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ABSTRACT

The use of admission interview comments to predict clinical clerkship success of medical students was evaluated. Narrative comments made by admissions interviewers regarding an applicant's skills and attitudes were coded, as were narrative evaluations of these students during year III of required clerkships in pediatrics and internal medicine in regard to their clinical skills, attitudes, maturity, and overall clerkship performance. For the 88 students of the University of Arizona College of Medicine, the predictive relationship between these variables was determined using multiple regression. Interview variables accounted for 22 percent of the variance in clinical performance as measured by evaluative comments. By comparison, objective preadmission variables for the same students accounted for 20 percent of the variance of clinical performance as measured by nationally standardized tests. The moderate correlation between these criteria suggests that they may be assessing different aspects of clinical performance, and thus require different kinds of predictors. The findings suggest that admissions interviews are useful in predicting clinical performance and that continuing the current admissions interview process is justified. Under the current selection process, admission interviewers are able to collect information that predicts clinical performance better than grade point averages and Medical College Admissions Tests do. However, the objective admissions measures best predict an objective measure of clinical knowledge. Therefore, choice of admissions variables will depend on which performance measures are of greatest concern. (SW)

USE OF ADMISSIONS INTERVIEW COMMENTS TO PREDICT CLINICAL CLERKSHIP SUCCESS

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In addition, it is noted that significant findings in this report are testimony to the care and attention given by our medical faculty to both the admissions interviewing and evaluation of student clinical performance.

Use of Admission Interview Comments to Predict Clinical Clerkship Success

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Is there a predictive relationship between admission interviews and narrative evaluations of clinical performance which justifies their continued use? Coding systems were used to quantify interview and clinical performance narratives. Interview variables accounted for 22% of the variance in clinical performance as measured by evaluative comments. By comparison, objective preadmission variables for the same students accounted for 20% of the variance of clinical performance as measured by nationally standardized tests. A moderate correlation between these criteria suggests that they may be assessing different aspects of clinical performance, and thus require different kinds of predictors.

Use of Admissions Interview Comments to Predict Clinical Clerkship Success

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SUMMARY

Some researchers have suggested that medical schools could select from applicants for admission most efficiently by eliminating interviews or other subjective sources of data and relying exclusively on scores from the Medical College Admission Test (MCATs) and Grade Point Averages (GPAs). However, many faculty members feel that since more than cognitive ability is required for successful performance in clinical medicine, more than cognitive ability should be assessed during the selection process. Interviews of candidates for admission by faculty members of the College of Medicine serve as one method of collecting data on non-cognitive attributes.

To test the extent to which these admission interviews are useful in predicting clinical performance, we coded narrative comments by admissions interviewers regarding the interviewers' assessments of applicant characteristics such as interpersonal skills, maturity, and ability. Similarly, we coded narrative evaluations of performance of these students during Year III required clerkships in Pediatrics and Internal Medicine regarding clinical skills, attitude, maturity, and overall clerkship performance. We then established predictive relationship between these variables using multiple regression. In the current study, the 88 students in the University of Arizona College of Medicine class graduating in 1981 were subjects.

One difficulty in attempting to show predictive relationships is that the prediction equations developed tend to take advantage of chance relationships. To control for this, we used concurrent cross-validation. This procedure involves randomly dividing the study sample into two groups, developing a prediction equation with Group I, and applying this equation to data from Group II. Data for half the 88 students were assigned to Group I and half to Group II.

The multiple correlation of admissions interview variables with total clinical performance as rated by faculty was .47 ($p = .003$) for Group I. For comparison, the multiple correlations of (old) MCATs and GPAs with NBME Part II examination total score was also calculated: this correlation was .44 ($p = .004$). These results show that admissions interview comments predict clinical evaluation comments as well as objective admissions measures predict objective measures of clinical knowledge. Objective admissions measures predicted overall clinical performance .23 (less well than narrative admissions comments did).

Concurrent cross validation involved applying prediction equations developed on Group I data to Group II data to get a "predicted" criterion score. This "predicted" score was then correlated with the scores actually obtained. This correlation for the narrative measures was .34 ($p = .01$), while the relationship between objective admissions measures and the NBME Part II examination was .35 ($p = .009$).

Our findings suggest that admissions interviews are useful in predicting clinical performance and that continuing the current admissions interview process is justified. Under our current selection process, admissions interviewers are able to collect information which predicts clinical performance better than MCATs and GPAs do. However, the objective admissions measures best predict an objective measure of clinical knowledge. Therefore, choice of admissions variables will depend on which performance measures are of greatest concern.

USE OF ADMISSION INTERVIEW COMMENTS TO PREDICT CLINICAL CLERKSHIP SUCCESS

Helen Hicks Baker and Margaret Reed Dunlap
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Procedures for selecting potential medical students seem to be constant, yet constantly changing. Admission committees usually combine objective measures of cognitive ability such as undergraduate grade point average (GPA) and the Medical College Admission Test (MCAT) with subjective measures such as letters of recommendation and personal interviews, as they have done for years. Yet the relative weightings of these data sources and the procedures for obtaining information for admission decisions vary from school to school and from year to year.

Several researchers have recommended selection procedures based solely on objective measures of students' abilities (1-4). The predictive validity of these measures has been established through correlations with grades during medical school or with objective measures of performance such as nationally standardized tests, e.g. National Board of Medical Examiners Parts I, II, and III examinations (NBME - I, II, or III). Schofield and Garrard (5) found that throughout medical training students who had been selected using actuarial methods based on GPAs and MCATs did not differ from those students who had been selected by committee action; they therefore concluded that other factors should be considered only for borderline or otherwise special applicants.

In spite of the evidence showing the usefulness of the actuarial approach, especially when time and cost are considered, many faculty members believe that personal interviews yield information which is predictive of later performance and which is unavailable through any other means. Proponents of interviews assert that since more than cognitive ability is required to perform successfully in clinical medicine, more than cognitive ability must be assessed at time of admission. This belief has support from research by Gough and his associates (6,7) who have demonstrated on several occasions that the correlation between objective preadmission measures (such as GPA and MCAT scores) and performance is low when performance is measured after the student has completed basic sciences. There is also evidence that prediction equations improve when personal characteristics are added to objective measures of cognitive ability (8,9) and that there is a positive correlation between personal attributes and non-cognitive measures of clinical performance (10). Unfortunately, attempts to use standardized pencil-and-paper instruments as predictors of clinical performance have been disappointing (11).

Complicating the search for valid and reliable predictors of clinical performance is the question of what criterion measure to use: an objective measure such as NBME-II examination or a subjective measure such as compiled preceptor and supervisor ratings. Unless extremely high correlations exist among the criterion measures, variables which will successfully predict one criterion may not be as valid for predicting another criterion. Thus, objective preadmission measures may not be effective in predicting clinical performance as measured by evaluative comments. A prediction equation for such a criterion may be better composed of comments from admission interviews. Theoretically, such predictors and criteria would assess more of

the non-cognitive attributes which seem to be part of clinical performance than would the objective measures so frequently now used.

This study addressed the question of whether admission interview comments predict clinical performance in medical school as measured by evaluation comments and ratings. Further, it addressed the question of whether a prediction equation developed from admission interview comments predicts evaluative comments of clinical performance as well as GPA and MCAT scores predict performance on NBME-II. In short, do comments predict comments as well as objective scores predict objective scores?

Additional questions addressed by the study are: 1) Do interview comments predict objective measures of clinical performance as well as objective predictors do? 2) What personal attributes described in the interview comments best predict overall clinical performance as measured by evaluative comments? 3) Will interview comments successfully predict specific aspects of clinical performance, or are they successful only for gross ratings such as overall performance? And, 4) Are the critera measures sufficiently different to require different kinds of predictive measures?

METHODOLOGY

The study was conducted in four phases. Phase I developed coding systems for the comments recorded from admission interviews and from clerkship evaluations. Phase II identified prediction equations for clinical performance criteria. Phase III cross validated these prediction equations. Phase IV employed other data analyses to contribute additional information.

This study was done on the University of Arizona College of Medicine graduating Class of 1981. Two students were transfers from other medical schools but had participated in the usual admission interview process, and therefore were included; the others were interviewed in 1977. The 88 students were randomly assigned to two groups, as is described below.

Phase I--Development of Coding Systems

Seven interview variables were chosen as potential predictors of clinical performance because they had been used successfully by other researchers, as described above, and/or were identified by faculty members from the admissions committee as important to the selection process. The variables used were: 1) maturity; 2) interpersonal skills; 3) achievement in groups or teams; 4) motivation/ interest in medicine; 5) judgment of ability; 6) individual achievement; and 7) support system. Each variable was behaviorally defined using a five-point scale (1 being unacceptable and 5 being outstanding). For each variable, each of the five scale points were defined and accompanied by example comments as they might appear on the interview report form. For instance, the scale "judgment of ability" was defined as:

"Applicant's or interviewer's judgment of applicant's ability to do well in medical school and as a physician. Terms such as the

following would refer to this category: talented, aggressive learner, bright, articulate, intelligent, hard worker, efficient technician, persevering, determined, sturdy, healthy, casual learner, lazy, frail."

A rating of "5" on this scale was defined as "Extremely able; very enhancing; highly salient positive qualities; large amount" with examples such as "An extremely talented individual"; "Appears to be highly intelligent"; "Very bright and articulate" and possibly including adverbs such as "extremely, very, highly, exceedingly". Preliminary testing of the coding scale led to the conclusion that raters could make more sensitive judgments than this five-point scale permitted. The scale was expanded by allowing raters to assign the scale points 1.5, 2.5, 3.5 and 4.5 as well as the originally defined points.

As part of the usual admission procedure at the University of Arizona College of Medicine, every applicant was interviewed by three faculty members of the College and by one community physician. None of these had access to applicants' MCAT scores, GPAs or other record information. Each interviewer was assigned a particular subject, such as "family background", as the primary focus of the interview (although the interview was not limited to this topic). After the interview, every interviewer wrote a narrative report describing subjective impressions of the applicant. Because not every narrative would mention all variables, the coded ratings could not be summed or averaged; therefore the rater assigned a score for each variable based on a composite of the four interview reports.

In order to assess the reliability of the coding system and rater judgment, the following steps were taken. Seven students' files were randomly selected from among applicants accepted for places in another entering class; and seven files were selected from among applicants who were rejected from that entering class. Each of the four interviewers' report forms were duplicated for all 14 students. Names were obliterated from the copies and a code number assigned. For each student the four interview report forms together composed a set. Sets were placed in random order for coding.

Two raters independently assigned a value between 1 and 5 (in increments of .5) for each of the seven categories for all 14 student-sets, according to the coding system. Reliability of the ratings assigned by two raters were estimated using Ebel's (12) intraclass correlation formula. This formula is similar to the product-moment correlation formula, but allows partition of variance into three components, attributable to subjects, raters, and error. Reliability estimates ranged from .57 to .91, with all except "individual achievement" being above .71.

A similar procedure was followed in developing a coding system for the evaluation comments from student performance in clinical clerkships. These comments were summaries compiled by clerkship directors from residents', preceptors' and supervisors' reviews of a student's performance over the six- or 12-week clerkship. They are written primarily for the students' use and for

use in composing Dean's letters of recommendation for residency positions. Preliminary review of student records indicated that the two clerkships tending to provide most detailed information were Pediatrics and Internal Medicine.

Eleven categories of clinical performance were delineated: 1) cognitive medical knowledge; 2) clinical skills; 3) history taking; 4) physical examination skills (both 3 & 4 are subsets of clinical skills); 5) presentations; 6) maturity; 7) rapport with patients; 8) rapport with health care team; 9) clinical judgment; 10) attitude; and 11) overall performance. Each variable scale was behaviorally defined, with each point on a scale of 1-5 (5 again being outstanding) being exemplified in a manner similar to the Interview Coding System. Again, the scale was subsequently expanded to a nine-point scale because raters indicated that they could make distinctions that fine, so a nine-point scale was used in the following analysis.

Fifteen students' files were chosen randomly from a class other than the study sample. The evaluation summaries for the pediatrics and internal medicine clerkships were duplicated for each of the 15 students. The two raters, blind to the identity of the students, assigned a rating to each of the specific criterion categories which was a composite for the two clerkships. A single "total clinical performance" score was also assigned for each student. Estimates of coding system reliability and of raters' judgment were computed, again using Ebel's intraclass correlation formula (12). Reliability estimates ranged from .57 to .86.

Phase II--Development of Prediction Equations

The admission interviews of all students entering the College of Medicine in Fall 1977 were coded by one rater according to the Interview Coding System. Independently, evaluation summaries of the students' performance in pediatrics and internal medicine were rated by one rater according to the Clinical Performance Coding System. For both tasks, the rater was blind to the identity of the students. These data from 88 students were randomly divided into two groups (I and II) before any statistical analyses were performed. The Group II data were conceptually "locked in a desk drawer" without any examination until the third phase of the study. Group I contained 42 sets of data and Group II contained 46 sets.

Using only data from Group I, the seven Admission Interview variables were regressed to each of the criterion variables using a step-wise multiple regression procedure (13) to identify the best prediction equation for each criterion. One interview variable, Achievement in Groups, was eliminated from the analyses because of excessive missing data. Additionally, Objective Preadmission variables (undergraduate science and non-science grade point averages and MCAT Verbal, Quantitative, General Information, and Science) of Group I were regressed to the NBME-II Total scores.

Phase III--Concurrent Cross-Validation

Significant prediction equations developed on Group I admissions interview data in Phase II were used to predict criterion ratings for Group II. Pearson correlations were then computed between these predicted scores and the actual scores for each of the criteria. A similar procedure was followed for prediction of NBME-II Total scores from the GPAs and MCAT scores and from Admission Interview variables. Total Clinical Performance ratings were also predicted and validated from the Objective Preadmission measures.

Phase IV--Additional Analyses

As supplemental analysis, data from Group II were used to generate prediction equations which were then applied to the Group I data to predict scores. These predicted scores were then correlated with actual scores, as was previously done with the first data set.

Several stepwise multiple regression analyses were performed on the entire sample of 88 students (Groups I and II combined) to determine prediction equations for the Total Clinical Performance rating and for the NBME-II Total score. Equations were developed from the Admission Interview variables, from the Objective Preadmission measures, and from all predictor variables together.

RESULTS

For Group I data, the multiple-correlation coefficient for Admission Interview variables with Total Clinical Performance ratings was .47 (p=.003). The coefficient for Objective Preadmission Variables with NBME-II Total Score was .44 (p=.004). Table I presents the correlation coefficients and significance levels of Overall Clinical Performance and NBME-II Total Score with Admission Interview variables and with Objective Preadmission measures for data from Group I.

Concurrent Cross-Validation

The prediction equations developed from Group I were applied to Group II data to predict Total Clinical Performance from admissions data. The relationship between these predicted scores and the actual Total Clinical Performance ratings was calculated, using a Pearson correlation coefficient, to be .34 (p=.01). Similarly, NBME Total Score was predicted, and this predicted value correlated with the obtained NBME Total Score .35 (p=.009). When Total Clinical Performance was predicted from Objective Preadmission variables, the Pearson correlation was not statistically significant (r=.23, p=.07).

Additional Analyses

Prediction equations were then developed from Group II data and predicted results were correlated to actual results for Group I. (See Table 2). The multiple correlation coefficient between Admission Interview variables and

Total Clinical Performance was .32 (p=.04), while that between Objective Preadmission variables and NBME-II Total Score was .39 (p=.007). When these prediction equations were applied to the Group I data, only the first equation was statistically significant (r=.47, p=.001). NBME-II Total Scores predicted from Objective Preadmission variables correlated with actual scores .13 (p=.22). While the multiple regression between Admission Interview variables and NBME-II Total Score was .51, the validation correlation between predicted and actual score was only .03 (see Table 2).

Table 3 shows the categories of clinical performance which were significantly predicted by Admission Interview variables for data from both Groups I and II. It also indicates the standardized beta weights for the significant variables in each equation as well as the multiple R and significance level. Ten of the eleven categories were significantly predicted from Group I data. Four of these (clinical skills, physical examinations, clinical judgment, and total performance) were significantly predicted by the same variables for both Groups I and II. Three other criteria (history taking, patient rapport and attitude) had significant prediction equations for both sets of data, but the variables in each equation were different. However, in at least one of those cases (history taking skills) both groups' equations were cross-validated as being statistically significant (p=.04 and .001).

Using the entire sample yielded a multiple R of .38 (p=.001) for the prediction of Total Clinical Performance from Admission Interview variables and a multiple R of .48 (p=.001) for the prediction of NBME-II Total Score from Objective Preadmission variables (see Table 3). Regressing all variables to each of the two criteria yielded correlation coefficients of .46 and .49 for Total Clinical Performance and NBME-II respectively.

A Pearson correlation of .43 was obtained between NBME-II Total scores and Total Clinical Performance ratings. Correction for attenuation led to an estimated correlation of .59.

DISCUSSION

The results indicate that admission interviews predict clinical performance evaluation comments as well as objective preadmission measures predict objective standardized measures of clinical performance. While the explained variance is relatively small, this finding supports continuing the practice of personally interviewing medical school applicants.

The question then seems to be: Are both types of predictors and criteria necessary or useful to the selection process? If there is a high correlation between the criterion measures, or if the interview comments were well able to predict performance on NBME-II exams (or conversely, if GPA and MCAT scores were able to predict supervisor's ratings of clinical performance), then only one set of predictors would be required. The choice of selection variables could be based on factors other than predictability, such as monetary or temporal costs. The present study provides no support for such a unitary

approach to selection. The correlation is moderate (r=.43) between the Total Clinical Performance rating and Total NBME-II score. After correcting for attenuation, the correlation is estimated to be .59; the criteria measure somewhat different aspects of clinical performance. Moreover, interview comments were only moderate predictors of NBME-II performance and objective preadmission measures were only slightly better predictors of evaluation comments. In neither set were predictors consistently validated for their "unlike" criteria. The two sets of predictors are not interchangeable. Just as Marienfeld and Reid (14) suggest that both supervisors' ratings of clinical performance and objective tests of knowledge are necessary in order to obtain the most accurate assessment of a medical student's learning, data from the present study suggest that it is important to include both measures of cognitive ability and assessment of other personal attributes in the selection process.

While it was possible to predict overall clinical performance, the attempt to devise reliable prediction equations for specific components of clinical performance was disappointing, perhaps because of the high correlations among the clinical performance variables. (Note: this was subject for further study, 16.)

In every criterion category which was predicted significantly for both Groups I and II, Judgment of Ability was a significant Admission Interview variable. The four interviewers for each applicant had no knowledge of the applicant's undergraduate grades or MCAT scores. This subjective impression of ability is more valuable in predicting clinical performance than objective ability measures are.

This was a conservative study for several reasons. First, this study used a validation phase to verify the reliability of proposed prediction equations on an independent sample. It is conceivable that a prediction equation would be statistically significant, yet when applied to new data, would fail to show a significant correlation between the predicted scores and the obtained scores. This study tested that possibility. Reducing the sample by half, as was required for cross-validation, also reduced the power to detect significant relationships.

Another conservative aspect of the study was the use of two coding systems by which comments are transformed to a quantified scale. A defined scale, with specific examples of comments for each point on the scale, was developed for both the admission interview comments and the clinical evaluation comments. Clear definitions of scale points promoted inter-rater reliability. However, the use of two such less-than-perfect scales is again conservative, for the final correlation is decreased by the error component of those two scales.

Future research will be directed toward following the medical student into residency and practice to determine whether interview variables continue to serve as useful predictors of performance and whether they are better predictors than the objective preadmission measures.

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Table 1. Results of multiple regression analysis predicting clinical performance from pre-admission variables.

	Overall Clinical Performance (Comments)		NBME - II Total Score	
	Multiple Regression	Cross Validation	Multiple Regression	Cross Validation
Group I				
Admission Interview Comments N=37*	$R = .47$ $R^2 = .22$ $p = .003$	$r = .34$ $r^2 = .11$ $p = .01$	$R = .24$ $R^2 = .06$ $p = .93$ (N.S.)	not done since not significant
Objective Preadmission Measures N=40	$R = .50$ $R^2 = .25$ $p = .005$	$r = .23$ $r^2 = .05$ $p = .07$ (N.S.)	$R = .44$ $R^2 = .20$ $p = .004$	$r = .35$ $r^2 = .12$ $p = .009$

*Sample size varies because of listwise deletion in regression procedure.

Table 2. Results of multiple regression analysis predicting clinical performance from pre-admission variables: Supplemental analysis using Group II and the entire sample.

	Overall Clinical Performance (Comments)		NBME - II Total Score	
	Multiple Regression	Cross Validation	Multiple Regression	Cross Validation
Group II				
Admission Interview Comments N-42*	R^2= .32 R = .10 p = .04	r = .47 r^2= .22 p = .001	R = .51 R^2= .26 p = .003	r = .03 r^2= .001 p = .42 (N.S.)
Objective Preadmission Measures N=45	No significant correlation		R = .39 R^2= .16 p = .007	r = .13 r^2= .02 p = .22 (N.S.)
Entire Sample				
Admission Interview Comments N=85	R = .38 R^2= .14 p = .001		R = .31 R^2= .10 p = .02	
Objective Preadmission Comments N=85	R = .34 R^2= .12 p = .001		R = .48 R^2= .23 p = .000	
All predictor variables N=79	R = .46 R^2= .22 p = .000		R = .49 R^2= .24 p = .000	

*Sample size varies because of listwise deletion in regression procedure.

TABLE 3 Significant predictors and their standardized beta weights for clinical performance criteria. Prediction equations developed separately for two groups.

Criteria	Group I Data (N=34) Significant Predictors	Beta Weights	Multiple R	Group II Data (N=42) Significant Predictors	Beta Weights	Multiple R
From Admission Comments						
Cognitive Knowledge	Judgment of Ability	.49	.49†	(None significant)	-	-
Clinical Ability	Judgment of Ability	.41	.41*	Judgment of Ability	.44	.44†
History Taking Skills	Interpersonal Skills	.40	.40*	Judgment of Ability	.46	.46†
Physical Examination	Judgment of Ability	.38	.38*	Judgment of Ability	.44	.44†
Maturity	(None significant)	-	-			
Presentation	Judgment of Ability	.57	.57‡	(None significant)	-	-
Patient Rapport	Interpersonal Skills	.46	.46†	Motivation Maturity	.45 -.33	.43*
Rapport with Health Care Team	Interpersonal Skills	.49	.49†	(None significant)	-	-
Clinical Judgment	Judgment of Ability	.51	.51†	Judgment of Ability	.31	.31*
Attitude	Judgment of Ability	.57	.57‡	Motivation	.35	.35*
Total Clinical Performance	Judgment of Ability	.47	.47†	Judgment of Ability	.32	.32*
NBME-II Total Score	(None significant)	-	-			
From Objective Preadmission Variables						
Total Clinical Performance	Nonscience GPA Quantitative MCAT	.44 .28	.50†	(None significant)	-	-
NBME-II Total Score	Science MCAT	.44	.44†	Nonscience GPA	.39	.39†

* = $p < .05$, † = $p < .01$, ‡ = $p < .001$

Table 4. Significant predictors of clinical performance and their standardized beta weights developed for the entire sample (N=79)

From Admissions Comments	Predictors	Beta	Multiple R
Total Clinical Performance	Judgment of Ability	.38	.38†
NBME-II Total Score	Judgment of Ability	.30	
	Interpersonal Skills	-.28	.31*
From Objective Preadmission Variables			
Total Clinical Performance	Nonscience GPA	.34	.34‡
NBME-II Total Score	Science MCAT	.39	
	Nonscience GPA	.25	.48‡
From All Predictors			
Total Clinical Performance	Judgment of Ability	.32	
	Nonscience GPA	.28	.46‡
NBME-II Total Score	Science MCAT	.40	
	Nonscience GPA	.25	.49‡

* = $p < .05$, † = $p < .01$, ‡ = $p < .001$