

Quality over Quantity: Reinventing Orthopaedic Surgery Resident Selection with a Machine-Learning Based Algorithm Assessing Research Output

William Huffman¹, Alexander Thomson, Divya Jain², Daniel C Farber³, Cara A Cipriano⁴

¹Vanderbilt University Medical Center, ²Perelman School of Medicine At the University of P, ³Penn Medicine Orthopaedics, ⁴Perelman Center For Advanced Medicine

INTRODUCTION:

Applicants to orthopaedic surgery residency programs submit more applications than any other specialty, totaling 171 applications per residency position in the 2022 match. Current numeric metrics available to program directors to filter high numbers of applicants are limited to raw number of research experiences listed, USMLE Step 1 scores, and Step 2 Clinical Knowledge scores. Adding research quality as an initial screening filter requires a time-intensive manual review that is highly impractical.

METHODS:

Our goal was to develop a machine-learning tool to rank orthopaedic surgery residency applicants in terms of both quality and quantity of research portfolios. We evaluated the research portfolios of 7,028 orthopaedic surgery residency applicants to our program from 2015 to 2023. We created an adjusted publication score by weighting similarity scores of individual entries to identify unique projects, impact factors of journals, and status of publications as “in-press” vs. “submitted.”

RESULTS:

From 2015 to 2023, the average number of self-reported publications per applicant increased by 272% (8.2 to 22.3), but the average quality adjusted research score increased by only 205% (4.1 to 8.4). The average quality score per publication decreased over the time period with a relative decrease of 17% between 2015 and 2023. When ranking applicants in 2023 against each other in terms of research scores, 20% of applicants would have been considered differently for interview based on adjusted research score compared with the ‘standard’ metric screen of research quantity.

DISCUSSION AND CONCLUSION:

We demonstrate the use of a novel machine-learning tool to evaluate orthopaedic surgery residency applicants for research quality as opposed to strictly raw publication counts. We show that as the number of self-reported publications by orthopaedic surgery applicants has dramatically risen over the past decade, the average quality of each publication has decreased. Applicants with high-quality and influential publications may never be considered for interviews whereas greater quantities of abstracts, presentations, or lower author publications elevate other applicants above initial screening measures. Current application filtering strategies encourage this inflation of research output in a highly competitive residency application process. By contrast, the machine-learning tool utilized in this study would restore focus on meaningful research, for example, by weighting publications in high impact journals; this is especially relevant given the observed trends of increasing numbers of abstracts and presentations by orthopaedic surgery residency applicants. This tool would not only allow for efficient review of an otherwise overwhelming numbers of applications, but, if widely utilized, could redirect hundreds of thousands of hours of time of orthopaedic surgery applicants toward more thoughtful efforts to affect the field of orthopaedic surgery and its patients.

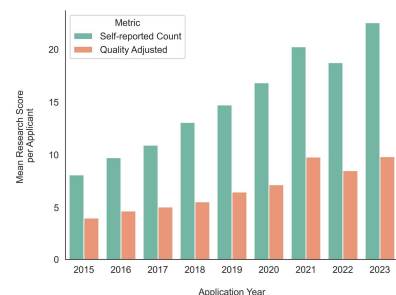


Figure 1: Self-reported publication counts and quality adjusted research scores of orthopaedic surgery residency applicants from 2015 to 2023

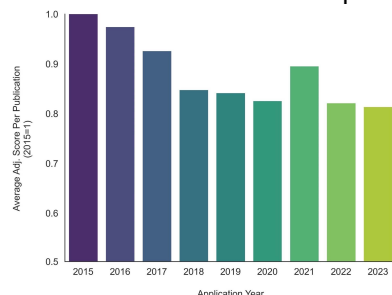


Figure 2: Average adjusted score per publication of orthopaedic surgery residency applicants from 2015 to 2023.

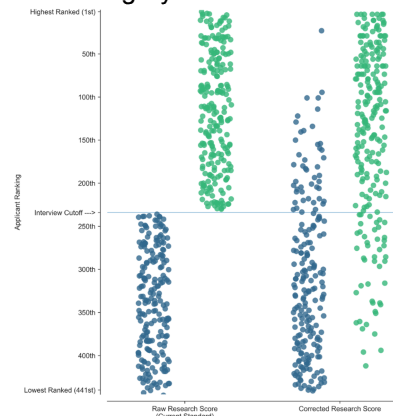


Figure 3: Orthopaedic surgery residency applicants for the 2023 match ranked by raw research score and corrected research scores after a filter for Step 2 Clinical Knowledge scores.