

Five-Year Institutional Bibliometric Profiles for 119 North American Neurosurgical Residency Programs: An Update

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■ **BACKGROUND:** We recently performed a comprehensive bibliometric analysis of 103 U.S. neurosurgical departments and found the ih(5)-index as meaningful and reproducible using public data. The present report expands this analysis by adding 14 Canadian and 2 additional U.S. programs.

■ **METHODS:** Departments were included if listed in the American Association of Neurological Surgeons Residency Directory. Each institution was considered a single entity, and original research articles with authors who were neurosurgeon faculty were counted only once per institution, although a single article may have been credited toward multiple institutions, if applicable. The following bibliometric indices were calculated and used to rank departments: ih(5), ig(5), ie(5), and i10(5). In addition, intradepartmental comparison of productivity among faculty members was analyzed by computing Gini coefficients for publications and citations.

■ **RESULTS:** The top 5 most academically productive North American neurosurgical programs based on ih(5)-index were found to be the University of Toronto, University of California at San Francisco, University of California at Los Angeles, University of Pittsburgh, and Brigham and Women's Hospital. The top 5 Canadian programs were the University of Toronto, University of Calgary, McGill University, University of Sherbrooke, and University of British Columbia. The median ih(5)-index for U.S. and Canadian programs was 12 and 10.5, respectively.

■ **CONCLUSIONS:** This is the most accurate comprehensive analysis to date of contemporary bibliometrics among North American neurosurgery departments. Using the ih(5)-index for institutional ranking allows for informative comparison of recent scholarly efforts.

INTRODUCTION

Recently, there has been increasing interest in the objective quantification of academic productivity among neurosurgery departments.¹⁻²⁰ Although each of these measures of publication output (or bibliometrics) captures only 1 aspect of a department's productivity, collectively they create a profile that can be used for intradepartmental and interdepartmental analysis, both at a single point in time and longitudinally. Such analysis may be of interest to funding bodies, prospective employees or trainees, and hospital or academic administration. It is therefore essential that appropriate statistics be used, allowing individuals and groups to make the most well-informed decisions.

Numerous metrics, including the h-index and its variations, have been applied to the publication data from neurosurgery departments.¹⁻²⁰ Many of these publications have focused on the lifetime cumulative output of a department's faculty members. Such cumulative statistics can be biased toward early career achievements and do not adequately represent more recent activity, or a lack thereof. In response, we recently introduced several 5-year institutional bibliometric measures to more accurately gauge

Key words

- Bibliometrics
- Canada
- e-Index
- g-Index
- Gini coefficient
- h-Index
- i10-Index
- Institutional
- Neurosurgery
- Rank

Abbreviations and Acronyms

JIF: Journal impact factor

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contemporary academic activity.¹⁵ These new benchmarks include the ih(5)-index, ig(5)-index, ie(5)-index, and iro(5)-index. We found the ih(5)-index particularly useful because it was predictive of intradepartmental publication equality yet relatively insensitive to factors that tend to distort other indices, such as outlier faculty who are either highly productive or no longer academically active.

Using these, as well as other measures of academic productivity, we analyzed the 5-year institutional bibliometric profiles for 103 U.S. neurosurgical departments with residency programs.¹⁵ The data from that analysis yielded an informative and novel set of institutional rankings. In the current analysis, we extended these methods to include the 14 Canadian neurosurgery departments with residency programs and added analyses of the National Capital Consortium Neurosurgery Residency Program (Walter Reed National Military Medical Center, Bethesda, Maryland, USA)² and Cleveland Clinic Neurosurgery Residency Program, creating a novel bibliometric analysis and ranking of 119 North American academic neurosurgical departments.

METHODS

The following methodologies are identical to those outlined in our previous publication.¹⁵

Selection of Programs

A list of the 2014 Canadian neurological surgery residency programs was compiled according to the American Association of Neurological Surgeons Residency Directory (<http://www.aans.org/Young%20Neurosurgeons/Medical%20Students/Residency%20Directory.aspx>). Departmental Web sites were consulted for faculty names, excluding all nonneurosurgical faculty members. Attempts were made by email and telephone to obtain unclear or unavailable relevant information in the departmental Web sites. All new data collection and calculations were carried out during August and September 2015, with the exception of Cleveland Clinic, for which data were collected in July 2016.

Bibliometric Analysis

Each neurosurgical institution was converted into a single entity whereby each neurosurgical faculty member's 5-year academic yield (measured in publications and citations) was compiled to compute the various metrics as listed later. A protocol was defined (also detailed later) for acquiring publication and citation data and then rigorously followed to ensure the most accurate evaluation of an institution's 5-year scholarly contributions to neurosurgery.

After composing a list of faculty for each institution, Scopus (Elsevier, www.scopus.com) was queried to obtain publication and citation data. The Author Search function was used to uniquely identify a faculty member, and each search was limited to include only peer-reviewed original research articles published from 2009 to 2013. An author's contributions counted toward the total publication and citation number of their affiliated institution at the time of publication. We accomplished this search by scrutinizing article headings of individual publications to account for any change in institutional affiliation over the last 5 years. If multiple authors from the same institution were on the same

article, the following authorship assignment algorithm was used to ensure that each publication was counted only once: the article was assigned in the order of first author, second author, last author, then third author, and so on. Conversely, if the publication was multi-institutional, each institution received credit for the academic product attributed by that institution's respective faculty.

Definition of Metrics

After identifying an institution's total publications and citations for 2009–2013 using Scopus, all data were entered into Microsoft Excel, where publications were listed in decreasing order by number of citations. The following bibliometric measurements were calculated for each institution (i). Each metric is noted as (5) to indicate that the metric was calculated for a finite 5-year period and not for each individual member's entire career.

- 1) ih(5)-index: $ih(5) = h(\text{publications with } \geq h(\text{citations}))$; an institution's number of publications (h) with at least h citations.²¹ It is the point at which the number of citations intersects the number of publications listed in descending order by citation count. We also normalized the ih(5)-index for the 119 neurosurgical residency programs to account for each institution's respective faculty number (at the time of our analysis) by using a simple ratio: ih(5)-index:faculty number. This result can be viewed as the average, equal contribution that each neurosurgeon on faculty makes to the department's 5-year (2009–2013) h-index.
- 2) ig(5)-index: $ig(5) = g(\text{publications with } \geq g^2(\text{citations}))$; an institution's number of publications (g) that cumulatively have received at least g^2 citations.²² The g-index is designed to complement the h-index to more accurately capture highly cited publications.
- 3) ie(5)-index: $ie(5) = \sqrt{(\text{total citations of } h \text{ papers, } h^2)}$; calculated by determining the total number of citations from articles that make up the institution's ih(5)-index, then subtracting the minimum number of citations required to reach that ih(5)-index (h^2).²³ The square root of this excess citation count is the ie(5)-index.²³ Like the g-index, the e-index was designed for highly cited publications.
- 4) iro(5)-index: $iro(5) = n(\text{publications with } \geq 10 \text{ citations})$. Initially created by Google Scholar (<http://scholar.google.com>), it tallies the number of articles produced by an institution within the allotted 5-year span, acquiring 10 or more citations.

Ranking of Programs

All American Association of Neurological Surgeons-listed Canadian ($n = 14$) neurosurgical training programs were ranked by the defined metrics, total number of publications and citations, as well as by Gini coefficients for publications and citations (see later discussion). In addition, all North American programs, which include the 14 Canadian programs, the Cleveland Clinic, and our recent analysis of the National Capital Consortium Neurosurgery Residency Program (Walter Reed National Military Medical Center),² were pooled to construct an overall ranking by the defined metrics.

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