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Research Brief

Comparison of the time-to-indexing in PubMed between biomedical journals according to impact factor, discipline, and focus

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A B S T R A C T

Background: Practicing evidence-based medicine requires health care professionals to efficiently retrieve relevant and current literature.
Objective: The purpose of this study was to compare the time interval between PubMed entry and indexing with Medical Subject Headings (MeSH) between biomedical journals with varying impact factors, focus areas, and health care discipline representation.
Methods: This was a cross-sectional study of articles entered into PubMed database between January 1 and December 31, 2012. The primary endpoint was the number of days between PubMed entry and indexing with MeSH terms.
Results: A total of 7906 articles were reviewed across 18 journals. In the first comparison, the time-to-indexing was 177 ± 100 days, 111 ± 69 days, and 23 ± 40 days for articles published in journals with impact factors of 2.0–2.5, 4.5–6.5, and >25, respectively ($P \leq 0.001$). In the second comparison, the time-to-indexing was 111 ± 69 days for general medicine versus 170 ± 74 days for specialty journals ($P \leq 0.001$). In the third comparison, the overall time-to-indexing was 177 ± 100 days, 234 ± 107 days, and 163 ± 58 days for medicine, nursing, and pharmacy journals, respectively ($P \leq 0.001$).
Conclusions: Study results identified a significant delay between entry of articles into the PubMed database and time-to-indexing with MeSH terms across journals of varying impact factor, discipline, and focus. Results suggest that there may be factors that influence the priority by which articles are indexed with MeSH terms. Future research should focus on determining those journal characteristics and any impact of this delay on clinical practice.

The Joint Commission of Pharmacy Practitioners has recently developed a consistent approach to patient care across the profession.[1–3] The Pharmacists' Patient Care Process is a method by which pharmacists, using evidence-based practice, provide patient-centered care through the steps collect, assess, plan, implement, and follow-up.[2,3] The integration of evidence-based practice, also called evidence-based medicine (EBM), into each steps is an example of how EBM has become a cornerstone in contemporary health care. It integrates the health care professional's clinical expertise, patient's values and expectations, and best external evidence to make decisions.[4,5] It emphasizes the use of high-quality evidence, and thus, practicing EBM requires that health care professionals be able to efficiently identify relevant and current biomedical literature.[4,5]

PubMed is one of the most widely used search engines by health care professionals, researchers, and the public to identify and retrieve biomedical literature. It is a free resource developed and maintained by the National Center for Biotechnology Information (NCBI) at the U.S. National Library of Medicine (NLM) and includes more than 25 million citations.[6] To facilitate retrieval of information and account for variations in terminology, the NLM has developed Medical Subject Headings (MeSH) to serve as a controlled vocabulary.[7] These MeSH words and phrases are assigned to citations by human indexers to describe content and other characteristics which then form the hierarchical structure by which citations can be retrieved from MEDLINE (indexed database) via PubMed (a search engine which searches MEDLINE and other citation records).[6,7]

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Using MeSH vocabulary improves the specificity and efficiency of PubMed searches[8,9] and the ability to use MeSH has been identified as one of PubMed's major advantages over other search engines (e.g., Google Scholar).[10–12] As a result, searching with MeSH terms either by themselves or in combination with keywords is often taught as the preferred PubMed search strategy in the education of many health care professionals.[13–15]

The time interval between when an article is entered in PubMed and indexed with MeSH terms is estimated to be upwards of 4 months for some pharmacy journals which may present an obstacle for health care professionals using PubMed to make evidence-based decisions.[16,17] There is limited information on factors that might contribute to this delay. As a result, the objective of this article was to compare the time-to-indexing between journals reflecting different subject areas, health care disciplines, or impact factor.

Methods

Study design

This was a cross-sectional study of articles entered into the PubMed database between January 1 and December 31, 2012. Three comparisons were performed (Table 1). In the first comparison, 3 general medicine journals were identified across varying impact factors: 2.0–2.5 *(American Journal of Managed Care, Current Medical Research and Opinion,* and *International Journal of Clinical Practice)*, 4.5–6.5 *(American Journal of Medicine, Journal of Internal Medicine,* and *Mayo Clinical Proceedings)*, and >25 *(New England Journal of Medicine, Journal of the American Medical Association,* and *The Lancet).* Ranges were selected through visual review of the impact factor as reported by ISI Web of Knowledge Journal Citation Reports for the category "medicine, general & internal" for a natural division in impact factor (e.g., 6.5 to > 25) and/or to facilitate matching necessary for subsequent comparisons.

In the second comparison, 3 journals classified as general medicine as outlined above were matched by impact factor (±0.5) to journals representing the specialty areas of cardiology *(American Heart Journal)*, infectious disease (*Journal of Antimicrobial Chemotherapy)*, and hematology *(Thrombosis and Haemostasis)*. In the third comparison, 3 journals representing medicine *(American Journal of Managed Care, Current Medical Research and Opinion,* and *International Journal of Clinical Practice)* were matched by impact factor (±0.5) to those representing nursing *(International Journal of Nursing Studies, Oncology Nursing Forum,* and *Research in Nursing & Health)* and pharmacy *(American Journal of Health-System Pharmacy, Annals of Pharmacotherapy,* and *Pharmacotherapy)*.

Journal category and impact factor were taken from the ISI Web of Knowledge Journal Citation Reports as reported for 2012.[18] Journal website were reviewed to ensure a clinical focus. All journals needed to be published in the English language and available electronically through the Oregon State University and/or Oregon Health & Science University library systems. This study was determined to be exempt from review by the Oregon State University Institutional Review Board.

Data sources

Data were abstracted from the PubMed searches using the Medline display format and entered into a data collection file. Data collected for each article included the PubMed entry date, MeSH indexing date, and publication type(s) through procedures described previously.[16] In the Medline display format, the PubMed entry date is defined as the Entrez Date (EDAT) (i.e., date the citation was added to the PubMed database) and the MeSH indexing date as the MeSH Date (MHDA) (i.e., date the citation was indexed with MeSH terms).[6] The NLM specifies that the MHDA remain the same as EDAT until MeSH terms are added; therefore, citations with this characteristic and no MeSH terms assigned were categorized as unindexed.[6,16]

Publication type(s) was determined by the NLM and reported as part of the Medline display format. Any publication type that represented less than 1% of articles within a set of journals across all 3 sets was classified as "other." Data were collected for all entered articles entered with the exception of those with an impact factor >25 where every fifth article was reviewed due to high volume.

Table 1
Journals included with impact factor and number of articles

Journal name	Impact factor	Number of articles reviewed
General medicine journals		
American Journal of Managed Care	2.117	230
Current Medical Research & Opinion	2.263	224
International Journal of Clinical Practice	2.427	209
American Journal of Medicine	4.768	378
Mayo Clinic Proceedings	5.790	221
Journal of Internal Medicine	6.455	158
Journal of the American Medical Association[a]	29.978	214
The Lancet[a]	39.060	322
New England Journal of Medicine[a]	51.658	266
Specialty medicine journals		
American Heart Journal	4.497	321
Journal of Antimicrobial Chemotherapy	5.338	679
Thrombosis and Haemostasis	6.094	374
Nursing journals		
International Journal of Nursing Studies	2.075	274
Research in Nursing & Health	2.181	70
Oncology Nursing Forum	2.393	114
Pharmacy journals		
American Journal of Health-System Pharmacists	1.984	347
Pharmacotherapy	2.311	152
Annals of Pharmacotherapy	2.567	273
Total		4826

[a] Due to the high number of articles published, only every fifth entry was reviewed. The original MEDLINE download contained 1330 articles for the *New England Journal of Medicine*, 1609 articles for *The Lancet*, and 1067 articles for the *Journal of the American Medical Association*.

Time-to-indexing was calculated as the number of days between EDAT and MHDA date.

Statistical analysis

Descriptive and inferential statistics were performed. Continuous and categorical variables are presented as mean ± standard deviation and number (percentage), respectively. Continuous variables were compared across groups using one-way analysis of variance (ANOVA) and Tukey post-hoc tests. All statistics were performed using SAS 9.2 (Cary, NC). Statistical significance was set at a P value of <0.05.

Results

A total of 4826 articles were reviewed across 18 journals (Table 1). Articles were categorized into 7906 publication types and each set of journals included a variety of publication types (Table 2). The most common publication type, as determined by the NLM, was "journal article" across all groups.

Impact factor comparison

In the first comparison, a total of 2222 articles were reviewed in general medicine journals with impact factor ranges of 2.0–2.5 (663 articles), 4.5–6.5 (757 articles), and greater than 25 (802 articles). In the articles reviewed, there were a total of 43 articles that remained unindexed: 2.0–2.5 range, 42 articles (6.3%); 4.5–6.5 range, 1 article (0.1%); greater than 25 range, 0 articles (0.0%). Classification of articles by unindexed by PubMed included (not mutually exclusive): journal article, 38 articles; review, 9 articles; editorial, 2 articles; interview, 1 article; letter, 1 article. For the 2179 articles indexed, the average time-to-indexing was 185 ± 96 days for those with an impact factor of 2.0–2.5, 111 ± 69 days for those with an impact factor of 4.5–6.5, and 24 ± 40 days for those with an impact factor of greater than 25 ($F = 953.57$, $P \leq 0.001$) (Table 3).

Table 3
Time-to-indexing across journals sets

	Time to indexing, days		P value[c]
	Mean ± SD	Range	
Impact factor ranges			<0.001
2.0–2.5[a]	185 ± 96	1–489	
4.5–6.5[b]	111 ± 69	41–359	
>25	24 ± 40	0–367	
General vs specialty medicine			<0.001
General medicine[b]	111 ± 69	41–359	
Specialty areas	170 ± 74	50–510	
Health professions			<0.001
Medicine[a]	185 ± 96	1–489	
Nursing[a]	234 ± 107	49–743	
Pharmacy[a]	163 ± 58	103–426	

SD – Standard deviation.
[a] General medicine journals with an impact factor range of 2.0–2.5 were matched with pharmacy and nursing journal by impact factor (±0.5).
[b] General medicine journal with an impact factor range of 4.5–6.5 were matched with journal representing the specialty areas by impact factor (±0.5).
[c] Tukeys post-hoc test revealed that all within group comparisons were statistically significant.

General medicine versus specialty area comparison

In the second comparison, a total of 2131 articles were reviewed across journals representing both general medicine (757 articles) and specialty areas (1374 articles) with similar impact factors. In the articles reviewed, as classified in PubMed, there was one "journal article" in the general medicine and one "retraction of publication" in the specialty journals that remained unindexed. For the 2129 articles indexed, the overall time-to-indexing was 111 ± 69 days for general medicine versus 170 ± 74 days for specialty journals ($F = 320.91$, $P \leq 0.001$) (Table 3).

Health care discipline comparison

In the third comparison, a total of 1893 articles were reviewed from journals publishing representing the disciplines of medicine (663 articles), pharmacy (772 articles), and nursing (458 articles). In the articles reviewed, there was a total of 75 articles that

Table 2
Types of articles published across journal (number, %)

Publication type	Pharmacy ($n = 772$)	Nursing ($n = 458$)	Medicine (impact factor: 2.0–2.5) ($n = 663$)	Medicine (impact factor: 4.5–6.5) ($n = 757$)	Medicine (impact factor: >25) ($n = 802$)	Specialty ($n = 1374$)
Bibliography	1 (0.1)	0 (0.0)	0 (0.0)	15 (1.2)	0 (0.0)	0 (0.0)
Biography	1 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	17 (1.2)	0 (0.0)
Case reports	85 (7.2)	5 (0.8)	2 (0.2)	123 (9.7)	59 (4.1)	61 (2.7)
Clinical trial	7 (0.6)	6 (0.9)	36 (3.2)	4 (0.3)	3 (0.2)	27 (1.2)
Comment	29 (2.5)	12 (1.8)	28 (2.5)	120 (9.4)	298 (20.6)	87 (3.9)
Comparative study	56 (4.7)	18 (2.7)	49 (4.4)	33 (2.6)	30 (2.1)	160 (7.2)
Editorial	18 (1.5)	26 (3.9)	39 (3.5)	76 (6.0)	78 (5.4)	39 (1.7)
Evaluation studies	6 (0.5)	5 (0.6)	34 (3.0)	3 (0.2)	0 (0.0)	40 (1.8)
Historical article	1 (0.1)	1 (0.2)	1 (0.1)	20 (1.6)	30 (2.1)	2 (0.1)
Journal article	606 (51.3)	425 (64.5)	582 (52.1)	551 (43.4)	416 (28.8)	1153 (51.7)
Letter	68 (5.8)	7 (1.1)	35 (3.1)	117 (9.2)	237 (16.4)	179 (8.0)
Meta-analysis	8 (0.7)	7 (1.1)	33 (3.0)	15 (1.2)	12 (0.8)	29 (1.3)
Multicenter study	10 (0.8)	38 (5.8)	75 (6.7)	26 (2.0)	54 (3.7)	129 (5.8)
News	72 (6.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Randomized controlled trial	15 (1.3)	43 (6.5)	61 (5.5)	25 (2.0)	61 (4.2)	138 (6.2)
Review	183 (15.5)	40 (6.1)	114 (10.2)	109 (8.6)	37 (2.6)	130 (5.8)
Validation study	2 (0.2)	23 (3.5)	5 (0.4)	4 (0.3)	0 (0.0)	15 (0.7)
Other[a]	13 (1.1)	4 (0.6)	24 (2.1)	30 (2.4)	55 (3.8)	43 (1.9)

[a] Other included clinical conference ($n = 10$), clinical trial – phase I ($n = 11$), clinical trial – phase II ($n = 25$), clinical trial – phase III ($n = 26$), clinical trial – phase IV ($n = 2$), congresses ($n = 2$), consensus development conference ($n = 5$), controlled clinical trial ($n = 9$), in vitro ($n = 8$), interactive tutorial ($n = 7$), interview ($n = 3$), introductory journal article ($n = 16$), lectures ($n = 4$), personal narrative ($n = 2$), portraits ($n = 10$), published erratum ($n = 1$), observational study ($n = 1$), overall ($n = 1$), patient education handout ($n = 9$), practice guidelines ($n = 5$), retraction of publication ($n = 1$), reports ($n = 2$), video-audio media ($n = 8$), and webcasts ($n = 1$).

remained unindexed: medicine, 42 articles (6.3%); pharmacy, 31 articles (4.0%); nursing, 2 articles (0.4%). All articles remaining unindexed in the pharmacy and nursing journals were classified as "journal articles" within PubMed. For the 1818 articles indexed, the time-to-indexing was 185 ± 96 days for medicine journals, 163 ± 58 days for pharmacy journals, and 234 ± 107 days for nursing ($F = 97$, $P < 0.001$) (Table 3).

Discussion

This study found significant delay between when many articles were available in PubMed and when they were indexed with MeSH terms. Differences were also identified between journals of varying impact factors, areas of focus, and health care discipline. While all of the comparisons were statistically significant due to the large number of articles reviewed, outside of impact factor where higher impact factor seemed corresponded with a faster time to indexing, study results did not identify a clear factor(s) that seemed to drive time-to-indexing.

Prior to selecting the included journals, the authors contacted the NLM to inquire about characteristics that might impact time-to-indexing. The response simply stated that they "… indexed 734,052 citations from 5640 journals in 2013. Unfortunately, the number of articles published online has exploded over recent years, and with governmental budget cuts plus government shutdown, we have less people and time to process them." As a result, other than the top medical journals represented by high impact factors, there may not be a formal process for prioritizing articles for indexing with MeSH terms.

To our knowledge, this is the first study evaluating the time-to-indexing across a variety of biomedical journals. There is some information in the pharmacy literature. One study looked at the same 3 pharmacy journals, but a different publication range (January 1, 2010–December 31, 2011) and reported a delay of 114 days (interquartile range, 98–141 days).[16] A second study looked at articles published between 2008 and 2012 across ten pharmacy journals and reported a delay of 134 ± 90 days.[17] The present analysis reports a longer delay of 163 ± 58 days. Since the articles included in this study were more recent, results could be consistent with information received from NLM citing a decreased staff alongside increased workload.

Regardless of whether journal characteristics exist that impact the time-to-indexing, this delay is problematic for clinicians and researchers. The ability to fully implement the Pharmacists' Patient Care Process requires use of evidence-based practice necessitating pharmacists to be able to identify relevant and current high-quality evidence. Since many pharmacists are trained to search with MeSH terms, if they are unaware of this delay, then they could unknowingly miss newly published information related to medications, treatment options, and recommendations resulting in suboptimal patient care. Delays in assigning MeSH terms for upwards of 6 months indicate that practitioners may need to search using keywords in addition to MeSH terms to ensure all pertinent literature is identified.

For researchers, the delay in or, in some instances, the lack of MeSH indexing could impact retrieval and decrease the likelihood of citation. Bibliometric parameters and indexes have been one strategy employed to document research achievement. It has been suggested that these metrics could be used by universities in promotion and tenure standards or by funding entities to measure research success.[19] Therefore, authors who wish to have their information most easily retrievable by MeSH terms might consider this delay when selecting a target journal and/or consider other platforms to highlight work.

Study limitations

While these results could impact the use of PubMed, this research is limited in that it only included a small number of biomedical journals searchable through PubMed with entries over a one year timeframe. While journals were selected for inclusion using the ISI Web of Knowledge with website review rather than author familiarity, selection bias could exist. The study also did not evaluate any differences between publication types. However, existing research in the pharmacy literature has suggested that time-to-indexing did not vary between publication types[16] and authors anecdotally noted the majority of indexing occurred by journal issue.

Conclusion

This analysis of 18 biomedical journals showed a significant delay between when many articles were available in PubMed and subsequently indexed with MeSH terms. Future research should focus on determining those journal characteristics, achieving clarification from the NLM regarding the indexing process, and assessing any impact of this delay on clinical practice.

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