

A Perspective on Human Computer Interaction and Information Retrieval – Health Information Searching



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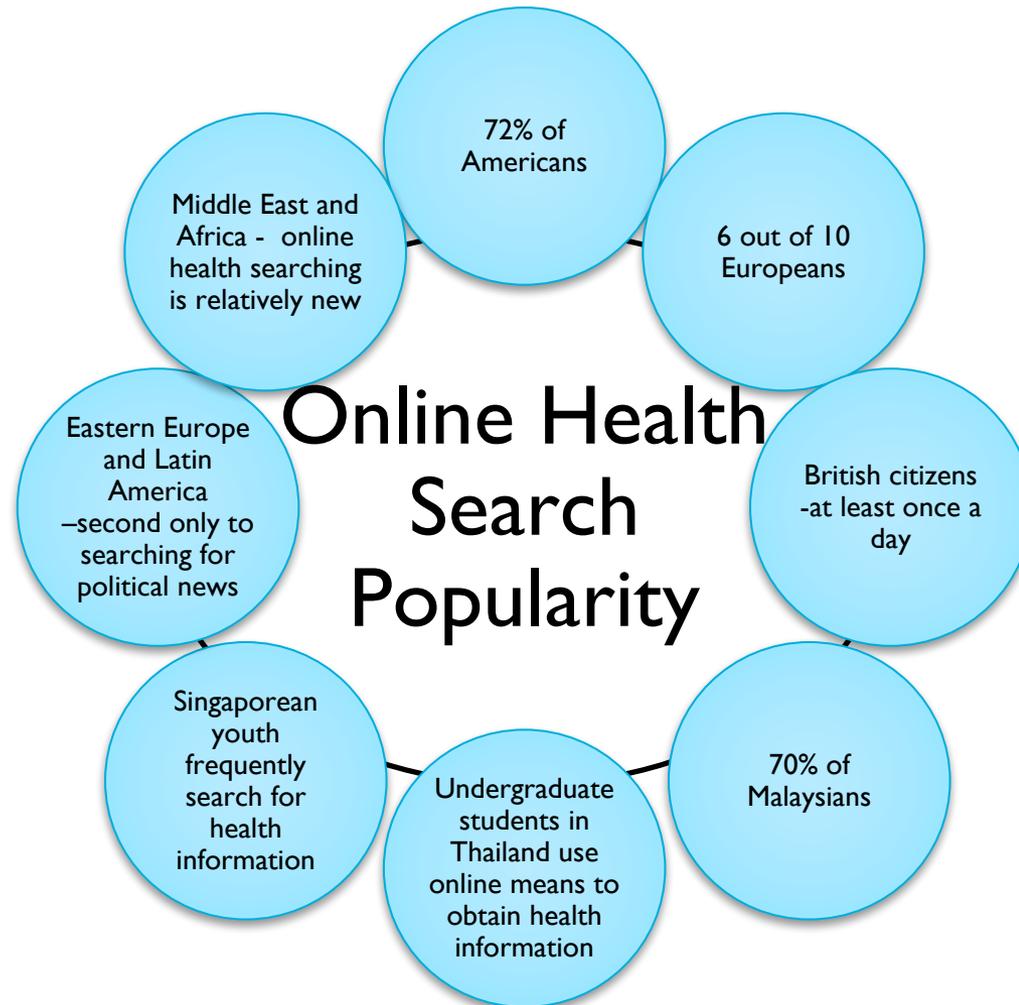
Dr. Google™
e-Diagnosis



Agenda

- Online Health Search & Evolution
- Online Search Patterns & Challenges
- Research Questions & Experiment Methodology
- Results
- Design Suggestions
- Limitations
- Future Work

Online Health Search



Online Health Search – New Zealand

- New Zealanders use Google to answer questions about cancer
- “breast cancer NZ”
- Third most preferred source of health information - Internet
- Two thirds of participants had used the Internet to access health information
- Little awareness or use of existing New Zealand-based online health resources

Evolution (I)

- Vertical search engines

The screenshot shows a web browser with several tabs open, including Outlook Web App, LEARN, online health searching, NZ health information, and promoting-meaningful-use-of. The address bar shows healthnavigator.org.nz. The website header includes the Health Navigator logo (NEW ZEALAND) and navigation links: About, Get involved, News, Languages, and a search bar labeled "Search health". Below the header is a teal navigation bar with categories: Health A-Z, Medicines, Healthy Living, Services & support, Clinicians, Apps, Videos, and Tools. The main content area features a large image of a child's feet on a scale. To the right of the image is a featured article titled "How much break: paracetamol should I give my child?" with a sub-headline "protect yourself, protect your whānau and protect our communities." and text stating "The dose of paracetamol (and ibuprofen) depends on your child's weight, not their age." Below the article are two green buttons: "2019 MEASLES OUTBREAK" and "TRY OUR DOSE CALCULATORS". On the right side of the page, there is a vertical social media sharing bar with icons for Facebook, Messenger, Twitter, LinkedIn, and Email. At the bottom of the page, there is a teal footer with the text "Like this content? Subscribe for updates!" and a green "Subscribe" button. A small chat icon is visible in the bottom right corner.

U.S. National Library of Medicine

MedlinePlus®

Trusted Health Information for You

Search MedlinePlus

About MedlinePlus Site Map FAQs Customer Support

Health Topics Drugs & Supplements Videos & Tools Español

Health Topics
Find information on health, wellness, disorders and conditions

Drugs & Supplements
Learn about prescription drugs, over-the-counter medicines, herbs, and supplements

Videos & Tools
Discover tutorials, health and surgery videos, games, and quizzes

Medical Tests
Learn why your doctor orders medical tests and what the results may mean

Share MedlinePlus



Going to college? Learn what you need to do to stay healthy and safe. See our College Health page.

1 2 3 4 ||

Tweets by @MedlinePlus

MedlinePlus @medlineplus
The Mediterranean-style diet has fewer meats and carbohydrates than a typical American diet. It also has more plant-based foods and monounsaturated (good) fat. People who live in the Mediterranean region have eaten this

Stay Connected
Sign up for the My MedlinePlus newsletter
Enter email or phone number

NIH MedlinePlus Magazine
Read the latest issue

healthfinder.gov

Office of Disease Prevention and Health Promotion

health.gov healthfinder.gov HealthyPeople.gov

U.S. Department of Health and Human Services

healthfinder.gov Live well. Learn how. En español

Home

Health Topics A to Z

myhealthfinder

Free Web Content

Find Services Near You

National Health Observances

Find us on:

Protect Your Newborn Baby
If you're pregnant, talk with your doctor or midwife about newborn screening before your baby is born.

1 2 3 4 5 ||

Health Topics
Get information to help you and your loved ones stay healthy.

Health Conditions and Diseases Nutrition and Physical Activity Pregnancy

myhealthfinder
See which preventive services you or a loved one may need this year.
Age:
Sex: Female

lanyadok.com

Arsip Konsultasi Artikel Kesehatan Cari Dokter Tanya Dokter

Apa masalah kesehatan sobat?

Tanya jawab dengan dokter ahli disini



Profil Dokter TanyaDok



Psikolog Irma Gustiana:
Pentingnya Perkembangan Anak



Dokter Lady Dhita Alfara,
M.Gizi, SpGK: Pendekatan Gizi secara Holistik



Dokter Bram Pradipta,
SpOG: Dokter Bertalenta sport Atletis Menyalis Ilmiah



Dokter Amanda: Ketahui Autisme Sejak Dini

NIH National Institutes of Health

Turning Discovery Into Health

headache

NIH Employee Intranet Staff Directory En Español

Health Information Grants & Funding News & Events Research & Training Institutes at NIH About NIH

NIH Loan Repayment Programs
Researchers may be eligible for student loan repayment. Apply through November 15, 2019.



In the News

Vertical Search Engines

The screenshot shows a web browser window with several tabs: Outlook Web App, LEARN: Log in to the site, MedlinePlus - Search Results for..., and myocardial infarction - Google S... The address bar shows the URL: vsearch.nlm.nih.gov/vivisimo/cgi-bin/query-meta?v%3Aproject=medlineplus&v%3Asources=medlineplus-bundle&query=heart+attack. The MedlinePlus logo is visible at the top left, with the tagline "Trusted Health Information for You". A search bar at the top right contains the text "heart attack" and a "GO" button. Below the search bar are navigation links: "About MedlinePlus", "Site Map", "FAQs", and "Customer Support". The main content area is divided into sections: "Health Topics", "Drugs & Supplements", "Videos & Tools", and "Español". The search results are displayed under the heading "Heart Attack". The first result is a text-based entry from the National Library of Medicine, which includes a paragraph of text and a small image of a man holding his chest. The text describes the symptoms and treatment of a heart attack. The search results are numbered "Results 1 - 10 of 2,121 for heart attack".

Outlook Web App | LEARN: Log in to the site | MedlinePlus - Search Results for... | myocardial infarction - Google S... | +

vsearch.nlm.nih.gov/vivisimo/cgi-bin/query-meta?v%3Aproject=medlineplus&v%3Asources=medlineplus-bundle&query=heart+attack

MedlinePlus
Trusted Health Information for You

heart attack X GO

About MedlinePlus | Site Map | FAQs | Customer Support

Health Topics | Drugs & Supplements | Videos & Tools | Español

Home → Search Results | Search Help

Refine by Type

All Results (2,509)

- Health Topics (68)
- Medical Encyclopedia (333)
- External Health Links (1,193)
- Medical Tests (21)
- Drugs and Supplements (445)
- National Institutes of Health (300)
- MedlinePlus Magazine (19)
- Healthy Recipes
- Multiple Languages (17)

Refine by Format

All Results (2,509)

- PDF (89)

Heart Attack

Each year almost 800,000 Americans have a heart attack. A heart attack happens when blood flow to the heart suddenly becomes blocked. Without the blood coming in, the heart can't get oxygen. If not treated quickly, the heart muscle begins to die. But if you do get quick treatment, you may be able to prevent or limit damage to the heart muscle. That's why it's important to know the symptoms of a heart attack and call 911 if you or someone else is having them. You should call, even if you are not sure that it is a heart attack.



The most common symptoms in men and women are

(Read more)

Results 1 - 10 of 2,121 for heart attack

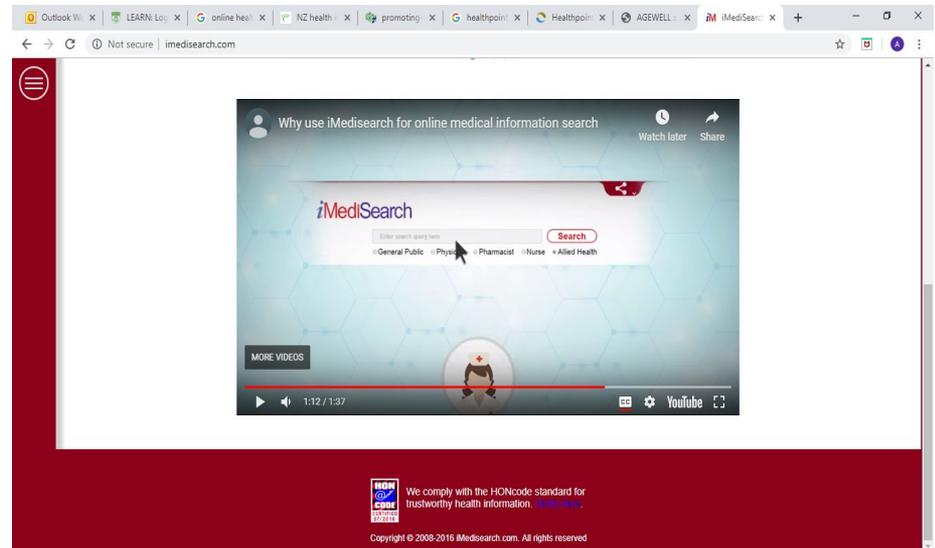
1. **Heart Attack** (National Library of Medicine)
Each year almost 800,000 Americans have a heart attack. A heart attack happens when blood flow to the heart suddenly becomes blocked. Without the blood coming in, the heart can't get oxygen. If not treated quickly, the heart muscle begins to die. But if you do get quick treatment, you may be able to prevent or limit damage to the heart muscle. That's why it's important to know the symptoms of a heart attack and call 911 if you or someone else is having them. You should call, even if you are not sure that it is a heart attack.

Vertical Search Engines

The screenshot shows a web browser window with several tabs. The active tab is 'myocardial infarction - Google S...', and the address bar shows the URL 'vsearch.nlm.nih.gov/vivisimo/cgi-bin/query-meta?v%3Aproject=medlineplus&v%3Asources=medlineplus-bundle&query=myocardial+infarction'. The MedlinePlus logo is visible at the top left, with the tagline 'Trusted Health Information for You'. A search bar at the top right contains the text 'myocardial infarction' and a 'GO' button. Below the search bar are links for 'About MedlinePlus', 'Site Map', 'FAQs', and 'Customer Support'. The main navigation bar includes 'Health Topics', 'Drugs & Supplements', 'Videos & Tools', and 'Español'. The page content shows 'Home → Search Results' and a 'Search Help' link. On the left, there are two 'Refine by' sections: 'Refine by Type' and 'Refine by Format'. The 'Refine by Type' section lists categories such as 'All Results (1,862)', 'Health Topics (46)', 'Medical Encyclopedia (265)', 'External Health Links (882)', 'Medical Tests (10)', 'Drugs and Supplements (374)', 'National Institutes of Health (175)', 'MedlinePlus Magazine (7)', 'Healthy Recipes', and 'Multiple Languages (17)'. The 'Refine by Format' section lists 'All Results (1,862)' and 'PDF (64)'. The main content area features a blue header for 'Heart Attack' and a text block describing the condition, accompanied by an image of a man holding his chest. Below this, there is a '(Read more)' link. At the bottom, the search results are listed as 'Results 1 - 10 of 1,622 for myocardial infarction', with the first result being '1. Heart Attack (National Library of Medicine)'. The text of the first result is partially visible, starting with 'Each year almost 800,000 Americans have a heart attack. A heart attack happens when blood flow to the heart suddenly becomes blocked. Without the blood coming in, the heart can't get oxygen. If not treated quickly, the heart muscle begins to die. But if you do get quick treatment, you may be able to prevent or limit damage to the heart muscle. That's why it's important to know the symptoms of a heart attack and call 911 if you or someone else is having them. You should call, even if you are not sure that it is a heart attack.'

Evolution (2)

- Next generation sources
 - imedisearch
 - Pogofrog
 - HON Foundation

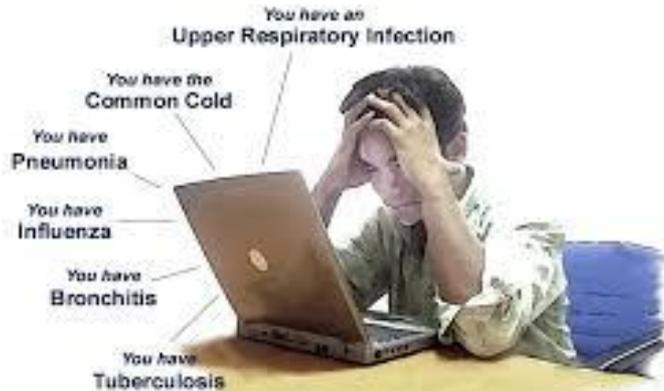


Evolution (3)

- Web 2.0 applications
 - health support groups (QuitNet)
 - consumer health portals (PatientsLikeMe, AfterTheInjury.org)
- track and share health indicators



Search Experience



How dangerous is Dr. Google?

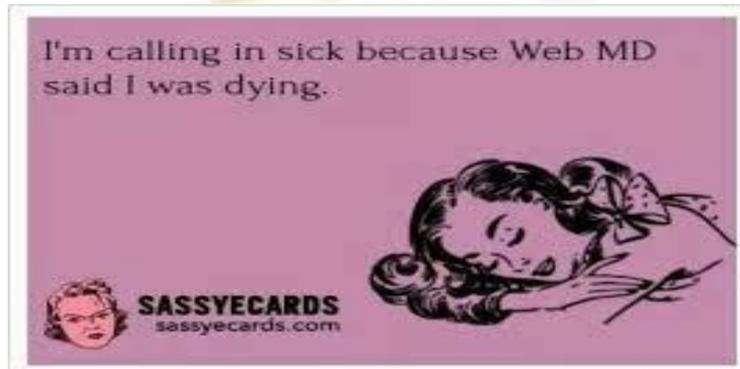
Not dangerous! It's easier to search diagnoses than symptoms. But google does not do too badly on symptoms either.



help me with my symptoms

Google Search

I'm Feeling Lucky



Headache

It's a Brain Tumor!

Google Search

I'm Feeling Lucky

Cyberchondria
(saɪbəˈkɒndrɪə)

noun

The unfounded anxiety concerning the state of one's health brought on by visiting health and medical websites

Google

Online Search Patterns

- Average Query Length
 - 3.3 terms per query, simple and short (2002-2007)
 - 6.27 terms per query (2011)
 - natural language type question queries (2011-2012)
 - query reformulation (2014)
- Average Number of Queries
 - 2.34 queries (2002-2007)
 - 4-5 queries (2012)
- Task Completion Time
 - low, average 3 minutes (2002-2007)
 - high, average 15 minutes (2011-2013)
- High Search Failure (2002-2012)
- Sequence of Searching & Browsing (2012-2014)

Search Challenges

Query Stage

- medical knowledge, medical terms
- misspelled, short
- no context, no perspective
- unspecific terms
- query reformulation

Can Information Retrieval strategies assist?

Results Viewing Stage

- comprehension of returned results
- change in acquisition behaviour
- not able to locate information

Research Question



- Describe the typology of patterns demonstrated when searching across tasks of varying levels of difficulty

Experiment Methodology

- Interactive Information Retrieval
 - User Centric
 - Information Retrieval System
- Instruments
 - Socio Demographic Questionnaire
 - Simulated Situations
 - Keylogging Software
 - Post Search Task Difficulty Interview
- Search Domain
 - MedlinePlus

Simulated Situations

- short cover story that describes a situation that leads to the use of an information retrieval system
- two parts: simulated work task scenario (cover story) and indicative request (search goal suggestion)
- substitute for real world information needs
- study and compare search behaviour using a standardised scenario
- invokes a common information need

Simulated Situations

Simulated work task scenario: Today morning after getting out of bed you noticed that you could not move your neck. You could not move it to the left or right. There is swelling on the left side of your neck. The swelling seems to be near lymphatic nodes. You are also experiencing some pain near the neck area. You want to find out what is wrong.

Indicative Request: Find for an instance, information to inform you of your condition, what can be done and why are you experiencing this pain at the neck.

Simulated Situations

Simulated work task scenario: Your colleague had just undergone a health test and found out that his kidney is enlarged and there is a stricture. A procedure called URS&RPG was performed. After this procedure, he experienced urine retention. He is in pain and has been told that surgery is required. You are concerned for your colleague and would like to use MedlinePlus to provide him with some information.

Indicative Request: Find for an instance, information to provide to your colleague to inform him of his condition, why is he experiencing this condition? Try to help him locate possible alternatives to treat his condition. Is surgery the only option?

Simulated Situations

Simulated work task scenario: Yesterday at the mall you witnessed a child about the age of five having fits/seizure. The child's parents who were nearby were in a state of shock. On arriving home, you were curious about the situation at the mall and would like to find out more about the child's condition. Use MedlinePlus to help you find out what could have been done to assist the child.

Indicative Request: Find for an instance, information advising you of what first aid measures you could have taken to assist the child and what are some possible reasons for the child to be experiencing this condition.

Search Domain - MedlinePlus

- free and publicly available clinical medical domain managed by the American National Library of Medicine and the National Institute of Health
- interface is similar to other publicly available medical search domains on the Internet
- retrieval strategy employed by MedlinePlus is basic text matching
- search assisting features must be explicitly invoked

MedlinePlus (I)

The screenshot shows the MedlinePlus website in a browser window. The browser's address bar displays the URL <https://www.nlm.nih.gov/medlineplus/>. The website header features the MedlinePlus logo with the tagline "Trusted Health Information for You" and a search bar. Navigation links include "About MedlinePlus", "Site Map", "FAQs", and "Contact Us".

The main content area is organized into several sections:

- Health Topics:** Find information on health, wellness, disorders and conditions.
- Drugs & Supplements:** Learn about prescription drugs, over-the-counter medicines, herbs, and supplements.
- Videos & Tools:** Discover tutorials, health and surgery videos, games, and quizzes.
- Medical Encyclopedia:** Articles and images for diseases, symptoms, tests, treatments.
- Medical Dictionary from Merriam-Webster:** Look up in Dictionary.

Additional features include:

- Today's Health News:** Articles such as "Could Spuds Be Bad for Blood Pressure?" and "Genetically Modified Crops Are Safe: Review".
- Stay Connected:** Sign up for MedlinePlus email updates.
- NIH MedlinePlus Magazine:** Read the latest issue.
- Clinical Trials:** Search ClinicalTrials.gov for drug and treatment studies.

The footer contains links for "Easy-to-Read Materials", "Organizations and Directories", "Health Information in Multiple Languages", and "MedlinePlus Connect for EHRs". It also includes social media icons for email, RSS, Twitter, and Facebook.

The Windows taskbar at the bottom shows the Start button, several open applications (including MedlinePlus, Microsoft Office, Windows Explorer, and PowerPoint), and the system clock displaying 2:45 PM.

<https://www.nlm.nih.gov/medlineplus>

MedlinePlus (2)

The screenshot shows a web browser window displaying the MedlinePlus website. The address bar shows the URL: <https://search.nlm.nih.gov/vivisimo/cgi-bin/query-meta?%963Aproject=medlineplus&v%963Aources=medlineplus-bundle&query=chestpain>. The page header includes the MedlinePlus logo and navigation links: About MedlinePlus, Site Map, FAQs, Contact Us, and a language selector for Español. The main content area is titled "Search Results" and features a "Refine by Type" sidebar and a "Chest Pain" article. The sidebar lists categories such as Health Topics (1), External Health Links, Drugs and Supplements, Medical Encyclopedia, Videos and Tutorials, News, MedlinePlus Magazine, Other Resources, and Multiple Languages. The "Chest Pain" article includes a description, a list of related conditions, and a "Read more" link. Below the article, there are search suggestions and a list of results, with the first result being "Chest Pain (National Library of Medicine)". The Windows taskbar at the bottom shows the Start button, taskbar icons, and the system tray with the time 2:46 PM.

U.S. National Library of Medicine

MedlinePlus
Trusted Health Information for You

chestpain GO

About MedlinePlus Site Map FAQs Contact Us

Health Topics Drugs & Supplements Videos & Tools Español

Home → Search Results Search Help

Refine by Type

All Results (1)

- Health Topics (1)
- External Health Links
- Drugs and Supplements
- Medical Encyclopedia
- Videos and Tutorials
- News
- MedlinePlus Magazine
- Other Resources
- Multiple Languages

Chest Pain

Having a pain in your chest can be scary. It does not always mean that you are having a heart attack. There can be many other causes, including

- Other heart problems, such as angina
- Panic attacks
- Digestive problems, such as heartburn or esophagus disorders
- Sore muscles
- Lung diseases, such as pneumonia, pleurisy, or pulmonary embolism
- Costochondritis - an inflammation of joints in your chest

Some of these problems can be serious. Get immediate medical care if you have chest pain that does not go away, crushing pain or pressure in the chest, or chest pain along with nausea, sweating, dizziness or shortness of breath. Treatment depends on the cause of the pain.

(Read more)

Results 1 - 1 of 1 for **chestpain**

Did you mean "chest pain"?

- Chest Pain (National Library of Medicine)
Having a pain in your chest can be scary. It does not always mean that you are having a heart attack. There can be many other causes, including Other heart ...
<https://www.nlm.nih.gov/medlineplus/chestpain.html> - Health Topics

Socio Demographic Details (I)

Category	Details			
Gender	Male	Female		
	38	22		
Use of the English Language (%)	1 st Language	2 nd Language	3 rd Language	
	55.0	25.0	20.0	
Age (years)	Max	Min	Mean	SD
	60	18	33.7	9.6

Category	Education Type	% Value
Undergraduate Students (20.0% of total participants)	Business	10.0
	Information Technology	10.0
Post-Grad Students (25.0% of total participants)	Business	8.0
	Information Technology	9.0
	Arts and Social Sciences	5.0
	Engineering	3.0
Occupation Details		
Working Professionals (55.0% of total participants)	University Lecturers	18.0
	Administrators	10.0
	Engineers	10.0
	Managers	10.0
	Consultants	7.0

Socio Demographic Details (2)

Category	Details			
General Search Experience (years)	Max	Min	Mean	SD
	16.0	2.0	10.3	3.5
Medical Search Experience (years)	10.0	0	6.2	3.5
Medical Search Experience On General Search Engines Only (75.0% of total participants) [years]	8.0	2.0	9.9	3.5
Medical Search Experience On Medical Search Engines Only (10.0% of total participants) [years]	8.0	1.0	6.2	3.5
Medical Search Experience on Medical Search Engines and General Search Engines (15.0% of total participants) [years]	5.0	1.0	5.0	2.0

Test Statistics Methods

- **Task Difficulty**
 - Chi Square and Standardised Residuals
- **Search Behaviour**
 - Kruskal-Wallis and Dunn's Post Hoc Test

Perception of Task Difficulty

- Easy

Simulated work task scenario: Your colleague had just undergone a health test and found out that his kidney is enlarged

.....

- Difficult

Simulated work task scenario: Today morning after getting out of bed you noticed that you could not move your neck

Criteria\Task		A1 (D) (N=60)	A2 (E) (N=60)	A3 (N=60)
# of queries issued per search session	Mean	2.8	3.7	2.6
	SD	1.5	1.9	1.8
	Median	3	4	2
	Min	1	1	1
	Max	8	8	10
	Test Statistics Mean # of Queries H=21.87, p<0.001	111.6	131.5	105.4
Query length per search session	Mean	8.5	8.5	6.5
	SD	5.9	6.5	5.3
	Median	7	7	5
	Min	1	2	1
	Max	26	32	21
	Test Statistics Mean Query Length H=15.94 p=0.0012	115.6	126.3	103.2
% of queries using query operator		15.0	22.0	10.0
% of queries re-issued		5.0	0	2.0
% medical queries		1.0	14.0	0
% queries without clicks		20.0	25.0	22.0
% natural language		0	0	2.0
% of ineffective queries	Spelling Error	2.0	2.0	0
	Query Too Specific	11.0	42.0	0
Querying Assistance				
% of usage Health Topics Tab		13.0	10.0	0
% of usage Videos & Cool Tools Tab		3.0	3.0	6.0
% of usage Drugs & Supplements Tab		16.0	3.0	6.0
% of usage Interactive Tutorial		3.0	3.0	6.0

Results Viewing Behaviour

Criteria\Task		A1 (D) (N=60)	A2 (E) (N=60)	A3 (N=60)
# of search results clicked per search session	Mean	2.0	1.8	1.8
	SD	1.4	1.7	0.7
	Median	2	2	1
	Min	1	1	1
	Max	8	10	8
# of sub-links clicked per search session	Mean	1.8	1.4	2.3
	SD	1.3	0.6	1
	Median	1	2	2
	Min	1	3	1
	Max	4	3	4
% of usage Control-F (find)		19.0	12.0	4.0
% of participants clicked beyond the 1 st results		21.0	3.0	10.0
% unsuccessful search sessions		15.0	35.0	3.0
Refining Search Results Assistance				
% of usage Refine by Keyword		5.0	25.0	5.0
% of usage Refine by Topic		0	2.0	2.0
% of usage Refine by Type		7.0	8.0	0

Comparison and Task Completion Time

Criteria\Task		A1 (D) (N=60)	A2 (E) (N=60)	A3 (N=60)
Total Querying versus Clicking Behaviour		173 vs 164	195 vs 127	139 vs 131
Task Completion Time Per Search Session (mins)	Mean	5.8	7.6	4.7
	SD	3.6	5.3	3.9
	Median	5	6	3.5
	Min	1	2	1
	Max	15	30	12
	Test Statistics Mean Task Completion Time H=15.92 p=0.0012	117.7	128.8	90.7

Search Behaviour - Easy



Search Behaviour Name	Unbalanced		
Sub-Classification	Active Technical Query Issuers	Slow and Unproductive	Critical Results Viewers
Features	Most number of queries	Most unsuccessful search sessions	Most results refining assistance usage
	Longest queries	High task completion time	Most queries without clicks
	Most query operators	Most ineffective queries	
	Most medical queries	Uneven querying versus clicking behaviour	

Search Behaviour - Difficult



Search Behaviour Name	Motivated	
Sub-Classification	Problematic Query Issuers	Active Results Viewers
Features	Most query re-issues	Most viewing results beyond the 1 st page
	Most usage of querying assistance	

Design Suggestions

For a term i in document j :

$$w_{i,j} = tf_{i,j} \times \log\left(\frac{N}{df_i}\right)$$

$tf_{i,j}$ = number of occurrences of i in j
 df_i = number of documents containing i
 N = total number of documents

- Profiles
 - typology of search behavior
 - intelligent agent to identify search patterns
- Summary Snippet Suggestions
 - relevance score based on weighted calculation
 - relevance score based on user voting
- Query and Search Results Refining Suggestions
 - query suggestion
 - search within results - specific keywords or terms
 - clustering - reduce the number of pages from the same site
 - page content identification



Search within results

Limitations



- results cannot be generalised
- explicit reasons as to why search sessions were perceived as easy or difficult
- pre and post task difficulty changes
- implement the think aloud protocol
- controlled search session

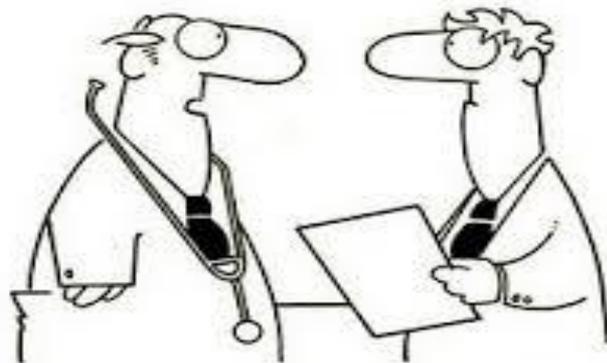
Future Work

- analyse data from a qualitative aspect
- examine search patterns of successful and unsuccessful search sessions
- prototype design suggestions



Thank you for your attention
Any Questions or Comments?

snaggy@canterbury.ac.nz



"More and more patients are going to the Internet for medical advice. To keep my practice going, I changed my name to Dr. Google."

Web MD

(proper noun)

Something that makes a mild cold into a deadly disease that will kill you within the next 24 hours.