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ORIGINAL RESEARCH

## Anesthesiology Residency Recruitment: A Prospective Study Comparing In-Person and Virtual Interviews

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### INTRODUCTION

The goal of residency recruitment is to familiarize resident applicants and residency programs with each other prior to the match. Until recently, residency recruitment has largely involved in-person interviews and recruitment events. The coronavirus disease 2019 pandemic has led to a complete overhaul of this process, and the 2020 recruitment season was conducted mostly virtually. While virtual recruitment was a reasonable substitute in 2020 due to pandemic conditions preventing in-person gatherings, the role of virtual interviews when pandemic conditions are no longer present is unclear.

Interviews are the primary way in which program directors and residency applicants interact during the recruitment process. Program directors report that interactions with applicants are one of the most important aspects affecting their impression of residency candidates.<sup>1</sup> At our large, academic medical center, we have previously demonstrated that in-person interviews led to a significant change in the scoring of anesthesiology residency applicants compared with scores determined after application review but before the interview.<sup>2</sup> However, in-person interviews are expensive, time consuming, and vulnerable to social disruptions of the kind caused by coronavirus disease 2019. In contrast, virtual interviews do not require travel, cost less, can be scheduled at multiple places on a single

day, and can reduce the burden of the application process to applicants.<sup>3-5</sup> In August 2021, the Coalition for Physician Accountability's Undergraduate Medical Education-Graduate Medical Education Review Committee released a report recommending the "ongoing study of the impact of virtual interviewing as a permanent means of interviewing for residency" to "ensure equity and fairness."<sup>6</sup>

To estimate the effect of virtual interviews on the residency selection process, we asked all faculty interviewers participating in anesthesiology resident recruitment at a large academic center to determine a score for candidates after their review of the applicant's Electronic Residency Application Service documentation (preinterview score) and then gave them the opportunity to change their score after the virtual applicant interview (postinterview score). The primary aim was to evaluate the change in score before and after the virtual interview and compare those scores with data from in-person recruitment controls from the preceding year.<sup>2</sup> Our secondary aim was to evaluate whether certain specified characteristics (personality/communication/interpersonal skills, physical appearance, professional demeanor, discussion regarding scholarly activity, and level of interest in the specialty) affected postinterview applicant scoring differently depending on whether the interview was virtual or in-person. Lastly, we queried faculty interviewers regarding the most important factor in determining

their preinterview score as well as the most important factor during the interview that affected the postinterview score.

Our primary hypothesis was that the virtual and in-person interviews would have the same effect on scoring residency applicants. For our secondary analysis, we a priori hypothesized that there would be no difference in the effects of specific characteristics on postinterview scores between the two interview modalities.

### METHODS

#### Participants and Data Collection

This prospective study was deemed exempt by the Institutional Review Board at the University of Chicago (IRB20-1795). All data collection took place at the University of Chicago between November 2020 and January 2021. Data from the previously published study<sup>2</sup> evaluating in-person interviews was acquired at the University of Chicago from November 2019 to January 2020 and included 12 interviewers from the 2020 to 2021 season and 6 additional interviewers. Faculty members join the recruitment committee by invitation from the program director team and are trained to participate in the interview and recruitment process by reviewing guidelines for appropriate and forbidden interview questions (per the National Resident Matching Program) as well as discussing the scoring anchors, which are provided to facilitate consistency

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between faculty evaluations (Figure 1A). Recruitment committee members were informed that participation in the study was completely voluntary, and all responses to study questions would be deidentified prior to data analysis. A consent script was included at the beginning of every data collection; continuation and completion of study questions implied consent. The study questions were explicitly marked, and interviewers were not required to complete every item (Supplemental Online Material, Document 1).

### Normal Recruitment Protocol

Each residency applicant is interviewed by 3 faculty members. Each faculty member participating in resident recruitment interviews 7 to 13 applicants a day, and each interview is 15 to 20 minutes in duration. As part of normal workflow, several days prior to the interview, each faculty member receives an online survey link (SurveyMonkey Inc, Portland, OR) for each applicant. Immediately after the interview, the faculty member scores each candidate on a 1 to 5 scale (scored to the nearest tenth). This score considers both materials available from the application and the interview. The score (described in this study as the postinterview score) is then averaged with the same applicant's scores by 2 other faculty members, and the result is used to determine the match list ranking.

### Study Protocol for In-Person and Virtual Interviews

We modified our standard protocol as follows. For purposes of this study, 4 additional questions were added to the survey. Each question was clearly designated as experimental and had no influence on applicant ranking (Supplemental Online Material, Document 1). These additional questions included a preinterview score (scored 1 to 5), a question regarding which factor had the largest impact on preinterview score, a postinterview request to categorize how each applicant characteristic affected postinterview scoring (positive, negative, or neutral), and a question regarding which factor during the interview had the largest impact in changing the score following the interview. The factors evaluated for the pre- and postinterview scoring are listed in Figure 1A-C. Each factor or characteristic

included a list of examples to provide guidance and clarification to the reviewers. A complete list of study questions and consent script are listed in the Supplemental Online Material, Document 1.

Faculty interviewers participating in the study were to document the preinterview score and most important preinterview factor through the survey link provided prior to meeting the applicant. They were then asked to reaccess the survey immediately following the interview to complete the remaining survey questions. Faculty members assigned the preinterview score prior to the candidate interview using Electronic Residency Application Service application materials, which included age, sex, Alpha Omega Alpha Honor Society status, United States Medical Licensing Examination (USMLE) Step exam scores, letters of recommendation, personal statement, ethnicity, medical school transcript, medical school performance evaluation, a photograph of the applicant, and documentation regarding research, volunteer, and work experiences. All virtual interviews were conducted with video. The postinterview score was the all-encompassing final score, taking into account all written application materials as well as the interview. For both the in-person and virtual arms of our study, each applicant interviewed with 3 faculty members, and the 3 postinterview scores were averaged to obtain a final score, which determined match list ranking. Refer to Figure 2 for a flow diagram of the study protocol.

### Additional Information for Data Analysis

In addition to interviewer scores pre- and postinterview, additional information gathered from the applicant file for data analysis included age, sex, Alpha Omega Alpha status, USMLE Step 1 score, and their self-identified ethnicity, which was used to determine whether the applicant was considered to be underrepresented in medicine. While this is an evolving term, for purposes of this study, this included Hispanic, Black/African American, Latinx, and Native American people.

### Statistical Analysis

This manuscript adheres to the applicable Strengthening the Reporting of Observational Studies in Epidemiology

guidelines.<sup>7</sup> Applicants' demographics were compared with the historical controls from a previously published study<sup>2</sup> using independent *t* tests for continuous variables and chi-square tests for categorical variables. Our data included 2 levels of clusters (interviewer and interviewee) and repeated measurements (pre- and postscore). Because the interviewees were separately interviewed by 3 faculty interviewers, interviewees were considered nested within multiple faculty interviewers. To account for the combination of multiple faculty interviewers interviewing multiple applicants, these data was cross-classified to measure the "true effect" of the virtual interview. Given the nested and cross-classified nature of our data, we used a multilevel cross-classified model<sup>8</sup> with crossed random effect for interviewers and interviewees. This addressed dependencies that may arise from the nested design and adjusted standard errors accordingly. As a measure of interrater reliability, we estimated intraclass correlation from the cross-classified mixed effects model with two random effects for applicants and interviewers. We evaluated whether the virtual interview led to score changes using the multilevel cross-classified mixed effects model with a main fixed effect for the postinterview indicator. The association between each characteristic and change in score was also assessed using the same cross-classified model including each characteristic as a main effect. For each characteristic factor, the change in score from virtual interview to in-person interview was evaluated using an interaction term between an interview type (virtual versus in-person) and each characteristic in a model. We reported model-based marginal means and 95% confidence interval. Marginal means are means obtained from a statistical model and represent the average of the score change variable. All *P* values are two sided. All the analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC).

## RESULTS

A total of 816 interviews involving 272 applicants and 19 faculty members were conducted for the 2020 to 2021 recruitment season. All faculty members (19/19) on the

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resident recruitment committee agreed to participate in the study. Four interviews were removed due to missing information. The distribution of applicant demographics both for the current study and the prior year's historical controls are shown in Table 1. Two hundred and seventy-two applicants were interviewed virtually compared with 232 applicants interviewed in-person in the prior year. Applicant demographics did not differ between in-person and virtual interview seasons except for USMLE Step 1 scores (240 versus 237, respectively;  $P = .008$ ).

Overall, the postinterview score was significantly higher than the preinterview score (4.06 versus 3.98, difference of  $0.08 \pm 0.02$ ;  $P < .0001$ ) with virtual recruitment. For calibration, a change in score by 0.08 away from the median applicant score led to a 17-21 position (average 19) change in match list rank at this institution in 2021. As a crude percentage, 51.4% (419/816) of the interview scores went up, 20.1% (164/816) of the scores went down, and 28.1% (229/816) remained the same [missing data in 0.4% (4/816)]. The intraclass correlation for interviews from the same interviewer was 0.129 and was 0.154 for interviews from the same applicant. For the in-person interviews (previously published historical controls),<sup>2</sup> the postinterview score was also significantly higher than the preinterview score (4.02 versus 3.93, difference of  $0.09 \pm 0.02$ ;  $P < .0001$ ). The change in scores after virtual interviews did not differ from that after in-person interviews conducted the previous year (mean difference in score change of  $-0.017$ ; 95% confidence interval of  $-0.055, 0.021$ ;  $P = .378$ ).

The factor identified by faculty as the most important in the preinterview score was academic achievements (64%) (Figure 3A). All characteristics evaluated during the virtual interviews affected postinterview scores (negative impression of physical appearance,  $P = .03$ ; negative impression of virtual environment,  $P = .04$ ; all other  $P$  values  $\leq .0001$ ) (Supplemental Online Material, Table 1). The effect of each characteristic on score change due to the interview did not differ between in-person and virtual interviews (all  $P$  values

$> .05$ ). The most important factor affecting postinterview score change, as selected by faculty interviewers for each applicant, was personality, communication, and/or interpersonal skills (72%) (Figure 3B).

## DISCUSSION

In this prospective study examining the impact of the virtual interview on residency applicant scoring during the 2020 residency recruitment season, we found that a virtual interview leads to a significant change in the overall scoring of applicants compared with scoring based upon the written application alone. Of the factors available to faculty members prior to the virtual interview, academic achievements were considered the most important. Of the factors related to the interview, personality/communication/interpersonal skills was considered the most important. Compared with historical controls involving in-person interviews, the effect of interview modality (in-person versus virtual) on pre- and postinterview score changes did not differ. Additionally, the relative effect of applicant interview characteristics on postinterview score changes did not differ between virtual and in-person interviews.

Our findings are consistent with existing literature on the role of the interview in residency recruitment. Several previous studies have observed that personal interview scores correlate with subsequent residency performance and meaningfully affect the judgments of program and applicant regarding residency choices.<sup>1,2,9-12</sup> A 2007 study by Brothers et al<sup>11</sup> found a positive correlation between surgical residency applicant interview scores and subsequent clinical performance evaluations. A 2017 study among anesthesiology residents found a similar correlation between interview performance and clinical performance in residency.<sup>13</sup> The importance of the interview is likely to increase when USMLE Step I results transition from a numerical score to a binary "pass/fail" score by 2022.<sup>14</sup> With fewer objective markers of academic performance in medical school, programs are likely to increasingly rely on other aspects of the application, such as the interview experience, to distinguish applicants.<sup>15,16</sup>

Our findings have implications for

both programs and applicants. Faculty participants in our study identified the most important determinant of the preinterview score to be academic achievements and the most important factor during the interview to be personality, communication, and/or interpersonal skills. These results support prior studies that identify academic achievement and interview impression as potential markers for successful performance in residency and applicant rank list position.<sup>17,18</sup> Additionally, in the 2021 National Resident Matching Program Program Director Survey, interpersonal skills were considered to be one of the top factors in deciding whom to rank by program directors.<sup>19</sup> Understanding the elements of the interview that make the most impact on applicant selection and interview performance can provide valuable guidance to prospective residency applicants.

Our study suggests that the effect of an interview on residency program judgments does not depend on whether the interview is in-person or virtual. The overall magnitude of applicant score changes was similar after in-person and virtual interviews, suggesting that programs can feel assured that the virtual interview process provides the same level of scrutiny as an in-person interview. Our findings are similar to a 2016 study in which applicants offered a choice between in-person or virtual interviews were found to have similar applicant rankings and acceptance rates regardless of interview modality.<sup>20</sup> These findings are critically important as the shift to virtual interviews for resident recruitment (and recruitment globally in medicine) appears to be a permanent move.

If replicated more widely, our findings have considerable potential to widen the pool of resident applicants for programs and to increase the number of accessible residencies for medical students.<sup>21</sup> An option for virtual interviews would reduce the time and expense of interviewing, allow medical students with less resources or time to consider geographically distant programs, and expose programs to a wider pool of potential residents.<sup>3-5</sup> A potential discrepancy between interview modalities that still warrants further evaluation

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includes the effect on applicants belonging to ethnic groups that are underrepresented in medicine as well as members of lower socioeconomic status.<sup>22</sup>

Our study has limitations. Data collection took place in a single, large academic center over 2 years and may not be generalizable to all anesthesiology residency programs. We found a significant difference in USMLE scores between study groups, and this may have affected the ability to compare our results between years. In addition, we assessed scoring of applicants immediately after interviews. Thus, our results do not take into account how other interviews and applicants may have affected the scoring of any individual candidate. Although we identified pre- and postinterview characteristics based on experience and prior studies,<sup>23-25</sup> we may not have included all factors that affect postinterview scoring of applicants. Interview characteristics, such as professional demeanor or personality, may also be subjective. While the vast majority of recruitment members had never met the applicants prior to their interview day, some applicants may have met their interviewers previously during clinical rotations or meetings. These preinterview interactions could have affected the preinterview scoring in these applicants. However, preapplication knowledge of the applicant should mitigate the influence of the interview in those cases. Although our statistical analysis did take into account the fact that the same candidate interviewed with 3 different faculty members and that the same faculty member interviewed many different candidates, we did not take into account the variability in the number of interviews per day or the length of the interviews. Furthermore, we did not control for composition of the recruitment committee between years. A different cohort of interviewers may have affected our results. Lastly, while our findings suggest similarities in scoring of applicants regardless of interview modality, our comparator group is historical, so other time-based confounders may also have affected our results.

In summary, we found that interview, whether virtual or in-person, has a significant impact on applicant recruitment

scores. In addition, we found that the influence of specific applicant characteristics on postinterview scoring did not differ between in-person and virtual interviews. If replicated, our study has considerable implications for both medical students and residency programs by permitting a virtual interview option that is cheaper and requires less time to conduct. Future work is needed to replicate our findings more widely, clarify the effect of in-person versus virtual interviews on the residency applicant, and evaluate whether a hybrid virtual and in-person option is viable for future recruitment seasons.

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## Abstract

**Background:** Residency recruitment requires significant resources for both applicants and residency programs. Virtual interviews offer a way to reduce the time and costs required during the residency interview process. This prospective study investigated how virtual interviews affected scoring of anesthesiology residency applicants and whether this effect differed from in-person interview historical controls.

**Methods:** Between November 2020 and January 2021, recruitment members at the University of Chicago scored applicants before their interview based upon written application materials alone (preinterview score). Applicants received a second score after their virtual interview (postinterview score). Recruitment members were queried regarding the most important factor affecting the preinterview score as well as the effect of certain specified applicant interview characteristics on the postinterview score. Previously published historical controls were used for comparison to in-person recruitment the year prior from the same institution.

**Results:** Eight hundred and sixteen virtual interviews involving 272 applicants and 19 faculty members were conducted. The postinterview score was higher than the preinterview score (4.06 versus 3.98,  $P$  value of  $<.0001$ ). The change in scores after virtual interviews did not differ from that after in-person interviews conducted the previous year ( $P = .378$ ). The effect of each characteristic on score change due to the interview did not differ between in-person and virtual interviews (all  $P$  values  $>.05$ ). The factor identified by faculty as the most important in the preinterview score was academic achievements (64%), and faculty identified the most important interview characteristic to be personality (72%).

**Conclusions:** Virtual interviews led to a significant change in scoring of residency applicants, and the magnitude of this change was similar compared with in-person interviews. Further studies should elaborate on the effect of virtual recruitment on residency programs and applicants.

**Keywords:** Residency, anesthesiology, recruitment, interview, graduate medical education

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## Figures

**Figure 1.** Items used to facilitate faculty scoring. (A) Scoring anchors. Scoring anchors were provided to faculty interviewers prior to recruitment start as well as in the individual applicant scoring surveys. (B) Factors affecting preinterview score. Faculty were asked to identify which of these factors had the greatest influence on each individual applicants' preinterview score.

(C) Factors affecting postinterview scoring. Faculty were asked to evaluate the influence of each of the following applicant interview characteristics on their postinterview score as well as to identify which characteristic had the greatest influence on their postinterview score change.

(A)

Scoring Anchors	
1	Would not want here
2	A potential challenge to get through
3	A passing resident
4	Upper ½ of residency class
5	Offer signing bonus now

(B)

Factors Affecting Pre-Interview Score	
<input type="radio"/>	Academic achievements excluding research (e.g. AOA status, medical school grades and awards)
<input type="radio"/>	USMLE scores
<input type="radio"/>	Research achievements (e.g. publications, presentations)
<input type="radio"/>	Extracurricular achievements (e.g. community service, sports)
<input type="radio"/>	Underrepresented minority status (e.g. Black, African American, Latinx, Native American)
<input type="radio"/>	Medical school reputation
<input type="radio"/>	Letters of recommendation
<input type="radio"/>	Personal statement

(C)

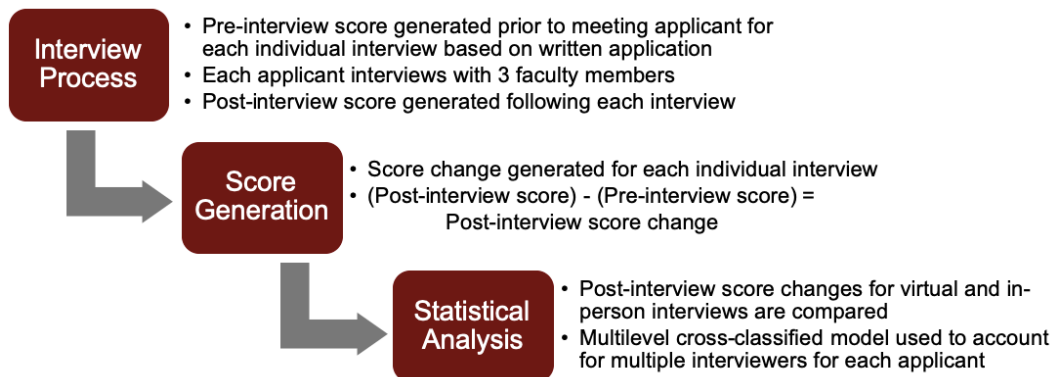
Factors Affecting Post-Interview Scoring	
<input type="radio"/>	Personality/communication/interpersonal skills (e.g. easy to talk to, well-spoken, energy level)
<input type="radio"/>	Physical appearance (e.g. neatness, grooming)
<input type="radio"/>	Professional demeanor (e.g. respectful tone, exudes integrity)
<input type="radio"/>	Discussion regarding academic/scholarly activity
<input type="radio"/>	Level of interest in the specialty based off interview discussion
<input type="radio"/>	Virtual environment (e.g. background, connectivity, other)

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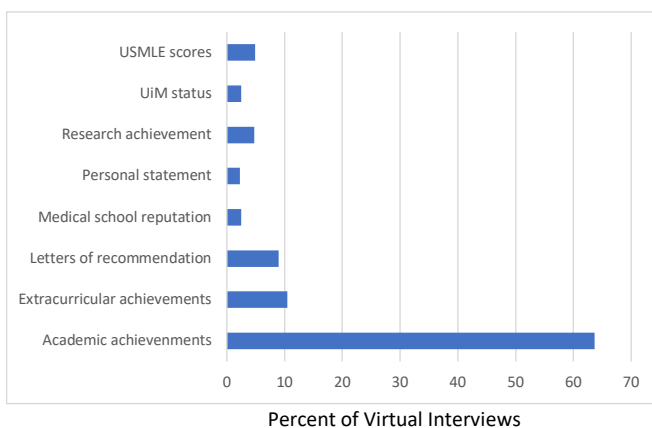
## Figures continued

**Figure 2.** Overview of study protocol. General protocol for score generation and analysis.

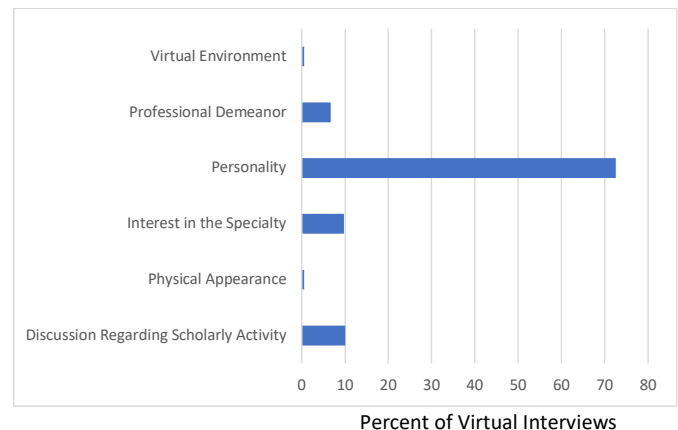


**Figure 3.** Most important factors. (A) Most important factor in preinterview score. The most important factor impacting the individual applicants' preinterview score, according to faculty interviewers; UiM, underrepresented in medicine. (B) Most important factor in the interview. The most important factor during the interview that impacted the individual applicants' postinterview score change, according to faculty interviewers.

(A)



(B)



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## Table

**Table 1. Applicant Demographics**

Characteristic	In-Person <sup>a</sup> (N = 232) n (%) or mean (±SD)	Virtual (N = 272) n (%) or mean (±SD)	P Value
Age [mean (±SD)]	27.3 (±2.6)	27.1 (±2.4)	.298
Gender			
Male	133 (57.3)	165 (60.7)	.448
Female	99 (42.7)	107 (39.3)	
Alpha Omega Alpha			
Yes	29 (12.5)	27 (9.9)	.360
No	203 (87.5)	245 (90.1)	
USMLE Step 1 score [mean (±SD)]	240.1 (±11.0)	237.2 (±12.9)	.008
Underrepresented in medicine <sup>b</sup>			
Yes	21 (9.1)	38 (14.0)	.097
No	201 (90.9)	226 (86.0)	

Abbreviation: SD, standard deviation.

<sup>a</sup> Historical controls from previously published study.<sup>2</sup>

<sup>b</sup> For the purposes of this study, those people considered as underrepresented in medicine included Hispanic, Black/African American, Latinx, and Native American people.

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## Supplemental Online Material

### Supplemental Document 1. A Complete List of Questions that Faculty Members were Asked to Complete for the Study

#### Consent:

The following questions which are denoted with an asterisk (\*) are for purposes of a study related to resident recruitment and will not be used in any way for scoring purposes for the applicant. This study was approved by the IRB (IRB20-1795). Participation in this study is completely voluntary, and responses will be blinded for interviewer and applicant names prior to being analyzed. Completion of study questions implies consent for participation in this study. For any questions regarding this study, please contact Sarah Nizamuddin at snizamuddin@dacc.uchicago.edu.

#### Questions:

For scoring: 1: "Would not want here," 2: "A potential challenge to get through," 3: "A passing resident," 4: "Upper ½ of residency class," and 5: "Offer signing bonus now!"

\*1. Pre-interview score: \_\_\_\_\_ (1-5; please score to 1 decimal point, e.g. 3.2)

\*2. Please choose the ONE most important factor, based upon the application, that affected the pre-interview scoring of the applicant.

- A. Academic achievements excluding research (e.g. AOA status, medical school grades and awards)
- B. USMLE scores
- C. Research achievements (e.g. publications, presentations)
- D. Extracurricular achievements (e.g. community service, sports)
- E. Underrepresented minority status (e.g. Black, African American, Latinx, Native American)
- F. Medical school reputation
- G. Letters of recommendation
- H. Personal statement

For scoring: 1: "Would not want here," 2: "A potential challenge to get through," 3: "A passing resident," 4: "Upper ½ of residency class," and 5: "Offer signing bonus now!"

3. Post-interview score: \_\_\_\_\_ (1-5; please score to 1 decimal point)

\*4. For each factor below, please rate the level of influence they had on your post-interview score. If a category did not influence you to change your score after the interview, then select "None." (For example, personality may have had a high level of influence on you changing your score because they had a a) wonderful personality and were very friendly (positive) or because they had a b) unfriendly personality and seemed rude at times (negative). Alternatively, you might select "none" for personality because they had a "normal" personality and it did not therefore influence you to change your score) :

Negative    None    Positive

- A. Personality/communication/interpersonal skills (e.g. easy to talk to, well-spoken, energy level)
- B. Physical appearance (e.g. neatness, grooming)
- C. Professional demeanor (e.g. respectful tone, exudes integrity)
- D. Discussion regarding academic/scholarly activity
- E. Level of interest in the specialty based off interview discussion
- F. Virtual environment (e.g. background, connectivity, other)

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## Supplemental Online Material *continued*

\*5. Please choose the ONE most important factor, based upon the interview alone, that affected post-interview scoring of the applicant.

- A. Personality/communication/interpersonal skills (e.g. easy to talk to, well-spoken, energy level)
- B. Physical appearance (e.g. neatness, grooming)
- C. Professional demeanor (e.g. respectful tone, exudes integrity)
- D. Discussion regarding academic/scholarly activity
- E. Level of interest in the specialty based off interview discussion
- F. Virtual environment (e.g. background, connectivity, other)

**Supplemental Table 1.** Association Between Characteristics and Change in Scores in Virtual Interviews

	Interviewer Impression	Mean Score Change <sup>a</sup>	SE	P Value
Personality	Negative	-0.26	0.023	<.0001
	Positive	0.196	0.017	<.0001
	None	ref.		
Physical Appearance	Negative	-0.19	0.089	0.03
	Positive	0.143	0.032	<.0001
	None	ref.		
Professional Demeanor	Negative	-0.373	0.054	<.0001
	Positive	0.186	0.02	<.0001
	None	ref.		
Discussion Regarding Scholarly Activity	Negative	-0.362	0.046	<.0001
	Positive	0.159	0.021	<.0001
	None	ref.		
Interest in the Specialty	Negative	-0.359	0.041	<.0001
	Positive	0.168	0.022	<.0001
	None	ref.		
Virtual Environment	Negative	-0.141	0.070	0.044
	Positive	0.244	0.039	<.0001
	None	ref.		

<sup>a</sup>Mean score change following the interview compared with the reference group.

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## Supplemental Online Material continued

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page no.
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1, 5
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3-4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7-9
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	7
		(b) For matched studies, give matching criteria and number of exposed and unexposed	n/a
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9-10
Bias	9	Describe any efforts to address potential sources of bias	9-10
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9-10
		(b) Describe any methods used to examine subgroups and interactions	9-10
		(c) Explain how missing data were addressed	11
		(d) If applicable, explain how loss to follow-up was addressed	n/a
		(e) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	14
		(b) Give reasons for non-participation at each stage	11
		(c) Consider use of a flow diagram	9

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## Supplemental Online Material continued

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11
		(b) Indicate number of participants with missing data for each variable of interest	11
		(c) Summarise follow-up time (eg, average and total amount)	11
Outcome data	15*	Report numbers of outcome events or summary measures over time	11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11
		(b) Report category boundaries when continuous variables were categorized	n/a
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	13-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14-15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.