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What you see depends on where you sit: the effect of geographical location on web-searching for systematic reviews: A case study.

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Background
There is limited guidance on how to web-search in systematic reviews and concern relates to the reproducibility of searches using search engines such as Google. The aim of this paper is to address one potential source of variation in Google searches: does the geographical location of a researcher affect Google search returns?

Methods
Using a virtual private network, we ran the same web-search for the medical technology Dasatinib in twelve different countries. Two researchers independently extracted the search returns by country organised by page rank.

We compared:

C1. any difference in the items returned by Google searches between countries; and
C2. any difference in the page rank of items returned between countries.

Findings
Searches were undertaken on Monday September 28th 2020. From 12 countries, 43 items were identified.

For C1: 19 items were common to all 12 countries. Twenty-four items were missed by searches in some countries. This means that there were differences in search returns between countries.

For C2: a randomised trial reported by Raddich *et al.* was the first search return for all countries. All other items, common to all countries, varied in their page-rank.

Conclusions
We find that geographic location would appear to influence Google search returns based on the findings of this case study.

The findings suggest that recording the location of the researcher undertaking web-searching may now be an important factor to report alongside detail on steps taken to minimise personalisation of web-searches covered by recent guidance. This finding also has implications for stopping-rules.

Background

Guidance indicates that web-searching should form part of a composite search for studies and study data when undertaking a systematic review.[1] There is limited guidance on how to web-search in systematic reviews, compared with the guidance available on how to search bibliographic databases, and conducting and documenting web searches presents specific challenges.[1-9]

One potential concern relates to the reproducibility of searches using search engines such as Google.[9-11] That is, unlike database searches, web searches may return different results depending on the user, such that the search process is not fully reproducible.[1,9-13] While this issue is widely recognised in theory, and some studies indicate it is a real concern,[14] detailed data on the extent of the variation are lacking.[9,12,13]

The aim of this paper is to address one potential source of variation in Google searches, namely geographical location. If running searches in different locations returns different results, this could have implications not only for searching, but also on the processing and reporting of web-searches in systematic reviews.

The lens we use to examine the hypothesis is that of a web-search for a single medical technology. This is not because we anticipate web-searching to be a key search method in reviews of medical technologies.[15] Rather, the focus on a medical technology is pragmatic. To test the hypothesis, we need a well-defined intervention which is consistently described and reported, and used globally, such that we could expect to identify search returns in different countries.

Research question

Does the geographical location of a researcher affect Google search returns when undertaking a web-search for a medical technology?

Methods

Searches

As a case study, we utilised a review of Dasatinib for patients with chronic myeloid leukemia.[16] A search strategy based on the searches undertaken for that review (written by the lead author of this paper) was developed, taking the following form:[7,16,17]

((Dasatinib OR DasatinibTM OR Sprycel OR SprycelTM OR "X78UG0A0RN" OR "302962-49-8")) "(RANDOM)"

Searches were undertaken using Google.Com on a PC (Windows 10, 64-bit) using the Chrome browser (version 85.0.4183.121). As with the original review, we attempted to limit our searches to studies reporting randomised trials or systematic reviews including randomised trials.[18] This was done by using the Royle and Waugh brief RCT search strategy (the BRSS), specifically the term “Random”.[19-21] A Virtual Private Network (VPN) was used to mimic the effect of geographic location. The VPN was SurfShark[22] with an extension for Google Chrome (version 2.1.4). No restrictions were placed on the searches (e.g. date or language). Cookies were cleared before each search and the same computer was used each time. The searcher (TL) was not logged into a Google account at the time of the searches.

Selecting countries

We selected countries pragmatically using the Nature Index (2019) list of countries by research output.[23] The sampling frame comprised the 12 highest countries in the Nature list for which a server was available in SurfShark, viz.:

1. Australia;
2. Canada;
3. France;
4. Germany;
5. India;
6. Italy;
7. Japan;
8. South Korea;
9. Spain;
10. Sweden;
11. the USA; and
12. UK;

Data extraction

The following data were extracted from all items returned by each of the 12 countries searched:

- Item type (i.e. study, systematic review etc.); and
- Item identifier (citation detail) and description (description of the item).

Data extraction was undertaken by one researcher and checked by another. Data were extracted into Microsoft Excel, organised by country and by page rank.

Analysis

To determine if the geographic location of a researcher influences Google search returns, we compared:

1. Any difference in the items returned by Google searches between countries. This comparison allows us to asses if a researcher's location influences search returns.

2. Any difference in the page rank of items returned between countries. This may be relevant as some guidance suggests that only the first few pages of search returns need be assessed for inclusion,[24,25] so page rank may influence whether items are included or not.

Findings

Results of the searches

Searches were undertaken on Monday September 28th 2020. From 12 countries, 43 items were identified in total across the searches (see Table 1: characteristics of items). The number of search returns varied between countries with the highest number of search returns being 22 (Canada) and the lowest being 19 (France/Japan). Eleven categories of items were identified

by the searches, namely: study reports, systematic reviews, protocols for systematic reviews, guidelines, reports, theses, wikis, web-pages, R Coding sheets, Web-hosted databases, and books.

Results of the analysis

Comparison 1: any difference in the items returned by Google searches between countries

Figure 1 summarises the search returns by country with their associated page rank. 19 items were common to all 12 countries, namely:

- two study reports (Raddich *et al.* reported as two items[26,27] and Cortes *et al.* DASISION reported as two items);[28,29]
- three systematic reviews (Douxfils *et al.* reported as two items;[30,31] Pavey *et al*. reported as three items;[16,18,32] and Tang *et al*. reported as one item);[33]
- one protocol for a systematic review (Balakumaran *et al*.);[34]
- one guideline (De Souza *et al.* reported as four items);[35-38]
- the Wikipedia page for Dasatinib;[39] and
- three books (Gunderson LL and Tepper JE;[40] Hehlmann R;[41] and Weissleder *et al.*:[42] all reported as single items).

Twenty-four items were missed by searches in some countries. This means that there were differences in search returns between countries.

Comparison 2: any difference in the page rank of items returned between countries

Figure 1 also details the difference between items in page rank between countries. The randomised trial reported by Raddich *et al.* was consistently the first search return for all 12 countries.[26] All other items, common to all countries, varied in their page rank. This means that, aside from Raddich *et al.,* there was variation in the reporting of items by page rank between countries.

Discussion

The findings indicate that the geographical location of a researcher influenced Google search returns when undertaking a web-search for a systematic review of a medical technology in this case study. We also found the distribution of search returns varied by country. This aligns with and confirms previous work which has raised concerns about the role of web-searching in systematic reviews.[10] That is, whilst it is possible to be systematic in searching (i.e. you can search using a search strategy defined *a priori* and transparently report your searches), it is not possible to replicate exactly search findings since these would appear to vary between countries.

Further research may examine other sources of variation, such as different users in the same location, the effect of non-English language search terms prioritising or excluding search returns by country, or the use of other search engines. We also see a space for further research to explore the influence of our findings in reviews which do utilise web-searching to identify studies, evidence or data, not available in bibliographic databases.[2,43-45] This is likely where the value of web-searching is to be found and where a problem may arise. Further work could examine if the effect we have identified here applies in other types of systematic review and if the effect we identify could be turned to be an advantage in study identification.[2,15]

We see two implications for practice:

1. Stopping-rules: 'the first 100 search returns were screened'[46]

Stopping-rules, that is when to stop searching or – in the case of web-searches – when to stop scrolling through search returns, are sometimes used by researchers to describe their approach to processing web-searches.[47-49] Our findings might suggest a problem. Using the example above, there is no guarantee that the first 100 search returns seen in one country are the same as in another and the order of search returns may vary such that eligible results may be within 100 results in one country but not in another. There is no obvious solution beyond reporting the geographic location of the researcher (see below). Reporting stopping rules may still be useful (even if arbitrary) since, at the very least, it explains how the researchers conducted their web-search.

2. Search reporting

It may be desirable to record the geographic location of the researcher undertaking web-searches (alongside other search data and steps to reduce personalisation of data).[9,50] Researcher location is not currently a requirement of relevant search reporting and, as we find in this case-study, it may be an influencing factor in study identification.[5,50,51]

Conclusions

Based on the findings of this case study, we find that geographic location would appear to influence Google search returns when searching for a single medical technology.

The implications for practice appear to focus on stopping rules and search reporting. Researchers should be aware that search results appear to vary by country and this may affect the use of informal stopping rules. Our findings also suggest that recording the location of the researcher undertaking web-searching may now be an important factor to report alongside detail on steps taken to minimise personalisation of web-searches covered by recent guidance.

Highlights

- **What is already known**

  Web-searching is recommended as a non-database search method in systematic reviews but there is concern as to the reproducibility of searches using web-search engines.

- **What is new**

  We critique the method of web-searching, finding that geographical location can affect search returns using the web-browser Google. We also found that the number of search returns and the order of search returns varies by country which may impact stopping rules.

- **Potential impact for *Research Synthesis Methods* readers outside the authors' field**
  - Researchers undertaking or reading systematic reviews which utilise web-searching should be aware that the search returns and page rank appear to vary by country. This could impact identification of relevant items and inform stopping rules.
  - Researchers undertaking web-searches should report their geographical location, alongside other search data.

Data sharing statement
All data relied upon is reported in the paper.

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1. Cooper C, Booth A, Varley-Campbell J, Britten N, Garside R. Defining the process to literature searching in systematic reviews: a literature review of guidance and supporting studies. *BMC Med Res Methodol.* 2018;18(1):85.
2. Cooper C, Lovell R, Husk K, Booth A, Garside R. Supplementary search methods were more effective and offered better value than bibliographic database searching: A case study from public health and environmental enhancement. *Res Synth Methods.* 2018;9(2):195-223.
3. Cooper C, Booth A, Britten N, Garside R. A comparison of results of empirical studies of supplementary search techniques and recommendations in review methodology handbooks: a methodological review. *Syst Rev.* 2017;6(1):234.
4. Stansfield C, Dickson K, Bangpan M. Exploring issues in the conduct of website searching and other online sources for systematic reviews: how can we be systematic? *Syst Rev.* 2016;5(1):191.
5. Briscoe S. Web searching for systematic reviews: a case study of reporting standards in the UK Health Technology Assessment programme. *BMC Res Notes.* 2015;8:153.
6. Ogilvie D, Hamilton V, Egan M, Petticrew M. Systematic reviews of health effects of social interventions: 1. Finding the evidence: how far should you go? *J Epidemiol Community Health.* 2005;59(9):804-808.
7. Eysenbach G, Tuische J, Diepgen TL. Evaluation of the usefulness of Internet searches to identify unpublished clinical trials for systematic reviews. *Med Inform Internet Med.* 2001;26(3):203-218.
8. Godin K, Stapleton J, Kirkpatrick SI, Hanning RM, Leatherdale ST. Applying systematic review search methods to the grey literature: a case study examining guidelines for school-based breakfast programs in Canada. *Syst Rev.* 2015;4(1):138.
9. Kliman-Silver C, Hannak A, Lazer D, Wilson C, Mislove A. Location, Location, Location: The Impact of Geolocation on Web Search Personalization. Proceedings of the 2015 Internet Measurement Conference; 2015; Tokyo, Japan.
10. Ćurković M, Košec A. Bubble effect: including internet search engines in systematic reviews introduces selection bias and impedes scientific reproducibility. *BMC Med Res Methodol.* 2018;18(1):130.
11. Lai C, Luczak-Roesch M. You Can't See What You Can't See: Experimental Evidence for How Much Relevant Information May Be Missed Due to Google's Web Search Personalisation. International Conference on Social Informatics, 2019; Doha, Qatar.
12. Hannak A, Sapiezynski P, Kakhki AM*, et al.* Measuring personalization of web search. Proceedings of the 22nd international conference on World Wide Web; 2013; Rio de Janeiro, Brazil.
13. Salehi S, Du JT, Ashman H. Examining Personalization in Academic Web Search. 26th ACM Conference on Hypertext & Social Media; 2015; Guzelyurt, Northern Cyprus.
14. Gusenbauer M, Haddaway NR. Which academic search systems are suitable for systematic reviews or meta-analyses? Evaluating retrieval qualities of Google Scholar, PubMed, and 26 other resources. *Res Synth Methods.* 2020;11(2):181-217.
15. Cooper C. *Improving literature searching in systematic reviews: the application of tailored literature searching compared to 'the conventional approach'. [dissertation].* Exeter, UK: University of Exeter; 2019. Available from: https://ore.exeter.ac.uk/repository/handle/10871/35637.
16. Pavey T, Hoyle M, Ciani O*, et al.* Dasatinib, nilotinib and standard-dose imatinib for the first-line treatment of chronic myeloid leukaemia: systematic reviews and economic analyses. *Health Technol Assess.* 2012;16(42):iii-iv, 1-277.
17. Lefebvre C, Glanville J, Briscoe S*, et al.* Technical Supplement to Chapter 4: Searching for and selecting studies. Higgins JPT, Thomas J, Chandler J*, et al.*, eds. Secondary Technical Supplement to Chapter 4: Searching for and selecting studies.2020 [Accessed Fri 2nd Oct 2020]. Available from: www.training.cochrane.org/handbook.
18. T Pavey MH, O Ciani, L Crathorne, T Jones-Hughes, C Cooper, L Osipenko, M Venkatachalam, C Rudin, O Ukoumunne, R Garside, and R Anderson. Dasatinib, nilotinib

and standard-dose imatinib for the first-line treatment of chronic myeloid leukaemia: systematic reviews and economic analyses (full report). https://www.journalslibrary.nihr.ac.uk/hta/hta16420/#/abstract. Published 2012. [Accessed October 7th 2020].

19. Royle P, Waugh N. A simplified search strategy for identifying randomised controlled trials for systematic reviews of health care interventions: a comparison with more exhaustive strategies. *BMC Med Res Methodol.* 2005;5(1):23.
20. Cooper C, Varley-Campbell J, Carter P. Established search filters may miss studies when identifying randomized controlled trials. *J Clin Epidemiol.* 2019;112:12-19.
21. Cooper C, Kaunelis D, Varley Campbell J, Carter P. Letter in response to Thompson and Scott Authors' letter reestablished search filters may miss studies when identifying randomized controlled trials. Language for trial phase necessary when searching for RCT. *J Clin Epidemiol.* 2020;117:154-156.
22. *SurfShark* [computer program]. British Virgin Islands: SurfShark ltd; 2020.
23. Nature Index. https://www.natureindex.com/annual-tables/2020/country/all. Published 2020. [Accessed Sept 20th].
24. Collaboration for Environmental Evidence. Guidelines for Systematic Review and Evidence Synthesis in Environmental Management [Internet]. Vol 4.2. Bangor: Environmental Evidence; 2013 [Accessed October 7th 2020]. Available from: http://www.environmentalevidence.org/wp-content/uploads/2017/01/Review-guidelines-version-4.2-final-update.pdf.
25. Smart JM, Burling D. Radiology and the internet: a systematic review of patient information resources. *Clin Radiol.* 2001;56(11):867-870.
26. Radich JP, Kopecky KJ, Appelbaum FR*, et al.* A randomized trial of dasatinib 100 mg versus imatinib 400 mg in newly diagnosed chronic-phase chronic myeloid leukemia. *Blood.* 2012;120(19):3898-3905.
27. Radich JP, Kopecky KJ, Appelbaum FR*, et al.* A randomized trial of dasatinib 100 mg vs imatinib 400 mg in newly diagnosed chronic phase chromic myeloid leukemia. ResearchGate. https://www.researchgate.net/publication/230723970_A_randomized_trial_of_dasatinib_100_mg_vs_imatinib_400_mg_in_newly_diagnosed_chronic_phase_chromic_myeloid_leukemia. Published 2012. [Accessed October 7th 2020].
28. Cortes JE, Saglio G, Kantarjian HM*, et al.* Final 5-Year Study Results of DASISION: The Dasatinib Versus Imatinib Study in Treatment-Naïve Chronic Myeloid Leukemia Patients Trial (PubMed Version). *Journal of clinical oncology : official journal of the American Society of Clinical Oncology.* 2016;34(20):2333-2340.
29. Cortes JE, Saglio G, Kantarjian HM*, et al.* Final 5-Year Study Results of DASISION: The Dasatinib Versus Imatinib Study in Treatment-Naïve Chronic Myeloid Leukemia Patients Trial (PubMed Version). *J Clin Oncol.* 2016;34(20):2333-2340.
30. Douxfils J, Haguet H, Mullier F, Chatelain C, Graux C, Dogné J-M. Association Between BCR-ABL Tyrosine Kinase Inhibitors for Chronic Myeloid Leukemia and Cardiovascular Events, Major Molecular Response, and Overall Survival: A Systematic Review and Meta-analysis. *JAMA Oncol.* 2016;2(5):625-632.
31. Douxfils J, Haguet H, Mullier F, Chatelain C, Graux C, Dogné J-M. Association Between BCR-ABL Tyrosine Kinase Inhibitors for Chronic Myeloid Leukemia and Cardiovascular Events, Major Molecular Response, and Overall Survival: A Systematic Review and Meta-analysis file:///Users/chris/Downloads/coi150110supp1_prod-2.pdf. Published 2016. [Accessed October 7th 2020].
32. T Pavey MH, O Ciani, L Crathorne, T Jones-Hughes, C Cooper, L Osipenko, M Venkatachalam, C Rudin, O Ukoumunne, R Garside, and R Anderson. Dasatinib, nilotinib and standard-dose imatinib for the first-line treatment of chronic myeloid leukaemia: systematic reviews and economic analyses (appendices). https://www.nice.org.uk/guidance/TA251/documents/leukaemia-chronic-myeloid-first-line-dasatinib-nilotinib-and-standarddose-imatinib-assessment-report-appendices4. Published 2012. [Accessed October 7th 2020].

33. Tang L, Zhang H, Peng YZ*, et al.* Comparative efficacy and tolerability of front-line treatments for newly diagnosed chronic-phase chronic myeloid leukemia: an update network meta-analysis. *BMC Cancer.* 2019;19(1):849.
34. Balakumaran J, Birk T, Golemiec B*, et al.* Evaluating the endometabolic and bone health effects of Tyrosine Kinase Inhibitors in Chronic Myeloid Leukaemia: a systematic review protocol. *BMJ Open.* 2019;9(9):e030092.
35. Souza CAd, Pagnano KBB, Bendit I*, et al.* Chronic myeloid leukemia treatment guidelines: Brazilian Association of Hematology, Hemotherapy and Cell Therapy. Brazilian Medical Association Guidelines Project - 2012. *Revista Brasileira de Hematologia e Hemoterapia.* 2012;34:367-382.
36. Souza CAd, Pagnano KBB, Bendit I*, et al. Chronic myeloid leukemia treatmentguidelines: Brazilian Association ofHematology, Hemotherapy and Cell Therapy.Brazilian Medical Association GuidelinesProject - 2012.* São Paulo: Universidade de São Paulo; [Accessed October 7th 2020] 2012.
37. de Souza CA, Pagnano KBB, Bendit I*, et al.* Página 68 - RBHH34V5_FLIP_2. http://www.rspress.com.br/userfiles/projetos/editorial_205/files/assets/basic-html/page68.html. Published 2012. [Accessed October 7th 2020].
38. de Souza CA, Pagnano KBB, Bendit I*, et al.* Página 67 - RBHH34V5_FLIP_2. http://www.rspress.com.br/userfiles/projetos/editorial_205/files/assets/basic-html/page67.html. Published 2012. [Accessed October 7th 2020].
39. Dasatinib (Wikipedia). Wikipedia. https://en.wikipedia.org/wiki/Dasatinib. Published 2020. [Accessed October 7th 2020].
40. Gunderson LL, Tepper JE. Clinical Radiation Oncology: Expert Consult. 2011]. Available from: https://books.google.co.uk/books?id=z906szt1iE0C&pg=PA1634&lpg=PA1634&dq=%22Clinical+Radiation+Oncology+E-Book%22+and+%22peak+(SOBP)+dose+distribution%22&source=bl&ots=QkOS7-l1DL&sig=ACfU3U0OpKjjRFhxtrVxqs5iuzGtzJDKqw&hl=en&sa=X&ved=2ahUKEwiRqKWv6JDsAhVwUBUIHVWFBIoQ6AEwAHoECAEQAQ#v=onepage&q=%22Clinical%20Radiation%20Oncology%20E-Book%22%20and%20%22peak%20(SOBP)%20dose%20distribution%22&f=false.
41. Hehlmann R. *Chronic Myeloid Leukemia (Hematologic Malignancies)* Switzerland: Springer https://books.google.co.uk/books?id=O8PeDAAAQBAJ&pg=PA248&lpg=PA248&dq=%22Microsimulations+were+also+conducted+by+simulating%22&source=bl&ots=mL7qupn-Qt&sig=ACfU3U3YhgJhuNnhK5KLStZIPS_2CJ555g&hl=en&sa=X&ved=2ahUKEwjXm_ql2ozsAhXrRhUIHWPvBhUQ6AEwAHoECAEQAQ#v=onepage&q=%22Microsimulations%20were%20also%20conducted%20by%20simulating%22&f=false. [Accessed October 7th 2020.]
42. Ralph Weissleder, Brian D. Ross, Alnawaz Rehemtulla, Sanjiv S. Gambhir. *Molecular Imaging: Principles and Practice.* New York: PMPH-USA https://books.google.co.uk/books?id=Q4USPF4Lm08C&pg=PA1275&lpg=PA1275&dq=In+each+new+randomized++data+set,+a+gene+of+a+given+sample+is+randomly%09in+the+expression+level+of+gene+uPA+of+dasatinib-sensitive+versus+dasatinib-resistant+&source=bl&ots=tvY62X8ocw&sig=ACfU3U3FV51ygg-Tjf9osk31gTepDym2gg&hl=en&sa=X&ved=2ahUKEwjB5KT32YzsAhUCQxUIHZ_GCOIQ6AEwAnoECAgQAQ#v=onepage&q=In%20each%20new%20randomized%20%20data%20set%2C%20a%20gene%20of%20a%20given%20sample%20is%20randomly%09in%20the%20expression%20level%20of%20gene%20uPA%20of%20dasatinib-sensitive%20versus%20dasatinib-resistant&f=false. [Accessed October 7th 2020.]
43. Brennan N, Bryce M, Pearson M, Wong G, Cooper C, Archer J. Towards an understanding of how appraisal of doctors produces its effects: a realist review. *Medical Education.* 2017;51(10):1002-1013.
44. Levay P, Ainsworth N, Kettle R, Morgan A. Identifying evidence for public health guidance: a comparison of citation searching with Web of Science and Google Scholar. *Res Synth Methods.* 2016;7(1):34-45.

45. Husk K, Lovell R, Cooper C, Stahl-Timmins W, Garside R. Participation in environmental enhancement and conservation activities for health and well-being in adults: a review of quantitative and qualitative evidence. *Cochrane Database Syst Rev.* 2016(5).
46. Azarpazhooh A, Lawrence HP, Shah PS. Xylitol for preventing acute otitis media in children up to 12 years of age. *Cochrane Database of Systematic Reviews.* 2016(8).
47. Booth A. How much searching is enough? Comprehensive versus optimal retrieval for technology assessments. *International Journal of Technology Assessment in Health Care.* 2010;26(4):431-435.
48. Cooper C, Varley-Campbell J, Booth A, Britten N, Garside R. Systematic review identifies six metrics and one method for assessing literature search effectiveness but no consensus on appropriate use. *J Clin Epidemiol.* 2018;99:53-63.
49. Briscoe S, Nunns M, Shaw L. How do Cochrane authors conduct web searching to identify studies? Findings from a cross-sectional sample of Cochrane Reviews. *Health Information & Libraries Journal.* 2020;37(4):293-318.
50. Rethlefsen ML, Kirtley S, Waffenschmidt S*, et al.* PRISMA-S: an extension to the PRISMA Statement for Reporting Literature Searches in Systematic Reviews. *Syst Rev.* 2021;10(1):39.
51. Lefebvre C, Glanville J, Briscoe S*, et al.* Chapter 4: Searching for and selecting studies. In: Higgins JPT TJ, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors), ed. *Cochrane Handbook for Systematic Reviews of Interventions version 6.0* 2019 [Accessed December 7th 2020]. Available from: www.training.cochrane.org/handbook.
52. Cortes JE, Jiang Q, Wang J*, et al.* Dasatinib vs. imatinib in patients with chronic myeloid leukemia in chronic phase (CML-CP) who have not achieved an optimal response to 3 months of imatinib therapy: the DASCERN randomized study. ResearchGate. https://www.researchgate.net/publication/340485999_Dasatinib_vs_imatinib_in_patients_with_chronic_myeloid_leukemia_in_chronic_phase_CML-CP_who_have_not_achieved_an_optimal_response_to_3_months_of_imatinib_therapy_the_DASCERN_randomized_study. Published 2020. [Accessed October 7th 2020].
53. Adam O, Min T, Jorge C*, et al.* Dynamics of chronic myeloid leukemia response to dasatinib, nilotinib, and high-dose imatinib. *Haematologica.* 2014;99(11):1701-1709.
54. Karaman MW, Herrgard S, Treiber DK*, et al.* A quantitative analysis of kinase inhibitor selectivity. *Nat Biotechnol.* 2008;26(1):127-132.
55. Krijanovski Y, Donato N, Sun H*, et al.* Dasatinib Resistance in Patients with Chronic Myelogenous Leukemia: Identification of a Novel bcr-abl Kinase Domain Mutation. *Clinical Leukemia.* 2008;2(4):267-271.
56. Shah NP, Guilhot F, Cortes JE*, et al.* Long-term outcome with dasatinib after imatinib failure in chronic-phase chronic myeloid leukemia: follow-up of a phase 3 study. *Blood.* 2014;123(15):2317-2324.
57. Fornier MN, Morris PG, Abbruzzi A*, et al.* A phase I study of dasatinib and weekly paclitaxel for metastatic breast cancer. *Annals of Oncology.* 2011;22(12):2575-2581.
58. Hausner. Appendix B: Search strategies. https://www.jclinepi.com/cms/10.1016/j.jclinepi.2016.05.002/attachment/76e74bdb-4ae3-4f96-9b7a-58e708c726bf/mmc2.pdf. Published 2016. [Accessed October 7th 2020].
59. Rossi RE, Pozzi R, Gonzalez-Lorenzo M*, et al.* Tyrosine kinase inhibitors for unresectable hepatocellular carcinoma in adults. *Cochrane Database Syst Rev.* 2015(3).
60. Canadian Agency for Drugs and Technologies in Health. *Pruning Emtree: Does Focusing Embase Subject Headings Impact Search Strategy Precision and Sensitivity?* ; [Accessed October 7th 2020] 2015.
61. (GbA) GB. *Kriterien zur Bestimmung der zweckmäßigen Vergleichstherapie undRecherche und Synopse der Evidenz zur Bestimmung der zweckmäßigen Vergleichstherapie nach § 35a SGB VVorgang: 2017-B-226 Bosutinib.* [Accessed October 7th 2020] 2017.
62. (EMA) EMA. ANNEX 1: SUMMARY OF PRODUCT CHARACTERISTICS https://www.ema.europa.eu/en/documents/product-information/sprycel-epar-product-information_en.pdf. Published 2020. [Accessed October 7th 2020].

63. Benjamin Gregory Carlisle. Appendices to The moral efficiency of clinical trials in anti-cancer drug development. http://blog.bgcarlisle.com/wp-content/uploads/2019/04/Appendices-A-G.pdf. Published 2019. [Accessed October 7th 2020].
64. Liu Lu. *In Vitro Investigation Of Intracellular Ponatinib Transport And Modeling Ponatinib Resistance In BCR,ABL1+ Cell Lines: Implications For Therapeutic Strategies*. Adelaide: Leukemia Research UnitSouth Australian Health and Medical Research Institute (SAHMRI): University of Adelaide; 2015. Available from: https://digital.library.adelaide.edu.au/dspace/bitstream/2440/114583/1/01front.pdf.
65. Dasatinib (Better Known as: Sprycel). https://proteopedia.org/wiki/index.php/Dasatinib. Published 2017. [Accessed October 7th 2020].
66. Dasatinib (Sprycel): Wiki. https://hemonc.org/wiki/Dasatinib_(Sprycel). Published 2020. [Accessed October 7th 2020].
67. DATA SHEET (Sprycel). https://www.medsafe.govt.nz/profs/datasheet/s/spryceltab.pdf. Published 2019. [Accessed October 7th 2020].
68. (emc) emc. Sprycel 20mg, 50mg, 80mg, 100mg and 140mg Film Coated Tablets . https://www.medicines.org.uk/emc/medicine/26080. Published 2020. [Accessed October 7th 2020].
69. (emc) emc. Sprycel 50mg Film Coated Tablets. https://www.medicines.org.uk/emc/product/7745/smpc#gref. Published 2020. [Accessed October 7th 2020].
70. Childs D. NPARC_workflow.Rmd https://git.embl.de/childs/TPP-data-analysis/blob/master/NPARC_paper/reports/NPARC_workflow.Rmd. Published 2019. [Accessed October 7th 2020].
71. NR. R/pRRophetic.R. https://rdrr.io/github/xlucpu/MOVICS/src/R/pRRophetic.R. Published NR. [Accessed October 7th 2020].
72. NR. AUSTRALIAN PRODUCT INFORMATION–SPRYCEL® (DASATINIB). https://apps.medicines.org.au/files/bqpspryc.pdf. Published NR. [Accessed October 7th 2020].
73. Scheme PTPB. Dasatinib, tablets, 20 mg, 50 mg, 70 mg and 100 mg, Sprycel® - July 2011. https://www.pbs.gov.au/info/industry/listing/elements/pbac-meetings/psd/2011-07/pbac-psd-dasatinib-july11. Published 2011. [Accessed October 7th 2020].
74. Science.gov Your Gateway to U.S. Federal Science. https://www.science.gov/topicpages/p/patient+receiving+dasatinib. Published NR. [Accessed October 7th 2020].
75. Liu R. *Water-Insoluble Drug Formulation.* 3rd ed. Boca Raton: CRC Press https://books.google.co.uk/books?id=ooNSDwAAQBAJ&pg=PA104&lpg=PA104&dq=%22CASE+STUDY+5+(Continued)+the+saturated+concentration+of+dasatinib+at+pH+4.0+was+3.6+%22&source=bl&ots=OF4woorbvX&sig=ACfU3U1_YXXxYcKsLLOPsbIx4U1p202-mA&hl=en&sa=X&ved=2ahUKEwiNn--82YzsAhXJUhUIHRe0A2IQ6AEwAHoECAEQAQ#v=onepage&q=%22CASE%20STUDY%205%20(Continued)%20the%20saturated%20concentration%20of%20dasatinib%20at%20pH%204.0%20was%203.6%20%22&f=false. [Accessed October 7th 2020.]

Table 1: Characteristics of items

Item type	Item identifier/ description	Version(s) identified	In which countries (X^2 = page rank)	Overall, was the item missed in any countries?
Study	Radich JP, Kopecky KJ, Appelbaum FR, et al. A randomized trial of dasatinib 100 mg versus imatinib 400 mg in newly diagnosed chronic-phase chronic myeloid leukemia. *Study report of the phase IIb trial (NCT00070499) comparing Dasatinib v Imatinib.*	1. PubMed Abstract of the study reported in the journal, *Blood.*[26]	AU:1 CA:1 FR:1 GE:1 I:1 IN:1 JA:1 S:1 SK:1 SP:1 UK:1 USA:1	No
		2. ResearchGate profile for the published study.[27]	AU:7 CA:7 FR:2 GE:2 I:2 IN:3 JA:2 S:2 SK:2 SP:2 UK:11 USA:9	
Study	Cortes JE, Jiang Q, Wang J, et al. Dasatinib vs. imatinib in patients with chronic myeloid leukemia in chronic phase (CML-CP) who have not achieved an optimal response to 3 months of imatinib therapy: the DASCERN randomized study *Study report of phase 2b DASCERN study (NCT01593254)*	3. ResearchGate profile for the published study.[52]	AU:19 FR:3 GE:3 I:3 IN:4 JA:3 S:3 SK:3 SP:3 UK:12	Canada USA
Study	Cortes JE, Saglio G, Kantarjian HM, et al. Final 5-Year Study Results of DASISION: The Dasatinib Versus Imatinib Study in Treatment-Naïve Chronic Myeloid Leukemia Patients Trial. *Study report of the phase 3 DASISION study (NCT00481247)*	4. Study reported on journal web-page (*Journal of Clinical Oncology).*[29]	AU:26 FR:16 GE:21 I:18 IN:19 JA:19 S:17 SK:19 SP:18 UK:16	No
		5. Bibliographic record from PubMed.[28]	CA:2 USA:2	
Study	Adam Olshen, Min Tang, Jorge Cortes, et al. Dynamics of chronic myeloid leukemia response to dasatinib, nilotinib, and high-dose imatinib.	6. Study reported on journal web-page (*Haematologica).*[53]	GE:22 I:19 S:18 USA:20	Australia Canada France India Japan South Korea Sweden UK
Study	Karaman MW, Herrgard S, Treiber DK, et al. A quantitative analysis of kinase inhibitor selectivity.	7. Link to the PDF version of the published study reported in *Nature*	AU:15 GE:16 UK:13 USA:7	Canada France India Italy

Item type	Item identifier/ description	Version(s) identified	In which countries (X^2 = page rank)	Overall, was the item missed in any countries?
	Study explores how Kinase inhibitors (e.g. Dasatinib) interact with the human kinome.	*Biotechnology* via Friends of Cancer.org web-site.[54]		Japan South Korea Spain Sweden
Study	Krijanovski Y, Donato N, Sun H, et al. Dasatinib Resistance in Patients with Chronic Myelogenous Leukemia: Identification of a Novel bcr-abl Kinase Domain Mutation. *Study re-analyses bcr-abl kinase domain from 22 CML patients who demonstrated clinical evidence of dasatinib failure to assess the potential mechanisms of Dasatinib resistance.*	8. Study reported on journal web-page (*Clinical Leukemia)*.[55]	FR:17 GE:20 I:21 JA:17 SK:18 SP:19	Australia Canada India Sweden UK USA
Study	Shah NP, Guilhot F, Cortes JE, et al. Long-term outcome with dasatinib after imatinib failure in chronic-phase chronic myeloid leukemia: follow-up of a phase 3 study. *Long-term follow-up of a Dasatinib patients with imatinib-resistant/-intolerant chronic myeloid leukemia (CML).*	9. Study reported on journal web-page (*Blood)*.[56]	CA:17 USA:17	Australia France Germany India Italy Japan South Korea Spain Sweden UK
Study	Fornier MN, Morris PG, Abbruzzi A, et al. A phase I study of dasatinib and weekly paclitaxel for metastatic breast cancer. *A phase I study of Dasatinib and weekly paclitaxel for metastatic breast cancer.*	10. Study reported on journal web-page (*Annals of Oncology)*.[57]	FR:18 JA:16 SK:16 SP:20	Australia Canada Germany India Italy Sweden UK USA
Study	Hausner et al (2016) Search appendix to Prospective comparison of search strategies for systematic reviews: an objective approach yielded higher sensitivity than a conceptual one	11. Appendix of study.[58]	S:12	Australia Canada France Germany India Italy

Item type	Item identifier/ description	Version(s) identified	In which countries (X^2 = page rank)	Overall, was the item missed in any countries?
				Japan South Korea Spain UK USA
Systematic Review	Douxfils J, Haguet H, Mullier F, Chatelain C, Graux C, Dogné J-M. Association Between BCR-ABL Tyrosine Kinase Inhibitors for Chronic Myeloid Leukemia and Cardiovascular Events, Major Molecular Response, and Overall Survival: A Systematic Review and Meta-analysis *Systematic review and meta-analysis to assess the risk of vascular occlusive events in patients with CML treated by new generations of TKIs and provide an overall assessment of the clinical benefit.*	12. Review reported on journal web-page (*JAMA Oncology*).[30]	AU:10 CA:8 FR:5 GE:6 I:6 IN:9 JA:5 S:5 SK:7 SP:5	No
		13. web-page linking to the PDF annex of the review.[31]	AU:4 CA:3 FR:4 GE:5 I:5 IN:5 JA:4 S:4 SK:4 SP:4 UK:5 USA:3	
Systematic Review	Pavey T, Hoyle M, Ciani O, et al. Dasatinib, nilotinib and standard-dose imatinib for the first-line treatment of chronic myeloid leukaemia: systematic reviews and economic analyses. *PenTAG Health Technology Assessment Report*	14. Link to PDF download of the NIHR library version of the review.[16]	UK:7	No
		15. University of Queensland repository version.[18]	AU:3 CA:12 FR:10 GE:12 I:14 IN:11 JA:10 S:10 SK:11 SP:15 UK:10 USA:8	
		16. Link to PDF download of the technical annex to item 14.[32]	AU:8 CA:9 FR:9 GE:9 I:9 IN:10 JA:8 S:7 SK:10 SP:11 UK:4 USA:10	
Systematic Review	Tang L, Zhang H, Peng YZ, et al. Comparative efficacy and tolerability of front-line treatments for newly diagnosed chronic-phase chronic myeloid leukemia: an update network meta-analysis.	17. Link to the PDF version of the published review reported in *BMC Cancer*.[33]	AU:25 CA:20 FR:19 I:20 IN:20 JA:18 S:19 SK:5 SP:21 UK:15 USA:19	Germany

Item type	Item identifier/ description	Version(s) identified	In which countries (X^2 = page rank)	Overall, was the item missed in any countries?
	Systematic review and meta-analyses of multiple treatments for direct and indirect evidence of efficacy and tolerability for patients with newly diagnosed CML.			
Protocol	Rossi RE, Pozzi R, Gonzalez-Lorenzo M, et al. Tyrosine kinase inhibitors for unresectable hepatocellular carcinoma in adults. *Cochrane systematic review of tyrosine kinase inhibitors for unresectable hepatocellular carcinoma in adults.*	18. Appendix (searches) to the protocol.[59]	CA:22 IN:22 UK:20 USA:21	Australia France Germany Italy Japan South Korea Spain Sweden
Protocol	Balakumaran J, Birk T, Golemiec B, et al. Evaluating the endometabolic and bone health effects of Tyrosine Kinase Inhibitors in Chronic Myeloid Leukaemia: a systematic review protocol. *Protocol for a systematic review to investigate the endometabolic and bone health effects of TKI therapy in CML*	19. PDF of the protocol reported in BMJ Open.[34]	AU:6 CA:5 FR:6 GE:7 I:7 IN:6 JA:6 S:6 SK:6 SP:7 UK:3 USA:5	No
Guideline	De Souza *et al.* Brazilian Medical Association Guideline *Guideline for diagnosis and treatment of Chronic myeloid leukemia (CML).*	20. repository copy.[36]	FR:7 SP:6 UK:8	No
		21. copy from SciELO.[35]	AU:12 FR:11 GE:11 I:8 IN:8 JA:9 S:8 SK:9 SP:10	
		22. PDF of page 67 of the technical annex to item 11.[38]	AU:13 I:11 IN:12 JA:7 SK:8 SP:8 USA:11	
		23. PDF of page 68 of the technical annex to item 11.[37]	AU:14 CA:10 GE:8 I:10 IN:14 USA:12	
Report	Canadian Agency for Drugs and Technologies in Health. *Pruning Emtree: Does Focusing Embase Subject Headings Impact Search Strategy Precision and Sensitivity?*	24. PDF of main report.[60]	CA:11	Australia France Germany India Italy

Item type	Item identifier/ description	Version(s) identified	In which countries (X^2 = page rank)	Overall, was the item missed in any countries?
	Report which examines the impact of focusing controlled indexing headings in Emtree (Embase)			Japan South Korea Spain Sweden UK USA
Report	Gemeinsamer Bundesausschuss (GbA). *Kriterien zur Bestimmung der zweckmäßigen Vergleichstherapie undRecherche und Synopse der Evidenz zur Bestimmung der zweckmäßigen Vergleichstherapie nach § 35a SGB VVorgang: 2017-B-226 Bosutinib.* 2017. Federal Joint Committee (GbA). Document describes which drugs are approved for CML in Germany and reports a search to identify potential comparators and a summary of identified literature.	25. PDF report.[61]	GE:4	Australia Canada France India Italy Japan South Korea Spain Sweden UK USA
Report	European Medicines Agency. *Sprycel: EPAR - Product Information.* *European Medicines Agency EPAR for Dasatinib (Sprycel)*	26. Annex 1 (Summary of product characteristics).[62]	FR:8 GE:18 I:16 IN:17 JA:11 S:11 SK:20 SP:9 UK:14	Australia Canada USA
Theses	Benjamin Gregory Carlisle: Appendices to The moral efficiency of clinical trials in anti-cancer drug development *Appendices to P.hD thesis of Benjamin Gregory Carlisle (2019)*	27. Appendices to the thesis.[63]	AU:21 CA:16 GE:19 I:17 IN:18 SK:17 SP:17 USA:13	Australia Canada Germany India Italy South Korea Spain USA
Theses	Liu Lu: in Vitro Investigation Of Intracellular Ponatinib Transport And Modeling Ponatinib Resistance In BCR,ABL1+ Cell Lines: Implications For Therapeutic Strategies *P.hD thesis of Liu Lu (2015)*	28. PDF copy of thesis from University of Adelaide Repository.[64]	AU:11	Canada France Germany India Italy Japan South Korea

Item type	Item identifier/ description	Version(s) identified	In which countries (X^2 = page rank)	Overall, was the item missed in any countries?
				Spain Sweden UK USA
Wiki	Dasatinib (Better Known as: Sprycel) *Wiki for detail on and mechanism of action for Dasatinib.*	29. wiki. Last updated 2017.[65]	CA:19	Australia France Germany India Italy Japan South Korea Spain Sweden UK USA
Wiki	Dasatinib (Sprycel): Wiki *A wiki for Dasatinib (Sprycel) by Hemonc.org*	30. wiki. Last updated Feb 2020.[66]	CA:21 USA:18	Australia France Germany India Italy Japan South Korea Spain Sweden UK
Web-page	MEDSAFE (New Zealand Medicines and Medical Devises Safety Authority) Data Sheet (Sprycel) (2019) *Data sheet for the drug Dasatinib (Sprycel). Lists doses and clinical particulars.*	31.[67]	AU:23	Canada France Germany India Italy Japan South Korea Spain Sweden UK USA

Item type	Item identifier/ description	Version(s) identified	In which countries (X^2 = page rank)	Overall, was the item missed in any countries?
Web-page	Dasatinib Wikipedia page	32. Updated 2020.[39]	AU:5 CA:4 FR:15 GE:10 I:4 IN:2 JA:15 S:13 SK:15 SP:16 UK:6 USA:4	No
Web-page	Sprycel 20mg, 50mg, 80mg, 100mg and 140mg Film Coated Tablets *The electronic medicines compendium (emc) page for Sprycel*	33. main item.[68]	S:20 UK:2	Australia Canada France Germany India Italy Japan South Korea Spain USA
Web-page	Sprycel 50mg Film Coated Tablets *The electronic medicines compendium (emc) Page for Sprycel 50mg film coated*	34. main item.[69]	IN:21	Australia Canada France Germany Italy Japan South Korea Spain Sweden UK USA
R Coding sheets	NPARC_workflow.Rmd for Dorothee Childs *Coding sheet for analysis for Non-Parametric Analysis of Thermal Proteome Profiles Reveals Novel Drug-Binding Proteins*	35.[70]	GE:17	Australia Canada France India Italy Japan South Korea Spain Sweden UK USA

Item type	Item identifier/ description	Version(s) identified	In which countries (X^2 = page rank)	Overall, was the item missed in any countries?
R Coding sheets	Coding sheet for R analyses (R/pRRophetic.R) *Coding sheet for R analyses Multi-Omics integration and VIsualization in Cancer Subtyping*	36.[71]	AU:22 CA:18	France Germany India Italy Japan South Korea Spain Sweden UK USA
Web-page	AUSTRALIAN PRODUCT INFORMATION–SPRYCEL®(DASATINIB) *Web-page of clinical data for Sprycel from meidcines.gov.au*	37.[72]	AU:2	Canada France Germany India Italy Japan South Korea Spain Sweden UK USA
Web-page	PBS: Dasatinib, tablets, 20 mg, 50 mg, 70 mg and 100 mg, Sprycel® - July 2011 *The Pharmacutical Benefits Scheme guidance for Dasatinib (2011)*	38.[73]	AU:20	Canada France Germany India Italy Japan South Korea Spain Sweden UK USA
Web-hosted database	Science.gov Gateway to U.S. Federal Science Search returns for the Cortes study from the Science.gov database.	39. Main database search returns for the Cortes study.[74]	AU:9 CA:6 IN:7 S:9 UK:9 USA:6	France Germany Italy Japan South Korea

Item type	Item identifier/ description	Version(s) identified	In which countries (X^2 = page rank)	Overall, was the item missed in any countries?
				Spain
Book	Clinical Radiation Oncology: Expert Consult *Gunderson LL, Tepper JE. Clinical Radiation Oncology: Expert Consult. (2011)*	40. Main.[40]	AU:24	Canada France Germany India Italy Japan South Korea Spain Sweden UK USA
Book	Chronic Myeloid Leukemia (Hematologic Malignancies) *Hehlmann R. Chronic Myeloid Leukemia (Hematologic Malignancies) (2016)*	41. Main.[41]	AU:18 CA:15 FR:14 GE:15 I:15 IN:16 JA:14 S:16 SK:14 SP:14 UK:19 USA:16	No
Book	Water-Insoluble Drug Formulation *Liu R. Water-Insoluble Drug Formulation. 3rd ed (2018)*	42. Main.[75]	AU:16 CA:13 FR:12 GE:13 I:12 IN:13 JA:12 S:14 SK:12 SP:12 UK:17 USA:14	No
Book	Molecular Imaging: Principles and Practice *Ralph Weissleder, Brian D. Ross, Alnawaz Rehemtulla, Sanjiv S. Gambhir. Molecular Imaging: Principles and Practice. (2010)*	43. Main.[42]	AU:17 CA:14 FR:13 GE:14 I:13 IN:15 JA:13 S:15 SK:13 SP:13 UK:18 USA:15	No

Key: Australia = AU; Canada CA; France FR; Germany = GE; Italy = I; India = IN; Japan = JA; Sweden = S; South Korea = SK; Spain = SP; United Kingdom = UK; and United Stated of America = USA. X2 = page rank of the item returned, for example GE9 indicated the item was the 9th returned from the searches in Germany.

FIGURE 1 a) Search returns by country and page rank

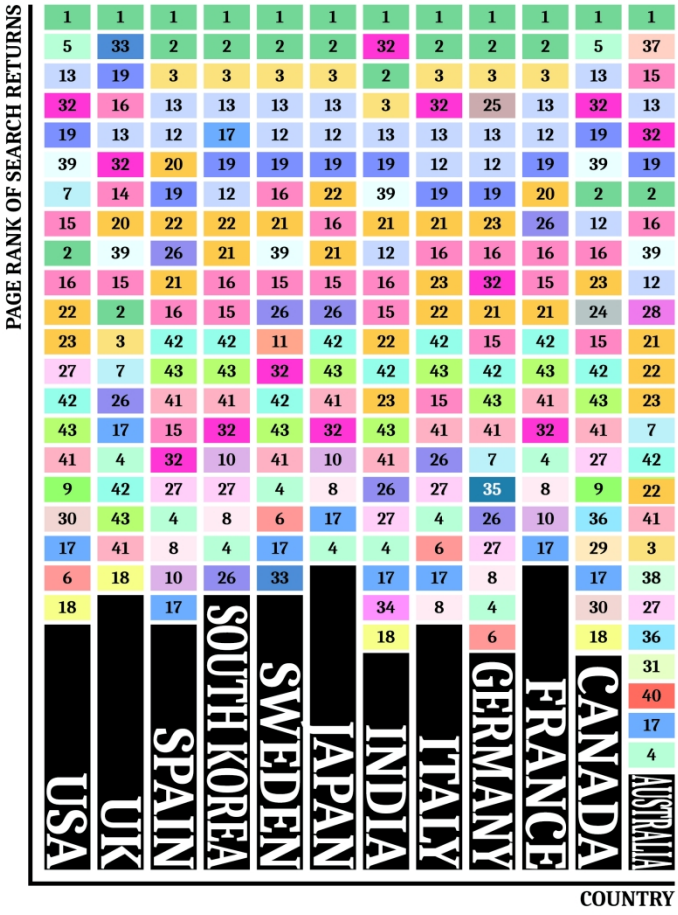

Figure 1a search returns by country and page rank

FIGURE 1 **b) Key: items and identified versions**

Figure 1b key: items and identifed versions