# From 5 to 15: The Impact of Increased Program Signals in the 2024 to 2025 General Surgery Application Cycle

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**OBJECTIVE:** To evaluate the change from 5 program signals to 15 program signals in General Surgery using data from the 2024 to 2025 cycle using AAMC ERAS® application, Thalamus interview, and NRMP ranking and matching data.

**DESIGN:** Data collected by the NNBME, AAMC, Thalamus, and NRMP were analyzed to assess the impact of program signals on: interview invitation, placement on a program's rank order list (ROL), ranking in the top quartile of a program's ROL, and applicants matching into programs.

**SETTING:** The 2024 to 2025 residency application cycle.

**PARTICIPANTS:** Applicants applying to and ranking programs in General Surgery during the 2024 to 2025 residency application cycle.

**RESULTS:** A significant decrease in the average number of applications per applicant between the 2024 and the 2025 cycle was noted. Candidates were more likely to get an interview invitation and be placed on a program's ROL at a program they signaled when compared to a program they did not signal. Signaling positively impacted candidate median match rate.

**CONCLUSIONS:** These data suggest that program signals are being used by both applicants and programs to help place the right applicant in the right program. The shift to large number of signals may have encouraged applicants to submit fewer applications and it did not negatively impact interview or match outcomes. Ongoing research in this area is critical to better understand the impacts of program signaling on residency and resident selection and to assess any unintended negative consequences. (J Surg Ed 83:104181. © 2026 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights are reserved, including those for text and data mining, AI training, and similar technologies.)

**KEY WORDS:** interview invitations, program signals, residency recruitment, residency match

## INTRODUCTION

Since 1952, hundreds of thousands of candidates have matched to residency programs via the National

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Resident Matching Program's (NRMP®) proprietary algorithm. This algorithm was designed to align the preferences of candidates with preferences of programs. The initial Match in 1952 included 5564 individuals. By 2025, the largest Match in history included over 47,000 individuals applying for 43,237 positions across multiple specialties.[1] Although the number of programs and positions have expanded over time, the rate of increase in the number of applicants has outpaced this growth. The current mismatch between positions and applicants in many specialties, including general surgery, has led to escalating anxiety and competition amongst candidates.

Candidates in general surgery submit applications through the Electronic Residency Application Service (ERAS®). In the 2024 to 2025 cycle, there were 5895 unique general surgery applicants who submitted an average of 60.4 (Standard Deviation = 58.13) applications.[2] This volume of applications has generated significant financial costs for applicants. During the 2024 to 2025 cycle, programs received an average of 1061 applications, or 62 applications per open position.[2] Figure 1 illustrates the rising number of applications over multiple application cycles. Holistic review of this volume of applications in the available short time frame is infeasible for programs. The value of holistic review is to evaluate an applicant based on their whole application without relying on 1 or 2 data elements. This necessitates increased attention to quantitative academic metrics (i.e., COMLEX-USA, USMLE Step 2 CK exam scores, clerkship grades, AOA status, or research publications) rather than best practice mission-aligned selection.[3]

To better understand applicants' preferences for programs at the time of application submission, general surgery adopted program signaling in the 2021 to 2022 cycle. At that time, each general surgery applicant was allowed five program signals. This is characterized as a small number signal approach (SNS) because the number of signals offered was less than 10% of the average number of applications submitted during the 2020 to 2021 cycle. Signals are intended to represent top choice programs.[4]

Over time, other specialties began experimenting with a large number signal (LNS) approach and 2-tier signaling (2TS) to reduce application volume and distribute signals more widely across programs.[4] Following 3 cycles with 5 program signals (2021-2024), the general surgery community opted to increase the number of program signals for the 2024 to 2025 cycle to 15. This change to a LNS approach was hypothesized to decrease the number of applicants per program, allowing programs to more comprehensively and holistically review applications of candidates with expressed specific and genuine interest.

A relatively large body of research on signaling has accumulated over the last 4 years.[5] Data from multiple cycles and specialties show that sending a signal is positively associated with interview invitation and that this effect is stronger when there are a large number of signals.[6-8] Applicants who signal also had higher likelihood of being placed on a rank order list when they signaled.[9]

As the role and number of signals evolve, data must be continuously reviewed to ensure signaling systems are achieving their intended purpose, without precipitating unintended consequences. Applicants with less mentorship, access to program information and sound advising may be most at risk and represent populations that should be carefully followed. The data from the 2025 application cycle and Main Residency Match (MRM) are reviewed here in an effort to understand the effect of the LNS approach in general surgery, specifically with respect to application, interview, ranking, and matching trends.

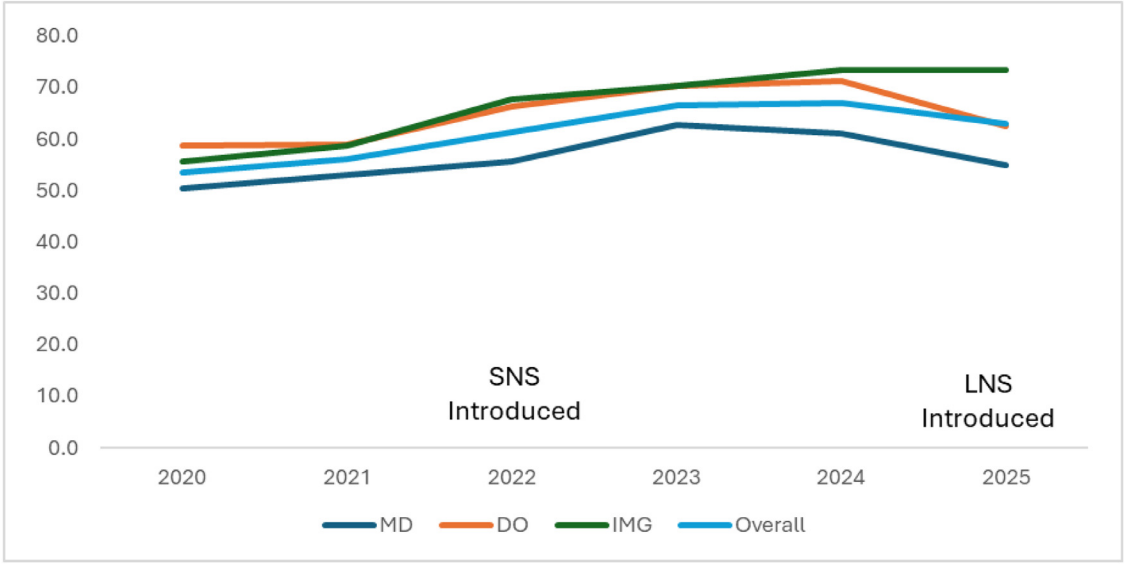



**FIGURE 1.** Mean number of applications submitted per applicant to general surgery programs (2020-2025 cycles).

## METHODS

Participants provided consent for their data to be used in research when they completed the MyERAS® application and registered for the MRM. Data were collected by AAMC and NRMP databases to study the 2024 to 2025 application cycle. This deidentified data was shared for the purpose of this project. Data included number of applications per applicant, signaled programs, interview invitations, rank order list, and Match outcomes.

### Sample

*Program Samples*

Twenty-three specialties participated in program signaling during the 2024 to 2025 cycle. This study explores outcomes in general surgery. Table 1 summarizes both program and applicant samples, with 87% (306/351) of general surgery programs participating in program signaling for the 2024 to 2025 cycle. Of those, 81% (249/306) were included in the interview sample and 92% (282/306) were included in the ranking/match sample due to inclusion rule of at least 30 applicants being invited to interview using Thalamus and being ranked by each program.

*Applicant Samples*

Applicants who submitted a MyERAS® application to at least one general surgery residency program during the 2024 to 2025 cycle were included. After applying inclusion criteria, the interview and ranking/match samples included 90% (5186/5746) and 88% (5044/5746) of all general surgery applicants, respectively. Both samples were similar to the overall general surgery applicant population with respect to demographics and other applicant characteristics.

### Predictor Data

The following data were collected directly from applicants when they applied during the 2024 to 2025 cycle.

*Program Signals*

Applicants were asked to indicate their interest in residency programs at the time of application by sending a signal to up to 15 general surgery residency programs that opted to participate in program signaling. Applicants who applied to multiple specialties could use the maximum number of signals available in each specialty. Participation in program signaling was voluntary; participating applicants were informed that programs would know whether an applicant signaled their program and that programs may consider signals in their selection processes. Signals were coded such that applicants who did not signal were the reference group.

*Ever Failed USMLE Step 1 and Ever Failed USMLE Step 2 CK*

USMLE Step 1 and USMLE Step 2 CK assess understanding and application of foundational science and clinical knowledge essential for safe and effective patient care. Ninety percent (5186/5746) and 88% (5044/5746) of general surgery applicants reported pass/fail information for their Boards and were included in the interview and ranking samples, respectively. These variables indicate whether an applicant ever failed either exam. The reference groups for analyses were applicants who had previously failed USMLE Step 1 or USMLE Step 2 CK.

*USMLE Step 2 Clinical Knowledge Scores*

USMLE Step 2 CK assesses the application of medical knowledge, skill, and understanding of clinical science essential for

**TABLE 1.** Program and applicant sample (2024-2025 cycle)

| | Surgery population | | Interview sample | | Ranking/match sample | |
|---|---|---|---|---|---|---|
| **Variables** | **N** | **%** | **N** | **%** | **N** | **%** |
| Programs | 351 | - | - | - | - | - |
| Participated in program signals | - | - | 306 | 87% | 306 | 87% |
| Final analytic sample | - | - | 249 | 81% | 282 | 92% |
| Applicants | | | | | | |
| Overall | 5746 | - | 5186 | 90% | 5044 | 88% |
| MD | 2803 | 49% | 2672 | 52% | 2631 | 52% |
| DO | 828 | 14% | 530 | 10% | 515 | 10% |
| US-IMG | 957 | 17% | 878 | 17% | 852 | 17% |
| Non-US IMG | 1158 | 20% | 1106 | 21% | 1046 | 21% |
| Non URIM | 3949 | 69% | 3553 | 69% | | |
| URIM | 1484 | 26% | 1351 | 26% | | |
| Other or missing | 313 | <1% | 282 | <1% | | |
| Man | 3113 | 54% | 2805 | 54% | - | - |
| Woman | 2610 | 45% | 2358 | 45% | - | - |
| Another gender identity | 17 | <1% | 17 | <1% | | |
| Declined to answer | 6 | <1% | 6 | <1% | - | - |

supervised patient care. Scores were centered on the mean score for applicants in the specialty. Results are limited to applicants who took the Step 2 CK exam.

*Medical Student Type*
Applicants' medical degree was collected through the ERAS application as either US-MD, DO, US-IMG, or Non-US IMG. The reference group for analyses was US-MD graduates.

*Medical School-residency Program State Alignment*
A generated variable indicated whether an applicant's medical school and the residency program they applied to are located in the same state. All applicants from international medical schools were considered out of state. The reference group for analyses was applicants with discordance between medical school and residency program state.

*Ratio of Signals to Applications*
This derived variable represents the proportion of signaled applications out of the total number of applications received by a program. Values were centered around the mean ratio for programs in general surgery.

*Medical School-residency Program Sponsor or Affiliate*
A generated variable indicated whether applicants' medical school was an affiliate or sponsor of a residency program. The reference group for analyses was applicants whose medical school was not an affiliate or sponsor of the program.

### Outcome Data

Four outcomes were used in this study: (1) A binary indicator of whether an applicant was invited to interview collected via Thalamus by March 5, 2025 (for program interview data to be included in the analyses, the program must have invited at least 30 applicants to interview), (2) a binary indicator of whether an applicant was ranked by a program, (3) a binary indicator of whether an applicant was ranked in the top quartile of a program's ROL, and (4) a binary indicator of whether the applicant matched to a program. All ranking and Match information was provided by NRMP and thus primary source verified. The focus of this paper was to examine the impact of signaling on matching to a program therefore being ranked by a program and being ranked in a program's top quartile were the emphasis of our analysis.

### Analyses

Descriptive analyses, including means, medians, and ranges, were used to explore how signaling was related to interview and ranking/match outcomes. We used a multilevel model (MLM) approach to explore the relationship between program signals, other application data, and our four outcomes. We used a multilevel approach to account for applicants being nested within programs. Six MLMs were run to explore the relationship between signaling and interview invitation, and 6 additional MLMs were run to explore the relationship between signaling and ranking/match outcomes. We compared model fit statistics (AIC and BIC) for each model and present results for model 6, which best fit the data and was most parsimonious for all outcomes. Appendix includes a description of each model and associated fit statistics. All analyses were conducted using (R: A Language and Environment for Statistical Computing, Vienna, Austria) and (SAS Institute Inc., Cary, NC, USA).

### IRB Approval

This study was reviewed by the AAMC Human Subjects Research Protection Program and data were approved for publication by the Institutional Review Board of the American Institutes for Research (FWA00003952).

## RESULTS

### Applications

Table 2 summarizes the mean number of applications submitted per applicant over the last 6 cycles overall and by applicant type. There was a significant decrease in the average number of applications per applicant between the 2024 to 2025 cycle ($M = 60.43$, $SD=58.13$; $t(11{,}568) = 3.54$, $p < 0.001$, Cohen's $d = 0.06$). This decrease held for US-MD and DO applicants, but not for IMG applicants.

### Impact of Signal on Interview Invitation and Ranking/Match Outcomes

Figure 2 shows the distribution of interview invitation rates by signal status. Figure 3 shows rates of being ranked, rates of being ranked in the top 25% of a program ROL, and match rates by signal status. The median interview invitation rate at programs for applicants who signaled was 25% compared to 5% for those who did not signal. Similarly, the median rate of being ranked by programs applicants signaled was 20% compared to 3% for applicants by programs that were not signaled. Of applicants who were ranked, 30% (median) of those who signaled were ranked competitively compared to 29% who did not signal. Of applicants on a ROL, the median match rate was 11% for those who signaled compared to 6% for those who did not signal.

### Factors Influencing Interview Invitations and Being Placed on a ROL

As shown in Table 3, signaling, concordance between an applicant's medical school and residency program location,

**TABLE 2.** Mean number of applications submitted per applicant to general surgery programs (2020-2025 cycles)

| | 2020 M (SD) N | 2021 M (SD) N | 2022 M (SD) N | 2023 M (SD) N | 2024 M (SD) N | 2025 M (SD) N |
|---|---|---|---|---|---|---|
| MD | 48.7 (44.1) 2661 | 51.4 (46.7) 2814 | 53.9 (47.9) 2921 | 61.2 (51.5) 2798 | 59.0 (50.2) 2738 | 53.4 (47.8) 2841 |
| DO | 56.7 (53.6) 724 | 56.6 (56.0) 828 | 64.3 (58.8) 838 | 68.1 (57.8) 849 | 69.3 (60.4) 887 | 60.4 (52.0) 847 |
| IMG | 53.1 (64.1) 1949 | 55.1 (66.9) 2360 | 64.0 (71.1) 1941 | 66.0 (72.8) 2049 | 69.4 (73.1) 2050 | 69.5 (70.0) 2207 |
| Overall | 51.4 (53.6) 5334 | 53.6 (56.7) 6002 | 58.8 (58.6) 5700 | 64 (60.9) 5696 | 64.4 (61.2) 5675 | 60.4 (58.1) 5895 |

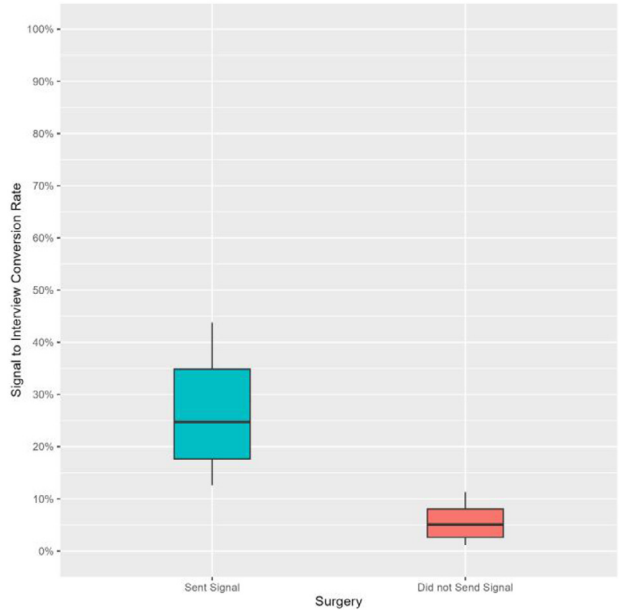



**FIGURE 2.** Distribution of interview offer rates by signal status (2024-2025 cycle).

whether the applicant's medical school and residency program had an affiliate or sponsor relationship, never failing Step 1 or Step 2 CK, and having a Step 2 CK score one standard deviation (SD) above the mean for general surgery applicants were positively associated with being invited to interview and being placed on a program's ROL. Attending an osteopathic or international medical school and applying to programs with a signal to application ratio one SD above the mean were negatively associated with being invited to interview and being ranked.

Applicants who signaled a program had 9.22 times greater odds of being invited to interview at that program (Odds ratio [OR] = 9.22, 95% confidence interval [CI] 8.84-9.63) and 8.77 times greater odds of being ranked by that program (OR = 8.77, 95% CI 8.40-9.16) compared to those who did not signal. Applicants who attended a medical school in the same state as a residency program had 3.09 times greater odds of being invited to interview at that program (OR = 3.09, 95% CI 2.9-3.30) and 3.35 times greater odds of being ranked by that program (OR = 3.35, 95% CI 3.13-3.58) compared to those who did not. Applicants who attended a medical school affiliated with or sponsored by a program had 4.54 times greater odds of being invited to interview at that program (OR = 4.54, 95% CI 4.16-4.95) and 3.68 times greater odds of being ranked by that program (OR = 3.68, 95% CI 3.40-3.99) compared to those who did not. Applicants who never failed the Step 1 exam had 1.88 times greater odds of being invited to interview at any program (OR = 1.88, 95% CI 1.73-2.05) and 1.81 times greater odds of being ranked by any program (OR = 1.81, 95% CI 1.64-1.98) compared to those who did not. Applicants who never failed the Step 2 CK exam had 2.73 times greater odds of being invited to interview at any program (OR = 2.73, 95% CI 2.21-3.38) and 3.68 times greater odds of being ranked by any program (OR = 3.68, 95% CI 2.82-4.82) compared to those who did not. Applicants who scored one SD above the Step 2 CK mean for general surgery applicants had 2.09 times greater odds of being invited to interview at any program (OR = 2.09, 95% CI 2.05-2.13) and 1.84 times greater odds of being ranked by any program (OR = 1.84, 95% CI 1.81-1.88) compared to those who did not.

Osteopathic, US-IMG, and Non-US IMG applicants had lower odds of being invited to interview (DO: OR = 0.61, 95% CI 0.57-0.65; US-IMG: OR = 0.17, 95% CI 0.16-0.18; Non-US IMG: OR = 0.10, 95% CI 0.09-0.11) and being ranked (DO: OR = 0.60, 95% CI 0.56-0.65; US-IMG: OR = 0.17, 95% CI 0.15-0.19; Non-US IMG: OR = 0.11, 95% CI 0.10-0.13) compared to US-MD applicants.

The relationship between signaling and being invited to interview or being ranked varied by school-program state alignment, applicant type, and signal-to-application ratio. The signal effect was weaker for in-state applicants (Interview invitation: OR = 0.31, 95% CI 0.29-0.34;

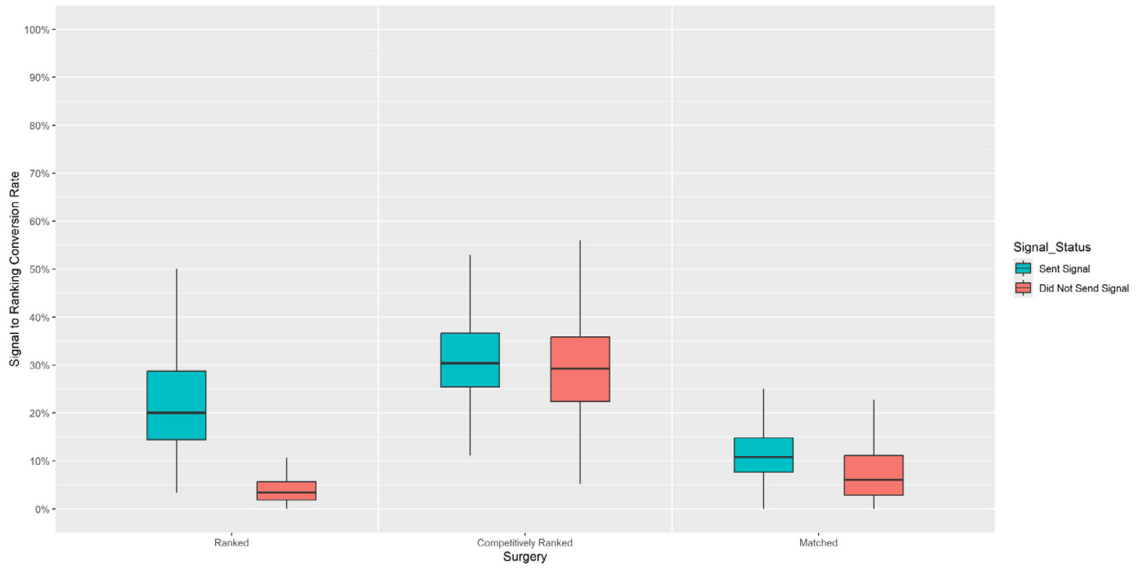



**FIGURE 3.** Distribution of rank, competitive rank, and match rates by signal status (2024-2025).

**TABLE 3.** Odds ratios, lower, and upper confidence interval for the best fitting model (model 6)

| | Invited to interview | | Placed on ROL | |
|---|---|---|---|---|
| **Variables** | **Odds ratio** | **95% CI LL** | **Odds ratio** | **95% CI LL** |
| Signal | 9.22* | [8.84, 9.63] | 8.77* | [8.40, 9.16] |
| School-program state alignment | 3.09* | [2.9, 3.3] | 3.35* | [3.13, 3.58] |
| Affiliate or sponsor institution | 4.54* | [4.16, 4.95] | 3.68* | [3.40, 3.99] |
| Applicant type (DO) | 0.61* | [0.57, 0.65] | 0.60* | [0.56, 0.65] |
| Applicant type (US IMG) | 0.17* | [0.16, 0.18] | 0.17* | [0.15, 0.19] |
| Applicant type (non-US IMG) | 0.10* | [0.09, 0.11] | 0.11* | [0.10, 0.13] |
| Never failed step 1 | 1.88* | [1.73, 2.05] | 1.81* | [1.64, 1.98] |
| Step 2 CK | 2.09* | [2.05, 2.13] | 1.84* | [1.81, 1.88] |
| Never failed step 2 | 2.73* | [2.21, 3.38] | 3.68* | [2.82, 4.825] |
| Signal to application ratio | 0.64* | [0.59, 0.69] | 0.67* | [0.63, 0.71] |
| Signal × school-program state alignment | 0.31* | [0.29, 0.34] | 0.27* | [0.25, 0.30] |
| Signal × signal to application ratio | 1.07* | [1.04, 1.11] | 1.10* | [1.06, 1.14] |
| Signal × applicant type (DO) | 0.94* | [0.85, 1.03] | 1.09 | [0.98, 1.20] |
| Signal × applicant type (US IMG) | 0.87* | [0.77, 0.99] | 1.09* | [0.95, 1.25] |
| Signal × applicant type (non-US IMG) | 0.94* | [0.83, 1.06] | 1.18 | [1.03, 1.35] |

*$p < 0.05$.

Ranked: OR = 0.27, 95% CI 0.25-0.30) compared to out-of-state applicants and was weaker for DO and Non-US IMG applicants compared to US-MDs for interview invitation only (Interview invitation: OR = 0.94, 95% CI 0.85-1.03). The signaling effect on interview invitation was weaker for US-IMG (Interview invitation: OR = 0.87, 95% CI 0.77-0.88) but stronger for US-IMGs being ranked (OR = 1.18, 95% CI 1.03-1.35). Applicants who applied to programs with a higher signal-to-application ratio had 1.56 times lower odds of being invited to interview at that program (OR = 0.64, 95% CI 0.59-0.69) and 1.49 times lower odds of being ranked by that program (OR = 0.67, 95% CI 0.63-0.71) compared to programs with a lower signal-to-application ratio.

## DISCUSSION

Analysis of the 2024 to 2025 cycle data suggests that the goals of general surgery's shift from SNS to LNS were met. First, application volume decreased amongst US-MD and DO applicants for the first time in 6 years after LNS was introduced. Programs also observed a decrease in the average number of applications per program.3 A reduction in the average number of applications submitted has reduced some of the costs of the residency application process for students. More research is needed to understand whether the decrease in the median number of applications per program was significant enough to increase holistic review of applications.

Second, general surgery approached LNS cautiously, increasing the number of available signals while avoiding the overemphasis of signals in the interview invitation and ranking processes. Results from this study show that while there was a strong association between signaling and interview invitation and inclusion on ROL, signaling was not a requirement to receive an interview or to be ranked by a program in the 2024 to 2025 cycle.

Compared with the 2024 to 2025 cycle, fewer 2025 applicants were offered interviews in general surgery if they did not signal, suggesting that general surgery programs considered program signals to be important in the selection process after moving to LNS. However, the fact that applicants who did not signal still received interview invitations demonstrates that the signals were not the only consideration in interview invitation.[4] In otolaryngology and orthopedic surgery, both of which use a LNS approach (25 and 30, respectively), very few applicants were invited to interview, were ranked or matched without signaling a program in the 2024 to 2025 cycle.[4] This suggests that true LNS (i.e., 30 signals/applicant) may act as a soft "cap" on applications. Limiting signals per applicant to 15 may provide the benefit of reducing the number of applications without creating this same application cap.

Of the eight variables evaluated, signaling a program had the strongest correlation with interviewing and being ranked by said program. However, the impact of a signal on receiving an interview or being ranked was slightly attenuated in programs with a higher proportion of signaled applications and in those with a higher proportion of applicants who attended a medical school in the same state, consistent with previously reported findings about the importance of in-state status in other specialties.[10] Other variables that increased odds of interview invitation and being ranked included school—program alignment, sponsor or affiliate status, being an MD, never failing Step 1 or Step 2 CK, and achieving higher Step 2 CK scores. Given the importance of signaling to interview invitation and being ranked, students should research programs in detail in advance of their applications to ensure that signals are assigned to programs in which they are truly interested.

As with all research, this study has limitations that may limit the generalizability of results. Results are based on a single year of data. With a better understanding of the use and impact of signals, applicants, program directors, and medical student advisors may implement novel strategies for signal selection, and programs may utilize the signals differently. This study modeled several important variables to the selection process, but it didn't account for all factors (e.g., home students and away rotations) that programs consider when evaluating applicants, nor did it account for interview performance. Results do not generalize to DO applicants without USMLE Step 2 CK scores, as these applicants were excluded from analysis. While the percentage of program and applicant participation in program signaling was high and about 90% of all general surgery programs used Thalamus to schedule interviews and therefore not all program data were not included in interview analyses.

Ongoing, multi-year research is needed for a more systematic and complete evaluation of program signals. For example, more research is needed to understand how program signals change the shape of interview distributions. The recent changes to program signal numbers, variability between in-person and virtual interviewing, and other impactful pressures may limit the conclusions that can be drawn from this study. With additional longitudinal data, survey results, and comparison to other specialties, we can develop evidence-based advice to our applicants and program directors regarding signal usage.

## CONCLUSION

With the transition from five to 15 signals for general surgery in the 2024 to 2025 cycle, a better understanding of the impact that this change has on the recruitment process in general surgery is essential. The recent increase in program signal number is associated with the first decrease in application volume seen in 6 years, likely resulting in both time and money saved for programs and applicants. Unlike other subspecialties with LNS, the selected value of 15 signals per applicant in general surgery may strike a balance between SNS, which may not decrease application numbers, and LNS approaches (i.e., 30 signals) where signals serve as an unofficial application cap. While signaling is a strong predictor of interview invitation and being ranked by a program, many candidates received interviews and were placed on ROL in programs to which they did not send a signal. Moving forward, continued evaluation of the recruitment process is needed to determine if these effects are sustained. Further, research is needed to determine how LNS may have variably impacted general surgery programs of differing types and sizes.

## ACKNOWLEDGMENTS

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## APPENDIX

Model Fit Statistics

| | Invited to interview | | | Placed on ROL | | |
|---|---|---|---|---|---|---|
| **Model** | **AIC** | **BIC** | **Chi-square**** | **AIC** | **BIC** | **Chi-square**** |
| Model 1† | 157,096.36 | 157,117.27 | | 144,325.6 | 144,332.9 | |
| Model 2‡ | 138,239.80 | 138,260.71 | | 126,698.3 | 126,711.4 | |
| Model 3§ | 122,443.56 | 122,548.11 | 1964.07* | 114,423.0 | 114,459.4 | 1531.50* |
| Model 4‖ | 121,545.10 | 121,701.93 | 169.24* | 113,266.1 | 113,320.8 | 227.72* |
| Model 5¶ | 114,748.28 | 114,873.75 | 2276.06* | 109,327.7 | 109,371.4 | 1316.47* |
| Model 6# | 114,038.10 | 114,215.84 | 131.58* | 108,363.60 | 108,425.50 | 189.18* |

AIC, Akaike information criterion; BIC, Bayesian information criterion.
*$p < 0.05$.
†Model 1 variables: random effects programs.
‡Model 2:variables Random Effects Applicants.
§Model 3 variables: Signal status, Medical School Program State Alignment, Medical School Sponsor or Affiliate with Program Alignment, Medical Student Type, Step 1 Ever Failed, Signal to Application Proportion, Random Effects Programs.
‖Model 4 variables Signal status, Medical School Program State Alignment, Medical School Sponsor or Affiliate with Program Alignment, Medical Student Type, Step 1 Ever Failed, Signal to Application Proportion, Signal Status and Medical School Program State Alignment Interaction, Signal Status and Signal to Application Proportion Interaction, Signal Status and Medical Student Type Interaction, Random Effects Programs.
¶Model 5 variables: Signal status, Medical School Program State Alignment, Medical School Sponsor or Affiliate with Program Alignment, Medical Student Type, Step 1 Ever Failed, Signal to Application Proportion, Step 2 Scores, Step 2 Ever Failed, Random Effects Programs.
#Model 6 variable: Signal status, Medical School Program State Alignment, Medical School Sponsor or Affiliate with Program Alignment, Medical Student Type, Step 1 Ever Failed, Signal to Application Proportion, Step 2 Scores, Step 2 Ever Failed, Signal Status and Medical School Program State Alignment Interaction, Signal Status and Signal to Application Proportion Interaction, Signal Status and Medical Student Type Interaction, Random Effects Programs.
**Chi-square formula to estimate the difference in model fit and $p < 0.05$; chi square statistic = First model bic − second model bic/df (difference in model parameters).

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