

Brief communication concerning the implications of algorithmic indexing in MEDLINE

Alexandre Amar-Zifkin (a), Taline Ekmekjian (b), Virginie Paquet (c) and Tara Landry (a)

(a) Bibliothèque de la Santé, Université de Montréal, Montréal, Québec, Canada

(b) Public Health Agency of Canada library, Office of the Chief Science Officer, Public Health Agency of Canada, Ottawa, Ontario, Canada

(c) Bibliothèque Marguerite-d'Youville, Université de Montréal, Montréal, Québec, Canada

Abstract

As of early 2022, indexing in the National Library of Medicine (NLM) MEDLINE database is performed by an algorithm, MTIA [Medical Text Indexer-Auto], with human curation as appropriate. Deployment of a machine learning classifier, MTIX (Medical Text Indexer-neXt generation) is planned for mid-2024. This brief communication outlines the processes of MTIA and raises concerns about the MeSH (Medical Subject Headings) applied by algorithm. Implications for searchers and educators are briefly discussed.

Key words: *medical subject headings; algorithms; abstracting and indexing; MEDLINE; vocabulary, controlled.*

Introduction

As of early 2022, indexing in the National Library of Medicine (NLM) MEDLINE database is performed by an algorithm named MTIA (Medical Text Indexer-Auto), supplemented “with human curation as appropriate” (1). Briefly, the algorithm determines which Medical Subject Heading (MeSH) terms should be applied to a record by:

- identifying uncommon or specific textwords in the article’s title and abstract;
- mapping those textwords to MeSH;
- gathering MeSH which have been assigned to other records with similar uncommon or specific textwords within MEDLINE; and
- ranking the identified MeSH before deciding which to apply to the record.

Several other processes occur within this. As examples: textwords in the title are double-counted, subheadings are preferred to headings when both are available, and secondary analyses to resolve ambiguities are conducted. One such ambiguity is “plaque” – “(the algorithm) currently cannot distinguish between the MeSH terms Senile Plaque and Dental Plaque when it encounters the term plaque during processing” (2). After generating a list of possible MeSH terms, the algorithm

“check(s) to see if there is any contextual evidence that we should pick Dental Plaque over Senile Plaque” (2). In addition, it should be noted that unlike human indexers, the MTIA does not consider the journal in which an article appears, the author-suggested keywords or the full-text of an article.

Our evaluation

We began to note unusual indexing in the course of regular MEDLINE searches and student consultations in mid-2022. Closer examination often revealed that these articles had been indexed automatically. Notable examples included:

- “Laparoscopic versus open elective right hemicolectomy with curative intent for colon adenocarcinoma” (3) indexed with only one age group – “Child, Preschool”, prompting a resident to tell us “something’s wrong with the database, you can’t do this with kids”;
- “Comparison of robot-assisted and conventional laparoscopy for colorectal surgery for endometriosis: a prospective cohort study” (4) indexed with “Colorectal Neoplasms/surgery” – leading us to question if endometriosis was neoplastic, because the MeSH being wrong was inconceivable to us at the time, and

Address for correspondence: Alexandre Amar-Zifkin, Bibliothèque de la Santé, Université de Montréal, CP 6128, succursale Centre-ville, Montréal, Québec, Canada, H3C 3J7. E-mail: alexandre.amar-zifkin@umontreal.ca.
ORCID: <https://orcid.org/0000-0002-1196-5209>

- “An exploratory study on support for caregivers of people with vision impairment in the UK” (5) – indexed with no MeSH indicating vision impairment or visually impaired persons.

Two broad concerns arose – educational and functional. As educators, we worried that we would need to revise, moderate or minimize our teaching of MeSH as a reliable indicator of aboutness. On function, we worried about searches. We use filters which rely on MeSH being accurate, and were finding questionable MeSH fairly frequently. We wondered how often a relevant concept might not be present whatsoever in the MeSH terms used to index an article. Operating under time pressures, we have performed MeSH-only searches, albeit with caveats regarding coverage and recency; were those caveats still accurate?

We assembled a team of four librarians from l'Université de Montréal, with years of experience searching to support patient care, literature reviews and knowledge synthesis projects (6-9), as well as teaching literature searching to medical and allied health students. We took a sample of 1000 MTIA-indexed articles from MEDLINE (998 after removing duplicates), blinded ourselves to the actual indexing, read the records' titles and abstracts, and noted what concepts we expected to find in the indexing for each article.

We then un-blinded ourselves to the indexing, and indicated agreement or disagreement. Of the articles that met our inclusion criteria, we found that slightly over half (53%) had been assigned MeSH terms that adequately represented the main concepts present in the article, while 47% had one or more inadequacies in indexing that would have affected their retrieval in a MeSH-only search.

Our preliminary findings, “Exploring the impact of automated indexing on completeness of MeSH terms” were presented the 2023 Canadian Health Library Association - Association des bibliothèques de la santé du Canada (CHLA-ABSC) conference. A full manuscript, with detailed examples of indexing issues, is currently under review.

Conclusions and lessons learned

Our conclusions and lessons learned are:

- although time-consuming, the exercise of reading abstracts and reflecting on expectations of indexing was illuminating. Exposure to articles outside of the demands of any particular search added to our

knowledge and expanded our horizons as searchers, increasing awareness of lesser-explored branches and features of the MeSH vocabulary;

- issues in algorithmic indexing cut both ways. The algorithm may apply inappropriate terms; it may also omit appropriate terms. The relative impacts of these issues vary depending on topic;
- as the algorithm has been trained on MEDLINE, oversights or systemic biases may be reproduced in the future. We note two articles (“Open access and predatory publishing: a survey of the publishing practices of academic pharmacists and nurses in the United States” (10) and “Interdisciplinary Cooperation between Pharmacists and Nurses-Experiences and Expectations” (11)) with very close ratios of pharmacist-to-nurse terms (1-to-1 and 7-to-5, respectively); in both cases, the indexing only has *Pharmacists*. We recognize that within MEDLINE, terms for pharmacists are a stronger indicator for the application of *Pharmacists* as a subject heading than terms for nurses for the application of *Nurses* as a subject heading; nonetheless, this is in line with existing under-representation of nurses (12, 13);
- automated indexing cannot “read between the lines” in areas with inherent semantic uncertainty like nursing or patient education. When searching in databases which use algorithmic indexing (MEDLINE and EMBASE, among others) searchers should similarly take care to intentionally incorporate these kinds of ambiguities into their comprehensive searches; for example, using the noisier, less-precise *Hearing Loss* for articles more acutely about *Hearing Impaired Persons*;
- the increasing frequency of revisions to indexing in MEDLINE may result in searches becoming marginally less replicable. A record with the status ‘Indexed for MEDLINE’ may have some or all of its MeSH terms changed following human curation, with its status unchanging. Previously the MeSH applied to a record seemed more permanent;
- not considering an article’s full-text is a very notable shortcoming. Human indexers had access to full-text, and could therefore apply appropriate and relevant MeSH terms for which there was no indication in the title or abstract. Searchers could then find a publication relevant to a particular condition or subgroup despite its or their omission from title-abstract.

Assessing the impact of this loss of indexing depth poses a complex and resource-intensive challenge.

Implications

We have shared our dataset with the NLM, and our preliminary findings with several other health information professional interest groups, notably the Agency for Healthcare Research and Quality (AHRQ) and the Canadian Agency for Drugs and Technologies in Health (CADTH). The NLM has been extraordinarily receptive to communications about specific indexing issues. We recall a vein of gestational diabetes articles, indexed with infants as the only age group, corrected within hours.

As the deployment of a new machine learning classifier, MTIX (Medical Text Indexer-neXt generation) is planned for 2024 (14), engagement by the information professional community can help calibrate and refine automated indexing moving forward.

Algorithmically generated content is increasingly present in many facets of education and health care. As information professionals guiding users through increasingly complex online landscapes, bolstering our knowledge about the underlying mechanisms of generative algorithms – broadly, AI – is of paramount importance. We hope that this brief communication presents easily-digestible examples and red flags*.

*Nota bene: Until we raised the issue, MTIA was indexing “red flags” with *Emblems and Insignia*. This is no longer the case.

Submitted on invitation.

Accepted on 27 February 2024.

REFERENCES

1. MEDLINE 2022 Initiative: transition to automated indexing: US National Library of Medicine; 2021 [updated 2021 December 01. e5]. Available from: https://www.nlm.nih.gov/pubs/techbull/nd21/nd21_medline_2022.html.
2. National Library of Medicine. MTI processing flow white paper 2006 [Available from: https://lhncbc.nlm.nih.gov/ii/tools/MTI/Medical_Text_Indexer_Processing_Flow.pdf].
3. Lovay K, Barla J, Vaško J, Lendel A, Rákoš M. Laparoscopic versus open elective right hemicolectomy with curative intent for colon adenocarcinoma. *Rozhl Chir.* 2022;100(12):584-91.
4. Ferrier C, Le Gac M, Kolanska K, Boudy AS, Dabi Y, Touboul C, et al. Comparison of robot-assisted and conventional laparoscopy for colorectal surgery for endometriosis: A prospective cohort study. *Int J Med Robot.* 2022;18(3):e2382.
5. Enoch J, Dickinson C, Potts J, Subramanian A. An exploratory study on support for caregivers of people with vision impairment in the UK. *Ophthalmic Physiol Opt.* 2022;42(4):858-71.
6. Garant A, Guilbault C, Ekmekjian T, Greenwald Z, Murgoi P, Vuong T. Concomitant use of corticosteroids and immune checkpoint inhibitors in patients with hematologic or solid neoplasms: A systematic review. *Crit Rev Oncol Hematol.* 2017;120:86-92.
7. Hendryckx C, Nalder E, Drake E, Leclaire É, Pituch E, Gouin-Vallerand C, et al. Managing challenging behaviours in adults with traumatic brain injury: A scoping review of technology-based interventions. *J Rehabil Assist Technol Eng.* 2023;10:20556683231191975.
8. Fiore JF, Jr., El-Kefraoui C, Chay MA, Nguyen-Powanda P, Do U, Olleik G, et al. Opioid versus opioid-free analgesia after surgical discharge: a systematic review and meta-analysis of randomised trials. *Lancet.* 2022;399(10343):2280-93.
9. Maertens H, Madani A, Landry T, Vermassen F, Van Herzeele I, Aggarwal R. Systematic review of e-learning for surgical training. *Br J Surg.* 2016;103(11):1428-37.
10. Conlogue BC, Gilman NV, Holmes LM. Open access and predatory publishing: a survey of the publishing practices of academic pharmacists and nurses in the United States. *J Med Libr Assoc.* 2022;110(3):294-305.
11. Waszyk-Nowaczyk M, Guzenda W, Dragun P, Olsztyńska L, Liwarska J, Michalak M, et al. Interdisciplinary cooperation between pharmacists and nurses-experiences and expectations. *Int J Environ Res Public Health.* 2022;19(18).
12. Girvin J, Jackson D, Hutchinson M. Contemporary public perceptions of nursing: a systematic review and narrative synthesis of the international research

- evidence. *J Nurs Manag.* 2016;24(8):994-1006.
13. Mason D, Glickstein B. Underrepresentation of nurses in health care coverage continues to be a concern: Association of Health Care Journalists; Center for Excellence in Health Care Journalism; 2018 [Available from: <https://healthjournalism.org/blog/2018/05/under-representation-of-nurses-in-health-care-coverage-continues-to-be-a-concern/>].
14. National Library of Medicine. Minutes of the Board of Regents Meeting [Minutes]. 2023 [updated February 7, 2023. 12]. Available from: https://www.nlm.nih.gov/od/bor/Feb_2023_BOR_Final_Minutes_Accessible.pdf.

