Measuring the Medical Knowledge Competency

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ABSTRACT
Background: Standardized tests relate to test-taking abilities and theoretical ("book") knowledge and do not measure the clinical application of medical knowledge (MK). Communication skills may have an influential effect on evaluating applied medical knowledge. We hypothesized that MK has two components: applied, clinical component, and standardized, book-knowledge component, where clinically assessed (at the bedside) MK is related to interpersonal communication skills and does not correspond to resident performance on standardized examination tests.

Methods: Faculty and self-evaluation scores (total n=4,836) were analyzed for 31 pediatric residents during one academic year. The evaluation form measured each of the six ACGME core competencies on a 5-point Likert scale. Regression was used to determine if bedside MK assessed by faculty correlated with resident in-training examination scores. Pearson coefficients were calculated to test for correlation, and factor analysis was used to identify interrelatedness between the six competencies.

Results: At all postgraduate levels, the assessment of clinical knowledge correlated with communication skills \( r = 0.94, \ p < 0.001 \); \( r = 0.90, \ p < 0.001 \); \( r = 0.84, \ p < 0.001 \). Linear regression and bivariate analysis failed to find any relationship between MK and in-training examination scores. Factor analyses of self- and faculty-assessed competencies resulted in a single factor loading, reflecting the high interrelatedness between the six competencies.

Conclusions: These results imply that resident MK is highly interrelated with other competencies, where faculty evaluation of clinical MK is strongly related to perceptions about resident communication skills. Therefore, differentiating between "book" and "bedside" knowledge becomes essential. The addition of a "skills" competency seems relevant in continued assessment of bedside-assessed MK. Importantly, we need to look into the question whether the traditional standardized tests measure the knowledge and abilities physicians need to function in a patient-oriented and medical-home based care system.

BACKGROUND
Current literature lacks supporting evidence that assessment of clinical knowledge predicts performance on written standardized tests. Several papers have discussed issues regarding reliability and validity of various assessment methods measuring medical knowledge (Downing et al, 2003; Williams et al, 2003; Pulito et al, 2006). Evaluation ratings for resident clinical knowledge have been linked to directly observed patient-doctor communication skills (Laidlaw et al, 2006). It can be argued that standardized testing may not actually measure clinical application of knowledge but rather relate to the test-taking abilities and theoretical ("book") knowledge of the learners. Moreover, communication skills may have an influential effect on evaluation of applied medical knowledge.

Previous studies have compared assessment methods of medical student clinical competency. Multiple choice tests are perceived to be better methods of assessing knowledge, while communication skills are best assessed through interactions. The relationship between clinical competence and interpersonal communication skills is influenced by the clinical encounter, which acts interdependently upon the two dimensions (Celliver, 1999). Faculty ratings are based on direct observation of clinical performance.

Pulito et al. (2006) found that faculty evaluations (n=331) of medical students indicated medical knowledge, professionalism, and clinical reasoning skills were gauged from direct interaction. H&P skills were inferred from quality of students' verbal presentation. Suzuki Laidlaw et al. (2006) noted that significant positive relationship was found between clinical content checklist and communication skills among PGY1 and PGY2 residents (n=78). Johnson and Cujec in 1998 studied the self-rating by residents (n=60) and found that they did not correlate to multiple choice test scores and differed in some criteria (clinical skills, professionalism, empathy) with end-rotational attending physician evaluations.

Standardized tests may not accurately measure applied medical knowledge. Standardized tests measure residents' test-taking skills and theoretical knowledge. Communication skills influence faculty evaluation of applied clinical knowledge and does not predict performance on standardized tests. We wanted to test for relationship between medical knowledge as assessed by faculty and residents in the clinical setting and by standardized tests, and the rest of the ACGME competencies. The investigators hypothesized that medical knowledge has two components: applied, clinical component, and standardized, book knowledge component, where clinically assessed (at the bedside) medical knowledge is related to interpersonal communication skills and does not predict resident performance on standardized examination tests.

Methods
We obtained faculty and self-evaluation scores for pediatric resi...
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dents (n=31) in one academic year. The study was approved by the Institutional Review Board at Texas Tech HSC – El Paso (IRB # E09076). The evaluation form measured each of the six ACGME core competencies by a 5-point Likert-type scale. Multiple imputations (WinMICE version 0.1, 2005) accounted for missing data (2%). For each postgraduate year level, regression was used to determine if medical knowledge as assessed by faculty at the bedside predicted pediatric in-training examination scores. Pearson coefficients were calculated to test correlation between mean in-training examination scores, mean faculty and self-assessment scores for medical knowledge (MK), and mean faculty and self-score for interpersonal communication skills (COM), each by postgraduate year level. Factor analysis of all faculty and self-assessed competencies served to identify any interrelatedness between competencies (patient care, medical knowledge, communication skills, practice-based learning, professionalism, and systems-based practice).

The assessment ratings for clinical knowledge are related to directly observed patient-doctor communication skills. We hypothesized that medical knowledge is comprised of two components:
1. “Bedside” Applied clinical knowledge related to communication skills
2. “Book” Standardized test-taking knowledge

The resident assessment form we used measured each ACGME competency on a 5-point scale, with the following numerical equivalents:
1) None/beginner
2) Some knowledge/Little experience
3) Familiar/Need more experience
4) Confident managing patients with minimal supervision
5) Ready for independent practice

A competency-based assessment form documented residents’ clinical performance during academic year. A total of 31 residents each received 2 sets of evaluations (self and faculty) across 13 block rotations for each of the six ACGME competencies (n=48.56). The mean scores were computed for each competency, for both self and faculty data points, for each postgraduate year level and all year levels combined.

Resident in-training examination scores served as a measurement of standardized test knowledge. Linear regression was performed for:
- In-training exam scores and faculty-assessed MK
- In-training exam scores and self-assessed MK
- Faculty-assessed MK and faculty-assessed COM
- Self-assessed MK and self-assessed COM

The test for Interrelatedness was Factor Analysis, principal component extraction method. The number of factor loadings for each competency determined which competencies are most salient in resident assessment. Missing faculty assessment scores for all resident years was 2% of the data. Multiple imputation method generated new scores for completely missing evaluations or “not applicable” questions. WinMice version 0.1 imputed values by random generated discrete values. Means were computed from newly generated data points.

Results
Among first-year pediatric residents, faculty assessment of MK strongly correlated with COM (r=0.94, p<0.001). At second-year level, self-evaluation of MK was significantly associated with self-assessed COM (r=0.90, p<0.001). Third-year resident MK and COM scores were highly correlated for both self- and faculty evaluations (r=0.84, p<0.001). Linear regression and bivariate correlation failed to find any relationship between faculty or resident-assessed MK and in-training examination scores. Factor analyses of self- and faculty-assessed competencies resulted in a single factor loading, reflecting the high interrelatedness between the six competencies.

Among PGY-1 residents, faculty-assessed MK had a strongly positive relationship with faculty-assessed COM (r=0.94, p<0.001). Similar relationship was seen for PGY-3 residents but not for PGY-2 group. Self-evaluated MK and self-evaluated COM were highly correlated for all residents. No relationship was found between faculty-assessed MK and in-training scores. Principal component analyses of all competencies resulted in a single factor loading, for both self- and faculty-assessed competencies. Eigenvalues identified how many individual competencies are being measured. Eigenvalues for self assessment and faculty assessment scores revealed between 4 to 5 competencies lumped into measurement of a single score.

DISCUSSION AND SIGNIFICANCE
There is a huge amount of medical knowledge that is tested in a standardized exam. Pragmatic clinicians might be poor test takers. Many clinicians concentrate on learning about the cases frequent in their clinical practice, and less about infrequent pathology. Translation of “book” medical knowledge to the bedside for “routine cases” might be much easier than for relatively infrequent cases that challenge clinical reasoning ability. In the beginning of their careers, the residents might have not yet developed solid criteria about what is relevant or important in a specific case. The dilemma is training the residents to do both - become great clinicians and at the same time be good test takers, and create a system for the evaluation that is objective.

Our results imply that resident knowledge is highly interrelated with other competencies, where faculty evaluation of clinical medical knowledge is strongly related to resident communication skills. The results indicate that the in-training examination does not measure clinical (bedside) knowledge and that clinical knowledge as assessed in clinical settings does not predict resident performance on standardized tests. Differentiating between “book” and “bedside” medical knowledge enables residency programs to enhance the quality of resident assessment, and more appropriately prepare residents for performance on standardized tests (e.g. in-training and certifying examinations). Limited literature on this topic warrants more rigorous studies that highlight differences between resident general medical knowledge, resident communication skills, and application of knowledge in practice. Continued assessment and improvement of the ways clinical faculty measure resident medical knowledge is essential. The addition of a “skills” competency seems important and relevant in continued assessment of at-the-bedside applied medical knowledge.

CONCLUSIONS
Based on the literature review and the outcomes of our study, we suggest that resident medical knowledge is highly interrelated with

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other competencies (patient care experience, communication skills, practice-based learning, professionalism, and systems-based practice). We further suggest that at the bedside, faculty evaluate medical knowledge based on resident communication skills. Our analysis showed that faculty-evaluation of resident bedside medical knowledge is unrelated to performance on standardized examinations. In light of these findings, we suggest that:

- Differentiation between “book” and “bedside” knowledge may improve assessment criteria for resident evaluation and may help improve residents’ preparation for standardized tests (e.g. Board certifying exam).
- More rigorous studies are needed to highlight the inter-relatedness between general medical knowledge, communication skills, and applied clinical knowledge.

REFERENCES


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