

Comparing the National Library of Medicine (NLM)'s Medical Text Indexer (MTI) to Human Indexing: A Pilot Study

Eileen Chen, MLIS

School of Information, University of British Columbia

Dr, Julia Bullard, MA, MLIS, PhD

School of Information, University of British Columbia

Dean Giustini, MLS, MEd

UBC Biomedical Branch Library, Vancouver Hospital



Background on the Medical Text Indexer (MTI):

MTI was developed in 2002 by the National Library of Medicine (NLM) & Lister Hill National Centre for Biomedical Communications.

There have been three versions:

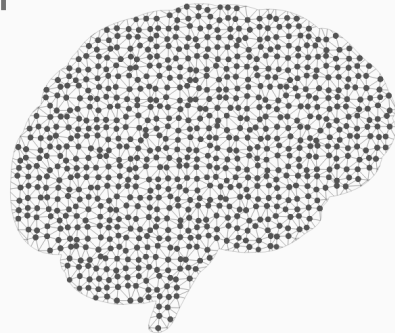
- **MTI (2002):** term recommender for human indexers
- **MTI First Line (2011-2021):** semi-automated MTI assisted by human indexers
- **MTI-Auto (2022):** fully automated indexer (extent of human curation unknown)



For more information (abstract, data, glossary, etc) on this project, see: <https://osf.io/4k69q/>

MTI-Auto (2022):

- Most recent version, but not publicly-available for testing
- *Pattern-based indexing* based on titles & abstracts of papers
- Machine learning used for applying subheadings
- Human reviewers perform quality assurance reviews for *'select citations'* ...



For more information on this project, see: <https://osf.io/4k69q/>

Aims:

- *To compare MTI with human indexing...*
- Evaluate indexing quality in high vs. low-impact biomedical journals indexed in Medline (PubMed)
- Identify MTI errors, and anomalies in assigning MeSH terms & check tags

For more information on this project, see:
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Method used for sample:

- *Selected* 20 biomedical articles published in year 2000 (before MTI was created)
- *Identified* key journals from the 'Abridged Index Medicus' (AIM) = a journal subset of *Medline (PubMed)*
 - Of 120+ AIM journals, 10 with the highest 2020 Journal Impact Factor (JIF) AND 10 with the lowest JIF were chosen (N=20)
- *Excluded* articles without abstracts or MeSH indexing

Interactive MTI Tool

...is a free online tool provided by the NLM. The version of the MTI available is the MTIFL (retired by the NLM in 2021)...

Two Output Options:

- 1) *Just the Facts (JTF):*
 - a) Shorter list of ranked terms that represents MTI's final choices
- 2) *Full Listing:*
 - a) Longer list of all terms retrieved by MTI, ranked & explained
 - b) Includes confidence scores, MeSH type, and pathway(s) used to retrieve term

Results

Assigned Index Terms – Mean #?

- **MTI and humans** created **more index terms** for high-JIF group than low-JIF group
- Difference was greater for MTI (6.4 terms)
- **Journals with most MTI terms?**
 - *Lancet* (26), *JAMA* (21), *Blood* (21), *Annals of Internal Medicine* (21)
- **Journals with least MTI terms?**
 - *Nursing Clinics of North America* (4), *Journal of Nursing Administration* (5), *Journal of Laryngology and Otology* (7)

	MTI assigned:	Human assigned:
Top 10 JIF journals:	16.6 terms	13.5
Lowest 10 JIF journals:	10.2 terms	11.2
Difference?	6.4 terms	2.3

Main Headings

- Of a total of **174** main headings used by humans for 20 articles, MTI included:
 - **80** in JTF list
 - **92** in Full Listing
 - Missed **2** altogether.
- In **19** instances, the MTI used an acceptable synonym to a human-indexed term.

The recall rate for relevant terms is high in the Full Listing, but many relevant terms are not ranked highly enough.



Case Study: MTI vs. Human Terms

- *The MTI missed several major headings*
- *The word “**attention**” was misinterpreted literally:*

*“The concept of nursing practice models [...] has attracted the **attention** of nursing administrators in the last decade...” (Upenieks 2000)*

Article #17: The relationship of nursing practice models and job satisfaction outcomes

Shared Terms	MTI Only	Human Only
<i>Humans</i> (0); <i>Job Satisfaction</i> * (1)	Social Responsibility (2); Climate Change (3); Attention (4)	Models, Nursing* (5); Nursing* (8); Outcome Assessment, Health Care* (31); <i>United States</i> (53)

Italics = check tags; * = human-indexed major heading; () = MTI rankings in Full Listing

Check Tag (Age, Sex, Species) Coverage

- Of **72** check tags used by humans across sample (N=20) articles, MTI shared **38**.
- Of remainder, **30** appeared in Full Listing, and **4** were missed altogether.
- MTI used **5** check tags not used by humans, **4** of which were appropriate choices.

The check tag “Aged” was missed in 4 instances.

<input type="checkbox"/> V Human	<input type="checkbox"/> U Animal
<input type="checkbox"/> W Male	<input type="checkbox"/> Q Mice
<input type="checkbox"/> X Female	<input type="checkbox"/> T Rats
<input type="checkbox"/> A Pregn	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/> J Cats
<input type="checkbox"/> B Inf New (to 1 mo)	<input type="checkbox"/> K Cattle
<input type="checkbox"/> C Inf (1 to 23 mo)	<input type="checkbox"/> L Chick Embryo
<input type="checkbox"/> D Child Pre (2-5)	<input type="checkbox"/> M Dogs
<input type="checkbox"/> E Child (6-12)	<input type="checkbox"/> O Guinea Pigs
<input type="checkbox"/> F Adolesc (13-18)	<input type="checkbox"/> P Hamsters
<input type="checkbox"/> R Young Adult (19-24)	<input type="checkbox"/> S Rabbits
<input type="checkbox"/> G Adult (19-44)	<input type="checkbox"/>
<input type="checkbox"/> H Mid Age (45-64)	<input type="checkbox"/>
<input type="checkbox"/> I Aged (65-79)	<input type="checkbox"/>
<input type="checkbox"/> N Aged (80+)	<input type="checkbox"/>

Sex Check Tags

Male (check tag) was ranked higher in all 6 instances in which *male/female* check tags were used.

Why is there such a bias in the sample?

Sex Check Tag Rank in MTI Full Listing

Article	Male	Female	Difference (F - M)
1	0*	3rd*	3 ranking places
2	5*	8*	3
13	15	50	35
16	1*	4*	3
18	12*	60*	48
20	9*	70*	61
Mean	7	32.5	25.5

Bolded = included in JTF list of MTI

* = labelled as a check tag

Sex Check Tags: MTI vs. Human Differences

Article Title	MTI check tags	Human check tags
Hypertensive emergencies	Pregnancy [0]; Female [1]; <i>Humans</i> [2]	<i>Humans</i>
Application of the Woman Abuse Screening Tool (WAST) and WAST-short in the family practice setting	<i>Humans</i> [0]; Male [1]; <i>Adult</i> [2]; <i>Middle Aged</i> [3]; Female [4]	<i>Adult, Female, Humans, Middle Aged</i>
A comparison of performance on the OMSITE and ABOMS written qualifying examination	<i>Humans</i> [0]; Male [1]; Female [2]	<i>Humans</i>

MTI can make erroneous assumptions based on populations suggested in abstract.

Summary of Findings:

- In sample (N=20), more MeSH terms & accuracy were seen in the **high-JIF articles from 2000**
- High retrieval rates for human-indexed main headings & check tags; however, MTI ranking mechanisms were not consistently reliable
- Check tags reflect a certain bias for **male populations that are not aged**
- *More frequent & accurate use of **medical, operationalizable MeSH terms** than social and emotional concepts / MeSH*

Implications:

- Check tag inaccuracy is related to MTI processing abstracts rather than full texts (Mork et al., 2017)
- MTI output would benefit from greater degree of indexer review
- PubMed/Medline end users are encouraged to report problems to [NLM Support Center](#)

Limitations & Future Research:

Limitations of this research:

- Our small sample of articles in Medline **does not** yield strong, generalizable findings... & it therefore **cannot** represent all Medline articles
- The Interactive MTI tool we used is dated & *may not be* representative of MTIA (2022) performance

Future research / directions:

- Monitor & track indexing biases & anomalies
- Collaborate with other scholars, researchers
- Involve indexers / subject experts in projects comparing MTIA indexing to past human indexing

References

Mork, J., Aronson, A., & Demner-Fushman, D. (2017). 12 years on—Is the NLM medical text indexer still useful and relevant? *Journal of Biomedical Semantics*, 8(1), 8. <https://doi.org/10.1186/s13326-017-0113-5>

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For a complete bibliography of our project, see <https://osf.io/4k69q/>





Questions?

Eileen Chen, MLIS
School of Information, UBC
eileen.0415@livemail.tw

Dr. Julia Bullard, MA, MLIS, PhD
School of Information, UBC
julia.bullard@ubc.ca

Dean Giustini, MLS, MEd
UBC Biomedical Branch Library, UBC
dean.giustini@ubc.ca

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