A Review of Program Signaling Effects, Perceptions, and Trends for Medical Residencies

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ABSTRACT

Background Program signaling is a relatively new tool in the residency application process, introduced to help applicants express genuine interest in programs amid rising application numbers. While its use has rapidly expanded across specialties, the number and type of signals vary. Limited cross-specialty analysis hinders identification of best practices, leaving applicants and programs without standardized guidance about how to use signaling to achieve specific goals.

Objective This review summarizes the quantitative effects of program signaling on application volume and interview yield, stakeholder perceptions, and evolving trends in signaling use.

Methods A systematic search on 3 databases was conducted from January 2021 through May 2024. Four independent reviewers screened studies for original, empirical data on program signaling. A narrative review synthesized findings on outcomes and stakeholder opinions.

Results Of 98 studies screened, 31 (32%) met inclusion criteria. Data from multiple specialties showed that signaling increased interview yield, though benefits did not scale with the number of signals offered. Allowing more signals was associated with fewer applications per program in some specialties. Both applicants and program directors generally viewed signaling positively. Applicant satisfaction was higher in specialties with fewer signals. Over time, there has been a trend toward increasing signals and implementing tiered models.

Conclusions Program signaling is associated with increased interview yield across specialties. Most program directors and applicants support its continued use. Applicants desire greater transparency in how programs use signals.

Introduction

Program signaling, also called preference signaling within the Electronic Residency Application System (ERAS), allows applicants to send a "signal" to a select number of programs to indicate special interest. Program signaling has emerged as a critical tool in managing high applicant volumes, enabling residency directors to better identify genuine interest from applicants.[1] Initially inspired by economic principles,[2] signaling was adapted to address the increasing challenges of applicant-program alignment. This is especially true as the COVID-19 pandemic and a shift to virtual interviews led to the unintended consequences of an increase in number of applications submitted per applicant, along with an increased disparity in number of interviews received and attended between applicants.[3] As more specialties adopt program signaling in residency application cycles, the structure, number of signals allowed, and perceived effectiveness vary widely. However, there is a lack of comprehensive, cross-specialty analysis evaluating how different signaling models affect interview yield, application volume, and stakeholder perceptions across different fields. This gap makes it difficult to determine best practices for specialties newly implementing or changing their signaling practices or to understand whether signaling benefits are consistent across specialties. Comparative analysis of signaling models across specialties is essential to promote transparency of their effects for both program directors and applicants, support advocacy within specialties for appropriate signal allocation, and advise applicants with evidence-based recommendations.

Currently, there is no standardization across specialties in the use of program signaling. The numbers of signals offered and the presence or absence of tiered signals available to applicants vary between specialties. Additionally, individual programs may use signals differently and advise applicants differently. Existing studies explore signaling effects within individual specialties on application volume, interview yield,

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Editor's Note: The online supplementary data contains the number of signals offered by specialty per year for those using tiered signaling.

and other quantitative effects, and offer preliminary insights into applicant and program experiences.[1,2,4] ERAS has published data across specialties largely examining participation by applicants and programs, signal allotment by applicants, number of signals received by programs, and aggregate opinions of applicants and program directors from many specialties.[4] Our group of authors, including educators from multiple specialties, undertook this review to compare the effects of signaling models between specialties. Our study aimed to address the following knowledge gaps: How do variations in signal quantity and type impact application volume received by programs and interview yield for applicants across specialties? What are the qualitative experiences and opinions of applicants and program directors regarding these signaling models in their own specialties? Are there identifiable trends in how specialties change their use of signals over time? To our knowledge, this is the first study to review both the quantitative and qualitative effects of program signaling between specialties. Although the number of allotted signals differs across specialties, an analysis of signal quantity and applicant outcomes is important to characterize the relative value of a signal, compare the effects of different models to determine the optimal approach for signal allotment based on specialty goals, and provide clarity in advising applicants during the Match process from program leadership.

Methods

Literature Search and Article Selection

On May 20, 2024, we performed a systematic, computerized search of PubMed, Embase, and Web of Science. Search terms included "preference signaling" OR "program signaling," searched by title, abstract, and keyword. Our study included peer-reviewed articles that contained original research and empirical data. Reviews, editorials, and commentaries, as well as perspective and opinion pieces were excluded. Only English-language articles on the medical residency application process in the United States were included. The date range of included articles was from January 1, 2021 through May 20, 2024.

This study is authored by a group of medical students and attending physicians from various specialties. The students contribute perspectives informed by their scholarly engagement with the residency application process, while the attending physicians offer insights grounded in their experience with applicant evaluation and program administration. A 2-tiered review process was used. To identify relevant articles, 4 reviewers (J.V., A.L., M.G., I.S.) independently screened all articles based on title and/or abstract. The reviewers then independently reviewed the full text of the selected articles to determine final inclusion and reviewed the reference list of the screened articles to identify additional articles.

Inclusion Criteria

Broad criteria were used for full-text review to ensure the inclusion of all relevant literature. Articles were included if they addressed any of the following topics: (1) impact of program signaling on interview yield for applicants, (2) effect of program signaling on application volume received by programs, (3) program directors' and applicants' opinions on the use of preference signaling, or (4) trends in how specialties change use of program signals over time. Quantitative results and qualitative trends identified by the screening authors were reviewed and analyzed by the entire author group to determine whether and how the results addressed the identified knowledge gaps.

Analysis

We performed a narrative review due to its flexibility and capacity for detailed interpretation, making it ideal for synthesizing existing knowledge on an emerging topic with varied applications across specialties. Given the lack of standardization in program signaling practices, a narrative review allowed us to include and analyze literature from different specialties with both quantitative and qualitative focuses, identifying trends, gaps, and qualitative insights that may be missed by more systematic review types with a narrower research question. Statistical analysis was deferred in favor of exploration of broad trends, given the heterogeneity of study types and methods among the reviewed articles.

Our study was exempt from institutional review board approval as it did not involve original data collection from individuals or direct interaction with human subjects.

Results

Of the 98 studies screened, our search yielded 52 articles containing original, empirical data surrounding the implementation of program signaling. The characteristics of these 52 articles are summarized in TABLE 1. Thirty-one articles met inclusion criteria by addressing 1 of the 4 topics for inclusion. The article selection process is detailed in FIGURE 1. TABLE 2 presents citations from all 31 articles that met final inclusion criteria and highlights both quantitative and qualitative trends in preference signaling across specialties.

Effects of Program Signaling on Interview Yield

Most specialties began with 7 or fewer signals, with some offering as few as 3 per applicant (FIGURE 2).

TABLE 1
Characteristics of the 52 Articles Meeting Preliminary Inclusion Criteria

Characteristics	n (% of Included Articles)
Publication year	
2021	1 (1.9)
2022	10 (19.2)
2023	17 (32.7)
2024	24 (46.1)
Specialty	
Multispecialty/general findings	9 (17.3)
Urology	8 (15.4)
Otolaryngology	7 (13.5)
Orthopedic surgery	6 (11.5)
Obstetrics and gynecology	5 (9.6)
Dermatology	5 (9.6)
Radiology	3 (5.8)
Plastic surgery	3 (5.8)
Internal medicine	2 (3.8)
General surgery	1 (1.9)
Ophthalmology	1 (1.9)
Family medicine	1 (1.9)
Child neurology	1 (1.9)

Otolaryngology (ENT) was the first to implement program signaling, offering 5 signals in the 2020-2021 and 2021-2022 application years, and 7 signals in the 2023 application year. The effect of program signaling on interview yield by specialty is summarized in TABLE 3. Early iterations of program signaling were associated with higher odds of receiving an interview, with studies reporting applicants who signaled having 8.5 and 6.7 times greater odds compared to those who did not signal.[5,6] Similarly, in internal medicine with 5 signals, an increase was observed in interview yield, with 2.95 times greater odds of receiving an interview at a signaled program.[7] In dermatology, with 3 signals, signaling increased chances of being interviewed,[8] with programs interviewing 21.1% of applicants who signaled and 3.7% of applicants who did not.[9] In urology, offering 5 signals in the 2021-2022 and 2022-2023 years, interview yield was also increased for applicants who signaled, with programs reporting an interview rate for signaling applicants of 54.2% and non-signaled applicants of 40.5%, and another reporting an odds ratio of 2.74 for applicants signaling vs not signaling.[10,11]

Several other specialties implemented program signaling using a larger number of signals. In the 2022-2023 application cycle, orthopedic surgery became the specialty with the largest number of program signals, offering applicants 30 signals.[12-17] Orthopedics applicants were significantly more likely to receive interviews at signaled programs,[12-14,17] and interviews were also spread more evenly across applicants.[13] Women were significantly more likely to receive interviews at signaled programs than male counterparts who signaled.[12,13] This amplified effect was not observed in those identifying as underrepresented in medicine (URiM), and did not change odds of matching for either women or URiM applicants.[13] Program directors consistently ranked program signaling among the 3 most important factors in resident selection,[15-17] and used signaling as a screening tool to decide whom to interview and to differentiate between similar applicants.[14,15] Just over half of orthopedics program directors reported they only interviewed applicants who signaled.[14,17]

Obstetrics and gynecology (OB/GYN) also implemented program signaling in the 2022-2023 application year, offering 18 signals, with 3 signals designated "gold," indicating a high level of interest, and 15 signals designated "silver," indicating a lower tier of special interest in programs.[18-21] Chances of obtaining an interview correlated with the value of the signal. Signaling most substantially increased the chances of receiving an interview (62.5%-66.0%) for gold signaled programs, followed by silver signaled programs (33.0%-43.8%).[19-21] There was no significant difference in number of interviews received from signaled programs as a function of race/ethnic group.[20] Program directors reported using program signaling to screen applicants and as a "tiebreaker" between applicants.[19]

Effects of Program Signaling on Application Volume

In urology, offering 5 signals in the 2021-2022 and 2022-2023 application years,[10] application volume continued to rise despite implementation of program signaling.[22,23] In OB/GYN, using 18 signals, there was no change in total applications submitted per applicant with implementation of program signaling.[21] In orthopedics, using 30 signals, both applicants and program directors reported a decrease in the average number of applications submitted per orthopedics applicant.[12,13,16] Over half of orthopedics program directors reported a decrease in total number of applications received by the program.[17]

Applicant and Program Director Opinions of Program Signaling

Data in specialties using fewer signals suggest overall positive perceptions of program signaling (TABLE 3). Otolaryngology applicants viewed signaling favorably in its inaugural year, with 75% supporting its use in future cycles.[6] Likewise, urology survey data from 2022 and 2023 indicated positive applicant

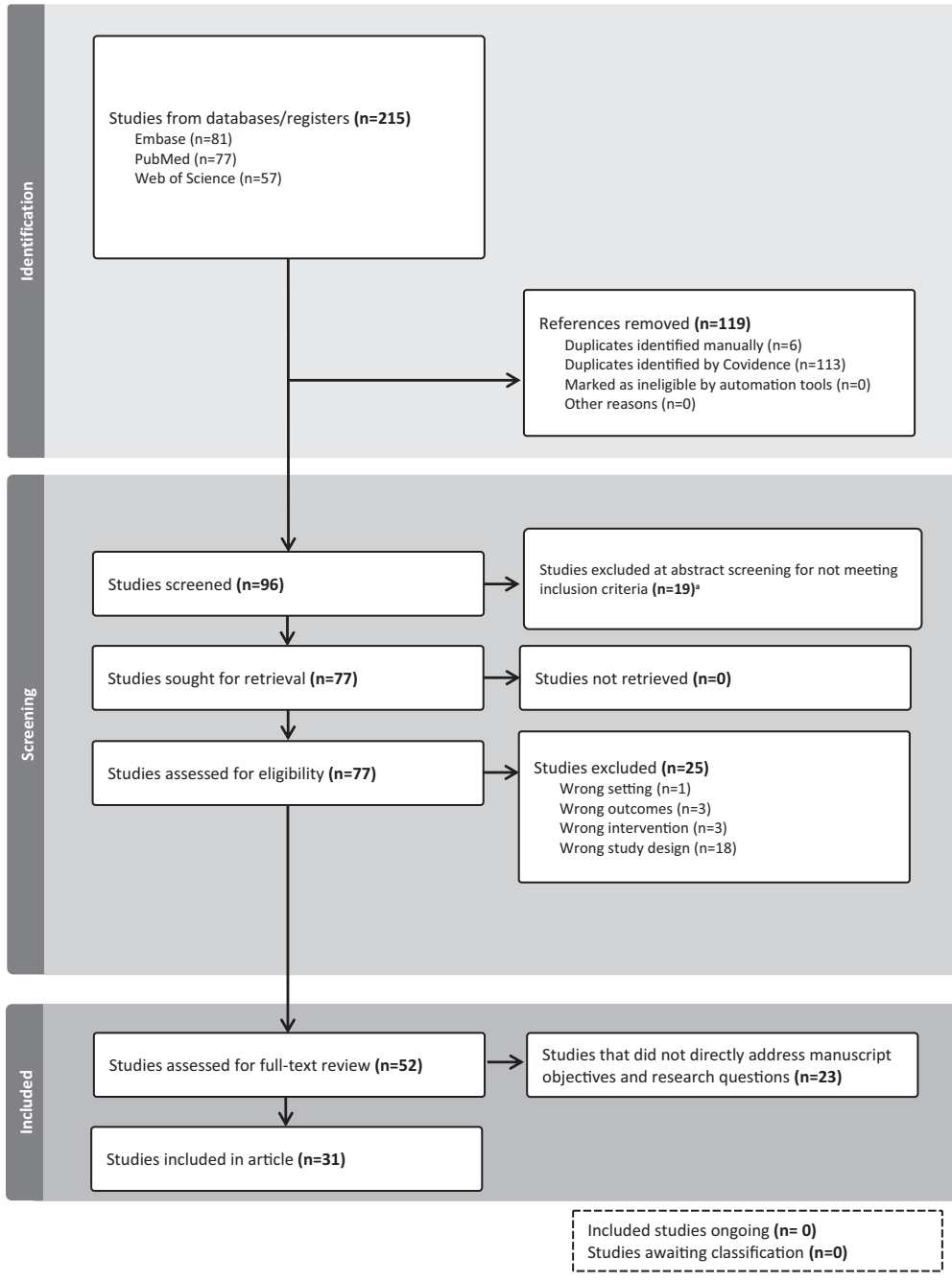

FIGURE 1
Article Selection Diagram

[a]These studies did not address core topics: impact of program signaling on interview yield for applicants, effect of program signaling on application volume received by programs, opinions of program directors or applicants on preference signaling, or trends in specialty use of program signaling over time.

opinions regarding signaling, with 82% to 96% of surveyed applicants supporting continued implementation.[10,11,22,24] One study across 3 integrated plastic surgery residency programs also noted that 80% of applicants were in favor of continuing program signaling.[4] Emergency medicine applicants viewed signaling favorably in its inaugural year, with 75% supporting its use in future cycles.[25] Program directors in specialties using fewer signals also viewed program signaling positively and supported continued usage: otolaryngology (91%), plastic surgery (78%), emergency medicine (90%), urology (81.8%), child neurology (97%), and family medicine (68%), according to nationwide program director survey data.[1,11,25-28]

In orthopedics, with 30 signals, over half of applicants surveyed found program signaling helpful, compared to

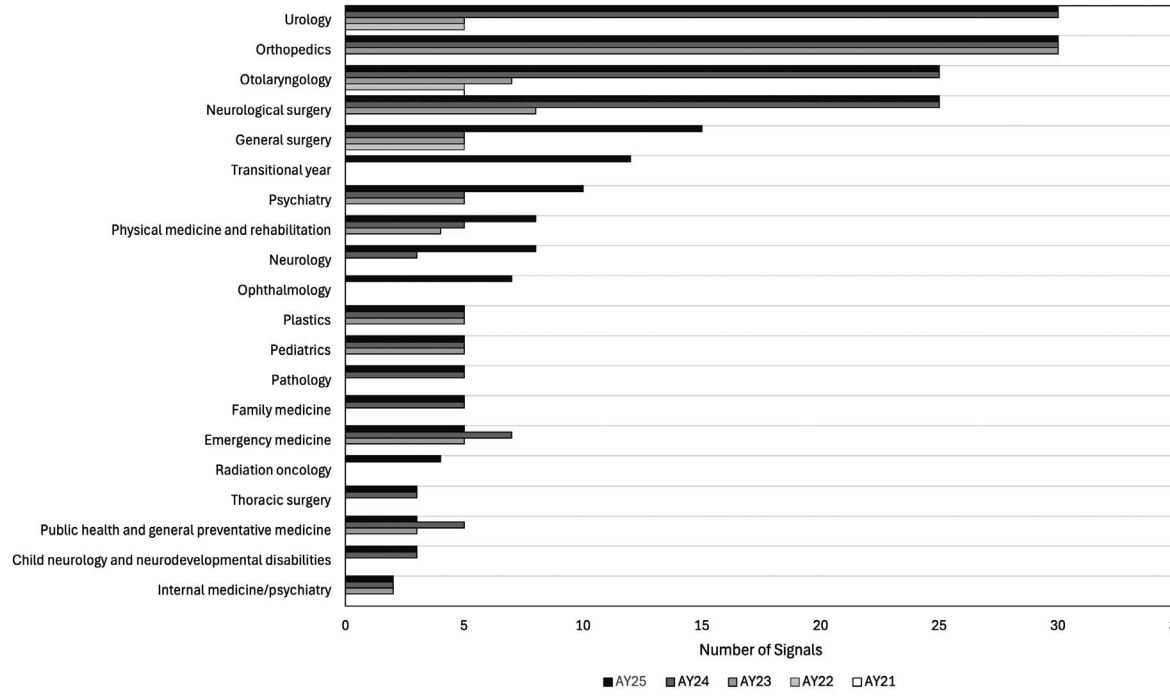

FIGURE 2
Number of Signals Offered Over Time by Specialty
Abbreviation: AY, academic year.

under a third who found it unhelpful.[12] Orthopedics applicants believed that signaling a program increased, and that not signaling a program decreased, their chance of receiving an interview.[15] Positive perceptions were also reported by over 90% of orthopedics program directors.[16,17]

In OB/GYN, with 18 tiered signals, half of the applicants felt positively, and just under a third felt negatively about the use of program signaling in their cycle.[20,21] OB/GYN applicants also noted that their experience with program signaling was hindered by inconsistent guidance, given the novelty of program signaling, and increased anxiety when allocating their signals. When reflecting, they called for greater transparency around programs' use of signals. For example, applicants expressed desire for a list of programs that felt "if you don't signal us we won't even look at your application" and wanted "more honest feedback about how program directors viewed signaling."[18] Applicants also expressed desire for centralized advising about how to use signaling, noting that information was often "word of mouth" and contained "varied feedback from different people."[18] Sixty-nine percent of OB/GYN program directors found program signaling helpful, and 45.4% felt that program signaling improved their ability to conduct holistic review and invite applicants for interviews that they may not have previously.[19]

Trends in Specialties Changing Their Use of Signaling

Since the implementation of program signaling, otolaryngology, dermatology, urology, internal medicine, anesthesiology, psychiatry, diagnostic and interventional radiology, neurological surgery, neurology, and physical medicine and rehabilitation have increased the number of signals offered, with otolaryngology, urology, dermatology, and neurological surgery offering the highest number of signals (FIGURE 2). Emergency medicine is one of the only specialties that decreased their specialty signal tokens from 7 in the 2023-2024 cycle to 5 in the 2024-2025 cycle (FIGURE 2).[4] Dermatology, internal medicine, anesthesiology, and diagnostic and interventional radiology have shifted to a tiered approach, increasing the number of signals and adding the option to allocate "gold" and "silver" signals (online supplementary data TABLE).

Discussion

Across specialties, signaling appears to be associated with an applicant's chance of receiving an interview, with all specialties having available data reporting an increase in interview yield with the use of a signal (TABLE 3). There does not appear to be a clear trend in the degree of increase in interview yield between specialties based on the number of signals offered.

TABLE 2
Summary of Literature on Preference Signaling in Medical Residency Applications

Authors	Title	Journal	Year	Key Focus Area
Pletcher SD et al[1]	Interview Invitations for Otolaryngology Residency Positions Across Demographic Groups Following Implementation of Preference Signaling	*JAMA Network Open*	2023	Otolaryngology
Salehi PP et al[2]	A Novel Approach to the National Resident Matching Program—The Star System	*JAMA Otolaryngology–Head & Neck Surgery*	2018	Matching process
Meyer AM et al[3]	COVID-19 Increased Residency Applications and How Virtual Interviews Impacted Applicants	*Cureus*	2022	COVID-19 impact
AAMC[4]	ERAS 2023: Supplemental ERAS Application Resources & Information	AAMC	2024	ERAS resources
Pletcher SD et al[5]	The Otolaryngology Residency Program Preference Signaling Experience	*Academic Medicine*	2022	Otolaryngology
Chang CWD et al[6]	Two-Year Interview and Match Outcomes of Otolaryngology Preference Signaling	*Otolaryngology–Head and Neck Surgery*	2023	Otolaryngology
Szumel ES et al[7]	Outcomes of the Internal Medicine Supplemental Application: Preliminary Data on the 2022-2023 Match	*Cureus*	2024	Internal medicine
Wyant WA et al[8]	Recommendations for Optimizing Preference Signaling in the Dermatology Residency Application Process	*Archives of Dermatological Research*	2023	Dermatology
Dirr MA et al[9]	Dermatology Match Preference Signaling Tokens: Impact and Implications	*Dermatologic Surgery*	2022	Dermatology
Leopold Z et al[10]	Preference Signaling in the 2022 Urology Residency Match—The Applicant Perspective	*Urology*	2022	Urology
Rodriguez-Alvarez JS et al[11]	Diversity Attracts Diversity: 2023 AUA Match Results	*Urology*	2023	Urology, diversity
Deckey DG et al[12]	Decoding the Signals: An Analysis of Preference Signaling in the 2023 Orthopaedic Surgery Residency Match	*JB & JS Open Access*	2023	Orthopaedic surgery
Kotlier JL et al[13]	Understanding the Match: The Effect of Signaling, Demographics, and Applicant Characteristics on Match Success in the Orthopaedic Residency Application Process	*Journal of the American Academy of Orthopaedic Surgeons*	2024	Orthopaedic surgery
Sorenson JC et al[14]	The Value of Signaling an Orthopaedic Surgery Program: A Survey to Orthopaedic Surgery Programs	*Journal of the American Academy of Orthopaedic Surgeons Research & Reviews*	2023	Orthopaedic surgery
Minhas A et al[15]	Perceptions of Preference Signaling in Orthopaedic Surgery: A Survey of Applicants and Program Directors	*Journal of the American Academy of Orthopaedic Surgeons*	2024	Orthopaedic surgery
Mun F et al[16]	Preference Signaling for Orthopaedic Surgery Applicants: A Survey of Residency Program Directors	*Journal of the American Academy of Orthopaedic Surgeons*	2022	Orthopaedic surgery

TABLE 2
Summary of Literature on Preference Signaling in Medical Residency Applications (continued)

Authors	Title	Journal	Year	Key Focus Area
Suresh KV et al[17]	Preference Signaling Survey of Program Directors—After the Match	*Journal of the American Academy of Orthopaedic Surgeons*	2024	Orthopaedic surgery
Kraus AC et al[18]	Mixed Signals: Navigating the Obstetrics and Gynecology Signaling Initiative	*Journal of Surgical Education*	2024	Obstetrics and gynecology
Banks E et al[19]	Program Signaling in Obstetrics and Gynecology Residency Applications	*Obstetrics & Gynecology*	2024	Obstetrics and gynecology
Schoppen Z et al[20]	Applicant Experience in Communication With Residency Programs After the Introduction of Program Signaling	*Journal of Surgical Education*	2023	Program communication
Cai F et al[21]	The Golden Tickets: Impact of Preference Signaling on Obstetrics and Gynecology Residency Applicants	*American Journal of Obstetrics and Gynecology*	2024	Obstetrics and gynecology
Carpinito GP et al[22]	Preference Signaling and Virtual Interviews: The New Urology Residency Match	*Urology*	2023	Urology
Heard J et al[23]	The New Urology Match: How Recent Innovations Including Virtual Interviews and Preference Signaling Have Changed Match Outcomes	*Cureus*	2024	Urology
Traxel E et al[24]	Preference Signaling Pilot in the Urology Match: Outcomes and Perceptions	*Urology*	2022	Urology
Pelletier-Bui AE et al[25]	Making Our Preference Known: Preference Signaling in the Emergency Medicine Residency Application	*The Western Journal of Emergency Medicine*	2021	Emergency medicine
Snellings JE et al[26]	New Tools for Resident Recruiting Season: A CERA Survey of Family Medicine Residency Program Directors	*Family Medicine*	2023	Family medicine
Sarac BA et al[27]	The Plastic Surgery Central Application versus ERAS: Which Is Preferred?	*Plastic and Reconstructive Surgery–Global Open*	2024	Plastic surgery
Mandle Q and Ream MA[28]	Child Neurology and Neurodevelopmental Disabilities Program Directors' Opinions on Preference Signaling in the 2023-2024 National Resident Matching Program Match: A Survey	*Pediatric Neurology*	2024	Child neurology
AAMC[29]	Supplemental ERAS Application Data and Reports	AAMC	2024	ERAS data
Zarate Rodriguez JG et al[30]	Preference Signaling for General Surgery Residency: How Should Applicants Use Signaling?	*Journal of Surgical Research*	2024	General surgery
Elboraey MA et al[31]	Preference Signaling for the Diagnostic Radiology Match: A Single Institution Experience	*Current Problems in Diagnostic Radiology*	2023	Diagnostic radiology

Abbreviations: AAMC, Association of American Medical Colleges; ERAS, Electronic Residency Application Service; AUA, American Urological Association; CERA, Council of Academic Family Medicine Educational Research Alliance.

TABLE 3
Quantitative and Qualitative Trends in Preference Signaling Across Specialties

Specialty	No. of Applications Received by Programs After Implementation	Interview Yield of Signaling	Applicant Perceptions	Program Director Perceptions
Urology	Increase[22,23]	Increase[10,11,24]	Positive[11,22,24]	Positive[24]
Internal medicine	No data	Increase[7]	No data	No data
Child neurology	No data	No data	No data	Positive[28]
Dermatology	No data	Increase[8,9]	No data	No data
Plastics	No data	No data	Positive[27]	Positive[27]
Family medicine	No data	No data	No data	Positive[26]
Otolaryngology	No data	Increase[1,5]	Positive[5]	Positive[1,5]
Orthopedics	Decrease[12,13,17]	Increase[12-15,17]	Positive[12]	Positive[15,17]
Obstetrics and gynecology	No change[20,21]	Gold-increase[19,21] Silver-increase[19,21]	Mixed[20,21]	Positive[19]

Note: Interview yield was defined as rates of interviews resulting from signaled programs compared to non-signaled programs. Specialties that had publications but did not address these themes include general surgery, anesthesiology, psychiatry, emergency medicine, diagnostic radiology, and interventional radiology. The following specialties implemented preference signaling but did not have published literature: internal medicine/psychiatry, neurodevelopmental disabilities, neurological surgery, neurology, pathology-anatomical and clinical, pediatrics, physical medicine and rehabilitation, public health and general preventive medicine, thoracic surgery-integrated, and radiation oncology.

The data on the effect of program signaling on application volume is limited, and an area for further research. While reducing application volume was identified as a central goal of implementing program signaling,[2,12,13,16,17] the use of as few as 5 signals in urology is not correlated with a reduction in number of applicants per program (TABLE 3). OB/GYN's use of 18 signals maintained applicant volume without change.[21] On the other hand, the use of 30 signals in orthopedics modestly reduced application volume.[17] This may suggest that increasing the number of signals increases the efficacy of the use of program signals at reducing application volume, potentially because omitting a program more strongly indicates disinterest.

Overall, most applicants and program directors appear to have positive perceptions of program signaling at any number of signals (TABLE 3). Interestingly, while program directors across all specialties indicated positive opinions and desire to continue the use of program signaling, applicant satisfaction and desire to continue use of program signaling was higher in specialties using fewer signals. This may be because the principal goal of applicants is to increase their chances of obtaining an interview at their most desired programs. While interview yield is increased for those who signal in any specialty, in specialties using fewer signals this increased chance of an interview is at one of the applicants' top few programs, rather than one of their top 30.

Lower applicant satisfaction rates were observed in applicants in OB/GYN (18 signals), who indicated a need for greater transparency in how applicants should use signals.[18] Tiered systems such as that used in OB/GYN may generate more anxiety due to the added layer of complication for applicants in deciding which tier to allocate to programs. Further, applicants in all specialties may receive conflicting information regarding how to allocate signals across "reach," "target," and "safety" programs, using geographic signals, as well as to home programs and programs where they completed away rotations. ERAS data from the 2021-2022 cycle indicates that strategy for how to use signals was the most common question asked of specialty advisors. Just under half of advisors in 2021-2022 and 2022-2023 reported they disagreed or strongly disagreed that they were confident in advising students how to use signals, and advisors took a variety of approaches, with just over 70% advising students to mix their signals between reach and safety programs, and just under half advising students to signal programs they were truly most interested in regardless of competitiveness.[4,29] Applicants need clear recommendations for how they should strategically use signals, as well as greater transparency from residency programs on how signals are used to make interview and rank list decisions.[6,30]

Specialties that have changed their program signaling policies appear to trend toward increasing the number of signals offered (FIGURE 2) and adding tiered signals (TABLE 3). This may indicate that although the use of fewer signals may make each signal a stronger indicator of interest, it is not sufficient to curb the rise in application numbers. Tier-based signaling is a possible method of identifying programs of particular interest (gold) while also providing enough signals (silver) to curb application volume.

Several gaps in literature still exist. At the time of review, most programs published data using a smaller number of signals, and data from specialties using a larger number of signals is limited to orthopedics and OB/GYN. The most recent cycle, which could offer a direct comparison between the use of few and many signals in programs such as urology, otolaryngology, and dermatology, is not well represented within our review. Potential areas for continued work include direct comparison of quantitative effects and opinions within specialties that have changed their signaling practices since implementation. Another area for future study is how signaling affects equity in the residency Match process. Traditional ways of showing interest, such as away rotations, faculty connections, and school prestige, can disadvantage applicants with fewer financial resources or less social capital. Future work should explore whether program signaling offers a more equitable alternative for expressing interest.

There are several limitations to this study. First, this review is limited by the scarcity of cross-specialty data. Differences in study scope (regional vs national) and methodology (survey vs database review) further complicate results interpretation. Second, in the residency application process, both applicant program signals and geographic signals play crucial roles in aligning applicants with programs.[11,22,31] Existing literature highlights that the geographic location of programs significantly influences applicant choices, with program and geographic signals often overlapping.[4] Another limitation of this study is its focus on program signals alone. Further research should investigate the combined influence of geographic and program signals on interview outcomes.

Conclusions

In many specialties with varying numbers of signals, program signaling is associated with an increased interview yield for applicants; however, decreased application volume for programs was reported only in specialties using a higher number of signals. Most program directors and applicants view program signaling positively and support its continued use, though in some specialties, applicants express the desire for greater transparency surrounding signals. As specialties change the number and type of signals offered for residency applications, most trend toward increasing the number and adding tiers.

References

1. Pletcher SD, Chang CWD, Thorne MC, et al. Interview invitations for otolaryngology residency positions across demographic groups following implementation of preference signaling. *JAMA Netw Open*. 2023;6(3):e231922. doi:10.1001/jamanetworkopen.2023.1922
2. Salehi PP, Benito D, Michaelides E. A novel approach to the National Resident Matching Program—the star system. *JAMA Otolaryngol Head Neck Surg*. 2018;144(5):397-398. doi:10.1001/jamaoto.2018.0068
3. Meyer AM, Hart AA, Keith JN. COVID-19 increased residency applications and how virtual interviews impacted applicants. *Cureus*. 2022;14(6):e26096. doi:10.7759/cureus.26096
4. Association of American Medical Colleges. ERAS 2023: Supplemental ERAS Application Resources & Information. Accessed July 14, 2024. connect.aamc.org/resourcelibraries/suppapp
5. Pletcher SD, Chang CWD, Thorne MC, Malekzadeh S. The otolaryngology residency program preference signaling experience. *Acad Med*. 2022;97(5):664-668. doi:10.1097/ACM.0000000000004441
6. Chang CWD, Thorne MC, Malekzadeh S, Pletcher SD. Two-year interview and Match outcomes of otolaryngology preference signaling. *Otolaryngol Head Neck Surg*. 2023;168(3):377-383. doi:10.1177/01945998221121312
7. Szumel ES, Dockery HO, Alexander SM, et al. Outcomes of the internal medicine supplemental application: preliminary data on the 2022-2023 Match. *Cureus*. 2024;16(1):e52305. doi:10.7759/cureus.52305
8. Wyant WA, Hammoud MM, Mosser-Goldfarb J, Strafford K, Tyler K, Korman AM. Recommendations for optimizing preference signaling in the dermatology residency application process. *Arch Dermatol Res*. 2023;316(1):62. doi:10.1007/s00403-023-02743-x
9. Dirr MA, Brownstone N, Zakria D, Rigel D. Dermatology Match preference signaling tokens: impact and implications. *Dermatol Surg*. 2022;48(12):1367-1368. doi:10.1097/DSS.0000000000003645
10. Leopold Z, Rajagopalan A, Mikhail M, et al. Preference signaling in the 2022 urology residency Match—the applicant perspective. *Urology*. 2022;170:33-37. doi:10.1016/j.urology.2022.09.009
11. Rodriguez-Alvarez JS, Munoz-Lopez C, Khouri RK, et al. Diversity attracts diversity: 2023 AUA Match results. *Urology*. 2023;180:21-27. doi:10.1016/j.urology.2023.07.008
12. Deckey DG, Lin E, Gerhart CRB, Brinkman JC, Patel KA, Bingham JS. Decoding the signals: an analysis of preference signaling in the 2023 orthopaedic surgery residency Match. *JB JS Open Access*. 2023;8(3):e23.00052. doi:10.2106/JBJS.OA.23.00052
13. Kotlier JL, Mihalic AP, Petrigliano FA, Liu JN. Understanding the Match: the effect of signaling, demographics, and applicant characteristics on Match success in the orthopaedic residency application process. *J Am Acad Orthop Surg*. 2024;32(5):e231-e239. doi:10.5435/JAAOS-D-23-00613

14. Sorenson JC, Ryan PM, Ward RA, Fornfeist DS. The value of signaling an orthopaedic surgery program: a survey to orthopaedic surgery programs. *J Am Acad Orthop Surg Glob Res Rev*. 2023;7(6):e23.00050. doi:10.5435/JAAOSGlobal-D-23-00050
15. Minhas A, Berkay F, Hudson T, Barry K, Froehle AW, Krishnamurthy A. Perceptions of preference signaling in orthopaedic surgery: a survey of applicants and program directors. *J Am Acad Orthop Surg*. 2024;32(2): e95-e105. doi:10.5435/JAAOS-D-23-00220
16. Mun F, Suresh KV, Li TP, Aiyer AA, LaPorte DM. Preference signaling for orthopaedic surgery applicants: a survey of residency program directors. *J Am Acad Orthop Surg*. 2022;30(23):1140-1145. doi:10.5435/JAAOS-D-22-00478
17. Suresh KV, Covarrubias O, Mun F, LaPorte DM, Aiyer AA. Preference signaling survey of program directors—after the Match. *J Am Acad Orthop Surg*. 2024;32(5): 220-227. doi:10.5435/JAAOS-D-23-00579
18. Kraus AC, Dalrymple JL, Schwartz E, et al. Mixed signals: navigating the obstetrics and gynecology signaling initiative. *J Surg Educ*. 2024;81(4):525-534. doi:10.1016/j.jsurg.2023.12.019
19. Banks E, Winkel AF, Morgan HK, Connolly A, Hammoud MM, George KE. Program signaling in obstetrics and gynecology residency applications. *Obstet Gynecol*. 2024;143(2):281-283. doi:10.1097/AOG.0000000000005470
20. Schoppen Z, Morgan HK, Hammoud M, Marzano D, George K, Winkel AF. Applicant experience in communication with residency programs after the introduction of program signaling. *J Surg Educ*. 2023; 80(12):1762-1772. doi:10.1016/j.jsurg.2023.08.005
21. Cai F, Southworth E, Santiago S, et al. The golden tickets: impact of preference signaling on obstetrics and gynecology residency applicants. *Am J Obstet Gynecol*. 2024;230(2):262.e1-262.e9. doi:10.1016/j.ajog.2023.10.014
22. Carpinito GP, Badia RR, Khouri RK, et al. Preference signaling and virtual interviews: the new Urology Residency Match. *Urology*. 2023;171:35-40. doi:10.1016/j.urology.2022.09.028
23. Heard J, Rawal RY, Amazan B, Jeune KR, Freedman A. The new Urology Match: how recent innovations including virtual interviews and preference signaling have changed Match outcomes. *Cureus*. 2024;16(1): e53167. doi:10.7759/cureus.53167
24. Traxel E, Richstone L, Brown J, Mirza M, Greene K, Thavaseelan S. Preference signaling pilot in the Urology Match: outcomes and perceptions. *Urology*. 2022;170: 27-32. doi:10.1016/j.urology.2022.08.034
25. Pelletier-Bui AE, Schnapp BH, Smith LG, et al. Making our preference known: preference signaling in the emergency medicine residency application. *West J Emerg Med*. 2021;23(1):72-75. doi:10.5811/westjem.2021.10.53996
26. Snellings JE, Moore MA, Meyer DL. New tools for resident recruiting season: a CERA survey of family medicine residency program directors. *Fam Med*. 2023;55(8):522-526. doi:10.22454/FamMed.2023.504726
27. Sarac BA, Jackson K, Schwartz R, Gosman AA, Lin SJ, Janis JE. The plastic surgery central application versus ERAS: which is preferred? *Plast Reconstr Surg Glob Open*. 2024;12(3):e5703. doi:10.1097/GOX.0000000000005703
28. Mandle Q, Ream MA. Child neurology and neurodevelopmental disabilities program directors' opinions on preference signaling in the 2023-2024 National Resident Matching Program Match: a survey. *Pediatr Neurol*. 2024;151:90-95. doi:10.1016/j.pediatrneurol.2023.11.018
29. Association of American Medical Colleges. Supplemental ERAS application data and reports. Accessed November 16, 2024. https://www.aamc.org/data-reports/students-residents/report/supplemental-eras-application-data-and-reports
30. Zarate Rodriguez JG, Caldwell KE, Donald CM, Wise PE, Awad MM. Preference signaling for general surgery residency: how should applicants use signaling? *J Surg Res*. 2024;293:580-586. doi:10.1016/j.jss.2023.09.023
31. Elboraey MA, Overfield C, Taylor SR, et al. Preference signaling for the diagnostic radiology Match: a single institution experience. *Curr Probl Diagn Radiol*. 2023;52(5):334-335. doi:10.1067/j.cpradiol.2023.04.005

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