

Characterization of published errors in high-impact oncology journals

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ABSTRACT

Purpose

To assess the frequency and propagation rate of published errors in the oncology literature and to determine possible contributing factors.

Methods

We reviewed 10 major oncology journals to determine variability in the online presentation of errata. Canadian oncologists were surveyed regarding characteristics that may influence error propagation. Errors published during 2004–2007 in the *Journal of Clinical Oncology* (JCO) and the *Journal of the National Cancer Institute* (JNCI) were classified as trivial or serious (that is, whether change in outcome was involved). The frequency of citation and error propagation was determined for serious errors.

Results

Of the 10 journals reviewed, 9 present links from the original article to the erratum; in 4 of those 9 journals, at least 1 link was missing. Survey results indicate that 33% of oncologists do not read errata, and 45% have read only the abstract when referencing an article. Although 59% of oncologists have noticed errors in cancer publications, only 13% reported the error. Together, JCO and JNCI published 190 errata, for an error rate of 4% ± 1% (standard deviation) annually; 26 of 190 errors were serious (14%). The median time from publication of the article to the corresponding erratum was 3.5 months for trivial errors as compared with 8.3 months for serious errors ($p = 0.03$). Error propagation in citations before and after publication of the erratum was 15% and 2% respectively ($p < 0.01$).

Conclusions

Error rates in high-impact oncology journals average 4%, which is likely an underestimate, because errors noticed by readers are not consistently reported. Propagation of serious errors decreases, but still continues, after publication of errata.

KEY WORDS

Health care quality, access, and evaluation; information dissemination; quality assurance

1. INTRODUCTION

The publication of scholarly articles is an essential component of scientific inquiry, and it occurs at a staggering rate. In 2008, MEDLINE alone added 600,000 citations [1]. However, increased publication rates are accompanied by an increased potential for error, and unintentional dissemination of errors may have ramifications for patient care (such as incorrect drug dosing, or dissemination of incorrect survival, toxicity, or response information), particularly in oncology, in which much clinical practice is evidence-based.

There is a paucity of literature investigating the frequency, notification, and propagation of published errors (also known as errata, corrigenda, or corrections). One older study examined errata in health science journals and found that half were trivial in nature, involving text changes, spelling mistakes, mislabelling of figures, or incorrect references [2]. However, 17% of the errata were deemed "crucial," in that they consisted of incorrect drug doses or incorrect formulas. A more recent study by Royle and Waugh estimated that 5% of published errors in randomized controlled trials had the potential to affect the conclusions of a meta-analysis or systematic review [3].

Notifying readers of errata once they are published is important to mitigate error propagation. Currently, MEDLINE cites every erratum and links the erratum to the original article [4]. Error presentation within journal Web sites is not standardized, however. A study of physical science journals discovered significant disparities in how online journals link original articles to their corresponding errata, and vice versa [5]. Even after retraction of an article for the most serious errors

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(or fraud), authors will continue to cite the retracted article as a valid scientific work [6].

The advent of online journals and hypertext links has made it easier for publishers to notify readers of errata. We investigated variability in the presentation of online errata in major oncology journals. Canadian medical oncologists were surveyed to qualify how reader or author characteristics influence error propagation. Furthermore, we investigated the frequency, seriousness, and propagation of errata in two high-impact oncology journals: the *Journal of Clinical Oncology* (JCO) and the *Journal of the National Cancer Institute* (JNCI).

2. METHODS

2.1 Examination of Online Presentation of Errata

Based on impact factor and publication of clinical trials, we selected 10 oncology journals from *Journal Citation Reports,* 2008: JCO, JNCI, *Lancet Oncology, Blood, Leukemia, Oncologist, Clinical Cancer Research, Cancer, Breast Cancer Research and Treatment,* and *Annals of Oncology*. For JCO and JNCI, all errata published during 2004–2007 were reviewed; for the remaining journals, 3 errata published within the past 7 years were identified at random. For each erratum, the original article was identified and reviewed to determine if the online version had been corrected and if a link to the erratum was present.

2.2 Survey

Canadian medical oncologists were surveyed for readership of JCO and JNCI, attention to errata in those journals, and personal experience with publication of papers, authorship, and errors. The survey (Table I) was conducted in two phases: by e-mail and then by regular mail. The study was approved by our local research ethics board.

2.3 Characterization of Errata

All errata published within JCO and JNCI during 2004–2007 were reviewed manually by 2 authors (AM, MMV). The corresponding original articles were analyzed and these data were abstracted: date of publication, number of authors, author nationality, industry sponsorship, and type of publication. The total number of articles published in JCO and JNCI during 2004–2007 was ascertained from *Science Citation Index* (SCI) and stratified by year and type (original research article, including conference-related papers; letter; editorial material; review; or correction). PubMed was used to determine the total number of randomized controlled trials published in each journal annually. The annual published error rate was calculated by dividing the number of published corrections for that year by the sum of original research articles, letters, and reviews for that year (editorial material was included in the denominator for JCO, but excluded from the denominator for JNCI because the editorial material count was greatly skewed by one-paragraph news summaries). A similar calculation was performed for randomized controlled trials. For each erratum, these data were recorded: date of publication, number of errors listed in the erratum, location or locations of those errors in the original article, and type of error. Each erratum was assigned to one of 7 possible categories:

- Simple typographical errors (spelling, grammar, mislabelling, abbreviations)
- Transposition (a more serious typographical error in which data or labels were correct but switched between 2 groups)
- Dosage error (dose value or unit of measurement)
- Author error (author spelling, order of authors, affiliations of authors, author disclosures)
- Reference error (incorrect citation)
- Outcome error (results were changed as a result of an error in methodology, or results from other studies were misquoted or misinterpreted)
- Other

After reviewing all published errata manually, we classified them as minor or serious. Serious errors were those which met one or more of these criteria:

- Outcome data was affected by the error to the extent that some conclusion of the article changed (for example, the error had an effect on statistical significance or major result).
- Outcome data was affected by the error (either methodologic or typographical), and the error was in a prominent location (abstract, for instance) such that final conclusions could be misquoted or misinterpreted by reader.
- Dosage errors appeared in prominent locations (for example, abstract, repeated throughout text).
- The article was retracted.

Minor errors included all errors not classified as serious.

2.4 Propagation of Serious Errors

We used SCI to identify all citations to publications that contained serious errors, from the date of original publication to December 2008. Each citation was then checked manually to determine whether the error was propagated. We noted whether the citations were published before or after publication of the erratum. For citations that numbered more than 150 for any given article, we randomly picked a 5% sample for manual inspection.

TABLE I The survey

1.	In which format do you read the *Journal of Clinical Oncology*?				
	Print only	Print and online version	Online version only	Neither	
2.	In which format do you read the *Journal of the National Cancer Institute*?				
	Print only	Print and online version	Online version only	Neither	
3.	Do you read the erratum section in each edition of JCO/JNCI?				
	Never	<25% of the time	25 to 50% of the time	50 to 75% of the time	>75% of the time
4.	How many publications have you co-authored? If you answer "0," please proceed to question 8.				
	0	1–10	11–20	21–50	>50
5.	Have you ever cited an article after only reading the abstract?				
	Yes	No			
6.	Have you ever reported an error in an article you have written? If your answer is "no" please proceed to question 8.				
	Yes	No			
7.	If your answer to the above question is "yes," who noticed the error in the article?				
	You	Co-author	Reader	Other (please specify)	
8.	Have you ever noticed an error in a published article (not your own)? If your answer is "no," please proceed to question 10.				
	Yes	No			
9.	If your answer to the above question is "yes," did you report the error to the publishing journal?				
	Yes	No			
10.	Are you a reviewer for a journal? If your answer is "no," you are finished!				
	Yes	No			
11.	How often do you notice errors in the articles you are reviewing?				
	Examples of errors include incorrect references, incorrect labelling of figures/tables, data reported incorrectly. Please exclude systemic problems in methodology and general problems with formatting.				
	Never	Less than 5% of articles	5–10% of articles	10–15% of articles	Greater than 16% of articles
	Any comments regarding the types of errors you see?				

2.4 Statistical Analysis

The statistics were analyzed in Microsoft Excel (Microsoft Corporation, Redmond, WA, U.S.A.), using the chi-square test to compare proportions and the *t*-test to compare continuous variables.

3. RESULTS

3.1 Presentation of Errata

Table II shows the variability in online presentation of errata. In 9 of the 10 journals reviewed, a link from the original article to the erratum was present; most journals placed the link in the sidebar. The missing link rate was 3% (5/155) for JCO; no omissions were detected for JNCI. For the remaining journals, only 3 errata per journal were reviewed, and missing links were discovered in 3 additional journals. Of the 10 journals reviewed, 3 either corrected the online version of the article or added the errata as an addendum on the downloaded Portable Document Format (Adobe Systems, San Jose, CA, U.S.A.) version of the original article; 7 provided complimentary access to errata to some degree; and 6 will alert a reader if a correction is posted.

3.2 Survey of Medical Oncologists

We received 247 survey responses (61 electronic, 177 postal mail) from 387 oncologists, for a response rate of 64%. All respondents indicated that they read

TABLE II Presentation of online errata

Journal	*Article link to erratum*		*Electronic article corrected?*	*Complimentary online access to errata?*	*Optional reader alerts to corrections?*
	Presence	*Location*			
Journal of Clinical Oncology	150/155	Sidebar	Yes	Yes	Yes
Journal of the National Cancer Institute	35/35	Sidebar	No	No	Yes
Lancet Oncology	3/3	Sidebar	Yes	No	No
Blood	3/3	Sidebar	Yes	Yes	Yes
Leukemia	1/3	Top	No	Yes	No
Oncologist	0/3	NA	No	No	Yes
Clinical Cancer Research	3/3	Sidebar	No	Yes (if published more than 1 year earlier)	Yes
Cancer	3/3	Top	No	Yes	No
Breast Cancer Research and Treatment	2/3	Bottom	No	Yes	No
Annals of Oncology	2/3	Sidebar	No	Yes (2/3)	Yes

NA = not applicable.

JCO; 70% read JNCI. Most JCO (81%) and JNCI readers (76%) access the journals online. Most respondents (88%) have co-authored at least 1 paper, with 27% co-authoring more than 20 papers. Half the respondents (49%) act as reviewers for a journal.

Most respondents (67%) had read the errata sections of JCO or JNCI at least once, but irregularly (<25% of the time). More than half the respondents (59%) had noticed errors in articles, but only 13% of those that noticed errors reported those errors to the journal.

Of respondents that had co-authored at least 1 paper, 45% had cited an article after reading only the abstract. Few respondents (11%) had reported an error in their own article, and among those that had, the person that noticed the error was equally likely to be the respondent, another co-author, or a reader.

3.3 Characterization of Errata in JCO and JNCI

Between 2004 and 2007, JCO and JNCI published 5118 articles and 190 errata (155 in JCO, 35 in JNCI). Of those 190 errata, 33 were for reports of randomized controlled trials. The annual published error rate was 4% (standard deviation of 1%), with no difference between journals (Figure 1). Similarly, we found an error rate of 5% for reports of randomized controlled trials.

Table III illustrates the types and locations of errors in the 190 published errata. Distinct errors totalled to 231, and because some errors were repeated in more than one section of the text, the 190 errata listed 285 corrections. Most corrections were for simple typographical, author-related, or outcome-related errors.

Among the 190 published errata, 26 corrected serious errors (14%). Errata correcting serious errors were distributed equally between JCO ($n = 20$) and JNCI ($n = 6$, $p = 0.7$). Within those 26 errata, distinct errors totalled to 37, involving 67 corrections to the text. Table IV lists the types and most prominent locations of the 26 errors that we were led to classify as "serious."

Table V compares the characteristics of serious and minor errors. The time to publication from original article to erratum was significantly longer for serious errors than for minor errors (8 months vs. 3 months, $p = 0.04$). The median number of errors corrected was greater for serious than for minor errata (2.5 vs. 1, $p = 0.01$). We observed no significant difference in the number of authors per original article, author nationality, frequency of industry sponsorship, or publication type for serious as compared with minor errata.

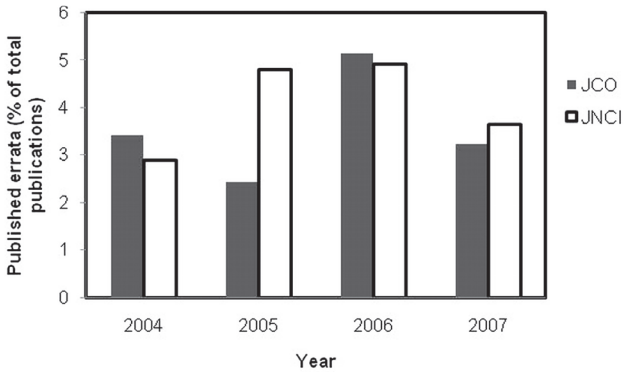


FIGURE 1 *Rates of errata publication in the* Journal of Clinical Oncology *(JCO) and the* Journal of the National Cancer Institute *(JNCI), 2004–2007.*

TABLE III Error type and location of correction for 190 errata

	Outcome	*Typographical*	*Transposition*	*Dosage*	*Author*	*Reference*	*Other*[a]
Abstract	15	2	3	4			
Methods		3	1	4			
Results	15	3	4				
Discussion	10	4		2			
Tables	25	20	7	11		3	
Figures	5	16	11	1		2	2
Author[b]					66		3
Miscellaneous[c]	2	20	2	4		10	5
TOTAL [*n* (%)]	72 (25)	68 (24)	28 (10)	26 (9)	66 (23)	15 (5)	10 (4)

[a] Includes pagination error, retraction of entire article, printing in the wrong color, omitting trademarks.
[b] Includes the author list, affiliations, disclosures, acknowledgments, and contributions.
[c] Includes errors in introduction, title, appendix, references, or text body not fitting under another category (for example, a section of a review or correspondence).

TABLE IV Error type and most prominent location for 26 serious errors

	Outcome	*Transposition*	*Dosage*	*Retraction*
Abstract	8	3	4	
Methods			2	
Results	2			
Discussion	1			
Tables		1		
Figures		1		
Other text[a]	1		1	2

[a] Includes an editorial in which a prominent conclusion was erroneous and retracted, and a guideline in which a drug dose was in error in the text body and 3 tables (all equally prominent). Two articles were retracted completely: one for an error in the underlying science, and the second for forgery of data.

TABLE V Comparison of serious and minor errata

Characteristic	*Errata type*		p *Value*
	Serious (n=26)	*Minor (n=164)*	
Time to erratum publication (months)	8	3	0.04
Median corrections (*n*/article)	2.5	1	0.01
Authors (*n*/article)	11	9	0.3
Author nationality (%)			
North American	73	55	0.3
European	19	16	
International	8	23	
Other	0	5	
Industry sponsorship (%)	15	16	0.8
Publication type (%)			
Phase III	23	16	0.7
Phase I/II	15	13	
Prospective/retrospective analysis	39	29	
Review	12	13	
Other	12	29	

3.4 Propagation of Serious Errors

As of December 1, 2008, the 26 original publications with serious errors had, according to SCI, been cited 1336 times; 256 of those citations were published before publication of the corresponding errata, 1080 afterward (Figure 2). We manually checked 95 citations published before publication of the corresponding errata and 549 citations published after. (We did not check foreign language articles, and 1 publication was cited 484 times, in which case we checked a random sample of 25 citations manually.)

Erroneous data was propagated from 9 of the 26 publications in 24 citations. A significantly higher proportion of serious errors were propagated before the errata publication dates: 14 citations (15% of total checked) were published before the errata publication date, 10 (2%) afterward ($p < 0.01$). Of the 10 citations published after the errata publication date, 3 directly quoted incorrect outcomes data, 3 directly quoted incorrect doses, and 4 made qualifying statements that were no longer correct (the error had altered the conclusions of the original paper). The 10 citations were published between 7 and 38 months after publication of the corresponding errata (median: 18 months, with 2 citations published within a year of publication of the errata).

In addition to the citations that propagated serious errors from the 24 non-retracted publications, we found 14 citations of the 2 retracted articles published after publication of the retraction notice. All but 1 implicitly endorsed the retracted article.

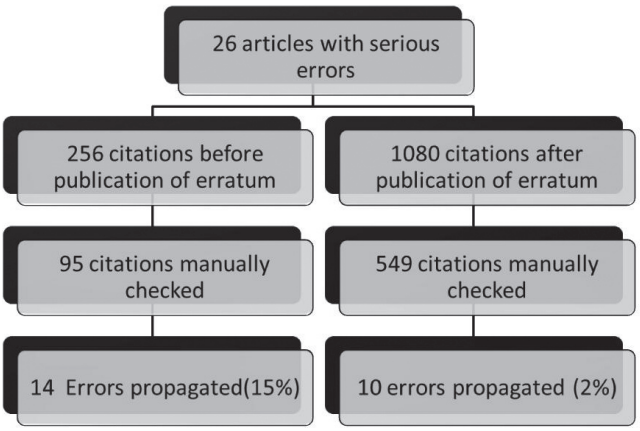


FIGURE 2 Propagation of serious errors.

4. DISCUSSION AND CONCLUSIONS

The present study is the first to assess, in the oncology literature, the frequency of published errata and the possible contributing factors. We found considerable inter-journal variability in the online presentation of errata, consistent with previous findings [5]. Links located in positions other than the sidebar of the Web page were easily overlooked (personal observation). The missing link rate for JCO was small (3%); no missing links were detected for JNCI. Only 3 errata per journal were reviewed for journals other than JCO and JNCI, and so the true frequency of missing links from articles to errata is unknown. However, we were surprised to detect missing links in 3 additional journals. The absence of those links can potentially contribute to error propagation.

Our review of published errata in JCO and JNCI revealed a published error rate of 4%. Higher-impact journals might be expected to have a higher published error rate, given increased readership. Conversely, with a more stringent review process, errors might also be caught sooner—and before publication. Compared with the MEDLINE error citation rate of approximately 1% during 2004–2007, the observed published error rate of 4% is substantially higher [1]. In a review of randomized controlled trials published during 1995–2001 in *BMJ, JAMA,* the *New England Journal of Medicine,* and *Lancet,* the errata rate was 5.6%–8.4%, similar to the present result [3]. Regardless, that rate is most certainly an underestimate of the true error rate, considering that we could not account for unpublished corrections of published errors. Even errors that are noticed may not be corrected, as indicated by our survey, in which respondents overwhelmingly indicated that they do not report errors to the publishing journals. However, our survey did not explore the magnitude of the unreported errors, nor the potential barriers to error reporting.

In our study, the propagation rate of errors in citations before and after publication of errata was 15% and 2% respectively. This finding highlights the potential impact of publication errors in high-profile journals. In addition, 2 articles in our study were retracted; of 14 citations of those articles, 13 endorsed the cited article as valid research. This result is similar to that in a 1998 study in which 280 of 299 citations to retracted articles referenced the retracted article as legitimate [6].

Our study addresses an important question: How can error propagation be prevented? All journals should provide links from articles to errata and also an option to alert readers if a correction is published. Ideally the links should be highly visible and placed consistently in the same location across all journals. Error propagation could be minimized with complimentary access to the online version of errata, placement of the erratum notice at the beginning of the electronic version of an article instead of at the end, and correction of the online version of the article if the error is serious. Error reporting could be facilitated through an anonymous "Report an error" link whenever articles are accessed online.

In addition to publishers, individual authors of scholarly articles should take steps to check whether their own reference lists contain articles with associated errata. A study of 17 serious errata in 2 physics journals showed that few citations (27%) properly referenced the erratum together with the original publication [7]. Checking individual references for errata should be part of a structured literature search strategy during manuscript preparation. Publishers may help by reminding authors of this process in their "Instructions for Authors" statements, and they can provide an example of how to properly cite an article that has a published erratum. Half our survey respondents admitted to citing articles after reading only the abstract; this practice also has the potential to propagate errors. Finally, authors who read only a print copy of the journal (fewer than 20% of our respondents) and who do not read the errata section consistently may never become aware of an error. Publication errors will continue to occur, and early identification, notification, and correction of such errors are the responsibility of authors, journals, and readers so as to try to avoid propagation of serious errors.

5. ACKNOWLEDGMENTS

We thank Dr. Daniel Heng for helpful discussions. Thank you as well to all the medical oncologists who replied to the survey!

6. CONFLICT OF INTEREST DISCLOSURES

This work was supported by a Tom Baker Cancer Centre in-house study grant. The authors have no financial conflicts of interest.

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