

# Journal retractions in oncology: a bibliometric study

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**Aim:** To investigate secular trends in article retractions in the oncology literature, particularly relating to cancer treatments and data available to patients. **Methods:** A bibliometric analysis of article retractions from PubMed in the period 2000–2018. **Results:** Analysis shows that article lifetime – that is the time period from initial publication to ultimate retraction – has decreased in recent years. It also shows that the retraction rate has also increased over the same period. Furthermore, over 20% of retracted oncology publications analyzed in this study relate to treatment-relevant topics such as clinical trials and studies in the anticancer properties of supplements. **Conclusion:** The causes and context of these trends are discussed and reference made to the dangers of scientific misconduct in oncology.

First draft submitted: 23 April 2019; Accepted for publication: 19 August 2019; Published online: 29 October 2019

**Keywords:** article retractions • oncology retractions • patient information • pseudoscience • science publishing • scientific fraud • scientific misconduct

In recent years there has been an increased focus on the retraction of scientific articles due to scientific misconduct – including cases where authors have been shown to have faked data or doctored images, committed plagiarism or other acts of misconduct. Websites such as RetractionWatch and PubPeer have served to highlight cases of misconduct or to raise expressions of concern leading to further investigations into suspected cases of fraud [1].

There has been a concern that the number of retracted articles has been increasing in recent years [2,3]. This is particularly important in the biomedical field where flawed publications may serve to mislead other scientists, clinicians and patients. Retracted publications are potentially damaging even in cases where there is no ill intent and the retractions are due to errors rather than to misconduct. The concern is particularly strong when such publications may influence patient choices with regards to treatment options. It is notable that two prolific authors of retracted publications, Fazlul H Sarkar and Bharat B Aggarwal, were active in the field of oncology and both focused on alternative cancer treatments [4,5]. In the case of Anil Potti, which was reported in a number of high-impact publications, his use of fraudulent data led to clinical trials that were subsequently abandoned [6]. Articles containing incorrect or fraudulent data pertaining to cancer treatments pose, therefore, a risk to patients in addition to their potentially negative scientific impact.

PubMed is one of the most accessible online resources for patients looking for scientific information, with around a third of searches estimated to be from members of the public [7]. Based on our own experience of supporting cancer patients we are aware that many well-educated and well-informed patients access PubMed, and it is listed as a reputable source of information by organizations such as the American Cancer Society [8]. A recent study showed that well over 50% of cancer patients had accessed information over the internet, and that 90% of searches were about diagnosis and treatment options [9]. Given that significant numbers of cancer patients are known to use complementary and alternative medicine (CAM) [10,11] and that CAM users tend to be well educated [12], understanding the scope of retracted papers in oncology is especially pertinent.

This paper focuses on article retractions listed on PubMed specifically in oncology. In addition to characterizing the landscape of article retractions in this area in recent years, an attempt is made to put this into the context of the growth of the oncology literature over the same period. Second, this article addresses the question of whether the period of time between publication and retraction shows any trend over time. The question of the influence,

in terms of citations, of these articles is also addressed. Finally, this corpus of retracted papers is also analyzed with respect to publications dealing with clinical trials, case reports and articles discussing supplements and other 'alternative' cancer treatments.

## Methodology

A bibliometric analysis of retracted oncology publications from the PubMed database was performed.

### Search criteria

PubMed uses the MeSH term 'Retraction of Publication' (MeSH Unique ID: D016440) to identify publications announcing the retraction of a publication (i.e., retraction notices). A retraction notice is included as an entry in the PubMed database, with similar data fields to a peer-reviewed journal article or other publication.

Retracted articles are identified using the MeSH term 'Retracted Publication' (MeSH Unique ID: D016441). Oncology publications, from all areas of cancer research, including preclinical and clinical studies, were included by using the search terms 'neoplasms'[MeSH Terms] OR 'neoplasms'[All Fields] OR 'cancer'[All Fields]. Two queries were executed, one for retraction notices and one for articles. No restrictions were placed on time period and no other filters were applied, therefore yielding the final search strings of:

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'Retraction of Publication' [Publication Type] and ('neoplasms'[MeSH Terms] OR 'neoplasms'[All Fields]
OR 'cancer'[All Fields])
'Retracted Publication' [Publication Type] and ('neoplasms'[MeSH Terms] OR 'neoplasms'[All Fields]
OR 'cancer'[All Fields])
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### Data processing

Each PubMed retraction notice, denoted by a unique PubMed identifier (PMID), may include one or more PMIDs identifying the original article being retracted. Similarly, retracted articles include the PMID of the associated retraction notice. The two queries therefore yielded a superset of retracted articles and associated retraction notices, with duplicated PMIDs removed. The PMIDs for these retracted articles were therefore extracted and used to create the corpus of retracted articles for further analysis. A subset of this corpus was manually assessed to confirm both the correctness of retraction notice/retracted article pairings, and also to check for oncological relevance.

Relevant fields for each retracted article included PMID, digital object identifier (DOI), PMID of associated retraction notice, article title, abstract, journal, authors and author affiliations. Each record included the date of publication of the article in a journal, the specific date of publication for the article and the date on which the article record was completed in PubMed. The earliest of these three dates was used as the date on which the article became available in the literature. A similar process established the date on which the retraction notice was first made available in the literature. The difference, in days, between the publication date of the retraction notice and the original article was calculated as the 'lifetime' of the original article.

### Citations

Citation counts for each original article were downloaded from Clarivate Web of Science.

### Authors

The list of authors for each retracted article was also extracted and processed to correct for alternative forms (for example with and without middle initial, alternative hyphenation and so on). The cleansed list was then used to generate a list of authors and the count of the number of retracted articles they had authored. Fractional authorship was not calculated, each author was credited a count of one if his or her name appeared as an author of a retracted article.

### Treatment-relevant articles

Articles that might influence cancer patient choices with respect to treatments and/or complementary and alternative medicines were identified using three mechanisms. The MeSH term Publication Type was used to identify all papers with type 'Case Reports' or 'Clinical Trial'. The MeSH qualifier code Q000627 ('therapeutic use') identified all papers related to treatment with drugs or supplements. Finally, a manual survey, by one of the authors (P Pantziarka), of all of the downloaded abstracts was used to identify all papers related to supplements, herbal medicines and traditional folk medicines (e.g., traditional Chinese medicine).

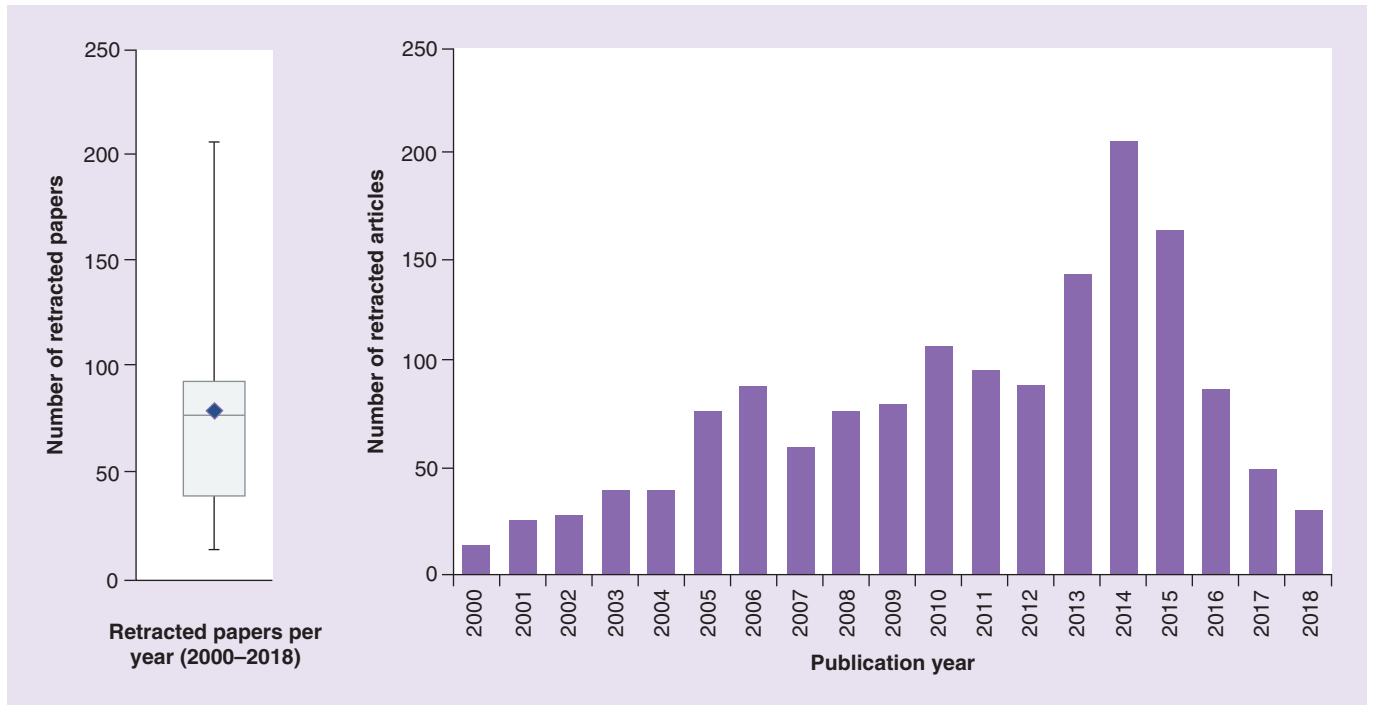


Figure 1. Annual distribution of retracted oncology articles in PubMed 2000–2018.

### Global oncology corpus

In order to place the pattern of oncology retractions in context the PubMed database was searched using the terms: ('neoplasms'[MeSH Terms] OR 'neoplasms'[All Fields] OR 'cancer'[All Fields]). The number of articles per year was downloaded and stored.

## Results

### Retraction notices

A PubMed search of both retraction notices and retracted articles was carried out on 3 June 2019, yielding a total of 1643 unique retraction notices. Of these 54 were *in-situ* retractions, in that the PMID of the original article was also used for the retraction notice. The majority, 1589, had unique PMIDs and listed the PMIDs of the retracted articles separately. There were 193 notices of multiple retractions in which two or more original articles were announced as being retracted. A number of these multiple retraction notices included articles from across different medical disciplines, including non-oncology articles, which were therefore out of scope for this study. In total the PMIDs of 1572 original articles were extracted from the data in the retraction notices.

### Retracted articles

A dataset of 1572 retracted articles was constructed as described in the Methodology. The dataset included retracted articles originally published in the period 1975 (the earliest year with a retracted article) to 2019. The number of articles per year in the period 1975–1999 was sparse, and data for 2019 were incomplete, therefore only data from articles published in 2000–2018, ( $n = 1512$  articles) were used for further analysis. As far as can be ascertained, this is the largest collection of oncological retractions described in the literature to date. The annual distribution of retracted articles is shown in Figure 1.

For the 19 years with retractions the mean number of retracted articles per year was 79.6, the median 78.0, standard deviation 50.0 and interquartile range (IQR) 40.0–93.5.

The article lifetime, defined as the number of days between publication of the original article and publication of the retraction notice is shown in Figure 2.

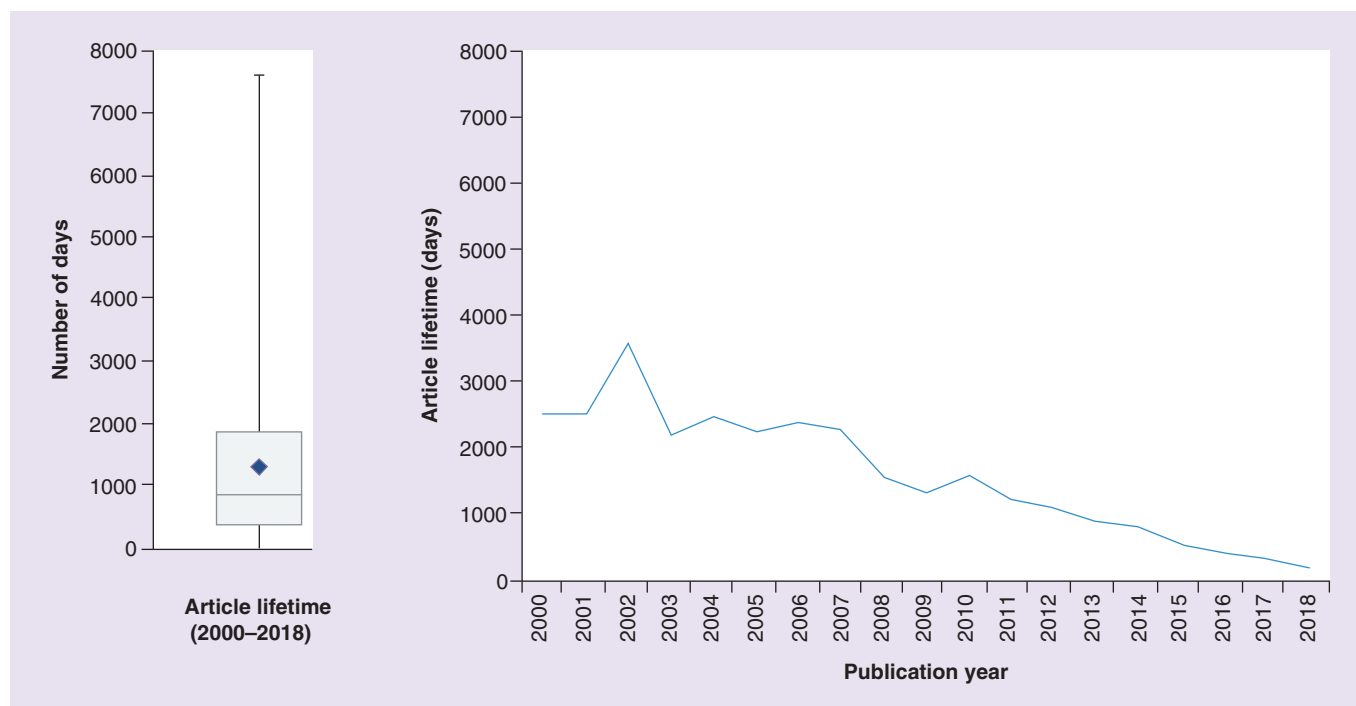


Figure 2. Mean article lifetime of retracted oncology articles in PubMed 2000–2018.

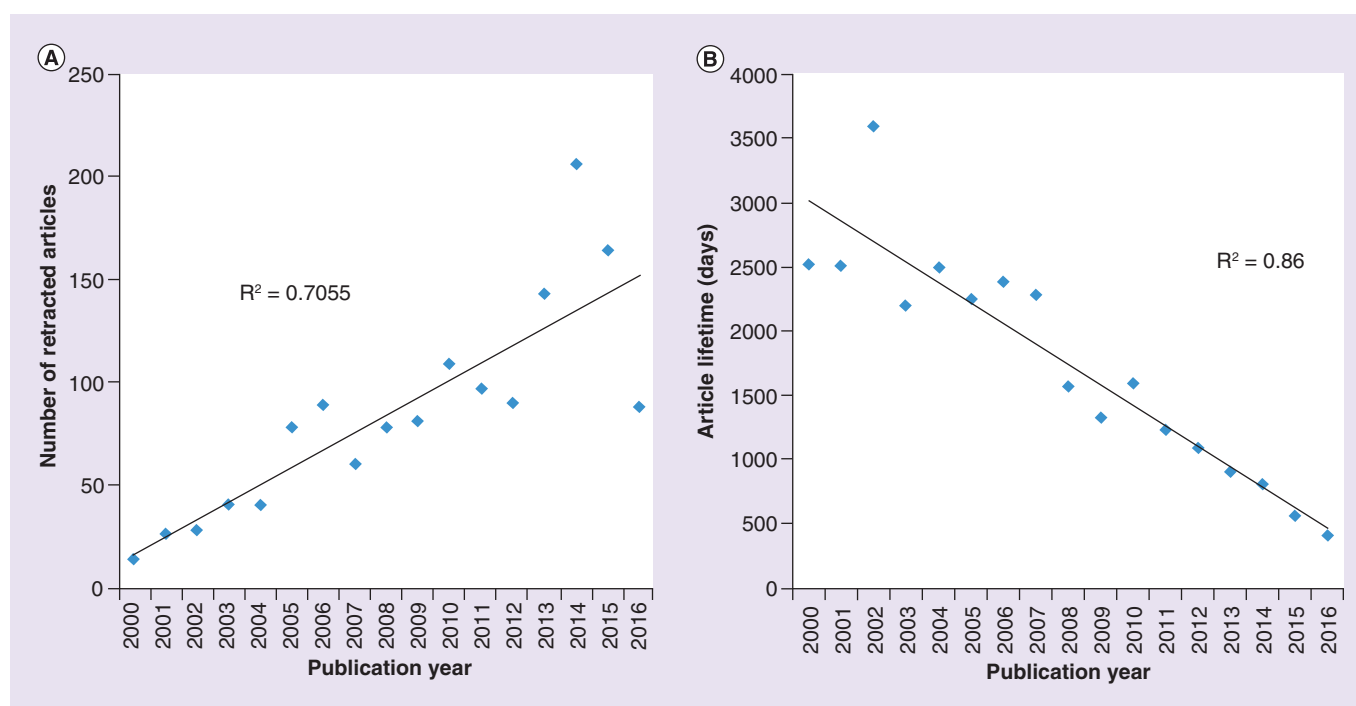
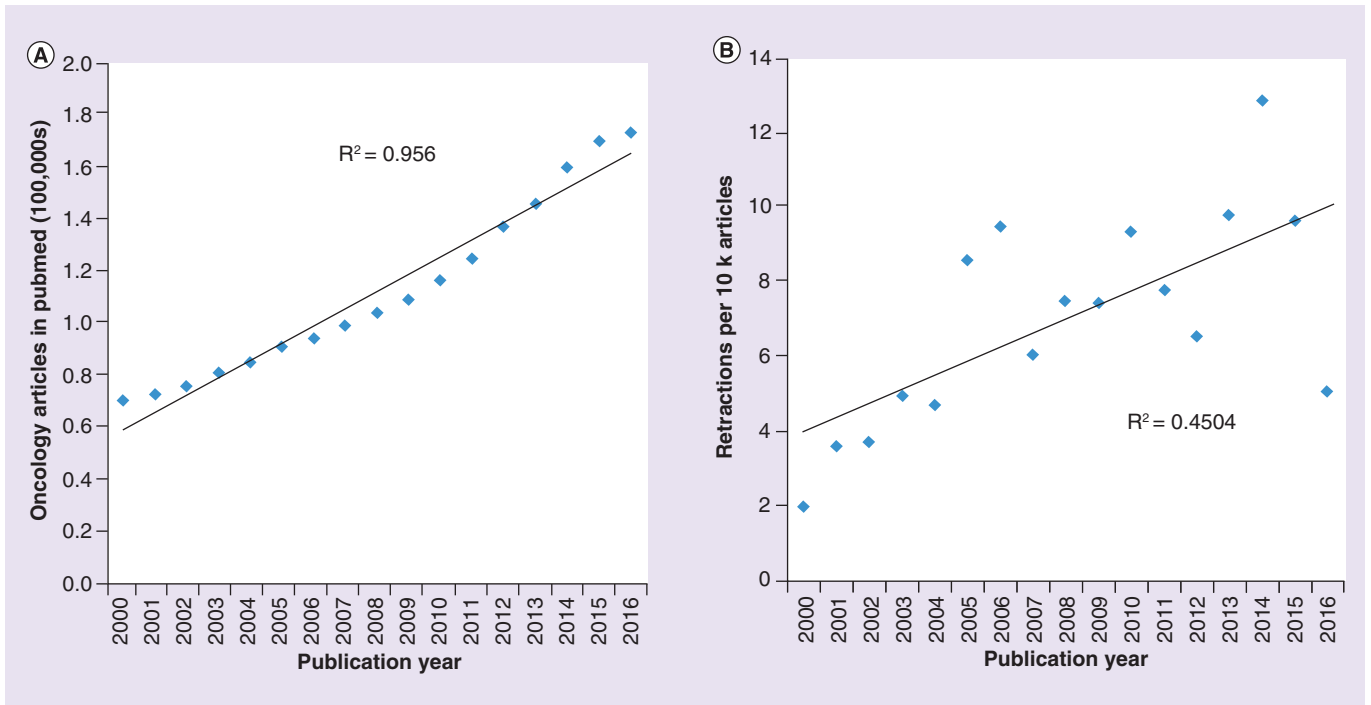


Figure 3. Trends in retracted article counts and article lifetimes 2000–2016.

For the 19 years with retractions the mean lifetime per retracted article per year was 1318 days, the median 870, the standard deviation 1271 and the IQR 1869–381. Given that the length of median article lifetime is over 2 years, we focus on the period 2000–2016 to assess the trends in article count and article lifetime.

Figure 3A shows the mean of the retracted article counts, and Figure 3B shows the associated lifetimes in retracted



**Figure 4. PubMed publications and retractions (2000–2016).** (A) Publication rate of all oncology articles in PubMed (2000–2016). (B) Retracted articles per 10 k oncology articles in PubMed (2000–2016).

oncology articles listed in PubMed for the period 2000–2016. Linear trend lines are also shown.

To place these figures in context [Figure 4A](#) shows the increase in oncology articles in PubMed between 2000 and 2016, exhibiting a very strong linear trend. [Figure 4B](#) shows the number of retractions per 10 k articles over the same period. This suggests that it is not just the absolute number of retractions that has increased, it is also the rate of retractions in the oncology literature as a whole. There is also clearly a negative correlation between the article lifetimes in [Figure 3B](#) and the retraction rate in [Figure 4B](#), a relationship that is statistically significant ( $p = 0.015$ ).

## Authors

In contrast to the downward trend in article lifetime, there is no discernible change in the mean number of authors per retracted paper. [Figure 5](#) shows the distribution of author counts in the entire period, including (in red) the mean.

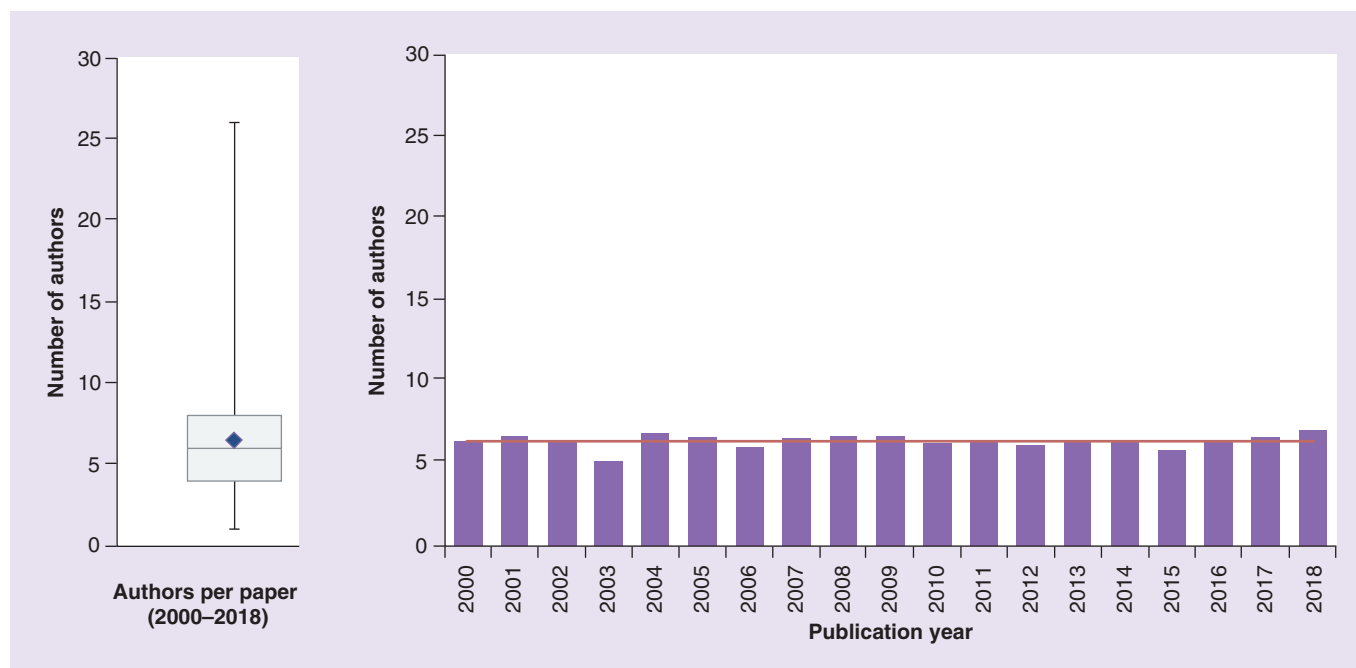
Across the entire period there are 7683 authors, with the vast majority (86%) only authoring one retracted article, and 9% authoring two retracted articles, [Figure 6A](#). The ten most prolific authors have 234 articles between them, with the most three prolific having 41, 34 and 29 retractions each respectively. [Figure 6B](#) shows the distribution of the number of authors per article, showing a peak at five, and also a small number of articles (3%) with large (> 15) author counts.

## Citations

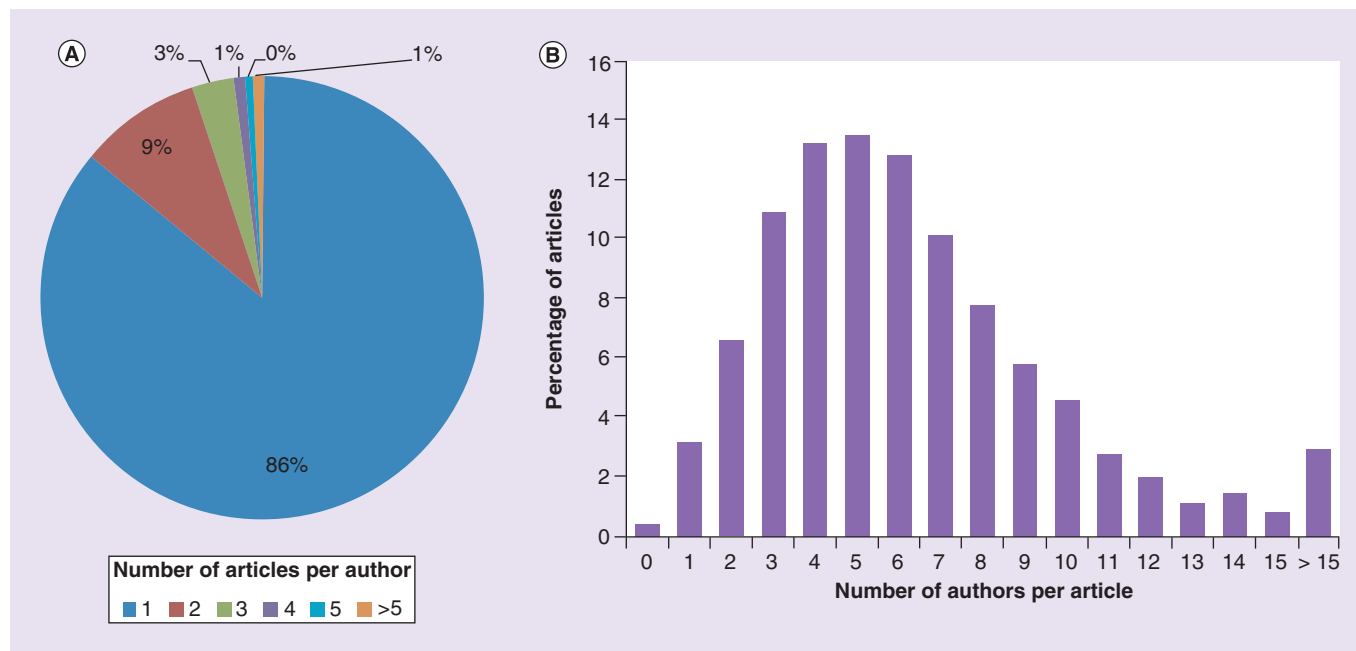
The article citation count is the basis of a number of key bibliometric measures, including the h-index [13]. Web of Science included citation counts for 1356 of the articles in the dataset, only these were included in the analysis. The citation counts of the retractions in this dataset are shown in [Figure 7](#). The mean citation count is 35.1, with a median of 14, IQR of 37.3–6.0 and standard deviation of 67.8. Intuitively one would expect to see a relationship between article lifetime and citation count, and indeed there is a significant relationship between the shorter lifetime and the lower citation rates for the period 2000–2018 ( $p = 5.06E-7$ ), the latter shown in [Figure 8](#).

## Journals

The retracted articles in this corpus appeared in 543 journals over the entire period. As shown in [Figure 9](#) the relationship is skewed. The majority of journals published one or two articles, which were retracted over the entire



**Figure 5.** Number of authors per retracted oncology article in PubMed (1983–2018). In red, the mean of number of authors per paper in the period 2000–2018.



**Figure 6.** Authors (1983–2018). (A) Distribution of number of articles per author (1983–2018). (B) Distribution of author counts per article (1983–2018).

period. However, 9% of journals had published more than five retracted articles. The mean number of retracted articles published per journal over the entire period was 2.9, the median 1.0, IQR 1.0–1.0 and the standard deviation 8.3. One notable characteristic of the journals with the highest numbers of retractions is that they had published some of the authors with the highest number of retractions – and that the serial retractions of these authors contribute strongly to the skewed relationship.

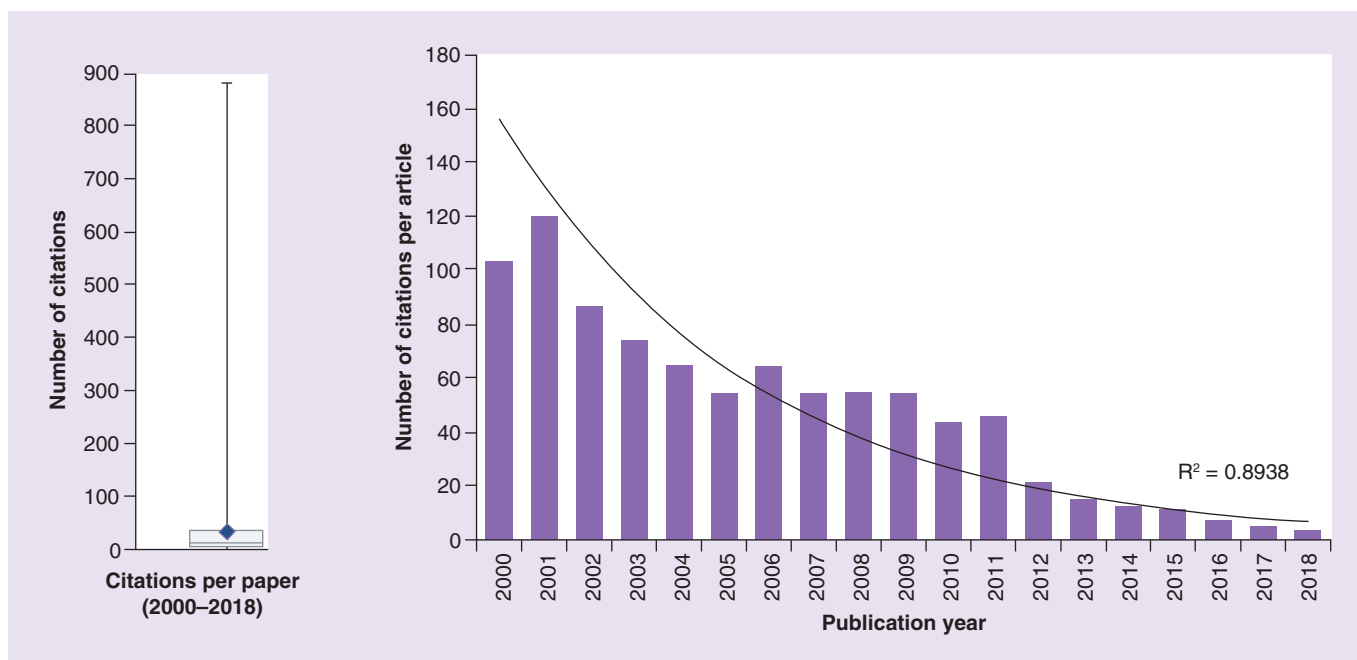


Figure 7. Citations per retracted oncology article in PubMed (2000–2018).

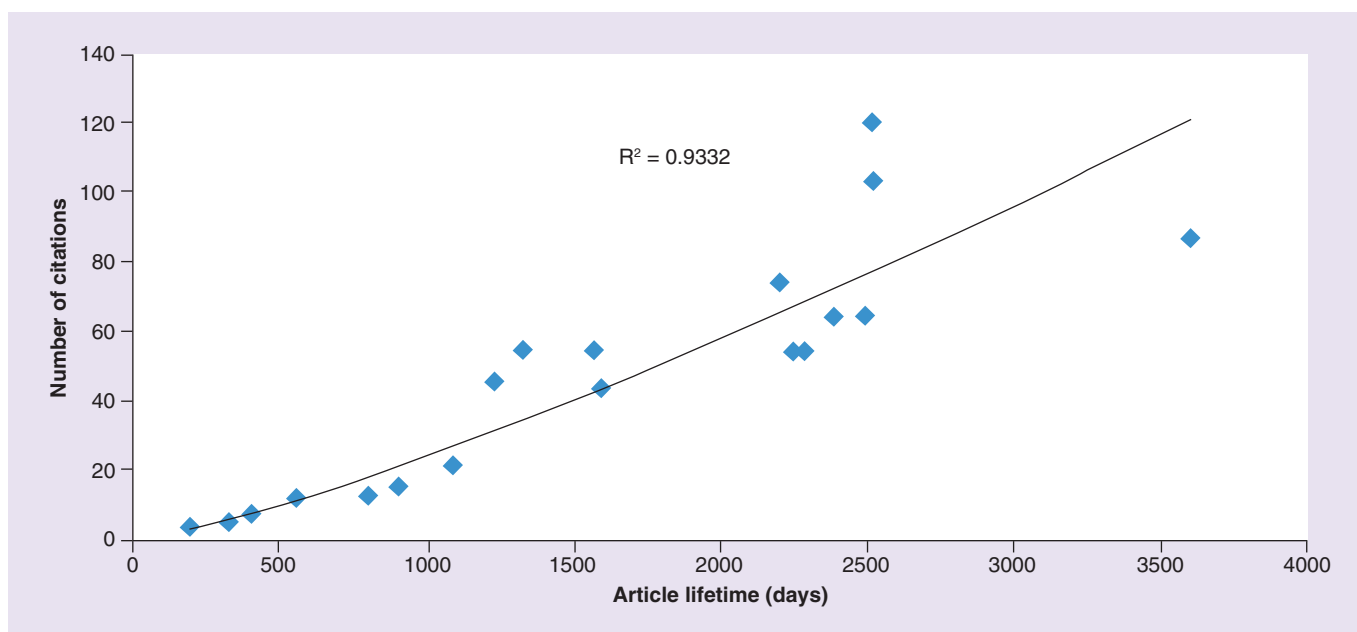


Figure 8. Number of citations versus article lifetime per retracted oncology article in PubMed (2000–2018).

### Treatment-relevant articles

Retracted articles relevant to cancer treatments, including case reports/clinical trials, therapeutic use of drugs or other agents and supplements (including nutraceuticals, herbs and traditional folk medicines) are shown in Figure 10. These three categories are not mutually exclusive and some papers, for example, those describing the therapeutic use of curcumin or genistein, are included twice. However, counting all papers only once shows that over 20% of retracted oncology papers are directly relevant to treatment options in terms of cases, trials or the anticancer properties of supplements, herbs or other nonstandard agents.

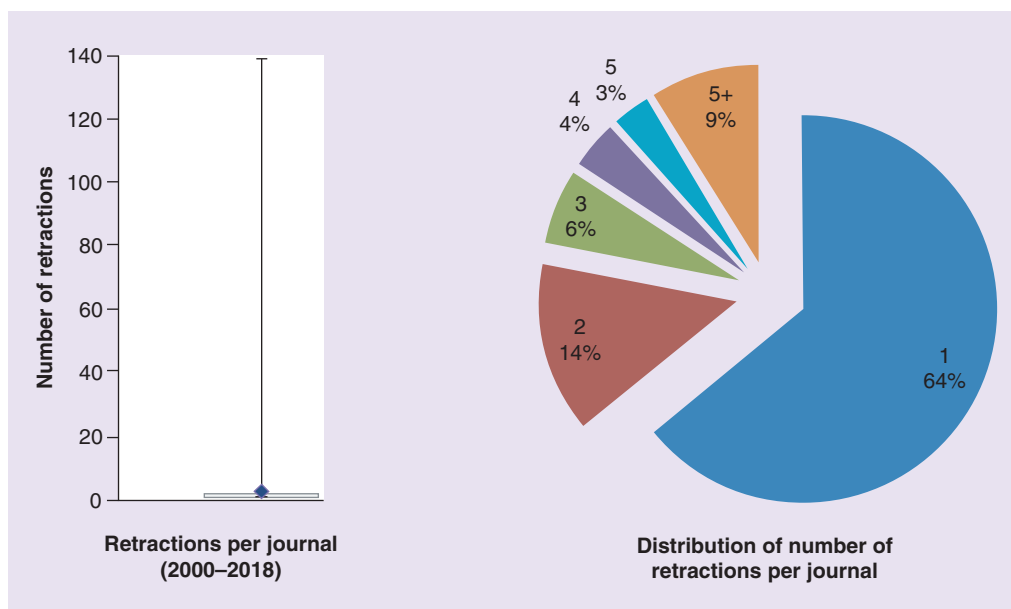


Figure 9. Distribution of retractions by journal, 1983–2018.

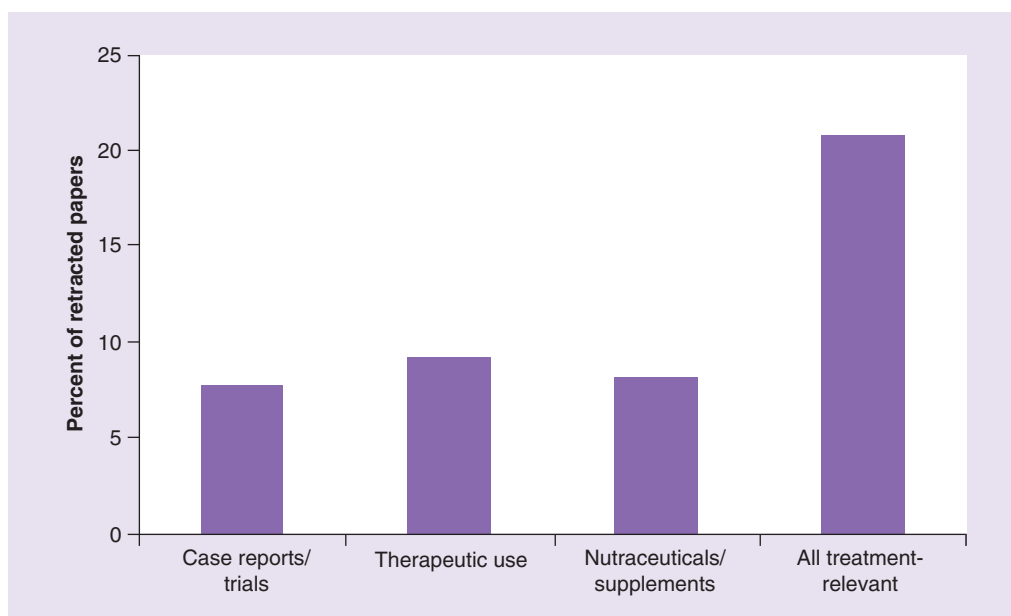


Figure 10. Treatment-related retractions.

In terms of citations, the papers in this treatment-relevant set of papers are no more highly cited than the average for the entire retracted corpus. The PubMed Central (PMC) database is an important repository of full texts that is also available to the general public. In terms of influence on treatment decisions the availability of the full text of an article may be an important factor. Overall 16.6% of the treatment-relevant papers were available on PubMed Central, compared with 38.6% of the entire retracted corpus. Free full texts are also available via journal web pages and other online repositories, in addition to being available for purchase direct from publishers. We note that, in general, retracted papers are clearly indicated as being retracted on journal websites but, regrettably, this is not always true of the downloadable PDF files.



## Discussion

This work has focused on the pattern of retractions in the field of oncology and has not addressed the issue of the causes of these retractions. Fang *et al.* assessed the causes of article retractions in biomedicine and the life sciences and determined that 67.4% of retractions were due to misconduct in one form or another, and only 21.3% due to error [14]. Bozzo *et al.* focused purely on retractions in oncology and determined that research misconduct was the cause of 61% of retractions [15]. Certainly in this work many of the highest scoring authors of retracted papers have been found guilty of research misconduct that has occurred over many years. The serial retractions of the work of these authors can be judged by the skewed distribution shown in Figure 9. It is in the context of this pattern of long-term serial offending that the question of the temporal trends in oncology retractions should be addressed.

The number of retracted articles in oncology has shown an overall annual increase during the period 2000–2018, as shown in Figure 1. For the period 2000–2016, as shown in Figure 3A, there is a strong linear trend representing an average annual growth rate of 26.1%. Over the same period the oncology literature also showed an overall annual increase in the number of publications, as shown in Figure 4A, representing an average annual growth rate of 6.0%. The data show, in Figure 4B, that the number of retractions as a proportion of the oncology literature has also increased. It is a fair assumption, therefore, that the number of retractions is likely to continue its upward trajectory in the near term.

Over the same period there has also been a very clear downward trend in article lifetime, as shown in Figure 2 for the entire period, and in Figure 3B for the period 2000–2016. This is a very positive finding, particularly as it suggests that erroneous or fraudulent articles are being identified in the literature more quickly despite the increases in the number of cancer-related publications. One consequence should be that these retracted articles are identified before they accrue significant numbers of citations. This assumption is supported by the data shown in Figure 7, which shows a decreasing number of citations per retracted article. One may ask whether these articles are highly cited even if the average citation rate is falling. Clearly there are some articles which have high citation rates, for example, Figure 7 shows a clear peak in 2001. A recent study analyzed citation rates in a number of scientific fields in order to assess the relative patterns of citations across different areas of study [16]. For oncology, the most highly cited articles in the period 2010–2014 had a mean of 260 citations. In our dataset only 26/1512 (1.7%) exceeded this value – the most recent of which dated from 2011. For the last 2 years for which we have reasonably complete data, (given the median article lifetime), 2015 and 2016, the highest number of citations was 143 and the mean was 10.2.

While there are clear trends in article counts, retraction rates and article lifetimes there are few clear trends in other areas. The number of authors per retracted article has remained fairly consistent with a median of six, as shown in Figures 5 & 6. In terms of the data on journals, as shown in Figure 9, the vast majority of journals (78%) have published only one or two retracted articles. A number of journals score high in this area primarily because they have published articles by some of the most prolific authors of retracted articles.

One possible explanation for the increasing rate of retractions lies in the ‘many eyes hypothesis’, which posits group size effects that lead to increases in antipredator vigilance among animals – at its most simple it states that as group size increases there are more eyes scanning the environment for predators [17]. A variant of this hypothesis, known as Linus’s Law, has become popular in the field of open-source software development and it is often stated as ‘given enough eyeballs, all bugs are shallow’ [18]. Certainly the growth in the published literature, Figure 4A, may be viewed as indirect evidence of increased group size. We may also view initiatives such as PubPeer and RetractionWatch, including the newly released RetractionWatch database, as mechanisms conducive to increased vigilance on the part of the scientific community.

In a recent analysis by Johnson *et al.* it was shown that refusal of conventional cancer treatment in favor of alternative therapies, for patients with curable cancers, may be associated with an increased risk of death [19]. In line with previous studies, that data showed that users of CAM were more likely to have higher socio-economic status and to be better educated than nonusers. We may speculate that some of these patients are making treatment decisions based on misleading or inaccurate data, some of which may be sourced from scientific publications. It is therefore some cause for concern that our study has identified that over 20% of retracted oncology papers refer to publications relevant to treatment, including clinical trials and the use of supplements with anticancer properties. We also note that many of these treatment-relevant retractions have a higher citation rate than the average for retracted oncology papers.

A very good illustration of the dangers of fraudulent scientific publications is the case of Nobuto Yamamoto and GcMAF, of whom three retracted publications are included in this dataset [20]. These retracted papers were used as foundational texts by sophisticated fraudsters selling fake cures for cancer, autism and HIV [21]. One may note that while the courts have been active in closing down this sophisticated and dangerous operation, a number of papers by the fraudsters have yet to be retracted and remain in the literature despite legitimate concerns about the veracity of the claims made by the authors.

The long article lifetime therefore remains a concern. There are considerable concerns that publishers do not act in a timely fashion in dealing with fraudulent or problematic publications. Long article lifetimes increase the risk that other publications may cite the problematic papers and also increase the risk that cancer patients may use these papers in making important treatment decisions. Journal editors must keep in mind the possible public health impacts of article retractions – particularly in the case of papers relating to supplements, herbal medicines and other alternative treatment modalities.

This work has clear limitations. The use of MeSH terms is sensitive to the accuracy of the entries submitted by the publisher. The use of the MeSH term ‘Retraction of Publication’ yields a smaller dataset than the term ‘Retracted Publication’ but with considerable overlap. Previous studies of retractions in oncology, such as Bozzo *et al.* [15], for broadly similar time periods have yielded few retracted articles – 531 for the period 1995–2015, compared with 1395 for the same period in this study. It is possible that the inclusion of additional databases or the use of expanded search criteria would increase the article counts but it is not clear that it would significantly alter the trends in the period 2000–2018 for which there is good data coverage. The data also show relatively high levels of interyear variability, with high standard deviations for annual article counts and article lifetimes for example. However, outliers in Figures 1 & 2 occur in different years and in sensitivity testing removal of these extreme values did not significantly alter the analysis. But it is also the case that future cases of serial fraud may retrospectively alter these trends as additional articles from prior years are retracted.

Finally, we note that within this dataset there are retraction notices which do not include details of the original publications. The practice of reusing a PMID of the original article for the retraction notice, which we have termed ‘*in-situ* retractions’, makes automated bibliometric analysis difficult.

## Conclusion

The data presented in this paper indicate that the number of retracted articles in oncology is on an upward trajectory, as is the share of retracted articles of the overall oncology literature. However, this increase in retractions is accompanied by a trend of lowered citation rates and lower article lifetimes. This positive trend suggests that the oncology community is becoming more active in identifying suspect articles. Given the potential for harm that arises from erroneous and/or fraudulent articles these positive trends are to be welcomed. Clinical oncologists must remain alert to the dangers posed by misleading information that may be gleaned by patients from retracted publications.

### Summary points

- Article retractions in oncology have been steadily increasing in the period 2000–2018.
- The rate of article retractions in oncology has been higher than the rate of increase of the oncology literature as a whole.
- Article lifetime, the time between article publication and retraction, has decreased over the same period.
- The number of citations per retracted article has decreased – corresponding to the lowered article lifetime.
- The majority (86%) of authors of retracted articles have only authored one retracted article.
- A small subset of authors are serial offenders – the ten most prolific authors have 234 articles between them.
- 20% of retracted articles are related to cancer treatments and may contain misleading information accessible to cancer patients.

### Acknowledgments

An earlier version of this study was previously released as a preprint [22]

### Financial & competing interests disclosure

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

No writing assistance was utilized in the production of this manuscript.

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