information require some time and it may be useful for obtaining the most complete coverage possible about a compound:
  - ✓ Identifying which database code for a compound also refers to (reliable) patent references with minimal redundancy/precision over other codes
  - ✓ Testing different file extensions (possibly using other relevant keywords)
  - ✓ Testing different site limitations (using the "site:" operator as well, eg "*drug" filetype:pdf site:.gov* OR *"drug" filetype:pdf site:.nih.gov*)
  - ✓ Sometime, making use of the right software to actually read the content of file identified in this manner

Final Observations:
(Fixing) Links Between Patent & Scientific Literature

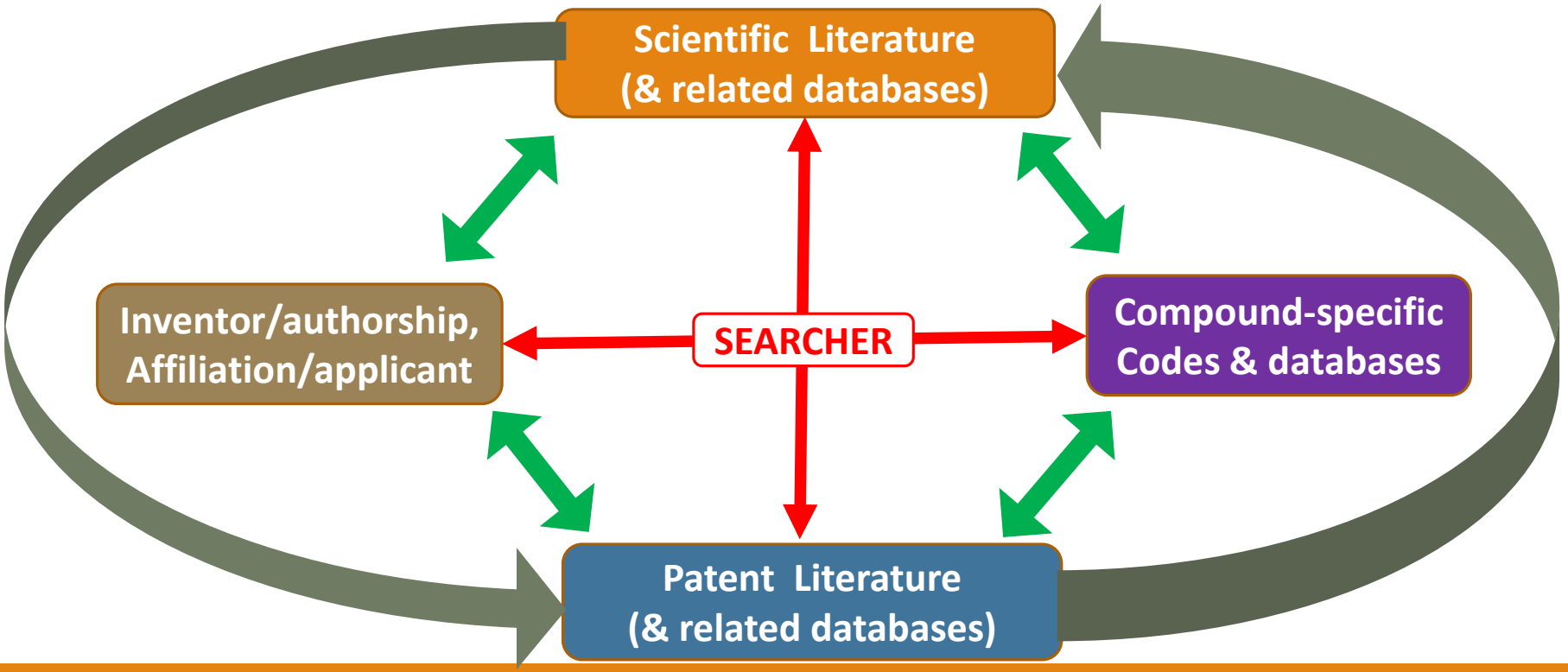
- The patent-relevant search in pharma & biotech scientific literature requires:
  - ✓ Some substantial preparation in mapping keywords and relevant resources
  - ✓ Testing the search strategies across the resources
  - ✓ Comparing names, findings, but still being aware of and making the distinction between what is experimentally confirmed and what is suggested within such disclosures

- Even more than the search in patent documentation, the preliminary analysis, the search execution, and analysis of results in scientific literature requires time and discussions with client, who may already use sources covering both patent and scientific literature but is rarely aware of actual limitations & opportunities

- Progresses are made by various information providers but still a lot relies upon the searcher's experience and choices in navigating the two oceans

Final Observations: Central Role of Searcher

- The citation flow is continuous between patent and scientific literature but links are deeper than expected and of major interest for the searcher, who has a central position when dealing with strategic objectives such as
  - ✓ Legally relevant topics
  - ✓ Competitive intelligence



References

- Main cited websites

Pubmed Tutorial	Google Advanced Search Page	NAR database section
Pharm Patent Analyst	Expert Opin Ther. Patents	Recent Patents series
J. Tech Transfer	World Patent Inf.	Technovation
Lens.org Support Page	Google Scholar Help Page	Google Patents Help Page
NCBI Tutorial	Pubchem Help page	EBI Services
Chembl FAQ	DrugBank Documentation	Iuphar-DB

- Some free readings

Bousfield D et al. , Patterns of database citation in articles and patents indicate long-term scientific and industry value of biological data resources. F1000Res. 2016 Feb 11;5

Ahmadpoor M, Jones BF. The dual frontier: Patented inventions and prior scientific advance. Science. 2017 Aug 11;357(6351):583-587

Thank you and (maybe) see you in Brussels!!

Luca.falciola@droiagroup.com

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