

## Mini clinical evaluation exercise: validity and feasibility evidences in literature

**Naveed Yousuf**

Department for Educational Development, Faculty of Health Sciences,  
Aga Khan University, Karachi, Pakistan

### Abstract

Clinical skills assessment has a very important role in Health Professions Education. However, the basic requirements of its reliability and validity have not been achieved or taken much care of. A mini Clinical Evaluation Exercise (mini-CEX) is approximately a twenty minute encounter, during which a trainee performs focused history taking and physical examination of a patient in a real setting while the faculty assessor observes. After a discussion on the diagnosis and management plan for the patient, the faculty assesses the trainee using the mini-CEX evaluation form and provides feedback. Based on the literature review mini-CEX is found to be a valid and reliable assessment strategy for clinical competence. It has shown to be content valid and differentiates well between different performance levels for both postgraduate and undergraduate trainees. The results are fairly reliable on four or more encounters with the standard error of measurement being very small. The mini-CEX scores have shown to be criterion valid and have sufficient desired educational impact on trainees. Overall, mini-CEX is found to be a fairly valid and feasible assessment strategy for clinical skills justifying its use for both undergraduate and post-graduate education.

### Keywords

Mini-CEX, Validity, Feasibility, Clinical Assessment

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## Introduction to Clinical Skills Assessment

It is a well-known fact that assessment drives learning. Clinical skills assessment has a very important role in Health Professions Education. However, the basic requirements of reliability and validity have not either been achieved or taken much care of. One of the major challenges in clinical skills assessment is it being case specific [1]. To maximize learning, the clinical skills assessment must also be educational and formative [2].

## Traditional Clinical Evaluation Exercise

The American Board of Internal Medicine abandoned using oral examination of residents in 1972 and requested the program directors to assess the residents on their clinical competence including clinical skills. The board recommended the use of clinical evaluation exercise (CEX) for this purpose. During a traditional clinical evaluation exercise (tCEX) the resident is required to take a complete history, perform clinical examination of a patient, and presents the patient's findings with the management plan to the faculty who is observing the resident. The faculty assessor then provides feedback to the resident and records the performance on a form provided by the board. In the end, the resident gives a written record of the patient work-up to the assessor. This entire tCEX process takes about two hours [3].

The tCEX has three limitations [3, 4]:

1. The resident is being assessed with only one patient. Clinical performance being case specific, a broader sample of patients is required in order to have a valid and reliable assessment.
2. The resident is being assessed by only one faculty. A strict or a lenient assessor may introduce error into the assessment.
3. The two hour interaction is not representative of routine real life patient-

doctor interactions which are of shorter duration, demanding focused history taking and examination skills.

## Mini Clinical Evaluation Exercise

Mini Clinical Evaluation Exercise (mini-CEX) was introduced with the aim of improving the limitations of tCEX in order to better assess the clinical competence of trainees.

A mini-CEX is expected to be a twenty minute encounter, when a trainee performs a focused history taking and physical examination of a patient while the faculty assessor observes. After a discussion on the diagnosis and management plan for the patient, the faculty assesses the trainee using the mini-CEX evaluation form and provides feedback.

The mini-CEX form is a nine point rating scale with 1,2,3 being unsatisfactory, 4,5,6 satisfactory and 7,8,9 being superior. Based on observation, the assessor rates the trainee on history taking, physical examination, clinical judgment and synthesis, humanistic qualities and overall clinical competence. If, for any competency, the assessor is unable to comment, a box is provided for "insufficient contact to judge". The assessor may also record the clinical setting of the encounter, complexity of the case and the medical problem or diagnosis. At the end, there are items to record the satisfaction level of the assessor and trainee on a nine point scale, 1 being lowest and 9 highest.

As each encounter is short, the trainee can be evaluated multiple times in a year with different patients and evaluators, and in different settings (inpatient, outpatient, emergency).

There are four major advantages of mini-CEX as compared to tCEX [4]:

1. Assessment in a variety of clinical settings
2. Shorter duration

3. Increased content validity and reliability
4. Focused patient evaluation which is more representative of real life scenario

## Validity Assessment of Mini-CEX

Downing in his article "Validity: on the meaningful interpretation of assessment data" states that all validity is construct validity [5]. He describes five important sources of validity evidence which are content, response process, internal structure, relation to other variables and consequences. Based on literature review, evidences regarding mini-CEX on four of these validity sources (except response process) are being discussed here.

## Content

Norcini et al. in one of the preliminary investigation on using mini-CEX for assessing internal medicine residents reported mini-CEX to have considerable content validity [3]. Their results showed that 54% of the mini-CEX encounters were with inpatients, 38% with outpatients and 14% with patients in the emergency department. Out of these, 58% of the patients were new patients and 36% were follow-up cases for the residents being assessed. The patients presented with a broad range of clinical problems representative of daily practice in internal medicine. There was no significant difference in the overall competence rating of the residents in different clinical settings, and for first / follow-up visits. One limitation of mini-CEX reported in their study was inability to observe the trainee doing a complete history and physical examination. Similar comprehensive content coverage was reported in a later study by Norcini et al [6].

One important component of validity for an assessment method is the ability to correctly differentiate between different levels of performance. The preliminary investigation by

Norcini et al found the mini-CEX scores to improve significantly with the level of training from first to third year of residency, but the number of residents in second and third year of training was small in their study [3]. Holmboe and colleagues in a study using scripted videotapes of standardized patients and standardized residents have shown that the faculty was clearly able to differentiate between different levels of resident performances using mini-CEX [7]. Only eleven of the forty faculty members in their study were unable to correctly identify a poor performance and marked them satisfactory or higher. Though the use of videotapes instead of real life observations for assessment was a limitation of the study, it showed mini-CEX to have considerable validity to identify different levels of trainees' performance. De Lima et al have also shown mini-CEX to discriminate between clinical seniority among cardiology residents with statistical significance [8].

In addition to the residency programs, mini-CEX has been found to differentiate between the levels of training for undergraduate medicine clerkships. Jennifer et al. found the mini-CEX scores of students to improve through the four blocks (quartiles) of the medicine clerkship [9]. They also found honors students to score significantly higher on mini-CEX than students who were assigned "Pass" on their clerkship summative assessments.

A recent study from UK has also shown more senior trainees to receive significantly higher scores on mini-CEX, but have reported clinical setting and case complexities to influence the mini-CEX scores. The scores were significantly higher for inpatient encounters as compared to outpatient and for more complex cases as compared to simpler ones [10].

## Internal Structure

The reproducibility / generalizability coefficient and standard error of measurement (SEM) of mini-CEX as reported by different studies are as follows:

- Norcini et al [3]: for internal medicine residency, 0.55 (SEM 0.35) for four encounters, 0.71 (SEM 0.25) for eight and 0.81 (SEM 0.19) for 14 encounters.
- Durning et al [4]: for internal medicine residency, 0.56 (SEM 0.35) for seven mini CEX encounters
- Kogan et al [9]: for medicine clerkship, 0.62 for four encounters, 0.71 for six and 0.77 for eight encounters.
- Nair et al [11]: for international medical graduates in Australia, 0.88 (SEM 0.35) for eight encounters
- Wilkinson et al [10]: for medical specialties in United Kingdom, 0.77 (SEM 0.34) for four encounters, 0.87 (SEM 0.24) for eight and 0.92 (SEM 0.18) for 14 encounters

The number of encounters required to have a fairly reliable examination using mini-CEX are similar to those required for other similar examinations like standardized patient encounters or standardized oral examinations [3]. The internal consistency reported for mini-CEX in two different studies are fairly high i.e. 0.79 and 0.90 [4,12].

Norcini et al reported high and statistically significant **correlations** among the different components of the mini-CEX scale (0.62-0.81) and between the components and overall competence ratings for the residents (0.66-0.90) [3, 6].

A study by Margolis et al has shown some interesting results [13]. Using multivariate generalizability analysis they have tried to identify the contribution of different influences on the observed mini-CEX score.

According to their study, examinee by case variance is very small, which has led to the proposition that the case specificity of mini-CEX may be lower than expected. Another interesting finding is that the rater variance is relatively large and even higher than the variance due to examinee. The study shows that error due to rater characteristics is larger than most of the other sources of variances. This finding has important implications i.e. for a reliable and reproducible mini-CEX score, an examinee must be evaluated by a larger number of raters even if the number of encounters is high. More mini-CEX encounters but with limited / same examiners may not produce as highly reliable results. The study also finds high correlations among the different competencies of mini-CEX, as is also shown by Norcini et al [3]. Various reasons are proposed for the high correlations based on the analysis i.e. if a case is difficult in one competency it may also be difficult for other competencies; if an examinee does relatively better on one competency in a case, he/she is likely to perform better in other competencies on that case; and lastly if the rater has marked an examinee high on one competency, it is likely that he will mark him high on other competencies as well; or vice versa.

## Relationship to Other Variables

Hatala et al have compared the performance of postgraduate year 4 (PG-Y 4) residents on mini-CEX and the national high stakes examination known as Royal College of Physicians and Surgeons of Canada Comprehensive Examination in Internal Medicine (RCPSC IM) [12]. RCPSC IM examinations includes a written 200 items multiple choice examination; an structured oral component assessing the ability to summarize and synthesize data, and to discuss, interpret and manage clinical cases; and bedside examination to test the physical examination, communication and ethical skills. The correlations between the mini-CEX

and the written examination, structured oral component and bedside station sub-score were 0.72, 0.73 and 0.67 respectively. Overall there was moderate correlation between the mini CEX score and the final score on RCPSC IM examination i.e. 0.73. The average mini CEX score of residents who passed the RCPSC IM examination was  $6.14 \pm 1.2$  as compared to  $4.2 \pm 1.0$  for those who did not. The high correlation between mini CEX and written examination scores are justified by the fact that the oral and written components of the RCPSC IM are also highly correlated, suggesting that both may be assessing similar constructs.

Another study by Durning et al have found statistically significant correlations on similar competencies between mini CEX scores and American Board of Internal Medicine monthly evaluation forms (ABIM MEF) for PGY 1 residents [4]. In addition this study also reports lower correlation coefficients for unrelated mini-CEX and ABIM MEF sections. Mini-CEX scores have also been found to be highly correlating with medical students clerkship assessments. Kogan et al have found significant correlations between mean mini-CEX scores and all components of internal medicine clerkship assessment [9]. The internal medicine clerkship assessment is composed of summative evaluations each for outpatient and inpatient rotations, written examinations and patient write-ups. They also found the honors students on clerkship assessments securing significantly higher scores on mini-CEX as compared to other passing students.

## Consequences

Studies published have reported mini-CEX to be of formative educational value as it provides opportunities for performance under direct supervision with inbuilt feedback from the supervisor / faculty [3,10].

De Lima et al have reported the perceptions and impact on learning of mini-CEX on cardiology residents [14]. In their qualitative study they have reported the residents to have an intrinsic interest and self-regulating strategies for their studies. The residents were at comfort with mini-CEX as it corresponded with their daily experiences with patients and future expectations. They found mini-CEX to be a useful strategy for assessment and learning.

Malhotra et al in their article have questioned the generalizability of the findings in the above study by De Lima et al., as mini-CEX was held once as a single encounter for cardiology residents [15]. In their qualitative study on perceptions of internal medicine residents of mini CEX, they found three major themes i.e. education, assessment and exam preparation. They found that their residents felt anxiety and stressed perceiving mini-CEX as an assessment. They also stated that the thought of being observed may have affected the residents' performance during mini-CEX. Though the residents valued the opportunity to interact with the faculty and receiving feedback, they were not appreciative of mini-CEX being evaluative at the same time. They also reported to become comfortable with mini-CEX with time and found this to be a useful opportunity for learning. They felt that exposure to mini-CEX helped them to prepare for their final high stakes examinations.

## Feasibility

Feasibility, though secondary to validity, is also an important consideration for implementation of any assessment strategy. Many studies have gathered evidences regarding the feasibility of mini-CEX using one or more of the following three criteria i.e. the time required for each encounter, the practical possibility of achieving the target encounters in the study, and acceptability /

satisfaction of faculty or trainees regarding mini-CEX.

### **Time for each mini CEX encounter**

The mini CEX encounter time ranged from 1 to 100 minutes for postgraduate trainees and 1 to 180 minutes for medical students [3, 9, 10]. The average time varied depending on the clinical setting, complexity of the case, and first/follow-up visit [3, 6]. For medical students, the average observation time during mini-CEX was significantly greater if resident assessors were used as compared to faculty assessors [9]. The average feedback time noted in studies is one-half to one-third of the mean observation time during mini-CEX [9, 10, 16].

### **Practicality**

Studies have reported up to an average of eight completed mini-CEX evaluations for medical students in a nine to twelve week medicine rotation [9,16]. Another study have reported 96% mini-CEX completion rate for the planned activities [4]. All of these studies have demonstrated mini-CEX to be a feasible assessment strategy. One study reports low completion rates and highlights the feasibility problem being lack of time, but still concludes with a probable possibility to successfully implement mini-CEX on a national scale [10]. De Lima et al did not find it practical to hold four evaluations of 108 residents each, in 20 months period using 53 evaluators [8]. Only 14.81% of their cohort was able to be evaluated four or more times using mini-CEX.

### **Acceptability / Satisfaction**

Studies have shown high satisfaction rates of faculty (mean rating ranging from 6.1 to 8.06 out of 9) and trainees (mean rating ranging from 6.6 to 8.0 out of 9) for mini-CEX [3,6,8,9]. The challenge of scheduling mini-CEX for trainees due to lack of time has been found to

be one of the issues hindering the practicality [3, 10, 11]. This may be resolved by encouraging more informal encounters which may alleviate the need for formal scheduling [3].

### **Conclusion**

Based on the five sources of validity evidences gathered from literature review, mini-CEX is found to be a valid and reliable assessment strategy for clinical competence. It has shown to be content valid and differentiates well between different performance levels for both postgraduate and undergraduate trainees. The results are fairly reliable on four or more encounters and the standard error of measurement is very small. The scores on mini-CEX have been shown to have criterion validity and the method has sufficient desired educational impact on trainees. A few studies have shown certain reservations regarding mini-CEX. The concerns identified by Margolis et al, that rater characteristic is one of the largest influence on trainee scores, needs attention and further study [13]. De Lima et al have not found it feasible to get four mini-CEX encounters in 20 months, but this can be remedied through more informal interaction among faculty and residents [8]. This was not found to be a major problem in other studies. The study by Malhotra et al reports increased stress among residents regarding mini-CEX, but this reduced with time and the residents reported mini-CEX to be an important exercise providing opportunities for interactions with faculty and thus enabling better learning [15].

Overall, Mini CEX is found to be a fairly valid and feasible assessment strategy for clinical skills justifying its use for both under-graduate and post-graduate education.

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## Corresponding author

### **Dr Naveed Yousuf**

Department for Educational Development, Faculty of Health Sciences,  
Aga Khan University, Stadium Road, P.O. Box 3500. Karachi 74800, Pakistan.  
Email: naveed.yousuf@aku.edu

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