

Searching fast & slow

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Uxlabs

Goldsmiths
UNIVERSITY OF LONDON

2Dsearch

Professional search



- We all need search but...
 - Some need it more than others
- Patent, healthcare, recruitment, media...
 - Keyword search is not good enough
- Professional search needs to be:
 - Comprehensive
 - Repeatable
 - Transparent

Query builders



World Health Organization



International Clinical Trials Registry Platform Search Portal

Home Advanced Search List By Search Tips UTN ICTRP website REGTRAC Contact us

Fields can be left blank. Click on the field name hyperlink for an explanation of each search field

Look for trials with the exact phrase or contains

Example: liver cancer OR breast cancer

AND Example: Diphtheria NOT tetanus

AND Example: transplant AND immunosuppressant

Search for [clinical trials in children](#)

[Recruitment status](#) is

[Primary sponsor](#) is or contains

[Secondary ID](#) is or contains

[Countries of recruitment](#) are

Free Text Country :

[Date of registration](#) is between and

[Phases](#) are

With results only

Rare diseases / orphan drugs

Genome editing

[Search Tips](#)

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A healthcare search strategy

1. randomized controlled trial.pt.
2. controlled clinical trial.pt.
3. randomized.ab.
4. placebo.ab.
5. clinical trials as topic.sh.
6. randomly.ab.
7. trial.ti.
8. 1 or 2 or 3 or 4 or 5 or 6 or 7
9. (animals not (humans and animals)).sh.
10. 8 not 9
11. exp Child/
12. ADOLESCENT/
13. exp infant/
14. child hospitalized/
15. adolescent hospitalized/
16. (child\$ or infant\$ or toddlers\$ or adolescens\$ or teenage\$).tw.
17. or/11-16
18. Child Nutrition Sciences/
19. exp Dietary Proteins/
20. Dietary Supplements/
21. Dietetics/
22. or/18-21
23. exp Infant, Newborn/
24. exp Overweight/
25. exp Eating Disorders/
26. Athletes/
27. exp Sports/
28. exp Pregnancy/
29. exp Viruses/
30. (newborn\$ or obes\$ or "eating disorder\$" or pregnan\$ or childbirth or virus\$ or influenza).tw.
31. or/23-30
32. 10 and 17 and 22
33. 32 not 31

Francis, D. K., Smith, J., Saljuqi, T., & Watling, R. M. (2015). Oral protein calorie supplementation for children with chronic disease. *Cochrane Database of Systematic Reviews*, (5).

Recruitment search strategies

Java AND (Design OR develop OR code OR Program) AND ("* Engineer" OR MTS OR "* Develop*" OR Scientist OR technologist) AND (J2EE OR Struts OR Spring) AND (Algorithm OR "Data Structure" OR PS OR "Problem Solving")

A screenshot of a Google search for "boolean strings". The search bar shows the query and a microphone icon. Below the search bar, there are tabs for "All", "Images", "Videos", "Shopping", "News", "More", "Settings", and "Tools". The search results show "About 16,400,000 results (0.36 seconds)". The first result is "A Recruiter's Guide to Boolean Searching (and the World's Largest ...)" with a URL and a brief description. Below the search results, there is a section titled "People also ask" with four questions: "What is a Boolean search string?", "What is an example of a Boolean?", "What is a Boolean Google search?", and "What are the three Boolean search terms?". Below this, there are three more search results: "The Beginner's Guide to Boolean Search Operators - SocialTalent", "Boolean Strings | By Irina Shamaeva", and "Boolean Search String Examples | Boolean Black Belt-Sourcing ...".

A screenshot of a LinkedIn search for the query: "(site:linkedin.com intitle:profile) (Java AND (Design OR develop OR code OR Program) AND (* Engineer OR MTS OR * Develop* OR Scientist OR technologist) AND (J2EE OR Struts OR Spring) AND (Algorithm OR Data Structure OR PS OR Problem Solving))". The search bar shows the query and a search icon. Below the search bar, there are tabs for "All", "Images", "Videos", "Maps", "News", "My saves", and "Sign in". The search results show "6,540 Results". The first result is "Latha Balne - Java Support Developer - KCOM | LinkedIn" with a URL and a brief description. Below this, there are three more search results: "Eugen Hoble - Senior J2EE Engineer - Crosscap Media ...", "Artem Gluhovskiy - Java Software Engineer - Exadel | ...", and "Shahzeb Khan - Sr. Java Developer - WizTech Pakistan ...".

Think outside the search box – www.2dsearch.com

Patent search & media monitoring

```
1      A01N0025-004/CPC
2      RODENT OR RAT OR RATS OR
MOUSE OR MICE
3      BAIT OR POISON
4      2 AND 3
5      1 OR 4
6      AVERSIVE OR ADVERSIVE OR
DETER? OR REPEL?
7      NONTARGET OR (NON WITH
TARGET) OR HUMAN OR DOMESTIC OR
PET OR DOG OR CAT
8      6 AND 7
9      8 AND 5
10     BITREX OR DENATONIUM OR
BITREXENE OR BITTERANT OR BITTER
11     10 AND 5
12     9 OR 11
```

```
(
  (
    (~Magnolia OR ~Magnolias) AND
    ('~Paul ~Anderson' OR '~Paul ~Thomas' OR paul* OR thom*
OR anders*)
  ) OR
  'jeremy blackman*' OR jeremy OR Jerem* OR
  (
    (~incredible OR ~coincidences) AND
    (role* OR chance* OR life* OR investigat* OR disturb*)
  ) OR
  (
    (~C NOT
      ('~John C' OR
        (
          (~Mister C' AND ~Shamen) OR
          ('~Tom C' AND ~Scientology)
        )
      )
    )
  ) OR ~XCs OR ~CV OR ~CVs OR
  (
    (
      (~CKR OR ~CKRs) NOT ('CKR 123' OR lawyer)
    )
  )
)
```

And more...

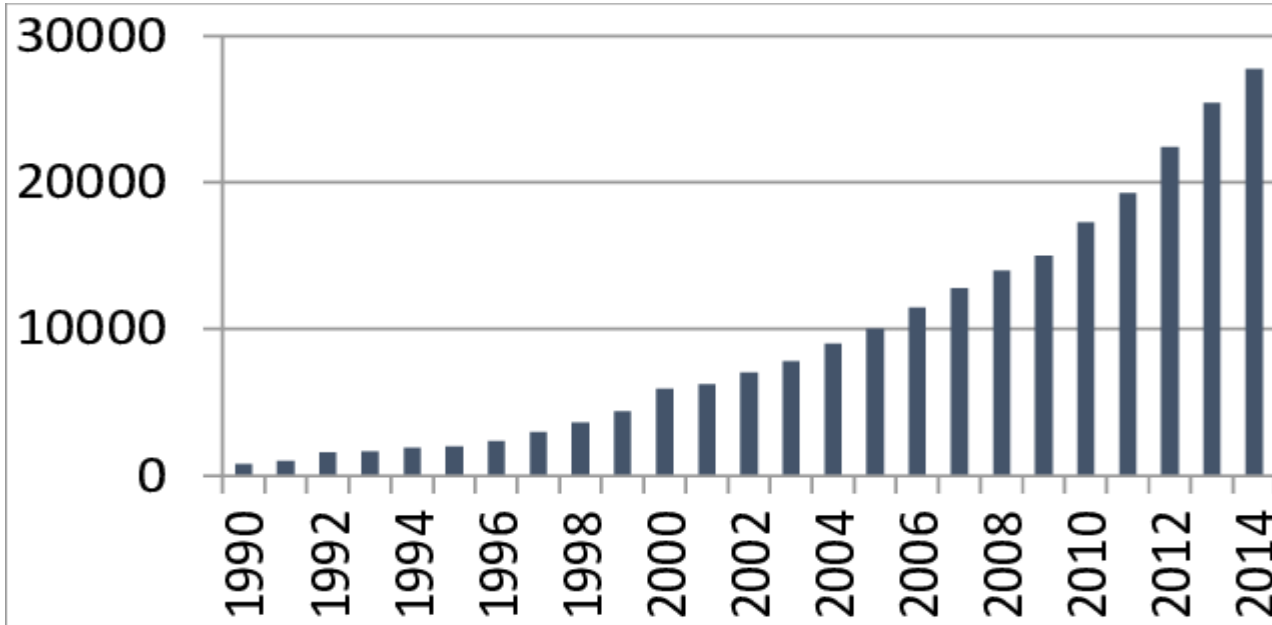
(topic:"d5f485b9\|aabo\|4d95\|a83b\|28b2decd900c" AND (topic:"bag42587\|854e\|407d\|81dc\|812ee29624bd" OR topic:"805a2281\|8fo4\|42b7\|a451\|e2b7daac4db1" OR topic:"1fc2a4f5\|3f23\|4c80\|943c\|42f789d1644" OR topic:"91e4df78\|db55\|4d63\|be65\|2fad1afa7a77" OR organization:"Argos" OR organization:"Sainsbury" OR organization:"Marks and Spencer" OR organization:"Morrisons" OR organization:"Signet" OR organization:"Rapha" OR organization:"Vodafone" OR organization:"Evans Cycle" OR organization:"The Body Shop" OR organization:"Homebase" OR organization:"Toppo Tiles" OR organization:"Carphone Warehouse" OR organization:"B&Q" OR organization:"Tesco" OR organization:"Lidl" OR organization:"Aldi" OR organization:"Waitrose" OR organization:"John Lewis" OR organization:"Dixons" OR organization:"Alliance Boots" OR organization:"AS Watson" OR organization:"Halfords" OR organization:"Vision Express" OR organization:"Pets at Home" OR organization:"Asda" OR organization:"Pret a Manger" OR organization:"Greggs" OR organization:"Majestic Wine" OR organization:"Ocado" OR organization:"Selfridges" OR organization:"Nike" OR organization:"Adidas" OR organization:"Walmart" OR organization:"Woolworths" OR organization:"Debenhams" OR organization:"Halfords" OR organization:"Punch Taverns" OR organization:"Monarch Group" OR organization:"Whitbread" OR organization:"Carnival Cruise" OR organization:"KFC" OR organization:"Yum!" OR organization:"Costa Coffee" OR organization:"Pizza Hut" OR organization:"Greene King" OR organization:"Carluccio's" OR organization:"Gondola" OR organization:"Starbucks" OR organization:"Sodexo" OR organization:"SSP" OR organization:"Nando's" OR organization:"Avis" OR organization:"Paddy Power" OR organization:"Easyjet" OR organization:"Emaar" OR organization:"Nuffield Health" OR organization:"Safestore" OR organization:"TUI" OR organization:"Merlin Entertainment" OR organization:"Virgin Atlantic" OR organization:"IHG" OR organization:"Virgin Active" OR organization:"Thomas Cook" OR organization:"Odeon Hilton" OR organization:"Pizza Express" OR organization:"Zizzi's" OR organization:"Gemfields" OR organization:"Orlebar Brown" OR organization:"Rebecca Trowell" OR organization:"Spring Studios" OR organization:"Loewe" OR organization:"Jimmy Choo" OR organization:"Burberry" OR organization:"Conde Nast" OR organization:"Zadig & Voltaire" OR organization:"Prada" OR organization:"Fendi" OR organization:"French Connection" OR organization:"Lyle & Scott" OR organization:"LK Bennett" OR organization:"Alexander Wang" OR organization:"Sandro" OR organization:"Isabel Marant" OR organization:"Rag & Bone" OR organization:"J Crew" OR organization:"Maje" OR organization:"Ralph Lauren" OR organization:"Tommy Hilfiger" OR organization:"Michael Kors" OR organization:"Kenzo" OR organization:"Pringle of Scotland" OR organization:"Heidi Klein" OR organization:"Louis Vuitton" OR organization:"Lanvin" OR organization:"Loewe" OR organization:"Chanel" OR organization:"Valentino" OR organization:"Celine" OR organization:"Dior" OR organization:"Alexander McQueen" OR organization:"Victoria Beckham" OR organization:"Sonia Rykel" OR organization:"Bally" OR organization:"Notonthehighstreet" OR organization:"Rupert Sanderson" OR organization:"Dunhill" OR organization:"De Beers" OR organization:"Swarovski" OR organization:"Hermes" OR organization:"Cartier" OR organization:"David Yurman" OR organization:"Mulberry" OR organization:"Tiffany & Co" OR organization:"Boucheron" OR organization:"Lancel" OR organization:"Marc Jacobs" OR organization:"Longchamp" OR organization:"Kate Spade" OR organization:"Salvatore Ferragamo" OR organization:"Asos" OR organization:"Net a porter" OR organization:"Astley Clarke" OR organization:"Fenwick" OR organization:"Yoox" OR organization:"Harrods" OR organization:"Selfridges" OR organization:"MyTheresa" OR organization:"Lane Crawford" OR organization:"Liberty of London" OR organization:"Gucci" OR organization:"Armani" OR organization:"Zara" OR organization:"Topshop" OR organization:"Arcadia" OR organization:"Balenciaga" OR organization:"Stella McCartney" OR organization:"Brioni" OR organization:"Bottega Veneta" OR organization:"Christopher Kane" OR organization:"Anya Hindmarch" OR organization:"Business of Fashion" OR organization:"zi" OR organization:"Active Private Equity" OR organization:"Advent International" OR organization:"Advent" OR organization:"Apollo Global Management" OR organization:"Apollo" OR organization:"Apax" OR organization:"Apax" OR organization:"Augmentum Capital" OR organization:"Bain" OR organization:"Endless" OR organization:"BC Partners" OR organization:"Better Capital" OR organization:"HuttonCollins" OR organization:"Hutton Collins" OR organization:"Bridgepoint" OR organization:"Business Growth Fund" OR organization:"CDR" OR organization:"Darwin" OR organization:"Duke Street Capital" OR organization:"Electra Partners" OR organization:"Exponent" OR organization:"European Capital" OR organization:"General Atlantic" OR organization:"Hilco" OR organization:"Inflexion" OR organization:"KKR" OR organization:"LGV" OR organization:"Lion" OR organization:"Magenta Partners" OR organization:"Montagu" OR organization:"Octopus" OR organization:"Octopus Capital" OR organization:"Piper Private Equity" OR organization:"Piper" OR organization:"Sun Capital" OR organization:"TA Associates" OR organization:"Warburg Pincus" OR organization:"Charterhouse" OR organization:"Primary Capital" OR organization:"Bowmark" OR organization:"Beringea" OR organization:"Business Growth Fund" OR organization:"Bridgepoint" OR organization:"Caird Capital" OR organization:"CapVest" OR organization:"Cerberus Capital" OR organization:"CBPE" OR organization:"CCMP" OR organization:"CDR" OR organization:"Change Capital" OR organization:"Cinven" OR organization:"CVC" OR organization:"Duke Street" OR organization:"EC1" OR organization:"Electra" OR organization:"Encore" OR organization:"EQT" OR organization:"Equistone" OR organization:"Graphite Capital" OR organization:"Caledonian" OR organization:"Kings Park Capital" OR organization:"L Capital" OR organization:"LDC"

Think outside the search box – www.2dsearch.com

Healthcare search

- Evidence based medicine
- *"A systematic review summarises the results of healthcare studies (controlled trials) and provides a high level of evidence on the effectiveness of healthcare interventions. Judgments may be made about the evidence and inform recommendations for healthcare."*
- Cochrane Consumer Network, <https://consumers.cochrane.org/what-systematic-review>

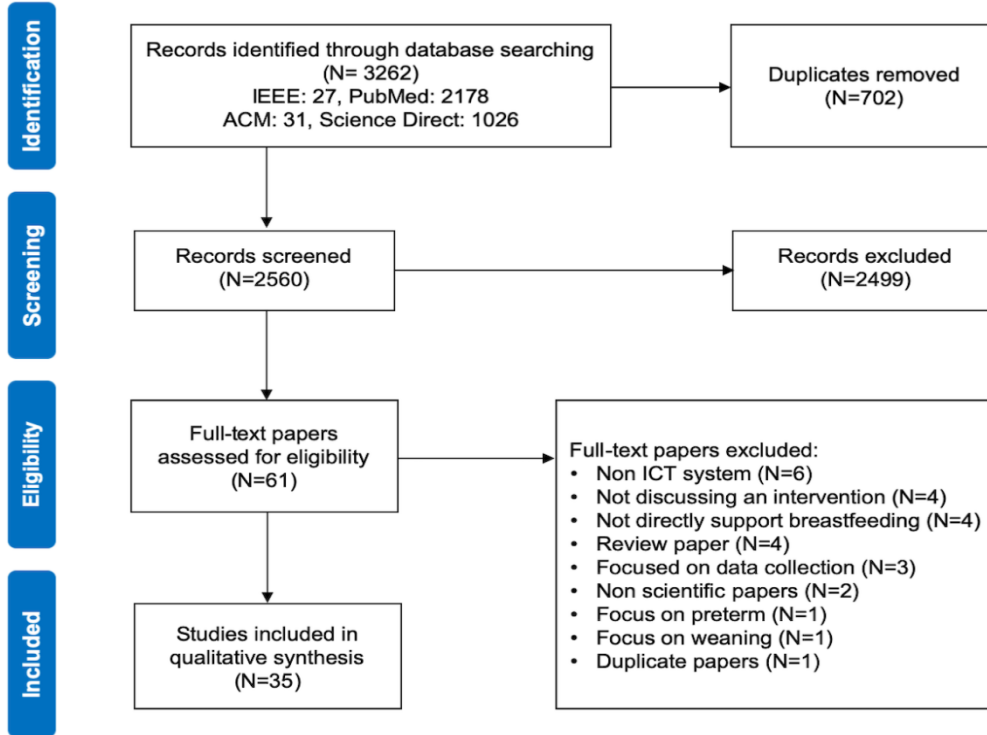
Big data in healthcare



Growth in systematic reviews over 25 years (N=233,785 MEDLINE citations)

Bekhuis T, Tseytlin E, Mitchell KJ. A Prototype for a Hybrid System to Support Systematic Review Teams: A Case Study of Organ Transplantation. *Proceedings IEEE International Conference on Bioinformatics and Biomedicine*. 2015;2015:940-947.

PRISMA flowchart



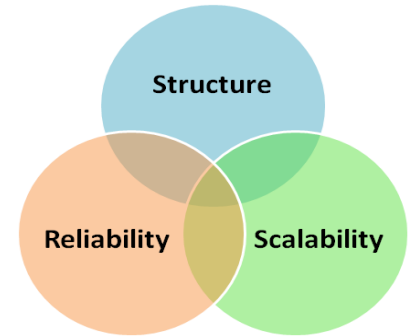
PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) is an evidence-based minimum set of items aimed at helping authors to report a wide array of [systematic reviews](https://en.wikipedia.org/wiki/Systematic_Reviews) and [meta-analyses](https://en.wikipedia.org/wiki/Meta-Analyses) that assess the benefits and harms of a health care intervention.

https://en.wikipedia.org/wiki/Preferred_Reporting_Items_for_Systematic_Reviews_and_Meta-Analyses

Tang, K., Gerling, K., Chen, W., & Geurts, L. (2019). Information and Communication Systems to Tackle Barriers to Breastfeeding: Systematic Search and Review. *Journal of Medical Internet Research*, 21(9), e13947.

What's wrong with Boolean strings?

- Ineffective for communicating *structure*
 - Visual cues needed
- Poor scalability
 - No abstraction
- Error-prone
 - Syntactic + semantic errors



- Salvador-Oliván, José Antonio, Gonzalo Marco-Cuenca, and Rosario Arquero-Avilés. "Errors in search strategies used in systematic reviews and their effects on information retrieval." *Journal of the Medical Library Association: JMLA* 107.2 (2019): 210.

Professional search practice

- Peer-reviewing search strategies (McGowan et al. 2016, J Clin Epidemiology)
- Search strategy development (Russell-Rose & Shokrane, Journal of Library UX)
 - Word Processors
 - Auto-conversion of straight to smart quotations
 - Auto-correction of truncation or wildcards: Creates duplicates
 - Auto-space-removal of shared documents
 - Need external program such as Microsoft Office or GoogleDocs
 - PDFs
 - Breaking paragraphs into lines when copies
 - Cannot be edited (without a installing another program)
 - Need external program such as Microsoft Office or GoogleDocs

Professional search practice

- Reproducibility of searches
- Training beginners
- Translating search strategies
 - PolyGlot
- Sharing search strategies (externally)
 - Unavailability of supplementary materials (Evangelou et al. 2005, FACEB J)
 - MedTerm Assist (Pittsburgh University), Search Strategy Library (Gulhane, 2019)
 - ISSG Search Filters, Search Blocks on Google Sites
 - Institutional Repositories or OSF
- Living Search Strategies (Shokraneh & Russell-Rose 2020, J Clin Epidemiol)
 - COVID-19

Quiz time! 2010 or 2020?



World Health Organization



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INTERNATIONAL CLINICAL TRIALS REGISTRY PLATFORM

SEARCH PORTAL

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Home **Advanced Search** Search Tips ICTRP website Contact us

Fields can be left blank. Click on the field name hyperlink for an explanation of each search field

Look for trials with

AND

AND

Search for clinical trials

Recruitment status

Primary sponsor contains

Secondary ID is contains

Countries of recruitment are

Date of registration

Disclaimer: Trials posted on this search portal are not endorsed by WHO, but are provided as a service to our users. In no event shall the World Health Organization be liable for any damages arising from the use of the information linked to in this section. None of the information obtained through use of the search portal should in any way be used in clinical care without consulting a physician or licensed health professional. WHO is not responsible for the accuracy, completeness and/or use made of the content displayed for any trial record.

Recruitment status is

Primary sponsor is or contains

Secondary ID is or contains

Countries of recruitment are

Date of registration is between

Sort by

Search Clear Search Tips

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I think outside the search box – www.2dsearch.com

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Look for trials with the exact phrase or contains

Example: liver cancer OR

in the [Title](#) , AND

Example: Diphtheria NOT tel

in the [Condition](#) , AND

Example: transplant AND im

in the [Intervention](#) , AND

Search for [clinical trials in children](#)

[Recruitment status](#) is

Recruiting ▼

[Primary sponsor](#) is or contains

[Secondary ID](#) is or contains

[Countries of recruitment](#) are

Afghanistan
Albania
Algeria
American Samoa

Add country and/or territory

Clear

[Date of registration](#) is between

dd/mm/yyyy



and



Sort by [Date of Registration](#) ▼

Search

Clear

[Search Tips](#)

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I think outside the search box – www.2dsearch.com

Learning from other disciplines

- Search strategies are:
 - Complex, logical constructs
 - Read many more times that they are written
 - Exhibit abstraction, modularity, encapsulation
 - Maintained, shared, optimised...
- *"For the IBM PC in the early 1980s, the software development process was text edit, compile, write down the errors, and debug with your eyes."*
 - The History of Visual Development Environments, <https://www.mendix.com/blog/the-history-of-visual-development-environments-imagine-theres-no-ides-its-difficult-if-you-try/>

Searching fast & slow

Slow thinking

- Procedural
- Static
- Monolithic
- Strings

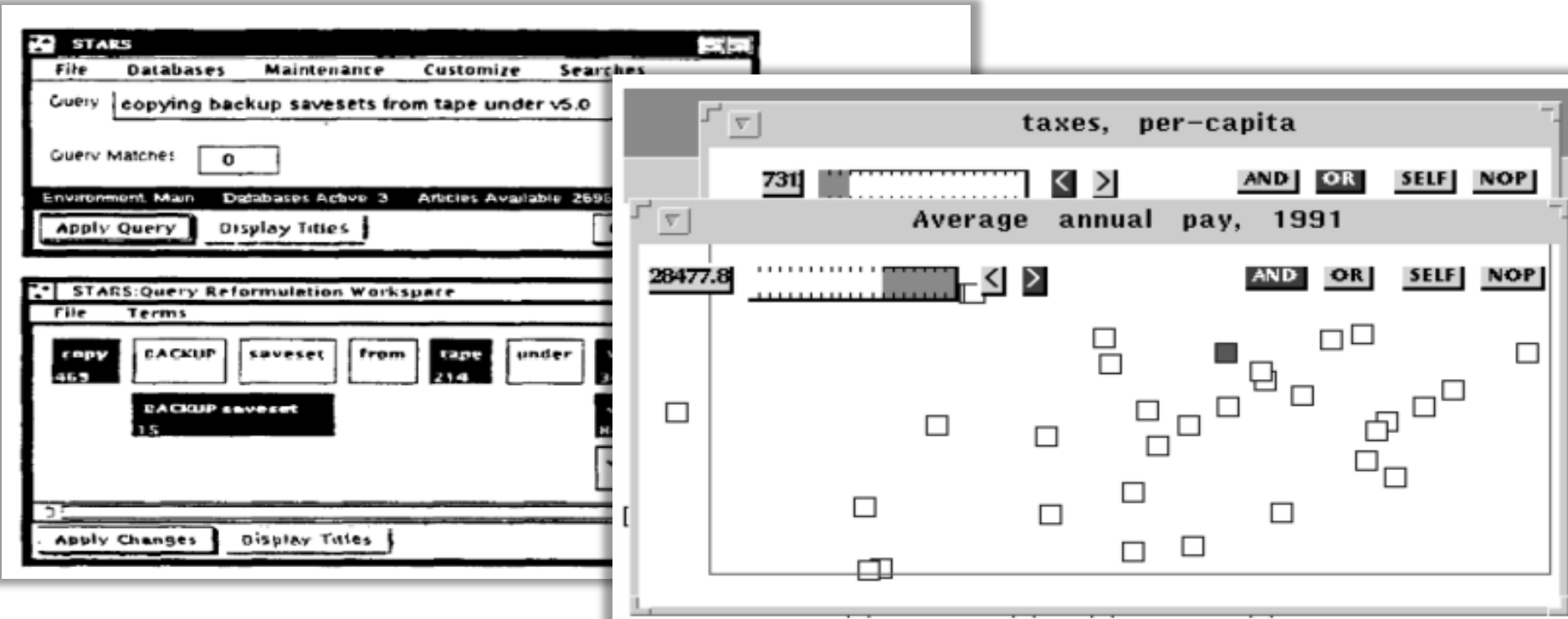
Fast thinking

- Declarative
- Interactive
- Executable
- Objects

Thinking outside the search box

- What if we could *visualize* search strategies?
 - Use metaphors the user already understands
 - Separate keyword selection from query manipulation
 - Provide a 'scratchpad' & 'debugging aids'
 - Provide instant feedback
 - Support abstraction (levels of composition)
 - Provide query suggestions

Anick et al (1989), Fishkin & Stone (1995)



Boolio, Search Whiteboard, Searchrefiner

AND
OR
NOT
RESET

Filetype - Off LinkedIn

Software Enrngineer	Platform
Software Developer	Softwa
	PaaS
	SaaS

(*Software Enrngineer" OR "Softwa

Patient	Interve
Hypertension	aspirin
high blood pressure	NSAIDS
"Hypertension"	"aspirin"
"high blood pressure"	"NSAIDS"
Hypertension[TI]	aspirin[TI]
"high blood pressure"[TI]	NSAIDS[TI]
"high blood pressure"[OT]	aspirin[MeSH]
Hypertension[MeSH]	Anti-Inflammat Non-Steroidal[

searchrefiner

Text Editor Structured Editor Tree View Console

1. exp ORTHODONTICS/
2. orthodontic\$.mp.
3. or/1-2
4. (retention or retain\$).mp.
5. (stabilise\$ or stabilizes\$).mp.
6. (fraenectom\$ or frenectom\$).mp.
7. (fiberotom\$ or fibreotom\$).mp.
8. interproximal stripping.mp.
9. percision.mp.
10. reproximat\$.mp.
11. ((gingiv\$ or periodont\$).mp. adj4 surg\$).mp.
12. (retain or retention).mp.
13. 11 and 12
14. or/4-10
15. 13 or 14
16. 3 and 15

Query Language [help?](#)

Ovid MEDLINE

Results > Edit >

Update Tree

4161 citations retrieved

10 citations relevant

7 citations relevant retrieved

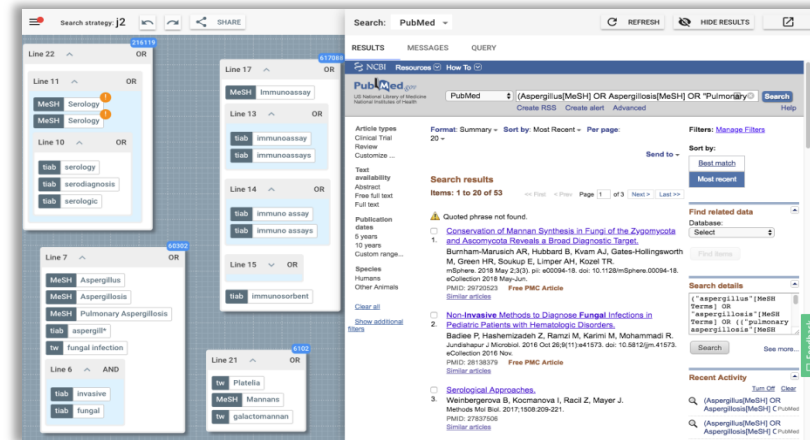
[help?](#)

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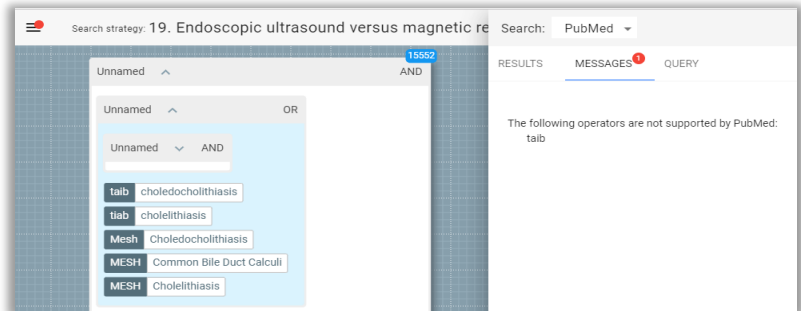
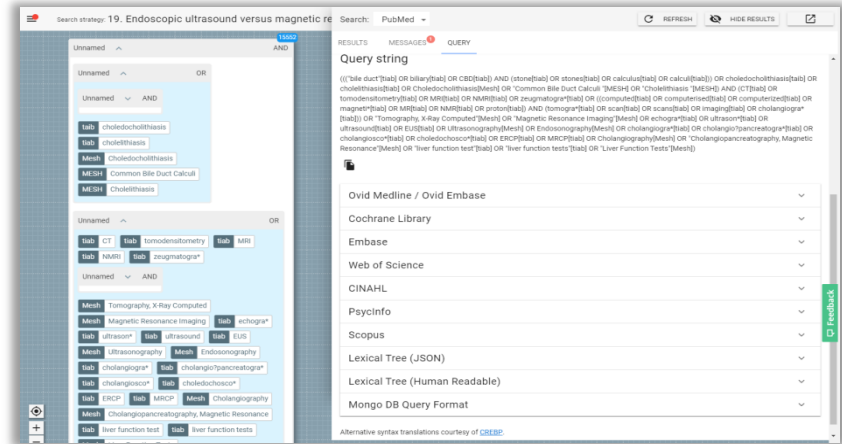
Query formulation

- Concepts are objects on a 2D canvas
- Relationships via direct manipulation
 - Syntactically correct expressions
 - Transparent semantics
 - Arbitrary levels of abstraction
- 'Lego' analogy
 - Optimisation thru exploration
 - Execute, enable/disable
 - Hit counts



Executing queries

- Integrations
 - 9 databases & counting...
- Universal representation
 - Auto-translation
 - Error-checking
- Interoperability with legacy formats
 - Boolean string I/O



That healthcare strategy...

Type of study 1198210 AND

- RCT OR
 - pt randomized controlled trial
 - pt controlled clinical trial
 - tiab randomized
 - tiab placebo
 - Mesh:NoExp clinical trials as topic
 - tiab randomly
 - ti trial

Humans only AND

- animals
- Unnamed AND
 - humans
 - animals

Target population 3994866 OR

- Mesh Child
- Mesh:NoExp ADOLESCENT
- Mesh infant
- Mesh:NoExp child hospitalized
- Mesh:NoExp adolescent hospitalized
- tiab child* tiab infant*
- tiab toddler*
- tiab adolescent*
- tiab teenage*

Intervention 161355 OR

- Mesh:NoExp Child Nutrition Sciences
- Mesh Dietary Proteins
- Mesh:NoExp Dietary Supplements
- Mesh:NoExp Dietetics

Exclusions 3024636 OR

- Mesh Infant, Newborn
- Mesh Overweight
- Mesh Eating Disorders
- Mesh:NoExp Athletes
- Mesh Sports
- Mesh Pregnancy
- Mesh Viruses tiab newborn*
- tiab obes*
- tiab eating disorder*
- tiab pregnan* tiab childbirth
- tiab virus* tiab influenza

That patent strategy...

The image displays a patent search interface with a complex query tree on the left and search results on the right.

Search Strategy (Left Panel):

- Level 12: AND (9, 11)
- Level 9: OR (6, 7)
- Level 11: AND (10, 5)
- Level 6: OR (AVERSIVE, ADVERSIVE, DETER?, REPEL?, NONTARGET, NON WITH TARGET, HUMAN, DOMESTIC, PET, DOG, CAT)
- Level 7: OR (BITREX, DENATONIUM, BITREXENE, BITTERANT, BITTER)
- Level 10: OR (CPC A01N0025-004, Unnamed AND (2, 3))
- Level 5: OR (CPC A01N0025-004, Unnamed AND (2, 3))
- Level 2: OR (RODENT, RAT, RATS, MOUSE, MICE)
- Level 3: OR (BAIT, POISON)

Search Results (Right Panel):

- Search: Lens.org
- RESULTS: 3,936 Scholarly Works, 1,266 Citing Patents (903 Families)
- Section: Citing Patents
- Filters: No filters applied
- Patent 1: Sheet Or Tubular Structure Consisting Of Elastic Biocompatible Material And Its Use
 - Published: Jun 10, 2009 | Filed: Dec 4, 2007 | Earliest Priority: Dec 4, 2007
 - Family: 2 | Cited Works: 22 | Cited by: 5 | Cites: 14 | Additional Info: 4 Cited Works | Published
 - Applicants: Charite Universitaetsmedizin
 - Inventors: Duda Georg, Manav Metha, Strube Patrick
 - Patent Application: EP 2067494 A1 | 004-204-033-924-753
- Patent 2: Methods For Production Of Growth-promoting Proteins And Peptides For Kidney Epithelial Cells
 - Published: Jun 23, 2009 | Filed: Nov 6, 2006 | Earliest Priority: Nov 22, 2002
 - Family: 4 | Cited Works: 20 | Cited by: 3 | Cites: 2 | Sequences: 49
 - Additional Info: 4 Cited Works | Full text | Published | Sequence

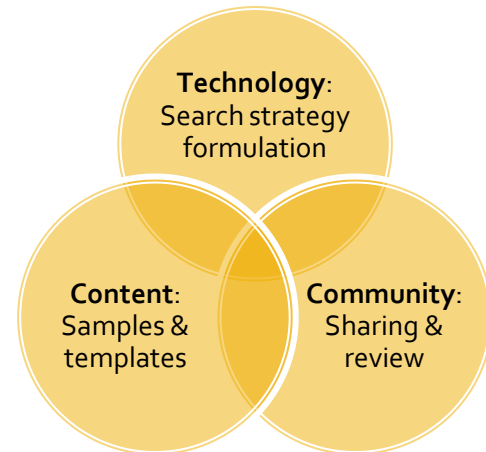
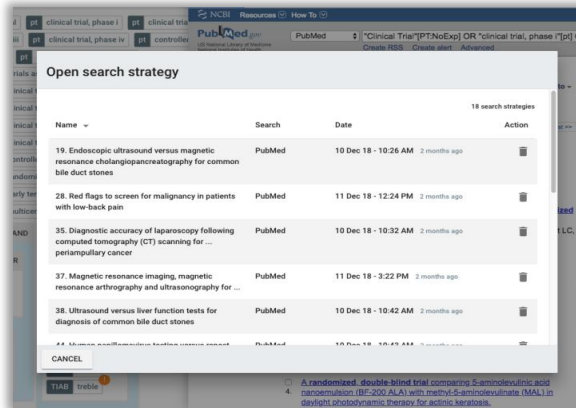
Design principles

1. Support **transparency** in the **mapping** between logical structure and physical structure
2. Adopt **scalable formalisms** that accommodate complexity
3. **Delegate lower-level syntactic operations** to system functions
4. Provide **real-time feedback** on query effectiveness
5. Provide support for **collaboration** and team working

Russell-Rose & MacFarlane, EARS 2020: The 3rd International Workshop on Explainable Recommendation and Search2020

Sharing, reuse, best practice

- Open content repository:
 - Templates and best practices
 - Library of shared strategies (aka 'GitHub')
 - Community of practice (aka 'Stack Overflow')



Summary

- Reimagining 'advanced search'
 - Eliminate syntactic error, make semantics transparent
 - Provide support for reuse, optimisation, best practice
- Key transformations:
 - Procedural → declarative
 - Static → interactive
 - Monolithic → executable
 - Strings → objects
- Try it for yourself: <https://www.2dsearch.com>
 - Tutorial videos: <https://www.2dsearch.com/help>

Thank you

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