
NLM's practices for handling errata and retractions

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The keystone of the scientific method is solid experimental design and reproducible results. The publishing of findings advances knowledge and establishes the basis for further research. In recent years, the foundations of this principle have been shaken as a small, but significant portion of the scientific literature is being flawed by the appearance of fraudulently produced research. Potentially as damaging are errors that result from poor editing and proofreading. Fraudulent articles and errors lead, at best, to misunderstandings and, at worst, to dire consequences in the treatment of patients. Errata and retraction notices are generally carried in the published literature but usually are not linked to the original data. Database producers, such as NLM, have the means to establish this link and to inform users of incorrect information in the source documents as well. This paper reports NLM's experience in bringing published retraction and errata notices to the public's attention and relates this experience to the library's overall interest in quality assurance.

We, unfortunately, live in an environment where no system exists to prevent the publication of fraudulent or erroneous data. In recent years, the National Library of Medicine (NLM) has taken a major role in informing the users of MEDLINE[®]† and *Index Medicus*[®] of published data that has been subsequently revealed as fraudulent and of substantive errors in journals that it indexes. Fewer than 1% of the 316,000 articles indexed in 1988 were retracted or contained error notices. However, the potential impact can be great if inaccurate information forms the basis for subsequent research or for the treatment of patients.

RETRACTIONS

NLM's definition of a retraction is a letter to the editor or an editorial stating that an article previously published was based on fraudulent research, that is, research in which deliberately falsified or unsubstantiated data were used. Fraud in medical research is

not new, but it was not until the famous Darsee affair* in the early 1980s that it began to attract the concern of many scientists. Dr. John Darsee, a researcher at Emory and Harvard Universities, admitted that he systematically falsified data in several experiments after inconsistencies in his data were detected by his lab chief. NLM became aware during the Darsee affair that, as the compiler of the largest biomedical database, it could be the unwitting conduit for disseminating incorrect information.

In 1984 the library implemented a policy for identifying and indexing published retractions. It was realized that the online database provided an opportunity to link the retracting article to the original article; no indexing system had previously attempted to do this. Although some suggested that the library remove the citation to the retracted article from the database, NLM felt this action might tend to affect historical perspective and opted instead for the linking of past and present events.

† MEDLINE and *Index Medicus* are registered trademarks of National Library of Medicine.

* The early reports of Dr. John Darsee's fraudulent research are found in: *N Engl J Med* 1983 Jun 9;308(23):1400 and *Ann Intern Med* 1983 Aug;99(2):275-6.

Figure 1
Retracting articles

• **RETRACTION OF TWO ARTICLES**

We would like to publish the following statement of retraction: An investigation by the UCSD School of Medicine has found that the conclusions of the following papers were not substantiated by valid experiments and analysis.

The listed co-authors (M. Murray, W.W. Peck) share none of the responsibility and, in fact, deny knowledge that the experiments were performed and that their names would be used on the papers.

RA Slutsky, M Murray. Computed tomographic analysis of the effects of hyperosmolar mannitol and methylprednisolone on myocardial infarct size. *JACC* 5:273-9, February 1985.

RA Slutsky, WW Peck. Effects of beta-adrenergic blockade on the natural progression of myocardial infarct size and compensatory hypertrophy. *JACC* 5:1132-7, May 1985.

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Professor and Chairman
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Not long after, a retraction was submitted by Robert Petersdorf, dean of the School of Medicine, and George Leopold, chairman of the Department of Radiology at the University of California, San Diego, retracting two articles by Robert Slutsky, who was senior author of these papers (Figure 1). The retraction was occasioned by the inability to substantiate the papers' conclusions.

In a retracted citation in MEDLINE (Figure 2), the original title is amended by a statement identifying the retracting paper, in this case written by Petersdorf and Leopold, in the December 1985 issue of the *Journal of the American College of Cardiology*. Whenever this reference is retrieved, the evidence that it has been retracted and the location of the retraction can be seen immediately.

The retracting article is also indexed (Figure 3). The title field is amended with the reference to the original journal articles it retracts. In addition, the retracting article is indexed with the subject heading (MeSH) RETRACTION OF PUBLICATION. Both the retracted and the retracting articles are linked, and through the RETRACTION OF PUBLICATION heading, one can locate all references to retracted articles in the database. For the 1989 MeSH, NLM has added a heading for RETRACTED PUBLICATION to be appended to all citations to retracted articles. Through

Figure 2
Retracted citation

AU - Slutsky RA
AU - Murray M
TI - Computed tomographic analysis of the effects of hyperosmolar mannitol and methylprednisolone on myocardial infarct size. [Retracted by Petersdorf RG, Leopold GR. In: *J Am Coll Cardiol* 1985 Dec;6(6):1440] ←
SO - *J Am Coll Cardiol* 1985 Feb;5(2 Pt 1):273-9

October 1988, only seventy retractions have appeared in MEDLINE; a small number, but potentially a concern when one realizes that the database is accessed millions of times each year.

The retraction policy has worked well, and clearly labeled retractions are identified by NLM indexers. Yet, there are occasions when publishers or editors cannot, for various reasons, label something a retraction. In fact, some journals have a policy of *not* issuing retractions. In 1982 the editor of the *Journal of Clinical Investigation* wrote, "Suggestions that journals take a greater role in ensuring against publication of false data are impractical. We are the JCI, not the FBI" [1]. His concern was that coauthors can be unfairly implicated or that other works by the retracted author can be determined fraudulent by association. The threat of legal action is clearly behind these decisions not to issue a retraction.

Another gray area occurs when the article uses a label such as "questionable" data instead of fraudulent or falsified data. The *American Journal of Cardiology* published the following letter from its editor, which refers to a lengthy report about articles by Robert Slutsky: "The Committee classified papers as valid, questionable, or demonstrably fraudulent. The conclusions of the following papers could not be shown to be supported by verifiable original experiments and analyses, and were therefore considered questionable" [2]. NLM did not consider these statements to be retractions and called the editor, who confirmed that the journal did not consider them retractions either.

A final example of a difficult-to-handle situation involved Stephen Breuning, a grantee of the National Institute of Mental Health (NIMH), whom an NIMH investigating panel found "repeatedly and over a long period of time engaged in serious scientific misconduct" [3]. Dr. Breuning was debarred from receiving federal grant support for ten years, and in 1988 was

Figure 3
Retracting citation

AU - Petersdorf RG
 AU - Leopold GR
 TI - Retraction of two articles: Myocardial infarct size [letter] [Retraction of Slutsky RA, ← Murray M. In: J Am Coll Cardiol 1985 Feb; 5(2 Pt 1):273-9 and Slutsky RA, Peck WW. In: J Am Coll Cardiol 1985 May;5(5):1132-7]
 LA - Eng
 MH - *Retraction of Publication ←
 SO - J Am Coll Cardiol 1985 Dec;6(6):1440

indicted on criminal charges of falsifying research. NIMH reported in its own journal that several Breuning articles contained "serious reporting irregularities" or were "seriously flawed" [4]. Yet, there was no published retraction by Breuning, his laboratory, or the journal editors; therefore, the citations remain in MEDLINE with no statement of retraction.

COMMENTS

The library hopes to alleviate this situation soon by alerting users of MEDLINE to the existence of comments on a previous article. A comment may criticize the referent article, question its findings, supplement it with additional data, or use it as the starting point for a discussion of the commenting author's own research or opinion.

Most comments are usually published in the form of letters and are often followed by a response from the author of the referent article. However, valuable comments also appear in the form of an editorial that introduces an article printed elsewhere in the journal issue. NLM introduced the linking of comments to

Figure 4
Erratum notice

• **ERRATUM:** Oral rehydration

To the Editor:

The article by Tamer et al contains two typographic errors in the abstract. The glucose concentration in solution A as reported in the body of the article is 2 gm/dL or 2%, not 2 mg/dL as noted in the abstract. In addition, the glucose concentration of solution is 3 gm/dL or 3%, not 3mg/dL.

Figure 5
Corrected citation and abstract

AU - Tamer AM
 AU - Friedman LB
 AU - Maxwell SR
 AU - Cynamon HA
 AU - Perez HN
 AU - Cleveland WW
 TI - Oral rehydration of infants in a large urban U.S. medical center [published erratum appears in ← J Pediatr 1986 Jan;108(1):160]
 SO - J Pediatr 1985 Jul;107(1):14-9

CORRECTED ABSTRACT ONLINE

A prospective randomized study of . . . 30mEq/L bicarbonate, 2 gm/dL [corrected] was given . . . ←

the originally indexed article beginning with the indexing of 1989 publications.

ERRATA

Another source of inaccurate information in journal literature is errata, defined as significant errors in the text, abstract, or descriptive part of an article. Errata do not include small imprecisions or typographic errors of little consequence. Still, indexers find as many as 200 substantive errata each month. NLM, under the aegis of its quality assurance program, began citing published errata in 1987. Even though no deliberate misrepresentation of results is at issue, the library believes it has the responsibility to notify its users of errors in the articles and to make corrections where possible. One basic question that arose in developing the errata policy was how far NLM should go in changing published data. It was decided that errors in the descriptive portion of the citation, such as the author, title, and the abstract, would be cor-

Figure 6
Correction to descriptive portion of citation

AU - Wallin H
 AU - Jeffrey AM
 AU - Santella RM
 AU - Jeffre AM [corrected to Jeffrey AM] ←
 TI - Investigation of benzo[a]pyrene-globin adducts [published erratum appears in Cancer Lett 1987 Oct 30;37(2):237] ←
 SO - Cancer Lett 1987 May;35(2):139-146

Figure 7
Correction of dosage error in abstract

Correction of Dosage, Measurement, etc.
without Erratum note:

Original Abstract

After primary surgery, 125 patients with epithelial ovarian cancer. . . were randomly allocated to receive PC (cisplatin 50 mg/m² + cyclophosphamide 600 mg/m² every day ← for 28 days) or PAC (PC+doxorubicin 45 mg/m²).

rected so long as the indication of the change to the online record was made evident to the users.

Figure 4 shows part of the text of a letter published in a journal issue calling attention to an error of dosage that appeared in the abstract that NLM made available in MEDLINE [5]. In this instance, NLM updated the original citation, noting that a published erratum appears in a particular issue of the *Journal of Pediatrics* (Figure 5) [6]. Since a dosage error also appeared in the abstract, the "2 mg" figure was corrected to "2 gm," and the changed text was noted for users.

When an error occurs in the descriptive portion of the text, NLM augments the title (Figure 6) with information about the issue of the journal in which the erratum notice was published [7]. In this case, an author's name was originally published as "JEFFRE" without the "Y." NLM adds the author entry "JEFFREY" but leaves "JEFFRE" without the "Y" in the record for those users who might have seen the original article miscited.

NLM policy states that only citable errata be acknowledged. The notice must be labeled clearly and printed on a numbered page of the journal. Loose

Figure 8
Discrepancy between text and abstract

Original text

Treatment Plan

Patients received CDDP 50 mg/m² + cyclophosphamide 600 mg/m² (PC) or PAC (PC+doxorubicin 45 mg/m² on day 1 ← every 28 days).

Correction to abstract after conversation with journal editor

(. . . on day 1 every 28 days) [correction to ← be published] or PAC (PC+doxorubicin 45 mg/m²).

Figure 9
Erratum notice

• ERRATUM

The following are errata for the article, "Improved Local Control of Thoracic Disease in a Small Cell Lung Cancer With Higher Dose Thoracic Irradiation and Cyclic Chemotherapy," *Int. J. Radiation Oncol. Biol. Phys.*, 13:993-998. 1987.

Throughout the text, doses of 3000 Gy and 6000 Gy were listed as total doses for treatment of thoracic disease in small cell lung cancer. Treatment to either 3000 Gy or 6000 Gy to any area of the body is not compatible with survival. Total treatment doses of 3000 cGy and 6000 cGy were used and the listing of 3000 Gy and 6000 Gy was an error in conversion of rads to Gray or centiGray.

sheets, letters, or phone calls to NLM are considered unacceptable. However, exceptions to this policy can be made when the error could have serious consequences. These types of errors, luckily, occur no more often than two or three times a month.

In an article discussing a particular drug treatment for cancer, the author's abstract stated the dosage was to be given *every day* for twenty-eight days (Figure 7). The text, however, described administering the drug *once* every twenty-eight days (Figure 8) [8]. This discrepancy was noticed by an NLM indexer. A call to the editor of the journal confirmed that the correct regimen was stated in the text. The abstract was corrected, and the title field was amended to state that an erratum notice was *to be* published. When the correction notice appeared in a subsequent issue of the journal, the citation was again updated to give notice of the published erratum.

In these worst-case examples, the risk is present, however small, that a course of action based on in-

Figure 10
Original abstract

• ABSTRACT

The penetration of imipenem and cilastatin into the cerebrospinal fluid (CSF) was determined in patients with bacterial meningitis. Four 1000 mg/kg doses of both imipenem and cilastatin were infused intravenously over 20-30 min at 6 h intervals, first between days 2 and 4, and again, whenever possible, between days 11 to 20, in 12 patients with bacterial meningitis undergoing treatment with other antibiotics.

Figure 11
Citation with erratum notice and corrected abstract

AU – Modai J
 AU – Vittecoq D
 AU – Decazes JM
 AU – Meulemans A
 TI – Penetration of imipenem and cilastatin into cerebrospinal fluid of patients with bacterial meningitis [corrected; erratum to be published] ←
 AB – The penetration of imipenem and cilastatin into the cerebrospinal fluid (CSF) was determined in patients with bacterial meningitis. Four 1000 mg doses [correction of 1000 mg/kg doses] of both imipenem and cilastatin were infused intravenously over 20-30 min at 6 h intervals, first between days 2 and 4, and again, whenever possible, between days 11 to 20, in 12 patients with bacterial meningitis undergoing treatment with other antibiotics. . .

correct data will be taken, resulting in potentially life-threatening consequences. For example, in the abstract and text of the article illustrated in Figure 9, radiation treatment doses of 3,000 Gray (i.e., 300,000 RAD) and 6,000 Gray were stipulated when the actual dosage should have been 3,000 centiGray and 6,000 centiGray [9]. Note the erratum notice: "Treatment to either 3,000 Gy or 6,000 Gy to any area of the body is not compatible with survival." This notice was published months after the original article; it is probable that the reference and original article containing the misinformation were read or cited by many people. NLM, of course, corrected its citation in MEDLINE.

Some errors are detected by users of NLM databases. A pharmacist called NLM and related that in his search retrieval, he found the following dosage

Figure 12
Summary of errors corrected

Breakdown of reported Errata by Field:

Field	# Citations		Total Cits.
	1987	1988	
AUTHORS	134	41	175
TITLES	48	22	70
ABSTRACTS	69	29	98
TEXT	1147	295	1442
TABLES	379	91	470
FIGURES	451	95	546
OTHER	28	6	34
TOTAL*	2256	579	2835

*Errata notices for citations often cite multiple errors which are recorded in several fields.

Figure 13
Frequency of errata notices

Journal	No. of Errata
Lancet	68
JAMA	47
J Biol Chem	44
Proc Natl Acad Sci USA	44
Biochim Biophys Res Commun	40
Ann Intern Med	36
Br Med J	34
Biochim Biophys Acta	32
Nature	32
FEBS Lett	29
Science	29
Ned Tijdschr Geneeskd	26
J Bacteriol	24
N Engl J Med	23
Nucleic Acids Res	20
MMWR	18
Biochem J	17
Biochemistry	16
J Clin Microbiol	15

error, which he thought would cause death if followed. The abstract stipulated "four 1,000 mg/kg doses of both imipenem and cilastatin were infused intravenously over twenty to thirty minutes at six-hour intervals (Figure 10)" [10]. However, the methods section of the text called for "four 1,000 mg doses regardless of the body weight of the patient." Since no published erratum existed, NLM contacted the editor and then corrected the citation and its abstract as shown in Figure 11. In cases of such potentially harmful error, NLM immediately notifies all licensees of its data that a serious error has been identified and should be corrected in their records as well.

Published errata notices, like retractions, are infrequent. In 1987 NLM added correction notices to 0.8% of the MEDLINE records. Figure 12 gives a summary of the types of errors published from January 1987 through March 1988. The journals that included fifteen or more erratum notices in this time period are displayed on the list in Figure 13. The library strongly emphasizes that even though many of the most recognized, substantive journals appear on this list, it in no way reflects negatively on their quality. Actually, it is a positive indication of the journals' diligence in identifying errors for users.

Whether errors of omission, typographic mistakes, statistical carelessness, or deliberate falsification of data, the results are the same—the distribution, transmission, and repetition of inaccurate information. While NLM's policies do not address the root of the problem, the policies do have considerable value in controlling the proliferation of errors.

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FROM THE *BULLETIN* – 50 YEARS AGO

Problems of microphotography

By Mary A. Bennett, Supervisor of the Department of Binding and Photography, and D. H. Litchfield, Supervisor of Periodicals and Microfilms, Columbia University Library

Meanwhile, those of us who are coping with microfilm feel like members of a lost generation. Many of us had passed our apprenticeship in library service, and were settling comfortably into middle age. Abruptly we discovered that our formative years ought to have been spent learning the laws of optics instead of conjugating the optative mood of Greek verbs, and that some knowledge of chemistry would be more useful than any half-dozen foreign languages. Problem number one in microphotography for librarians is: how shall we, basically trained in the humanities, adapt ourselves to a new medium which is the product of the physical sciences? Can a non-scientific library staff make intelligent use of microfilm?

Let us remember that there are two entirely different kinds of work in the field of microphotography; *making* microfilm and *handling* it. Few librarians in the field have an equally minute knowledge of both these branches and their problems.

Bull Med Libr Assoc 1939 Dec;28(2):106