

Unintended Consequences: The Escalating Research Demands of the Neurosurgery Match

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| Keywords: | research fever, Neurosurgery, medical education |
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| Abstract: | <p>Background: Following the transition of the United States Medical Licensing Examination (USMLE) Step 1 to pass/fail scoring in 2022, medical students and residency programs have shifted greater attention to alternative metrics, such as research output (RO), to evaluate applicant competitiveness. This shift may have unintended consequences for equity and sustainability, particularly in highly competitive specialties like neurological surgery.</p> <p>Objectives: To analyze recent trends in research productivity among neurological surgery residency applicants and assess the impact of the USMLE Step 1 scoring change on applicant behavior and systemic pressures.</p> <p>Methods: We conducted a retrospective analysis of National Resident Matching Program (NRMP) data from 2014 to 2024. RO was defined as the total number of abstracts, presentations, and publications reported by matched and unmatched U.S. MD applicants to neurological surgery. Percent increases were calculated for each two-year cycle. Findings were contextualized using published literature on match competitiveness, academic integrity, and research equity.</p> <p>Results: Between 2022 and 2024—the first application cycle affected by pass/fail Step 1 scoring—matched applicants' average RO increased by 46.7% (from 25.5 to 37.4), while unmatched applicants saw a 171.8% increase (from 11.7 to 31.8). These surges far exceeded the linear growth observed in prior cycles. This escalation raises concerns about the rising use of research productivity as a de facto screening tool, potential increases in unethical practices such as unverifiable publications, and growing inequities for students lacking institutional or financial support.</p> <p>Conclusions: The elimination of numeric Step 1 scores may have inadvertently intensified pressure on medical students to produce research,</p> |

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| | exacerbating existing disparities and encouraging unsustainable academic behaviors. Increased transparency around how residency programs evaluate RO, along with safeguards for equity and academic integrity, are urgently needed. |
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Unintended Consequences: The Escalating Research Demands of the Neurosurgery Match

By

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List of Abbreviations

NS – Neurological Surgery

USMLE – United States Medical Licensing Examination

RO – Research Output

NRMP – National Resident Matching Program

P/F – Pass/Fail

IRB – Institutional Review Board

Abstract

Background:

Following the transition of the United States Medical Licensing Examination (USMLE) Step 1 to pass/fail scoring in 2022, medical students and residency programs have shifted greater attention to alternative metrics, such as research output (RO), to evaluate applicant competitiveness. This shift may have unintended consequences for equity and sustainability, particularly in highly competitive specialties like neurological surgery.

Objectives:

To analyze recent trends in research productivity among neurological surgery residency applicants and assess the impact of the USMLE Step 1 scoring change on applicant behavior and systemic pressures.

Methods:

We conducted a retrospective analysis of National Resident Matching Program (NRMP) data from 2014 to 2024. RO was defined as the total number of abstracts, presentations, and publications reported by matched and unmatched U.S. MD applicants to neurological surgery. Percent increases were calculated for each two-year cycle. Findings were contextualized using published literature on match competitiveness, academic integrity, and research equity.

Results:

Between 2022 and 2024—the first application cycle affected by pass/fail Step 1 scoring—matched applicants' average RO increased by 46.7% (from 25.5 to 37.4), while unmatched applicants saw a 171.8% increase (from 11.7 to 31.8). These surges far exceeded the linear growth observed in prior cycles. This escalation raises concerns about the rising use of research

productivity as a de facto screening tool, potential increases in unethical practices such as unverifiable publications, and growing inequities for students lacking institutional or financial support.

Conclusions:

The elimination of numeric Step 1 scores may have inadvertently intensified pressure on medical students to produce research, exacerbating existing disparities and encouraging unsustainable academic behaviors. Increased transparency around how residency programs evaluate RO, along with safeguards for equity and academic integrity, are urgently needed.

Introduction

Neurological surgery (NS) is among the most competitive medical specialties, with 331 U.S. MD applicants vying for just 268 positions in the 2025 Match.¹ Successful applicants often excel in a variety of academic metrics including standardized test scores, clerkship performances, letters of recommendation, and research. Historically, numeric USMLE Step 1 scores were utilized by residency program leadership to screen and assess applicants.² In January 2022, however, Step 1 shifted to a pass/fail (P/F) scoring system, eliminating the ability for residency programs to utilize this score as a screening metric.³ This change has led many to speculate that other academic factors, such as research experiences and publications, would grow in importance. This makes the Class of 2025 a critical inflection point for evaluating how various selection criteria may evolve in competitive specialties, such as neurosurgery.

Methods

Research output (RO) is defined by the NRMP as the sum of abstracts, presentations, and publications, serving as the primary measure of scholarly productivity among applicants. Every two years, the National Resident Matching Program (NRMP) releases a biennial report that outlines various applicant metrics provided to residency programs for each participating specialty for both matched and unmatched applicants, including RO.⁴

Results

Over the last decade, data from the NRMP has shown RO among successfully matched NS applicants with Step 1 scores has demonstrated positive, linear growth.⁴ On average, RO for this cohort during this time increased by 21.5% during each two-year interval. From 2022 to

2024, however, RO for successfully matched applicants increased by 46.7% (25.5 to 37.4) (Figure 1A). Figure 1A shows this clear trend in RO growth among matched applicants from 2014–2024. This surge diverges significantly from previous growth patterns, signaling a potential shift in how applicants are evaluated. Moreover, RO among unmatched applicants over the past decade remained relatively constant from 2014 to 2022. From 2022 to 2024, however, RO increased from 11.7 to 31.8, representing a 171.8% increase in just two years. Figure 1B further illustrates the accelerating rate of growth in RO since 2016.

This unprecedented spike among both successful and unsuccessful applicants suggests that a novel factor, such as the lack of a Step 1 score, may be responsible for this increase that has exceeded the expected RO based on historical trends. One such explanation may be that NS program directors have shifted the weight placed on Step 1 scores to RO and are now utilizing this metric as a screening tool. An alternative explanation may be that applicants who no longer can distinguish themselves from their peers with Step 1 scores are turning to research to bolster their applications. This theory is supported by the increase in RO seen in both matched and unmatched NS applicants, as 2024 unmatched applicants have 24.7% greater RO than their 2022 matched counterparts. It is likely that this increase in RO was possible due in part by the additional time medical students would have been able to devote to scholarly activities during their preclinical years rather than maximizing their Step 1 scores.

Discussion

While the ability to produce a significantly higher amount of RO may be explained in part by the decreased time spent preparing for Step 1, there is also a concern for potential abuse

of this system in the form of “ghost publications” where applicants falsely list publications they have authored despite having never done so. For example, at one general surgery residency program, 33% of all publications listed on applications by students were unverifiable.⁵ This raises concern about the current mechanisms used to verify applicant credentials and whether safeguards are adequate in the P/F era. Another questionable practice that may be in play among students wishing to maximize their RO is authorship padding in which a group of students reciprocally list one another as authors on papers to which they did not contribute.

Others have suggested that the increased pressure placed on students to produce high quantities of research has led to lower-quality publications deemed “research pollution.”⁶ The intense pressure to produce an ever-increasing volume of research, combined with other academic requirements to complete medical school, may contribute to an unsustainable burden on students. This environment may contribute to burnout even before entering residency. This pressure is compounded by the ambiguity in how research is being weighed relative to other application components, leaving students clueless to the optimal strategy to maximize application success. The current trajectory of RO among NS applicants suggests a system that may be reaching a breaking point. Table 1 summarizes the raw RO data and percent change per cycle, further contextualizing the increased trend.

Although RO as a metric is helpful for tracking the total number of abstracts, presentations, or publications, it has limitations. Specifically, it does not provide specific insight into where the bulk of this metric may lie. Without transparency into this breakdown, applicants may overemphasize quantity over quality, which may risk diluting the academic rigor of

published work. As a result, it can be difficult to accurately assess if the rise in RO is due to higher rates of abstracts, publications, or presentations. This knowledge is important as it has implications for those wishing to successfully match into NS. If the rise in RO has been due more in part to increased publications, those at institutions that provide better access to open-access funding may be at a distinct advantage. If the rise in RO is due to an increase in conference presentations, those at schools that provide travel stipends or students from families of higher socioeconomic backgrounds will likely benefit. Moreover, the rising pressure to increase RO may force more students to pursue research years before applying to residency in order to build a competitive application. This poses additional challenges as research years often impose financial sacrifices that students must accept by delaying their time to practice by an additional year. In addition to the opportunity cost of time, students may incur significant financial burdens from research experiences, including unpaid research years, travel expenses to present at conferences, and open-access publication fees. These cumulative costs can exceed several thousand dollars per applicant, especially for those undertaking a dedicated research year. These barriers may disproportionately affect students from less privileged backgrounds, further widening the gap in access to competitive specialties.

Table 1 summarizes the raw RO data and percent change per cycle, further contextualizing the increasing trend. Taken together, these findings reflect a shifting standard that places more weight on scholarly productivity, yet lacks transparent benchmarks or equity safeguards.

| Year | Avg. Research Output (Matched) | % Increase from Previous Cycle |
|------|-----------------------------------|-----------------------------------|
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| 2014 | 11.7 | — |
| 2016 | 13.4 | 14.5% |
| 2018 | 18.3 | 36.6% |
| 2020 | 23.4 | 27.9% |
| 2022 | 25.5 | 9.0% |
| 2024 | 37.4 | 46.7% |

Table 1: Research Output and Percent Increase (2014-2024)

Conclusion

Additional research is needed to determine how residency leadership evaluates research productivity in the absence of Step 1 scores. Surveys of neurosurgery program directors, along with analysis of actual applicant publication records, could clarify which components of RO matter most and how they influence selection decisions. Such insights would help standardize expectations for applicants and potentially mitigate the unintended consequences of the current arms race in research production. This is especially important as research productivity may now function as a de facto screening metric in place of Step 1 scores.

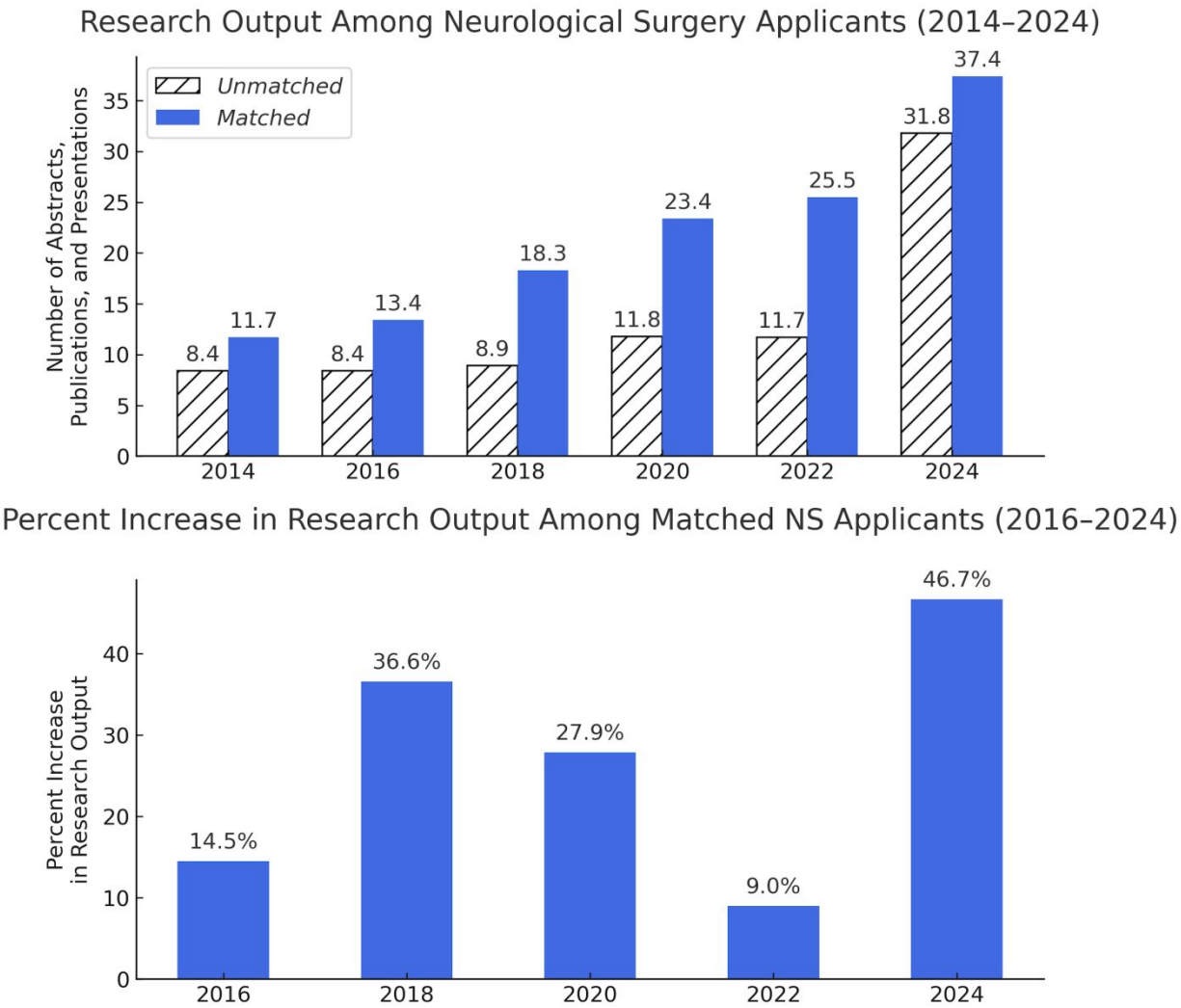


Figure 1.

A) Research output among neurological surgery applicants from 2014–2024, measured as the average number of abstracts, presentations, and publications reported by matched and unmatched U.S. MD applicants per NRMP cycle.

B) Percent increase in research output among matched neurological surgery applicants from 2016–2024, illustrating the acceleration in scholarly activity over recent application cycles.

Ethical considerations: This study did not involve human subjects research or patient data. All data were derived from publicly available, de-identified datasets and did not require IRB approval.

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Consent for publication: Not applicable.

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Writing – original draft: James R. Burmeister, Ismail Zazay

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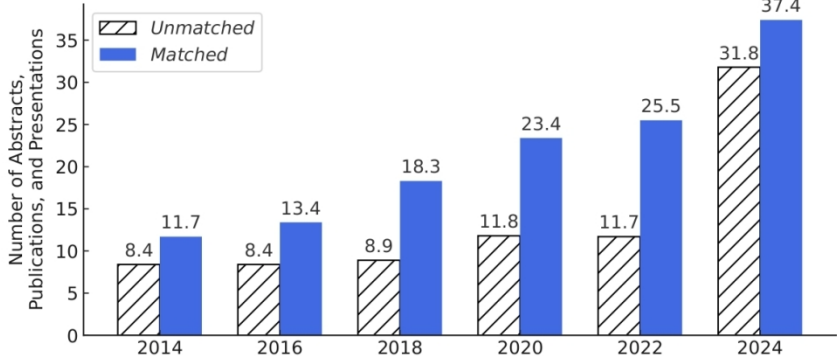
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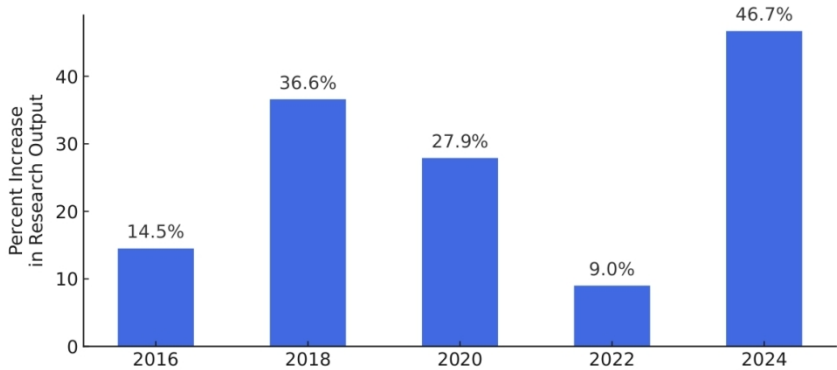
References

1. Results and Data: 2024 Main Residency Match. NRMP. May 29, 2025. Accessed June 14, 2025. <https://www.nrmp.org/match-data/2024/06/results-and-data-2024-main-residency-match/>
2. Vaysburg DM, Cortez AR, Hanseman DJ, et al. An analysis of applicant competitiveness to general surgery, surgical subspecialties, and integrated programs. *Surgery*. 2021;170(4):1087-1092. doi:10.1016/j.surg.2021.03.035
3. Huq S, Khalafallah AM, Botros D, et al. Perceived impact of USMLE Step 1 pass/fail scoring change on neurosurgery: program director survey. *J Neurosurg*. 2020;133(3):928-935. doi:10.3171/2020.4.JNS20748
4. Charting Outcomes™: Characteristics of U.S. MD Seniors Who Matched to Their Preferred Specialty: 2024 Main Residency Match®. NRMP. August 20, 2024. Accessed September 22, 2024. <https://www.nrmp.org/match-data/2024/08/charting-outcomes-characteristics-of-u-s-md-seniors-who-matched-to-their-preferred-specialty-2024-main-residency-match/>
5. Kuo PC, Schroeder RA, Shah A, Shah J, Jacobs DO, Pietrobon R. “Ghost” publications among applicants to a general surgery residency program. *J Am Coll Surg*. 2008;207(4):485-489. doi:10.1016/j.jamcollsurg.2008.04.029
6. Elliott B, Carmody JB. Publish or Perish: The Research Arms Race in Residency Selection. *J Grad Med Educ*. 2023;15(5):524-527. doi:10.4300/JGME-D-23-00262.1

Research Output Among Neurological Surgery Applicants (2014–2024)



Percent Increase in Research Output Among Matched NS Applicants (2016–2024)



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