The use of bibliometrics to rank the most academically productive programs in neurosurgery is a trend that is growing in popularity. These analyses are often based on the number of publications accumulated over time as well their respective citations as a proxy for quality. Using this approach, an index or value can be ascribed to an individual, a group (e.g., department or university), or even a scholarly journal, in an effort to capture its relative productivity and impact on the academic community.

Taylor and colleagues have undertaken a commendable effort to develop a way to assess the academic productivity of our peers in neurosurgery using a 5-year institutional h-index ($h[ih]^5$-index), which they propose is tailored to more accurately reflect a program’s recent research achievements. They also demonstrate that the $ih(5)$-index has predictive capacity in characterizing intradepartmental publishing equity—that is to say, the degree to which individuals within a department contribute equally—which in turn may be correlated with greater productivity overall. Subsequently, Lozano and colleagues employed the $ih(5)$-index in a separate study to demonstrate that the University of Toronto, when compared to all United States neurosurgery programs, ranks first in terms of generating the highest number of publications that are cited most frequently.

Certainly, much like bibliometric profiles that have preceded it, the $ih(5)$-index seems reasonable insofar as it uses many if not all of the fundamental elements to provide a score. It is similar to the more general $h$-index, which also refers to the number of papers ($h$) that receive $h$ or more citations, except that it is restricted to a 5-year time course and institutional data. Other more recently developed indices, including the $g$-index and $e$-index, are meant to complement the $h$-index and are designed to capture highly cited publications or “ignored” citations, whereas the $m$-index reflects an $h$-index that is corrected for the number of years since a first published paper, which essentially eliminates bias against more junior scholars who have been active for a shorter period of time.

Despite their differences, the various strategies that have been developed to analyze bibliometric data are more similar than not, and thus some of the same caveats should be considered when interpreting the $ih(5)$. Because the field of neurosurgery is relatively small, one of the primary sources of bias in the $ih(5)$ is the degree to which neurosurgeons choose to publish in neurosurgical specialty journals—which de facto garner a smaller audience—versus more broadly in other fields. In addition, the $ih(5)$ conversely favors certain publications like those that develop clinical guidelines; one such manuscript referenced by Lozano and colleagues entitled “Guidelines for the management of spontaneous intracerebral hemorrhage” was published in Stroke, and as the authors correctly identify, it is the most-cited manuscript from the University of Toronto neurosurgery program. Wider appeal can often be achieved through close collaboration with faculty and scientists in nonneurosurgical departments; incidentally, a prime example of this is the same highly cited manuscript.

**EDITORIAL**

Not everything that matters can be measured and not everything that can be measured matters

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from University of Toronto whose first author, Dr. Lewis B. Morgenstern, despite having a faculty appointment in the Department of Neurosurgery, happens to be a clinical neurologist by training.

As such, it is not unreasonable to interpret the $ih(5)$-index, at least in some cases, to be a mark of successful academic collaboration. Supporting this is the finding by Taylor and colleagues that all bibliometric indices, including the $ih(5)$, were positively correlated with the number of faculty in a neurosurgical department; however, this certainly begs the question of whether disparities between programs persist after controlling for faculty size. To reiterate the point, not only the number, but the type of faculty present in a department needs to be considered when interpreting the $ih(5)$-index. Depending on the organization of a particular department, the presence of nonclinical basic science faculty—or those with varying degrees of clinical responsibilities—further confounds the conclusions to be gleaned from index publication data. That is to say, if a neurosurgeon is listed as an author on a particular paper that was primarily driven by oncologists, neurologists, or basic scientists, that paper may in fact elevate the reputation of a neurosurgical program without accurately reflecting the involvement of a neurosurgeon in its success.

Overall, there does seem to be some truth to the saying that “not everything that matters can be measured and not everything that can be measured matters.” While the $ih(5)$-index represents a useful new tool, there is certainly more to academic productivity than publications and their respective citations. Indeed, a successful department needs to balance different talents and contributions in the realms of teaching activities, politics, and the production of work relative value units (RVUs). Toward that end, it is important to note that neurosurgery program rankings by the $ih(5)$-index do not directly recapitulate those published by sources such as the Doximity Residency Navigator and U.S. News & World Report. Specifically, the Doximity rank list identifies a number of programs that are not rated within the $ih(5)$ top 10; these include NewYork-Presbyterian Hospital (Columbia Campus), Mayo Clinic College of Medicine, Washington University, Massachusetts General Hospital, University of Washington, and Emory University.

Bibliometric indices are of emerging importance in neurosurgery and represent one way to assess academic productivity among departments while allowing for reassessments of this activity over time. As these metrics continue to be refined, perhaps the most interesting questions remain; for instance, what are the drivers that are most important for academic productivity? Do the manuscripts that rank departments also give us a roadmap to develop or choose a promising program? Many successful programs produce high-impact publications that are centered on a few individuals, often at the expense of clinical volume (i.e., the Pareto principle). Does this trade-off ultimately benefit neurosurgery faculty and residents? There is some component of academic mission here that is important to consider for surgical training. Lastly, there are several financial models that differ in reimbursement pathways, not only at the individual faculty level but also institutionally. The manner in which incentives are aligned—vis-à-vis hospital-driven or university-based salary or promotions—will skew the balance between RVUs versus academic productivity and in turn influence the interpretation of program ranking by bibliometric index alone.

http://thejns.org/doi/abs/10.3171/2015.2.JNS142977

References

Response
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Like an engine that requires the integration of multiple components, there are numerous facets of a neurosurgical residency that theoretically should work synchronously to produce highly educated, competent, and safe neurosurgeons. Research and its end result—publications—are just some of those components, now mandated as part of the ACGME neurosurgery milestones curriculum. A neurosurgical program’s ability to attract the most innovative and productive resident or faculty applicant relies on the accurate and transparent display of the programs’ attributes. We attempted to define the most accurate method of measuring the contemporary academic productivity of each US neurosurgical residency program. We found the $ih(5)$-index to be a simple and reproducible metric that may answer our quest.

When utilizing the $ih(5)$-index, there are several issues to consider. First, the $ih(5)$-index is best used when comparing departments within the same field and using the same methodology. Choi et al. are incorrect in labeling it a biased metric if such departments include neurosurgeons that publish in broader journals. In fact, such departments should be commended, and their impact (publication and associated citations) would be accurately captured with the $ih(5)$-index. The overall impact such academic neurosurgeons have is likely to be small, as we demonstrated in a pilot study that only 10% of neurosurgeons have at least 1 publication in a journal with an impact factor greater than 8.0. Citations take time to accrue, so publications at the end of the 5-year period are underrepresented in the total citation count. While the effect of this drawback on our current analysis is negated by the fact that the $ih(5)$ calculation was uniformly applied to all programs, this could be remedied by repeating the 5-year analysis at in-