Bibliometric Analysis of Radiation Oncology Departmental Scholarly Publication Productivity at Domestic Residency Training Institutions

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Purpose: Corporate scientific activity lies at the heart of the modern academic institution, and yet field-specific estimates of institutional or departmental scholarly productivity are difficult to assess. The authors sought to estimate long-term and current departmental research efforts at residency-sponsoring US radiation oncology departments, using modifications of established bibliometric indices.

Methods: Bibliometric citation database searches were performed for all residency-affiliated academic radiation oncology departments and their component physician radiation oncology faculty members. Metrics based on publication, citation, and the Hirsch index (*h*-index) were calculated, and departments were ranked by departmental productivity from 1996 to 2007, as well as by current mean faculty bibliometric output.

Results: Seventy-eight academic radiation oncology departments and their component 826 radiation oncologist faculty members were analyzed bibliometrically. The average number of publications per department from 1996 to 2007 was 363.8, with a mean of 8,116.0 citations and a mean institutional *h*-index of 37.2. Departments at academic institutions demonstrated a grand mean of 41.0 publications, 709.0 citations, and an *h*-index of 7.6 as of fall 2007. A larger number of physician faculty members (>12) was associated with increased scholarly activity.

Conclusions: The use of quantitative metrics provides departments and researchers with a mechanism to evaluate collective scientific productivity and serves as an impetus for improved performance across the field.

Key Words: Bibliometrics, citations, *h*-index, radiation oncology, residency programs

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INTRODUCTION

The scientific process is at heart a social endeavor [1]. Consequently, the institutional constructs that define academia have developed to provide a specific infrastructure for scientific efforts [2]. Academic or scientific disciplines such as radiation oncology have a distinct scientific culture that determines, corporately, what paradigms or scientific claims are accepted as valid [3]. Academicians themselves are also often able to describe specific institutional or even departmental subcultures of note. Some departments are known anecdotally to be "research powerhouses," whereas others are termed "academic backwaters."

However, the ready quantification of departmental scientific productivity is no mean feat. Academic and scientific efforts could be quantified in a host of ways, including grant award rates, professional reputations, professional society leadership posts, or the academic faculty retention rate of graduates [4-8]. Such data, however, may be difficult to find and are often ambiguous. Consequently, it would be valuable to establish comparative quantitative measures of research scholarly activity. One potential approach is bibliometric analysis, whereby publication-related data are used as a surrogate for broad research activity.

The impetus for this study lies in a recent fourth-year medical student's query: "What are the top productive research radiation oncology departments in the United

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States?" The authors were struck by the fact that although mountains of statistical data and performance metrics were available for their preferred local sports collectives [9,10], minimal data existed for the comparative evaluation of departmental publication productivity in radiation oncology departments, although such data are extant for other specialties [11].

In an effort to quantify the publication productivity of academic training sites, analysis using established bibliometric indices [12] was undertaken to pursue the following specific aims:

- the examination of publication and citation metrics for US residency training programs affiliated with radiation oncology departments, and
- the tabulation and comparison of departmental publication productivity.

METHODS

Departmental and Faculty Inclusion Criteria

Listed radiation oncology departments from the Web site of the Association of Residents in Radiation Oncology [13] were included for analysis. Departmental Web sites were individually accessed to provide a listing of current faculty members (October 29, 2007, to December 10, 2007). Faculty members were included for analysis if listed on institutional Web sites. Only physician-scientists were included individually; basic science or physics faculty members were excluded (eg, faculty members with PhDs or other doctoral degrees only).

Bibliometric Analysis

For each institutional department and faculty member, a custom search was performed using the Scopus bibliographic database (Elsevier BV, Amsterdam, the Netherlands). For each department, a custom search string was created using the advanced search function of the bibliographic database. The bibliographic database includes a composite search string ("AFFIL"), which contains author address and affiliation information. The specific terms *radiation*, *radiation oncology*, *therapeutic radiology*, and *radiation medicine*, as well as the geographic location ("AFFILCITY") and departmental title listed on the institution's Web site ("AFFILORG"), were included using Boolean operators to select all publications attributable to each department for the evaluable time period (1996 to 2007). The Citation Tracker function was then used to generate the total number of publications, total number of citations, and Hirsch index (*h*-index) for each specified department, derived from the bibliographic database.

Faculty members' bibliometric data were extracted by using the Author Search feature of the bibliographic database to select all publications attributed by the bibliographic database to given physician faculty members posted on the Web site of each residency program listed by the Association of Residents in Radiation Oncology during the evaluable time span (1996 to 2007). All attributable articles were included, regardless of faculty members' affiliations at the time of initial article publication. The Citation Tracker function was then used to generate the total number of publications, total number of citations, and *h*-index for each specified faculty member, derived from the bibliographic database. Faculty data were then labeled to identify the current affiliation of each faculty member for analysis.

The *h*-Index

The bibliographic database's outputs of the total number of publications, total number of citations, and *h*-index were tabulated. The *h*-index was initially suggested by Jorge Hirsch, PhD, of the University of California, San Diego, as a method to quantify researchers' scientific output [12]. The *h*-index has become a widely implemented and used tool across academic disciplines and is widely available in bibliographic software packages.

The *h*-index includes the number of papers (*Np*) published *h* or more times. Hirsch [12] wrote, "A scientist has index h if h of his or her papers (Np) have at least h citations each and the other (Np − h) papers have ≤h citations each."

For instance, a researcher with 5 papers that have been cited 5 or more times has an *h*-index of 5. The *h*-index can also be calculated for institutions or, in our case, departments. To account for the fact that departmental faculty members are mobile and change over time, to avoid confusion, all publication metrics attributed to an institutional department are designated with the subscript "inst." Those derived from composites of individual current faculty members affiliated with a department at the time of data collection (October 29, 2007 to December 10, 2007) carry the subscript "fac."

Descriptive analysis was performed to calculate the mean, median, and standard deviation of the total number of publications (Np_{inst}) and the total number of citations ($Ncit_{\text{inst}}$). The institutional department *h*-index (H_{inst}) was derived from the bibliographic data set. A numeric ranking was performed of all included institutional department *h*-indices.

For evaluation of the academic productivity of current faculty members, the mean number of publications (p_{fac}) and citations (c_{fac}) for each department were tabulated. A novel *h*-index modification, the current faculty index (η_{fac}), was calculated as the mean of all current individual faculty *h*-indices in a department. A numeric ranking was performed of current faculty indices.

Table 1. Descriptive parameters for institutional bibliometric measures, 1996 to 2007

	Np_{inst}	$Ncit_{inst}$	H_{inst}
Mean	363.8	8,116.0	37.2
SD	374.8	9,478.5	18.9
Median	231.0	5,302.5	35.5

Note: Np_{inst} is the total number of publications attributed to a department; $Ncit_{inst}$ is the total number of citations attributed to a department; and H_{inst} is the institutional department *h*-index.

Table 2. Descriptive parameters for current departmental faculty bibliometric measures, fall 2007

	p_{fac}	c_{fac}	η_{fac}
Grand mean	41.0	709.0	7.6
SD	50.3	518.8	3.6

Note: p_{fac} is the the mean number of publications of current departmental faculty members; c_{fac} is the mean number citations; and η_{fac} is the current faculty index (mean of all current individual faculty *h*-indices).

Exploratory Analysis

Exploratory post hoc analysis was performed to evaluate the impact of department size as an association with H_{inst} and η_{fac}. H_{inst} and η_{fac} were plotted using bivariate regression plot by faculty number. Additionally, recursive partitioning analysis was used to determine faculty number "thresholds" nonparametrically associated with increased values of H_{inst} and η_{fac}.

RESULTS

A total of 78 radiation oncology departments and their 826 component faculty members were recorded. Tabulated institutional departmental parameters are listed in Table 1 and graphically represented in Figure 1 [14]. Current faculty composite parameters are listed in Table 2 and graphically represented in Figure 1.

Table 3 lists the top 20 ranked institutional departmental *h*-indices. Table 4 lists the top 20 ranked current faculty mean *h*-indices.

Figures 2 and 3 demonstrate an association between physician faculty number and H_{inst} and η_{fac}, respectively ($P < .001$). Recursive partitioning analysis demonstrated a numerical "breakpoint" at 12 faculty members that was associated with greater values of H_{inst} and η_{fac}, both at the $P < .05$ level.

DISCUSSION

To date, there have been comparatively few bibliometric analyses within the specialty of radiation oncology [15-17]. Recent years have seen a gain in interest in bibliometric analyses of individual scholastic output, married to the ready accessibility of online access. It is now easy to

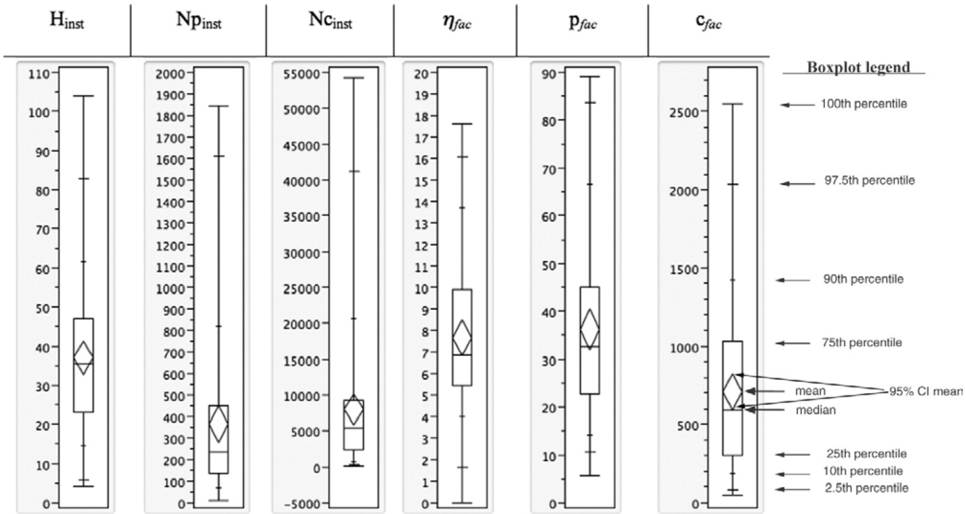

Fig 1. Quantile boxplot of the distribution of bibliometric parameters. Whiskers represent the 0th to 100th percentile range, with tick marks identifying outlying quantiles as per the legend on the rightmost plot. Ends of the box are the 25th and 75th percentiles. Central diamonds represent the means. Lengths of diamonds demonstrate the 95% confidence intervals of the means [14]. p_{fac} is the mean number of publications of current departmental faculty members; c_{fac} is the mean number of citations; η_{fac} is the current faculty index (mean of all current individual faculty *h*-indices); Np_{inst} is the total number of publications attributed to a department; $Ncit_{inst}$ is the total number of citations attributed to a department; H_{inst} is the institutional department *h*-index.

Table 3. Top 20 domestic radiation oncology residency program sponsoring departments by H_{inst}

Institution	Location	H_{inst}
Harvard Radiation Oncology Program	Boston, Massachusetts	104
Stanford University Affiliated Hospitals	Stanford, California	81
University of Texas M.D. Anderson Cancer Center	Houston, Texas	77
University of Michigan Affiliated Hospitals	Ann Arbor, Michigan	74
Yale University-New Haven Hospital	New Haven, Connecticut	74
Duke University Affiliated Hospitals	Durham, North California	70
National Capital Consortium of Affiliated Hospitals	Bethesda, Maryland	70
Fox Chase Cancer Center	Philadelphia, Pennsylvania	63
University of Pennsylvania Affiliated Hospitals	Philadelphia, Pennsylvania	61
University of California, San Francisco	San Francisco, California	59
University of Chicago Hospitals	Chicago, Illinois	59
Washington University Affiliated Hospital	St. Louis, Missouri	58
Mayo Graduate School of Medicine	Rochester, Minnesota	57
University of Washington Affiliated Hospitals	Seattle, Washington	57
Columbia University Medical Center	New York, New York	53
Memorial Sloan-Kettering Cancer Center	New York, New York	52
William Beaumont Hospital	Royal Oak, Michigan	52
The Johns Hopkins Hospital	Baltimore, Maryland	51
University of Wisconsin Hospitals and Clinics of Madison	Madison, Wisconsin	48
Wayne State University Affiliated Hospital	Detroit, Michigan	48

Note: H_{inst} is the institutional department *h*-index.

quantitatively or semiquantitatively evaluate a current or potential faculty physician's total publication output with a click of the mouse [18,19]. Journals have long touted their "impact factors" [16,18,20-27] as estimates of comparative value within academic fields. Furthermore, citation and publication analyses by geographic

Table 4. Top 20 domestic radiation oncology residency program sponsoring departments by η_{fac}

Institution	Location	η_{fac}
William Beaumont Hospital	Royal Oak, Michigan	17.6
Fox Chase Cancer Center	Philadelphia, Pennsylvania	16.0
The Johns Hopkins Hospital	Baltimore, Maryland	14.7
University of North Carolina Hospitals	Chapel Hill, North California	14.3
University of California, San Francisco	San Francisco, California	14.3
Baylor College of Medicine Affiliated Hospitals	Houston, Texas	14.2
Stanford University Affiliated Hospitals	Stanford, California	14.1
Washington University Affiliated Hospital	St. Louis, Missouri	13.6
University of Texas M.D. Anderson Cancer Center	Houston, Texas	13.3
Tufts University Affiliated Hospitals	Boston, Massachusetts	13.0
UCLA Affiliated Hospitals	Los Angeles, California	12.8
University of Michigan Affiliated Hospitals	Ann Arbor, Michigan	11.6
University of Colorado Health Science Center	Aurora, Colo	11.3
University of Chicago Hospitals	Chicago, Illinois	11.3
Harvard Radiation Oncology Program	Boston, Massachusetts	11.3
Mayo Graduate School of Medicine	Rochester, Minnesota	10.7
National Capital Consortium of Affiliated Hospitals	Bethesda, Maryland	10.6
Duke University Affiliated Hospitals	Durham, North California	10.4
University of Florida College of Medicine at Shands Hospital	Gainesville, Florida	10.2
Medical College of Wisconsin	Milwaukee, Wisconsin	9.2

Note: η_{fac} is the current faculty index (mean of all current individual faculty *h*-indices).

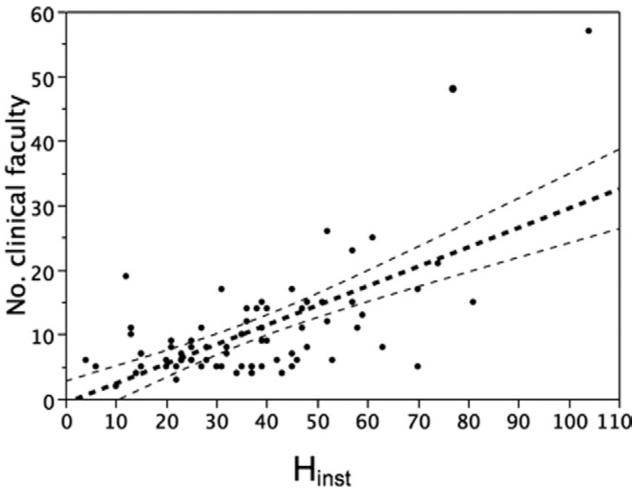

Fig 2. Bivariate plot for faculty number and H_{inst}. Heavy dotted line graphically indicates linear regression, with 95% confidence intervals as thin, dashed lines.

region are also seen occasionally [28]. As has been seen in other specialties [3,11,29-31], it is a reasonable pursuit to attempt to derive comparative measures of scientific productivity at the institutional and departmental levels as well.

The *h*-index, because of its unique use of both scientific impact (measured by citation) and volume (publication number), has become a widely implemented tool for assessing individual productivity in different disciplines [12,25,32-34]. The *h*-index, however, is field specific, such that the *h*-indices of researchers in particle physics and medical physics should be considered distinct, with different baseline distributions. That *h*-indices may be calculated for groups (such as research institutions or departments in this case) as an added value.

This task is complicated a bit by the fact that, like many group constructs, the individual component faculty members of a department change over any span of time. Thus, we sought to compare both departmental performance over a long term (H_{inst}) and an estimate of current departmental faculty productivity (η_{fac}). H_{inst} accounts for all publications attributed to a given department over an extended span (1996 to 2007), does not account for departmental size, and does not differentiate between the publications of clinical (MD or DO) and nonclinical faculty members. Thus, large institutions with many faculty members, or institutions with particularly active or large biology or physics divisions, may be overrepresented in the H_{inst} analysis and rankings. On the whole, however, H_{inst} represents a reasonable surrogate for an institution's capability to maintain a scientifically productive department of a $>$10-year span of recent history. By comparison, η_{fac} represents the achievements of current departmental physician faculty members alone and, as an average, is weighted by the number of physician faculty members. Thus, η_{fac} represents a "current snapshot" of a department's productivity, as well as a surrogate for "average faculty member" scholastic productivity. Because it counts each faculty member's publications, if multiple faculty members from an institution appear as coauthors on highly cited papers, η_{fac} may be skewed.

Using these indices in tandem provides a fuller picture than either index alone. For instance, newly expanded departments with no institutional traditions of scholarly activity may show higher current faculty *h*-indices compared with the historical institutional departmental *h*-index (H_{inst}); conversely, η_{fac} may better present the more recent academic output of an academic cohort.

The presented rankings have been included to identify the most academically productive departments as a benchmark for future comparison. Alternatively, using Figure 1, it is relatively easy to plot a given department's performance compared with the entire cohort of departments sponsoring residency programs. Interested parties can thus, with a simple search using bibliographic software in the manner described, derive an approximation of their departmental performance compared with that of other departments. Departmental faculty members also may contact the corresponding author directly if summaries of their specific institutions' data are desired.

Although the impetus for this study was the analysis of a metric for the comparison of radiation oncology residency program productivity, it is conceivable that there may exist more utilitarian applications for these data. Medical students could use such data to determine which

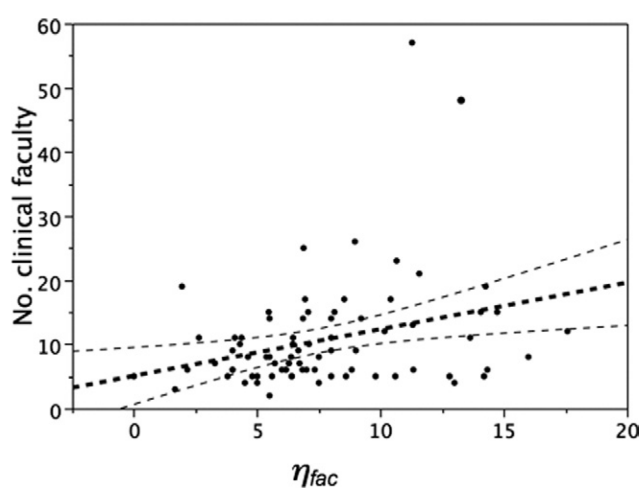

Fig 3. Bivariate plot for faculty number and η_{fac}. Heavy dotted line graphically indicates linear regression, with 95% confidence intervals as thin, dashed lines.

institutions demonstrate long-term research capability (H_{inst}) or have current faculty members who are engaged in frequent publication (p_{fac}) or are highly cited (c_{fac}). Departments or institutions could conceivably track data from year to year to assess cumulative performance. Faculty candidates could, using such information, also derive potentially meaningful data suggesting whether a given institution has a track record (H_{inst}) or a current faculty cohort (η_{fac}) with a notably fruitful scholarly activity level. Additionally, combined with the ease with which individual data may be extracted from bibliographic databases, researchers can compare their individual *h*-indices with a departmental average (η_{fac}), either at their home institutions or at other academic centers.

Although comparisons of corporate (institutional or departmental) bibliometric parameters are far less common than individual *h*-index, publication, or citation measures, these data demonstrate trends that may be of interest to those in the field of radiation oncology. For example, large institutions are disproportionately represented within the rankings presented, suggesting that the research output in radiation oncology is correlated with the number of clinical faculty members (Figures 2 and 3). Also, the advent of sites that catalogue bibliographic data as social networks (eg, BiomedExperts) may add value to identifying potential institutions that are "research friendly" and those that, either historically or at present, have devoted their energies to other arenas. This could potentially allow students and junior faculty members in the career development phase an opportunity to compare prospective future employers. It also increases the transparency of the match and job selection process and allows accurate evaluation of the institutional and social resources available.

Several caveats should be noted. Although we attempted to be thorough, there is no guarantee of complete accuracy with regard to publication attribution. Additionally, we were reliant on publicly available Web site data from academic institutions; if institutional Web sites were to inaccurately reflect current active faculty rosters (or include nonpublishing clinical or adjunct or emeritus faculty members), our data would be skewed. Multiple departmental affiliations or changes in a department's or institution's name over time might also conceivably alter the accuracy of these data. Authors using multiple identifiers (eg, maiden and married names, nicknames, initials) not grouped by the bibliographic software might potentially skew results. Multiple authorship, endemic in medicine, represents a significant potential confounder [17,35-38]. This analysis is unable to assess the degree to which a given departmental author actively participated in the conception and design, provided financial or administrative support, enrolled patients or provided specimens for a trial or experiment, contributed to the data (including collection, assembly, critical analysis, and interpretation), and actually wrote portions of the manuscript [37,38]. Furthermore, it must always be remembered that scholarly efforts comprise more than just publication (eg, teaching, grant acquisition, professional society activities), and many publishable data may be embargoed because of patent-related or industry-related rationales. The effectiveness of clinical care, teaching, mentorship (including junior faculty members, trainees, and students), and overall mission balance within a department's home institution cannot be derived from this bibliometric analysis alone. However, this data set represents a first effort at evaluating comparative departmental research publication propensity and, on the whole, provides a rough estimate of the dominant departmental players in the arena of scholarly activity within the specialty of radiation oncology.

It is not our intent to create rivalry or increase competitiveness between radiation oncology departments; however, without usable benchmarks, it is difficult to mark progress over time. The use of quantitative metrics prevents departments from relying on subjective measures such as institutional reputation to evaluate collective scientific productivity and serves as an impetus for improved performance across our field. To our knowledge, no similar attempt to recognize departmental and institutional achievement has been reported in the radiation oncology literature, as in other disciplines [11]. We hope that by applauding those programs that have demonstrated scholarly activity, we might all be encouraged to increase our scientific efforts.

REFERENCES

1. Kuhn TS. The structure of scientific revolutions. Chicago, Ill: University of Chicago Press; 1962.
2. Willing SJ, Cochran PL, Gunderman RB. The polity of academic medicine: status of faculty governance. J Am Coll Radiol 2004;1:679-84.
3. Riechelmann RP, Townsley CA, Pond GR, et al. The influence of mentorship on research productivity in oncology. Am J Clin Oncol 2007;30: 549-55.
4. Balboni TA, Chen MH, Harris JR, et al. Academic career selection and retention in radiation oncology: the Joint Center for Radiation Therapy experience. Int J Radiat Oncol Biol Phys 2007;68:183-6.
5. Patel S, Jagsi R, Wilson J, et al. Results of the 2004 Association of Residents in Radiation Oncology (ARRO) survey. Int J Radiat Oncol Biol Phys 2006;66:1199-203.
6. Yee D, Fairchild A, Keyes M, et al. 2003 survey of Canadian radiation oncology residents. Int J Radiat Oncol Biol Phys 2005;62:526-34.
7. Jagsi R, Buck DA, Singh AK, et al. Results of the 2003 Association of Residents in Radiation Oncology (ARRO) surveys of residents and chief residents in the United States. Int J Radiat Oncol Biol Phys 2005;61: 642-8.
8. Schilling PJ, Wall TJ. Results of the 1992 Association of Residents in Radiation Oncology (ARRO) survey. Int J Radiat Oncol Biol Phys 1994; 28:1267-70.

9. Frisch A. San Antonio Spurs. Mankato, Minn: Creative Education; 2007.
10. Donovan J, Sins K, Coffey F. The Dallas Cowboys encyclopedia: the ultimate guide to America's team. Rev and updated ed. Secaucus, NJ: Carol; 1999.
11. Wu JJ, Ramirez CC, Alonso CA, et al. Ranking the dermatology programs based on measurements of academic achievement. Dermatol Online J 2007;13:3.
12. Hirsch JE. An index to quantify an individual's scientific research output. Proc Natl Acad Sci U S A 2005;102:16569-72.
13. Association of Residents in Radiation Oncology. Directory January 2007-June 2007. Available at: http://www.arro.org/residents/resident_directory/index.asp. Accessed October 27, 2007.
14. Williamson DF, Parker RA, Kendrick JS. The box plot: a simple visual method to interpret data. Ann Intern Med 1989;110:916-21.
15. Yang GY, Schoenwetter MF, Wagner TD, et al. Misrepresentation of publications among radiation oncology residency applicants. J Am Coll Radiol 2006;3:259-64.
16. Dubben HH, Beck-Bornholdt HP, Schmidt A. Authorship of scientific publications. Audit of the periodical "Strahlentherapie und Onkologie." Strahlenther Onkol 2001;177:547-53.
17. Halperin EC, Scott J, George SL. Multiple authorship in two English-language journals in radiation oncology. Acad Med 1992;67:850-6.
18. Bakkalbasi N, Bauer K, Glover J, et al. Three options for citation tracking: Google Scholar, Scopus and Web of Science. Biomed Digit Libr 2006;3:7.
19. Falagas ME, Pitsouni EI, Malietzis GA, et al. Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses. FASEB J 2008;22:338-42.
20. Barendse W. The strike rate index: a new index for journal quality based on journal size and the h-index of citations. Biomed Digit Libr 2007;4:3.
21. Castelnuovo G. Ditching impact factors: time for the single researcher impact factor. BMJ 2008;336:789.
22. Cavalli F. What has prevented Annals of Oncology from reaching an impact factor of 6? Ann Oncol 1999;10:1403-4.
23. Falagas ME, Charitidou E, Alexiou VG. Article and journal impact factor in various scientific fields. Am J Med Sci 2008;335:188-91.
24. Favaloro EJ. Measuring the quality of journals and journal articles: the impact factor tells but a portion of the story. Semin Thromb Hemost 2008;34:7-25.
25. Jeang KT. Impact factor, H index, peer comparisons, and retrovirology: is it time to individualize citation metrics? Retrovirology 2007;4:42.
26. Ketcham CM, Crawford JM. Can impact factor data be trusted? Lab Invest 2008;88:340-1.
27. Ogden TL, Bartley DL. The ups and downs of journal impact factors. Ann Occup Hyg 2008;52:73-82.
28. Lopez-Illescas C, de Moya-Anegon F, Moed HF. The actual citation impact of European oncological research. Eur J Cancer 2008;44:228-36.
29. Emery SE, Gregory C. Physician incentives for academic productivity. An analysis of orthopaedic department compensation strategies. J Bone Joint Surg Am 2006;88:2049-56.
30. Kruse JE, Bradley J, Wesley RM, et al. Research support infrastructure and productivity in U.S. family practice residency programs. Acad Med 2003;78:54-60.
31. el-Guebaly N, Atkinson M. Research training and productivity among faculty: the Canadian Association of Professors of Psychiatry and the Canadian Psychiatric Association Survey. Can J Psychiatry 1996;41:144-9.
32. Purvis A. The h index: playing the numbers game. Trends Ecol Evol 2006;21:422.
33. Kelly CD, Jennions MD. The h index and career assessment by numbers. Trends Ecol Evol 2006;21:167-70.
34. Hirsch JE. Does the H index have predictive power? Proc Natl Acad Sci U S A 2007;104:19193-8.
35. Hoen WP, Walvoort HC, Overbeke AJ. What are the factors determining authorship and the order of the authors' names? A study among authors of the Nederlands Tijdschrift voor Geneeskunde (Dutch Journal of Medicine). JAMA 1998;280:217-8.
36. Baerlocher MO, Newton M, Gautam T, et al. The meaning of author order in medical research. J Investig Med 2007;55:174-80.
37. Slone RM. Coauthors' contributions to major papers published in the AJR: frequency of undeserved coauthorship. AJR Am J Roentgenol 1996;167:571-9.
38. Flanagin A, Carey LA, Fontanarosa PB, et al. Prevalence of articles with honorary authors and ghost authors in peer-reviewed medical journals. JAMA 1998;280:222-4.