

# Characteristics Associated With Outstanding General Surgery Residency Graduate Performance, as Rated by Surgical Educators

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**IMPORTANCE** Characteristics of outstanding graduating surgical residents are currently undefined. Identifying these qualities may be important in guiding resident selection and resident education.

**OBJECTIVE** To determine characteristics that are most strongly associated with being rated as an outstanding graduating surgical resident.

**DESIGN, SETTING, AND PARTICIPANTS** The multi-institutional study had 3 phases. First, an expert panel developed a list of characteristics embodied by top graduating surgical residents. Second, groups of faculty from 14 US general-surgery residency programs ranked 2017 through 2020 graduates into quartiles of overall performance. Third, faculty evaluated their graduates on each characteristic using a 5-point Likert scale (1 = lowest performance, 5 = highest performance).



trained all graduates in the cohort. Faculty were excluded if they graduated from their institution during the study period, as they would also be a study participant.

**Phase 3: Characteristic Rankings**

After each institution submitted their quartile rankings, the same faculty were then sent the list of characteristics developed by our expert panel, along with detailed descriptions of each characteristic. Faculty were asked to score the same general surgery residency graduates from phase 1 on each of the characteristics identified in phase 2 using a 5-point Likert scale, which was categorized as: 1-poor (this is an area of weakness), 2-good (slightly below recent graduates), 3-excellent (slightly better than recent graduates), 4-outstanding (seen in a small fraction of graduates each year), or 5-truly exceptional (far exceeds most recent graduates). Characteristic ratings were determined via a consensus decision of the same 50 faculty members from each institution as phase 2.

**Statistical Evaluation**

Deidentified data were collected into an Excel database (Microsoft Excel; Microsoft Corp) and imported into R (version 4.0.2; R Core Team). The main outcome measure was surgical educators’ assessments of general surgery residency graduates on their overall performance. The Spearman rank-order correlation coefficient (*r*) between each characteristic rating and the overall performance rating was calculated, with *r* > 0.7 or more considered a strong correlation, 0.5 to 0.7 considered moderate, and 0.3 or less considered weak. *P* < .05 was considered statistically significant. A least absolute shrinkage and selection operator (LASSO) ordinal regression was performed to select a parsimonious model able to predict the outcome of overall performance rating from a subset of the characteristic scores measured in this survey. Minimization of the Bayesian Information Criterion was used for model selection and 5-fold cross validation was used to determine measures of goodness of fit; mean prediction accuracy, mean prediction accuracy to within 1 quartile, and mean squared error (in which the quartile rankings were considered as a continuous variable). The R package glmnet was used to conduct the LASSO regression. 95% CIs were estimated via bootstrap resampling with 1000 iterations.

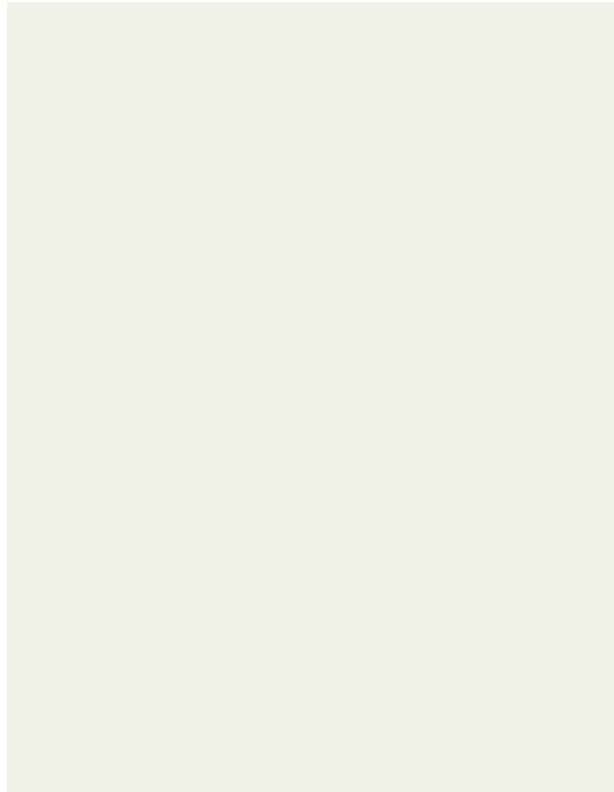
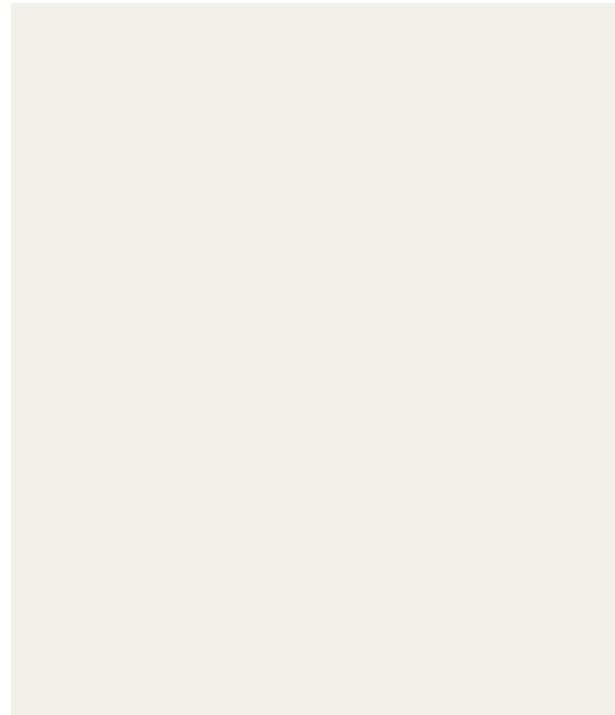
**Results**

Surgical educators developed a list of 100 characteristics embodied by top general surgery residency graduates, as well as definitions for each. Characteristics and their definitions are listed in **Table 1**. Fifty faculty from 10 US residency programs with a median of 15 (range, 10–20) years of surgical education experience evaluated 100 general surgery residency graduates. Ten of the 50 faculty that rated residents in phases 1 and 2 were involved in the development of the characteristic list in phase 3. One hundred fifty-two graduates (64%) were from university programs, 30 graduates (20%) were from university-affiliated programs, and 22 graduates (16%) were from independent programs. Seventy-five graduates were placed in

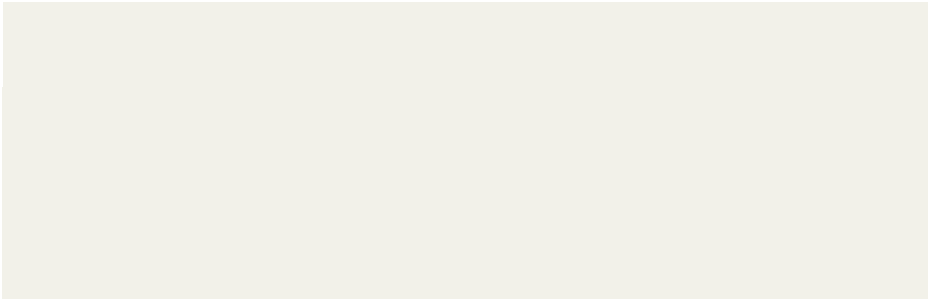

**Table 1. Characteristics Embodied by Top General Surgery Residency Graduates as Determined by an Expert Panel**

Characteristic	Definition
1. Ability to work independently	Graduate is able to work independently without supervision.
2. Ability to work in a team	Graduate is able to work in a team and contribute to the team's success.
3. Ability to communicate effectively	Graduate is able to communicate effectively with patients, colleagues, and other healthcare professionals.
4. Ability to manage time	Graduate is able to manage time effectively and complete tasks in a timely manner.
5. Ability to handle stress	Graduate is able to handle stress effectively and maintain a high level of performance.
6. Ability to learn from experience	Graduate is able to learn from experience and apply it to future situations.
7. Ability to provide patient care	Graduate is able to provide patient care in a safe and effective manner.
8. Ability to work in a high-pressure environment	Graduate is able to work in a high-pressure environment and maintain a high level of performance.
9. Ability to work in a team	Graduate is able to work in a team and contribute to the team's success.
10. Ability to communicate effectively	Graduate is able to communicate effectively with patients, colleagues, and other healthcare professionals.
11. Ability to manage time	Graduate is able to manage time effectively and complete tasks in a timely manner.
12. Ability to handle stress	Graduate is able to handle stress effectively and maintain a high level of performance.
13. Ability to learn from experience	Graduate is able to learn from experience and apply it to future situations.
14. Ability to provide patient care	Graduate is able to provide patient care in a safe and effective manner.
15. Ability to work in a high-pressure environment	Graduate is able to work in a high-pressure environment and maintain a high level of performance.
16. Ability to work in a team	Graduate is able to work in a team and contribute to the team's success.
17. Ability to communicate effectively	Graduate is able to communicate effectively with patients, colleagues, and other healthcare professionals.
18. Ability to manage time	Graduate is able to manage time effectively and complete tasks in a timely manner.
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22. Ability to work in a high-pressure environment	Graduate is able to work in a high-pressure environment and maintain a high level of performance.
23. Ability to work in a team	Graduate is able to work in a team and contribute to the team's success.
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47. Ability to handle stress	Graduate is able to handle stress effectively and maintain a high level of performance.
48. Ability to learn from experience	Graduate is able to learn from experience and apply it to future situations.
49. Ability to provide patient care	Graduate is able to provide patient care in a safe and effective manner.
50. Ability to work in a high-pressure environment	Graduate is able to work in a high-pressure environment and maintain a high level of performance.

(continued)



the “outstanding, best” quartile ( . %), in the “excellent” quartile ( . %), in the “very good” quartile ( . %), and in the “competent, lowest” quartile ( . %). Higher scores in all characteristics identified by surgical educators correlated with better overall performance quartile (**Table 2**). Characteristics that were strongly associated with overall performance included surgical judgment ( $r = .$  ;  $P$



correlate with other performance measures in surgical residency. For instance, Mainthia et al found that top surgical residents who won awards during residency, such as “Best Resident in Research,” “Best Resident in Teaching,” and “Best Resident Overall,” actually had slightly lower USMLE step scores than those who did not win awards. Ray et al found no association between ABSITE scores and residency performance evaluations. Tolan et al evaluated which factors on surgical residency applications were associated with futu-153.4(w)10(e7r)5(esidenn)-lc3s-153.4(wtgc)-we T Th,h,an,5dh,4orserrors14.8(not)-284.8klda” E

and technical skills. Similarly, a resident with exceptional leadership skills likely also displays outstanding emotional intelligence, interpersonal skills, teaching, teamwork, organization, and trustworthiness. The existing milestones include many of the building blocks for surgical judgment, including intraoperative patient care and technical skills. However, they are noticeably lacking any true assessment of surgical judgment, which is more representative of the ability to synthesize information and skills in order to make sound clinical decisions. Leadership skills are indirectly brought up in the surgical milestones, as the spectrum of performance for most milestones range from level 1 (describes the skill) to level 4 (leads or teaches the skill). However, we propose that leadership skills and surgical judgment are deserving of their own individual milestones to ensure surgical residency curriculums prioritize these important skills.

### Limitations

There are several limitations to our study. First, the conclusions of our analysis are limited by the end point selected, that is, the overall assessment of graduating surgical resident performance as judged by surgical educators. Given the retrospective nature of these evaluations, they are subject to recall bias and may not necessarily be the overarching gold standard measurement of overall residency graduate quality. Other stakeholders such as patients, co-residents, students, and ancillary staff, may have different opinions of what makes a graduating surgeon outstanding. We chose to use experienced surgical educators to assess overall graduate performance because they have had significant involvement throughout their careers evaluating trainees. However, some characteristics evaluated in our study, such as compassion toward patients, teaching skills, and teamwork skills, may be more accurately assessed by patients or junior residents. Another potential source of bias is that some of the members of the expert panel that created the list of characteristics were also

included as raters in phases 1 and 2, although most raters (10 of 15) were not part of the expert panel. Also, the raters in phases 1 and 2 were the same. We tried to limit bias by completing the study in phases, with a period of time between each phase. We also did not provide information about the subsequent phase until the prior phase was completed. To further limit bias, we made it clear in phase 1 that the goal was simply to construct an all-inclusive list of characteristics that may be important for general surgery residents to embody, and not to rate their importance. However, it is possible that some important characteristics may be missing. The determination of the characteristic list and the rating of graduates are inherently subjective. We also did not collect demographic data, such as race, ethnicity, or sex, for graduates or evaluators in order to protect the identities of participants. This limits our ability to evaluate how biases may contribute to the scoring of graduates.

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### Conclusions

An expert panel of surgical educators identified 10 characteristics that were all associated with higher overall graduating general-surgery resident rating. Surgical judgment and leadership had the strongest correlations with overall performance. Leadership and teamwork were the most frequently cited characteristics by the expert panel.

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