



## COMMENTARY

# Promoting Stewardship of Academic Productivity in Emergency Medicine: Using the H-index to Advance Beyond the Impact Factor

The science of the academic “impact” of researchers and the journals in which they publish has become largely one of citation metrics. The impact factor was the uncontested metric for decades, but is an imperfect journal-level measure that provides no assessment of individual authors or potential scientific impact.<sup>1</sup> Electronic indexing systems have made it very easy to calculate how often any given scholarly paper has been cited by other scholarly products, and since we favor quantifying what we can easily measure,<sup>2</sup> a number of citation metrics have been developed that purport to assess the quality of journals, papers, and authors, including the h- and m-indices, as well as country or language-stratified first- and second-generation citation reports and an evolving series of vendor products like Faculty of 1000, Researcher ID, Google Scholar, SciVerse, SCOPUS, ORCID, Gopubmed, and Microsoft Academic Search.<sup>3</sup>

In this issue of *Academic Emergency Medicine*, DeLuca et al.<sup>4</sup> present what we believe is the first data-driven look at the h-index as a measure of the academic productivity of emergency physicians. Hirsch first proposed the h-index in the field of physics and also suggested the m-index for younger authors.<sup>5</sup> Like the older and better-known impact factor, the h-index is a fairly simple calculation, reflecting the number of papers you have published that each have been cited that same number of times. Your h-index is 18 if you have published 18 papers each of which has been cited 18 times, but you do not yet have 19 papers each of which has been cited at least 19 times. Perhaps 16 of those 18 papers have already been cited 19 or more times each; as soon as the 17th and 18th are each cited one more time, and one other paper in your CV is cited 19 times, your h-index increases to 19. It is immediately obvious that high h-indices are difficult to achieve: your work must have been cited at least 400 times (20 papers at 20 citations each) to reach an h-index of 20. The h-index is available from a variety of databases including Web of Science and Scopus, but the numerical estimate of

h-index can vary between databases.<sup>6</sup> One calculates the m-index by dividing the h-index by the number of years since the author’s first paper was published.<sup>5</sup>

As DeLuca et al. note, there are a number of attractive features to h-index.<sup>4</sup> For example, it is fairly resistant to self-citation, at least at the high end; if you cite your first paper in your second paper, your h-index jumps from 0 to 1, but it would be difficult to artificially inflate your h-index once it is greater than perhaps 10 by citing yourself.<sup>7,8</sup> Also, a single frequently cited paper will not increase one’s h-index, nor will a large number of rarely cited papers; a researcher must consistently produce papers that are frequently cited to increase his or her h-index. While there may be academic value to either one sentinel paper or a large number of less-cited works, it can be argued that the authors of such papers are less “academically productive” than those who sustain the production of highly cited papers over time. The h- and m-index have been used to project an investigator’s research productivity trajectory and will probably be used increasingly by promotion committees and grant study section reviewers to compare one candidate with another.<sup>9,10</sup> In addition, higher h-indices are associated with more accurate conclusions and higher methodologic research reporting, although the shelf-life of “truth” is not correlated with higher indices.<sup>11</sup>

The h-index should evaluate the quality and sustainability of scientific productivity at the level of the individual investigator, but it is also imperfect. It does not factor in the context of citations, which could be pertinent because suboptimal research can be cited as an example of what not to do.<sup>12</sup> Both the h-index and the impact factor fail to correct for interprofessional (cardiology vs. neurology vs. surgery, for example) differences in citation practices.<sup>13</sup> In addition, the h-index fails to reflect the source of citations or the actual effect of the work on physician behavior, patient outcomes, or public welfare.<sup>14</sup> Finally, the h-index does not assess the intellectual contributions of each author in multiauthored papers.<sup>12</sup>

Journals also have h-indices; ours is currently 67, indicating that 67 of the papers published in *Academic Emergency Medicine* to date have been cited at least 67 times each. Obviously, journal h-index, like author

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h-index, is very sensitive to time: the longer a journal has been around, the more time it has had to accumulate citations. This makes it difficult to compare the h-indices of, say, *Annals of Emergency Medicine* (h-index of 89, in the journal's 30th year), our journal (in its 20th year), and *BMC Emergency Medicine* (h-index of 12, in its 13th year). DeLuca et al. attempted to address the role of the longevity of authors in their paper, examining increases in h-index per year as a way to perhaps gauge sustained productivity.<sup>4</sup> Unlike impact factor, which looks only at citations from the 2 years prior to the year being examined (e.g., citations from 2010 and 2011 are used in calculating a journal's 2012 impact factor), h-index is simply cumulative, and an author's or journal's h-index can never go down—even if that author ceases writing papers or the journal ceases publication. This may make h-index a better gauge of the entirety of a scholar's career or journal's history than impact factor, but a less useful measure of recent productivity.

One of the primary criticisms of impact factor is that even though it was designed to be a measure of journal quality, it is used as a measure of author and paper quality: you are assumed to be a "better" scholar if you publish in journals with higher impact factors and your papers are assumed to be "better" if they are published in such journals. These assumptions do not hold up to scrutiny, for a number of reasons,<sup>15,16</sup> and we may be seeing the beginning of a trend away from the use of impact factor.<sup>17</sup> DeLuca et al.<sup>4</sup> hint that perhaps h-index can fill this void, as it was specifically designed to assess the career output of individual scholars.

The findings of DeLuca et al. are not particularly surprising: we are a fairly young specialty, with a relatively small number of highly accomplished senior academic faculty and large numbers of faculty members who are not (yet) academically productive in terms of peer-reviewed papers. Many of our colleagues at the left-hand end of Figure 4 are "pure" clinicians helping to staff our academic EDs, educators who provide much of the clinical teaching for our residents and medical students but are not writing for the academic literature, and administrative leaders such as ED medical directors whose work is essential to keeping our teaching EDs running but does not translate into publishable material. What the data from this study do, however, is give us a general look at the distribution of h-indices across the spectrum of academic EDs. As DeLuca et al. note, understanding this distribution within each specialty is an important first step in using the h-index to quantitatively assess and compare academic scholarly productivity within the context of our peers.<sup>4</sup> Whereas 85% of academic ED faculty have h-indices less than or equal to 6, the top 5th percentile have h-indices of 13 or greater. Furthermore, only 10% of academic faculty increase their h-indices by more than 0.5 points per year. Among the top 20 h-index performers in emergency medicine, the mean ( $\pm$ SD) increase between years 12 and 24 is 15.8 ( $\pm$ 7.6), indicating that the h-index is also predictive of future academic productivity in our specialty. These estimates provide a baseline from which leaders can begin to compare scientific productivity between individual

academicians for the purposes of promotions, grants, and tenure.

DeLuca et al.<sup>4</sup> acknowledge the limitations of their work that are primarily related to the h-index. First and foremost, the h-index ignores the indisputable value of clinical care, teaching, editing, committee involvement, and textbook authorship that are all foundations of academic medicine. The h-index estimates only one facet of academia: peer-reviewed publication impact. Efforts to enhance the validity of the h-index continue,<sup>18,19</sup> and these refinements should also explore methods to quantify these other essential contributions of academic physicians. In addition, future academic productivity indices should incorporate measures of "clinical relevance" instead of the surrogate citation counts to highlight the attributes of medical scientists that are most important to society.<sup>14</sup> Nonetheless, DeLuca et al. provide individual ED clinicians, departments, medical centers, and journals with a contemporary personal measuring stick of their academic profiles. Investigators and emergency medicine can use the h-index to proactively promote worthy stewardship of our contributions to science.

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