

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

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 Invited Commentary

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. Data were analyzed using Spearman rank-order correlation to identify which individual characteristics were associated with overall graduate performance. A least absolute shrinkage and selection operator (LASSO) ordinal regression was performed to select a parsimonious model to predict the outcome of overall performance rating from individual characteristic scores.

MAIN OUTCOME AND MEASURES Surgical educators' rankings of general surgery residency graduates' overall performance.

RESULTS Fifty faculty from 14 US residency programs with a median of 13 (range, 5-30) years of surgical education experience evaluated 297 general surgery residency graduates. Surgical educators identified 21 characteristics that they believed outstanding graduating surgical residents possessed. Two hundred ninety-seven surgical residency graduates were evaluated. Higher scores in every characteristic correlated with better overall performance. Characteristics most strongly associated with higher overall performance scores were surgical judgment ($r = 0.728$; $P < .001$), leadership ($r = 0.726$; $P < .001$), postoperative clinical skills ($r = 0.715$; $P < .001$), and preoperative clinical skills ($r = 0.707$; $P < .001$). The remainder of the characteristics were moderately associated with overall performance. The LASSO regression model identified 3 characteristics from which overall resident performance could be accurately predicted without measuring other qualities: surgical judgment (odds ratio [OR] per 1 level of 5-level Likert scale OR, 1.27; 95% CI, 1.03-1.51), leadership (OR, 1.27; 95% CI, 1.06-1.48), and medical knowledge (OR, 1.16; 95% CI, 1.01-1.33).

CONCLUSIONS AND RELEVANCE All individual characteristics identified by surgical educators as being qualities of outstanding graduating surgical residents were positively associated with overall graduate performance. Surgical judgment and leadership skills had the strongest individual associations. Assessment of only 3 qualities (surgical judgment, leadership, and medical knowledge) were required to predict overall resident performance ratings. These findings highlight the importance of developing specific surgical judgment and leadership skills curricula and assessments during surgical residency.

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What makes a great surgeon? It would seem that medical knowledge, as measured by test-taking skills, is paramount given the emphasis placed on standardized test scores. This emphasis begins with the Medical College Admission Test in medical student selection, the US Medical Licensing Examination (USMLE) in resident selection, the American Board of Surgery In-Training Examination (AB-SITE) in fellow selection, and culminates with the American Board of Surgery (ABS) Qualifying Examination, a requirement for board certification.¹⁻⁵ However, recent studies suggest that medical knowledge, as measured by the ABSITE, has poor correlation with resident clinical evaluations.⁶ In addition, achievement awards in residency have not been shown to positively correlate with USMLE scores, ABSITE scores, or first-time passing of the ABS examination.⁷ It is also important to note that standardized test scores are not necessarily a perfect measure of medical knowledge. This lends support to the premise that test-taking skills alone do not equate with surgeon excellence.

There is a paucity of literature defining the qualities that make an excellent surgeon. In an editorial, Sir Barry Jackson distinguishes between a merely competent surgeon and an excellent one. According to him,⁸ an excellent surgeon has superlative technical skill, first-class surgical judgment, good communication, humility, and teamwork skills. While this sounds accurate, the characteristics associated with being an outstanding general surgery residency graduate have not been well defined. Prior studies have focused on analyzing whether certain characteristics in a student's residency application correlate to specific end points, such as passing the ABS Examinations on the first attempt, receiving a chief resident award, and core competency scores in residency.^{7,9-13} However, there are limitations to these end points. Defining attributes of successful residency graduates could enhance curricular development and inform future resident selection.

The goals of our multi-institutional study were to identify characteristics that surgical educators believed were important for outstanding general surgery residency graduates to embody, to determine which of these characteristics were most strongly associated with surgical educators' evaluations of overall graduate performance, and to determine the minimum set of characteristics that allow accurate prediction overall graduate performance ratings.

Methods

This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines. Fourteen general surgery programs from an established Surgery Educators Workgroup participated in the study. This workgroup was established in 2010 to collaborate on surgical education projects, and includes surgical educators from university-based, university-affiliated, and independent programs from across the US. Participating institutions included Brookwood Baptist Health, Cedars-Sinai, Cleveland Clinic, Cleveland Clinic Florida, Gunderson Lutheran Medical Center, Harbor-University of California (UC) Los Angeles, Loma

Key Points

Question What characteristics do surgical educators think are important for graduating general surgery residents to possess, and which of these characteristics are associated with being rated as an outstanding surgical residency graduate?

Findings In this multi-institutional study, an expert panel identified 21 important characteristics, which all were individually associated with overall graduating surgical resident performance, as rated by surgical educators. Overall performance ratings could be predicted from 3 traits (surgical judgment, leadership, and medical knowledge) without measuring the others.

Meaning These findings identify traits that are important to be an outstanding surgical residency graduate and may help guide future curricular development.

Linda University, Southern Illinois University, UC Davis, UC Irvine, UC Los Angeles, University of Arkansas, University of Hawaii, and University of Washington. This study comprised 3 phases. The study was considered exempt from requiring institutional review board approval by the Lundquist Institute.

Phase 1: Creating the List of Characteristics

Through an iterative process, an expert panel of surgical educators developed an inclusive list of characteristics that they believed outstanding general surgery residents embody. In addition to the actual characteristics, the panel also came up with descriptions for each characteristic. The panel was instructed to make the list as inclusive as possible, meaning that the aim was to not exclude any characteristics that may be important. No attempt was made to try to rank the importance of each characteristic at this stage. The initial meeting included a panel of 13 surgical educators from 8 of the 14 participating institutions, plus 1 from an institution that did not participate in the subsequent phases. Following the initial meeting, the preliminary characteristic list was distributed as a living document to allow panelists to add any characteristics. Subsequently, a series of virtual meetings were held, where educators discussed the characteristics and added any they felt were missing. This process was repeated until consensus was achieved, defined as the point at which no other characteristics were added.

Phase 2: Ranking Overall Performance of Recent Graduates

Ten weeks after the completion of phase 1, a group of faculty from each program were asked to rank their categorical general surgery residents who graduated June 2017 through June 2020 into quartiles based on overall performance. Faculty were instructed to equally divide their graduates into 1 of 4 quartiles: quartile 1 (competent, lowest), quartile 2 (very good), quartile 3 (excellent), or quartile 4 (outstanding, best). We purposely did not further define the metrics they should use to place residents into quartiles, as this would allow them to use their own opinions. Rankings were determined via consensus decisions of 2 to 5 faculty members from each institution. To be included as raters, faculty had to be involved with resident education for a minimum of 5 years and had to have

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 2 on each of the characteristics identified in phase 1 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 2 to 5 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 4.1.1; 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* 0.700 or more considered a strong correlation, 0.400 to 0.699 considered moderate, and 0.400 or less considered weak.¹⁴ *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.¹⁵ Minimization of the Bayesian Information Criterion was used for model selection and 10-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).¹⁶ The R package glmnet was used to conduct the LASSO regression. 95% CIs were estimated via bootstrap resampling with 100 iterations.¹⁷

Results

Surgical educators developed a list of 21 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 14 US residency programs with a median of 13 (range, 5-30) years of surgical education experience evaluated 297 general surgery residency graduates. Ten of the 50 faculty that rated residents in phases 2 and 3 were involved in the development of the characteristic list in phase 1. One hundred fifty-two graduates (51.2%) were from 6 university programs, 91 graduates (30.6%) were from 4 university-affiliated programs, and 54 graduates (18.2%) 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	Description
Adaptability	Someone with excellent adaptability is consistently able to adapt to unexpected changes. They are resilient in the face of changes.
Compassion toward patients	Someone with excellent compassion toward patients is consistently empathetic toward patients’ needs and demonstrates exceptional bedside manner. They are also compassionate toward patients’ families. They consistently prioritize patient care and do everything possible to do right by the patient.
Confidence	Someone with excellent confidence consistently handles stressful situations with calmness. They trust their own abilities and knowledge, and are not hampered by self-doubt.
Drive to improve	Someone with excellent drive to improve is extremely motivated, often takes time to self-reflect, and frequently seeks out constructive criticism. They always make it a point to learn and improve from their mistakes. They are appropriately responsive to constructive criticism and seek mentorship.
Emotional intelligence	Someone with excellent emotional intelligence is consistently aware and in control of their own emotions. They also have excellent conflict-resolution skills and empathetically handle interpersonal relationships.
Interpersonal skills	Someone with excellent interpersonal skills displays professional behavior when communicating within the surgical team, with other departments, and with ancillary staff. They are easy to work with and consistently courteous to everyone they interact with.
Leadership skills	Someone with excellent leadership skills is consistently able to inspire and gain respect of team members. They are approachable and a good listener who cares for all team members. They are able to provide the appropriate amount of team supervision without intrusion. They communicate effectively with the team.
Medical knowledge	Someone with excellent medical knowledge has an exceptional fund of knowledge and keeps up with up-to-date literature and guidelines. It is obvious that they take time to read outside of work.
Organizational skills	Someone with excellent organizational skills has exceptional time management skills and is extremely efficient. They are able to multitask and appropriately triage tasks. When needed, they delegate tasks appropriately.
Postoperative clinical skills	Someone with excellent postoperative clinical skills is able to consistently and quickly recognize, workup, and address postoperative complications. They demonstrate excellent attention to detail when caring for patients postoperatively.
Preoperative clinical skills	Someone with excellent preoperative clinical skills is consistently able to accurately evaluate, workup, and optimize patients with a myriad of surgical issues preoperatively. They demonstrate excellent attention to detail when caring for surgical patients preoperatively.
Professionalism (administrative tasks)	Someone with excellent professionalism in regard to administrative tasks always completes administrative tasks on time without being reminded. This includes logging hours, dictating operative reports, logging cases, completing training/licensure requirements, and completing medical records on time.
Research skills	Someone with excellent research skills is able to critically evaluate literature. They are intellectually curious about addressing unanswered questions. They are knowledgeable about research methodology and are able to design and carry out research projects.
Self-awareness	Someone with excellent self-awareness is aware of their own limitations and is not over-confident. They consistently ask for help when appropriate.
Surgical judgment	Someone with excellent surgical judgment is consistently and accurately able to determine when a patient should or should not undergo an operation. They also consistently determine the urgency of surgical interventions when necessary, and can decide which operation is most appropriate. They also consistently display exceptional intraoperative decision-making.

(continued)

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

Characteristic	Description
Teaching skills	Someone with excellent teaching skills consistently prioritizes teaching residents and/or students. They have a remarkable ability to adapt to the learner and communicate teaching points effectively. They are very patient with learners and foster an environment where learners feel comfortable asking questions. They can effectively lead junior residents through appropriate operations.
Teamwork skills	Someone who is an excellent team player works exceptionally well within a team. They are open to other viewpoints and are willing to compromise. They consistently put the well-being and interests of the collective team over themselves, and are not selfish. When they disagree with a senior team member's decision, they are able to respectfully bring up their point of view.
Technical skills	Someone with excellent technical skills is able to function independently in the operating room and has proficient knowledge of operative steps. They have excellent tissue-handling skills, consistently find tissue planes, and operate efficiently and safely.
Test-taking ability	Someone with excellent test-taking ability is consistently able to apply their knowledge when taking tests. They consistently score exceptionally on standardized examinations.
Trustworthiness	Someone with excellent trustworthiness is extremely honest and has integrity. They are always reliable, dependable, and accountable.
Work ethic	Someone with excellent work ethic is willing to work hard and is extremely diligent and dedicated to their work. They display significant grit and take tremendous pride in excellence.

the “outstanding, best” quartile (25.3%), 80 in the “excellent” quartile (26.9%), 75 in the “very good” quartile (25.3%), and 67 in the “competent, lowest” quartile (22.6%). Higher scores in all 21 characteristics identified by surgical educators correlated with better overall performance quartile (Table 2). Characteristics that were strongly associated with overall performance included surgical judgment ($r = 0.728$; $P < .001$), leadership ($r = 0.726$; $P < .001$), postoperative clinical skills ($r = 0.715$; $P < .001$), and preoperative clinical skills ($r = 0.707$; $P < .001$). Medical knowledge had the fifth-highest correlation with overall performance ($r = 0.694$; $P < .001$). Higher scores in the remainder of the characteristics were all moderately associated with overall resident performance (Table 2).

The ordinal LASSO regression model defined 3 characteristics from which surgical educator ratings of overall residency graduate performance could be accurately predicted without needing to measure other qualities: surgical judgment (odds ratio [OR] per one level of 5-level Likert scale OR, 1.27; 95% CI, 1.03-1.51), leadership (OR, 1.27; 95% CI, 1.06-1.48), and medical knowledge (OR, 1.16; 95% CI, 1.01-1.33). As measured by 10-fold cross validation, the model predicted quartile ranking accurately for 91% of residents, predicted to within 1 quartile of the true ranking for 100% of residents, and had a mean squared error of 0.09 (Table 3).

Discussion

This multi-institutional study sought to determine which qualities are most strongly associated with overall graduating chief general surgical resident performance. Experts in surgical edu-

Table 2. Association Between Characteristic Scores and Overall Performance Quartile in Recent General Surgery Residency Graduates

Characteristic	Correlation with overall performance (Spearman correlation coefficient, r)	P value
Surgical judgment	0.728	<.001
Leadership skills	0.726	<.001
Postoperative clinical skills	0.715	<.001
Preoperative clinical skills	0.707	<.001
Medical knowledge	0.694	<.001
Technical skills	0.651	<.001
Organizational skills	0.648	<.001
Confidence	0.642	<.001
Teamwork skills	0.625	<.001
Self-awareness	0.622	<.001
Work ethic	0.617	<.001
Emotional intelligence	0.617	<.001
Trustworthiness	0.608	<.001
Teaching skills	0.605	<.001
Drive to improve	0.602	<.001
Adaptability	0.580	<.001
Interpersonal skills	0.569	<.001
Professionalism (administrative tasks)	0.522	<.001
Test-taking ability	0.485	<.001
Compassion toward patients	0.482	<.001
Research skills	0.438	<.001

cation identified 21 characteristics that outstanding surgical graduates embody, which were subsequently used to evaluate 297 resident graduates from 14 US residency programs. Higher ratings in each of the 21 characteristics were associated with better ratings of overall resident performance. The characteristics that were most strongly associated with overall performance were surgical judgment, leadership, postoperative clinical skills, and preoperative clinical skills. LASSO regression model identified surgical judgment, leadership skills, and medical knowledge as 3 characteristics sufficient to predict the overall performance quartile without measuring others.

The existing literature disproportionately emphasizes standardized test performance, as a surrogate marker for medical knowledge, as either a predictor or measure of success. Of course, one cannot discount that better performance on past standardized tests, such as the USMLE and ABSITE, is associated with passing the ABS examinations on the first attempt, which is necessary to become a board-certified surgeon.^{9,10,18} However, performance on standardized tests can be affected by test-taking anxiety and learning difficulties.¹⁹ It is also possible that standardized tests may not test all aspects of medical knowledge, or may overemphasize rare topics that are easier to write multiple choice questions about, but are not necessarily relevant to everyday clinical practice. In addition, race, ethnicity, and sex are associated with surgery-board passage rates, suggesting the potential for unconscious bias.²⁰ It is important to distinguish between medical knowledge and test-taking ability as standardized test scores do not consistently

Table 3. Observed Accuracy of the 3-Predictor Least Absolute Shrinkage and Selection Operator (LASSO) Model for Performance Rating of Residents^a

Characteristic	Overall performance rating of resident, No. of residents			
	Quartile 4 (outstanding, best)	Quartile 3 (excellent)	Quartile 2 (very good)	Quartile 1 (competent, lowest)
Performance rating predicted by LASSO model				
Quartile 4 (outstanding, best)	50	11	1	0
Quartile 3 (excellent)	23	43	22	6
Quartile 2 (very good)	2	21	36	20
Quartile 1 (competent, lowest)	0	2	16	41

^a The performance demonstrated here is likely to be a biased estimate of model accuracy, because the model was applied to the same data that were used for model development. An unbiased estimate of model performance is provided by cross-validation (see text).

correlate with other performance measures in surgical residency. For instance, Mainthia et al⁷ 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 1 scores than those who did not win awards. Ray et al⁶ found no association between ABSITE scores and residency performance evaluations. Tolan et al¹³ evaluated which factors on surgical residency applications were associated with future core competency-based evaluations, and found that USMLE scores were predictive of only medical knowledge, and not associated with any of the other 5 competencies. The inconsistent association between test-taking performance and true medical knowledge that has been demonstrated in the literature led experts in our study to differentiate them as 2 separate characteristics. We also found that medical knowledge was an important attribute that contributed to overall surgical residency graduate performance rating. Interestingly, medical knowledge ($r = 0.694$) had a stronger association with being considered an outstanding graduate than test-taking ability ($r = 0.485$).

Excellent surgical judgment, as identified in the present study, is vital in shaping outstanding surgeons. Yet, surgical judgment remains ill-defined. In the present study, an expert panel of surgical educators defined someone with excellent surgical judgment as someone who is consistently and accurately able to determine when a patient should or should not undergo an operation, the urgency of surgical intervention, the operation indicated, and who displays exceptional intraoperative decision-making. Others have defined judgment as a balance between decision-making, clinical acumen and reasoning, intuition, and problem solving.²¹ To effectively teach and monitor residents’ progress, as well as establish competency in this domain, we feel that the description of surgical judgment should be standardized. Notably, despite its importance, surgical judgment is absent from the established surgery milestones and is not formally taught during residency education curricula.²² As stated by Kempton and Bentz,²³ “traditional opinion suggests that good judgment comes from experience, and experience comes from bad judgment,” but in our competency-based era of surgical education, this approach is not acceptable. Our study highlights the importance of developing reliable ways to teach and assess surgical judgment throughout training. The Briefing, Intraoperative Teaching, Debriefing Model for Teaching in the Operating Room

is one useful approach to set objectives prior to an operation and give immediate feedback afterwards.²⁴ Simulation has also been suggested as a potential mechanism to train surgical judgment throughout residency.^{25,26} While most simulators focus on training and assessing technical skill, Lin et al²⁵ developed a novel web-based gaming platform to assess surgical judgment that provides real-time feedback. In this simulation, trainees prioritize the care of 3 patients and make decisions about their care preoperatively and intraoperatively.²⁵ More work is needed to develop and validate simulation activities to cultivate surgical judgment skills during residency.

The present study highlights the importance of leadership training in surgical residency. Like surgical judgment, leadership skills are absent from surgery milestones and are not formally taught at most residency programs.²² Yet, there is increasing interest in developing leadership training in surgical residency. Kostka et al²⁷ drew parallels between the structures of surgical and military teams. They noted that while leadership skills are critical in both, the military has a constant focus on leadership development, while formal leadership training was absent from surgical residency. McCulloch et al²⁸ propose mechanisms for surgical residencies to enhance leadership training, including providing formal curricula to teach mental models of leadership, providing residents with dedicated feedback regarding their leadership performance, and encouraging residents to set leadership goals throughout training. One mechanism to ensure that leadership training is more widely prioritized by training programs could be to incorporate leadership skills into the surgery milestones.

It is interesting to consider that while higher scores in each of the 21 characteristics were individually associated with better overall performance rating, only 3 qualities were required to predict overall performance quartile. The identification of these predictors by the LASSO regression does not imply that other characteristics are not important, but rather that faculty’s assessments of a graduate’s overall performance can be predicted from these 3 characteristics without separately measuring others. But if all characteristics are important, how can overall performance quartile be predicted using only 3 of them? One possible explanation is that these 3 qualities—surgical judgment, leadership, and medical knowledge—may represent a culmination of several other important traits. For example, exceptional surgical judgment may represent an amalgamation of other important prerequisite attributes, such as drive to improve, confidence, preoperative clinical skills, self-awareness,

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.²² 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 5 (leads or teaches the skill).²² 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 2 and 3, although most raters (40 of 50) were not part of the expert panel. Also, the raters in phases 2 and 3 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.

Conclusions

An expert panel of surgical educators identified 21 characteristics that were all associated with higher overall graduating general-surgery resident rating. Surgical judgment and leadership had the strongest correlations with overall performance. LASSO regression found that the assessment of only 3 characteristics (surgical judgment, leadership, and medical knowledge) were sufficient to predict overall performance quartile ratings without having to measure others. Methods to more reliably teach and assess surgical judgment and leadership skills during surgical residency training should be identified and consideration should be given to add these to surgical milestones. Future work should determine if applicants displaying these characteristics can be identified during the resident selection process, and also how these characteristics can be cultivated during residency training.

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