Assessing Student Competencies in Antibiotic Stewardship and Patient Counseling

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BACKGROUND AND OBJECTIVES: Antibiotic misuse contributes to antibiotic resistance and is a growing public health threat in the United States and globally. Professional medical societies promote antibiotic stewardship education for medical students, ideally before inappropriate practice habits form. To our knowledge, no tools exist to assess medical student competency in antibiotic stewardship and the communication skills necessary to engage patients in this endeavor. The aim of this study was to develop a novel instrument to measure medical students’ communication skills and competency in antibiotic stewardship and patient counseling.

METHODS: We created and pilot tested a novel instrument to assess student competencies in contextual knowledge and communication skills about antibiotic stewardship with standardized patients (SP). Students from two institutions (N=178; Albert Einstein College of Medicine and Warren Alpert Medical School of Brown University) participated in an observed, structured clinical encounter during which SPs trained in the use of the instrument assessed student performance using the novel instrument.

RESULTS: In ranking examinee instrument scores, Cronbach α was 0.64 (95% CI: 0.53 to 0.74) at Einstein and 0.71 (95% CI: 0.60 to 0.79) at Brown, both within a commonly accepted range for estimating reliability. Global ratings and instrument scores were positively correlated (r=0.52, F[3, 174]=30.71, P<.001), providing evidence of concurrent validity.

CONCLUSIONS: Similar results at both schools supported external validity. The instrument performed reliably at both institutions under different examination conditions, providing evidence for the validity and utility of this instrument in assessing medical students’ skills related to antibiotic stewardship.

Methods
Setting and Participants
Third-year students at the Albert Einstein College of Medicine (Einstein, n=96) and the Warren Alpert Medical School of Brown University (Brown, n=82) participated in this

From the Albert Einstein College of Medicine, Bronx, NY (Drs Santos, Oza, Jordan, Joo, and Naqvi); Fordham University, Department of Psychology, Bronx, NY (Dr Grochowalski); and The Warren Alpert Medical School of Brown University, Providence, RI (Dr George).
study during their family medicine clerkship (2017-2018). Both institutional review boards deemed this study exempt.

**Intervention**

At both institutions, antibiotic stewardship instruction is integrated into the preclinical Microbiology/Infectious Disease course. Students reviewed the CW website and its related videos during the family medicine clerkship. At the clerkship’s conclusion, student competency attainment is assessed via an observed structured clinical encounter (OSCE).

We completed a multistage, iterative development and implementation of a CW-OSCE with trained standardized patients (SPs) as evaluators. At both institutions, the CW-OSCE was one of five end-of-clerkship OSCE stations. Each student interviewed and counseled an SP requesting antibiotics for URI symptoms using the framework of CW concepts. The SPs and simulated cases were different at each school: viral pharyngitis (Brown) and viral rhinosinusitis (Einstein).

**Measures**

Using the CW framework, we designed eight items to measure students’ ability to engage patients meaningfully in appropriate prescribing of antibiotics. For example, these items included whether the student explored patient's reason for requesting antibiotics, explained the side effects of antibiotics, and planned a follow up. Each antibiotic stewardship concept was measured by one to three items, and each item had a yes (2 points), partial (1 point), or no (0 point) rating scale. All items measured antibiotic stewardship concepts rather than general communication skills. Table 1 gives the main-item concepts for assessing antibiotic stewardship. SPs also assigned a single-item global rating of the student performance (range from 0-2, with higher ratings indicating better overall performance for the station).

SPs at both institutions received training in the use of the instrument. The instrument is currently in use, and is available from the authors upon request.

| Table 1: Item Analysis Statistics for the Eight-Item Instrument Administered at Two Sites |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| CW Skills and Description | Instrument Items and Description | Mean (SD) | Cronbach α (SE) | Raw | Std | Drop | Mean (SD) | Cronbach α (SE) | Raw | Std | Drop |
| Elicits concerns | 1. Reason for request | 1.6 (0.5) | 0.61 (0.06) | 0.54 | 0.52 | 0.32 | 1.7 (0.5) | 0.66 (0.06) | 0.55 | 0.60 | 0.42 |
| Demonstrates empathy | 2. Understanding concerns | 1.7 (0.5) | 0.59 (0.06) | 0.57 | 0.57 | 0.38 | 1.8 (0.5) | 0.68 (0.05) | 0.47 | 0.53 | 0.34 |
| Provides clear information | 3. Partnership | 1.5 (0.6) | 0.55 (0.07) | 0.70 | 0.65 | 0.49 | 1.6 (0.6) | 0.63 (0.06) | 0.67 | 0.68 | 0.54 |
| | 4. Etiology | 1.9 (0.2) | 0.65 (0.05) | 0.22 | 0.35 | 0.11 | 1.7 (0.6) | 0.63 (0.06) | 0.67 | 0.68 | 0.54 |
| | 5. Symptom resolution | 1.9 (0.3) | 0.64 (0.05) | 0.31 | 0.42 | 0.19 | 1.2 (0.8) | 0.61 (0.07) | 0.74 | 0.74 | 0.59 |
| | 6. Antibiotic consequences | 1.6 (0.6) | 0.64 (0.05) | 0.47 | 0.45 | 0.23 | 1.2 (0.8) | 0.72 (0.05) | 0.41 | 0.39 | 0.17 |
| Confirms agreement | 7. Plan negotiation | 1.7 (0.5) | 0.56 (0.06) | 0.67 | 0.64 | 0.50 | 1.6 (0.7) | 0.69 (0.05) | 0.49 | 0.48 | 0.29 |
| | 8. Follow up | 1.6 (0.6) | 0.59 (0.06) | 0.62 | 0.56 | 0.39 | 1.0 (0.9) | 0.69 (0.05) | 0.57 | 0.52 | 0.33 |
| Global rating | | 1.2 (0.6) | | | | | 1.2 (0.6) | | | |

Item scale: 0 = No (absence), 1=Partial (SP had to prompt), 2=Yes (desired item content present).

Mean=mean of item score.

Abbreviations: CW, Choosing Wisely; SD, standard deviation of item score; α, reliability measured as coefficient α; SE, standard error of α; Raw, raw correlation between item and total score; Std, correlation between items and total score when all items are standardized; Drop, correlation between item and total score if item were removed from the instrument; Cronbach α, measure (range 0 to 1) of how reliable and consistent total scores would be over repeated administrations, with higher values indicating more consistent scores.

Correlations are a measure of association (range -1 to 1) indicating how similar two items are, where values closer to zero indicate no relationship and absolute values closer to one indicate stronger similarities.
Analyses
Preliminary analysis of the initial Einstein data showed minimal variability in the student scores (SP gave perfect scores to almost all students). This prompted SP retraining and exclusion of the first 6 months’ data from the final analyses. We used the R statistical software program and the Psych package (R Foundation for Statistical Computing, Vienna, Austria) to calculate a total instrument score for each student, as well as item difficulties, score distributions, scale structure, reliability (Cronbach α), and concurrent validity via item-total correlations.20

We analyzed results separately from each school to generate initial evidence for external validity. Taken together, these analyses were intended to determine the psychometric properties of the instrument.18,19,21-24

Results
Analysis of the instrument scores of all students during the study period (Einstein: 96, Brown: 82) showed that item difficulties averaged 1.6 (range 1-1.9), which is ideal for discriminating student ability. Cronbach α was 0.64 (Einstein, 95% CI: 0.53 to 0.74) and 0.71 (Brown, 95% CI: 0.60-0.79), both within a commonly accepted range (ie, 0.60-0.85) for estimating reliability (Table 1).

Table 2 shows that simple correlations (r) between items were in an acceptable range (ie, 0.15-0.50), considering that correlations deflate when item score ranges are limited to discrete values of 0 to 2. Except for items Q4 and Q5, with smaller Drop correlations due to the ceiling effect, item correlations were similar in magnitude for the two locations (eg, Q3 had relatively high, and Q6 relatively low correlations at both schools).

Global ratings and instrument scores were positively correlated (r=0.52, F[3, 174]=30.71, P<.001): higher instrument scores were correlated with more positive global rating scores. Table 3 shows that regression analysis predicting global scores based on total score and test site showed no significant interaction of scores by site, suggesting that the relationship between total score and global score did not differ by institution and only total scores predicted global scores (coefficient estimate=0.13, t(174)=9.24, P<.001).

Discussion
Literature reports that objectively designed instruments can assess students’ contextual knowledge and communication skills in identifying issues impacting clinical outcomes.11 We have developed a novel instrument measuring students’ demonstration of antibiotic stewardship concepts.12 The reliability and item statistics results demonstrate that the instrument measured scores reliably and support its use for similar purposes at other institutions. Higher instrument scores predict higher

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**Table 2: Correlation Matrices of Item Scores for the Eight-Item Instrument Administered at Two Sites**

| Instrument Item and Description | Item Number | Einstein | Brown |
|---------------------------------|-------------|----------|-------|
| 1: Reason                        | 1           | -        | -     |
| 2: Understanding                | 0.23        | -        | 0.33  |
| 3: Partnership                  | 0.11        | 0.50     | 0.49  |
| 4: Etiology                     | 0.06        | 0.04     | 0.13  |
| 5: Resolution                   | 0.03        | 0.26     | 0.43  |
| 6: Consequences                 | 0.14        | -0.04    | 0.09  |
| 7: Plan                         | 0.33        | 0.17     | 0.05  |
| 8: Follow up                    | 0.28        | 0.22     | 0.24  |

Correlations are a measure of association (range -1 to 1) indicating how similar two items are, where values closer to zero indicate no relationship and absolute values closer to one indicate stronger similarities.

**Table 3: Results of Regression of Global Scores on Instrument Scores Across Two Sites**

|                      | Coefficient Estimate | Standard Error | t      | P Value |
|----------------------|----------------------|----------------|--------|---------|
| (Intercept)          | -0.30                | 0.17           | -1.81  | .07     |
| Checklist score      | 0.13                 | 0.01           | 9.24   | <.001*  |
| Einstein             | 0.46                 | 0.53           | 0.87   | .39     |
| Interaction          | -0.07                | 0.036          | -1.82  | .07     |
global ratings, providing evidence of concurrent validity.

Our study has limitations. Students were assessed on a single case during their third-year family medicine clerkship, limiting generalizability to other educational settings and stages of training. Ideally, there should be coordinated preclerkship and clerkship curricula and assessments reinforcing antibiotic stewardship. Additionally, we cannot provide evidence of behavior beyond the clerkship nor in the clinical setting. Assessing these competencies in practice requires novel interventions such as unannounced SPs in patient care settings.25

We developed and tested a novel instrument to measure medical student antibiotic stewardship competencies. Implementation at other institutions with different cases and learners would provide additional validity evidence for the instrument and elucidate item performance under various conditions.

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