

Research Article

Effectiveness of Mini-Clinical Evaluation Exercise (Mini-Cex) as a Formative Assessment Tool for Mbbs Students During Short-Term Respiratory Medicine Posting

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Received: 18.07.2026, Revised: 21.08.2026, Accepted: 23.09.2026

ABSTRACT

Background: Short undergraduate clinical postings may limit opportunities for direct observation of clinical skills and individualised feedback. The mini-clinical evaluation exercise (Mini-CEX) offers a structured approach to workplace-based formative assessment. The study was undertaken to evaluate changes in clinical performance scores between two Mini-CEX encounters and assess student and faculty perceptions of its educational value and feasibility during a short-term respiratory medicine posting.

Methods: Final professional MBBS students underwent an initial Mini-CEX assessment following structured clinical teaching, received feedback and targeted teaching, and subsequently underwent reassessment using a different patient encounter. Six competency domains were rated on a nine-point scale, and overall clinical competence was assessed separately. Paired scores were compared using a paired *t*-test for the composite outcome and the Wilcoxon signed-rank test for individual domains. Student and faculty perceptions were assessed using structured questionnaires.

Results: Ninety-four paired Mini-CEX assessment sets were analysed. Mean scores increased across all six competency domains, with mean differences ranging from 0.39 points for medical interviewing to 0.59 points for organisation and efficiency. Overall clinical competence scores increased from 4.79 ± 0.95 to 5.25 ± 1.36 ($p = 0.004$). Student perceptions were predominantly favourable, with agreement or strong agreement ranging from 90.4% to 96.8% across the six questionnaire statements. All four faculty respondents supported continuation of Mini-CEX, and all considered feedback discussions useful for student learning.

Conclusion: Mini-CEX was feasible to implement during a short undergraduate respiratory medicine posting and was associated with higher observed clinical performance scores at reassessment, alongside favourable student and faculty perceptions.

Keywords: Mini-CEX; workplace-based assessment; formative assessment; undergraduate medical education; respiratory medicine; clinical competence.

INTRODUCTION

Assessment of clinical competence is an essential component of medical education to ensure students develop the knowledge, practical, communication and professionalism required for safe and effective patient care. Conventional assessment methods, including written examinations, viva voce and long- or short-case examinations, remain important but may not consistently capture performance during routine clinical encounters or provide

opportunities for immediate, individualized feedback.

Workplace-based assessment (WBA) was developed to address this gap by judging learners in authentic clinical encounters. The mini-clinical evaluation exercise (Mini-CEX), introduced by the American Board of Internal Medicine, is among the most widely used WBA tools where a faculty member observes a focused encounter of roughly 10–20 minutes, rates several competencies on a 9-point scale

and gives immediate feedback. [1,2] It can assess multiple aspects of clinical performance, including history taking, physical examination, clinical judgement, communication, professionalism and efficiency. Reviews of Mini-CEX and related workplace-based assessment tools have highlighted their potential educational value while also emphasizing the importance of implementation, feedback quality and repeated observations. [3-5]

Although studies across various clinical specialties have demonstrated its educational potential, its effectiveness depends on the quality of feedback, repeated observations and feasibility of implementation. [4-9] However, evidence regarding its use among undergraduate medical students during short specialty postings remains limited, with few studies exploring its application in respiratory medicine and similar settings. [10-12] In India, where competency-based undergraduate medical education emphasises formative assessment and feedback, evaluating structured assessment methods within brief clinical postings is particularly relevant. [13,14] Respiratory medicine postings pose specific challenges because students must acquire essential skills, including focused history taking, systematic respiratory examination, chest radiograph interpretation, basic arterial blood gas analysis and initial clinical assessment, within a limited period. The present study evaluated the effectiveness of a two-encounter Mini-CEX cycle during a 14-day respiratory medicine posting for MBBS students, with the primary objective of comparing clinical performance scores between the first and second encounters following feedback and targeted teaching. Secondary objectives were to assess student and faculty perceptions and determine the feasibility of implementing Mini-CEX within the short posting period.

MATERIALS AND METHODS

Study design, setting, participants and intervention

This prospective, single-group pre-post educational intervention study was conducted in the Department of Respiratory Medicine in collaboration with the Department of General Medicine at Dr. B. R. Ambedkar State Institute of Medical Sciences (AIMS), Mohali, Punjab, India. The study evaluated the effectiveness and feasibility of the Mini-CEX as a formative assessment tool during undergraduate respiratory medicine clinical postings. The intervention was conducted over a total

duration of two months across four batches of Phase 3- Part 2 (final professional) MBBS students, with 25 students in each batch. Students undertaking the 14-day respiratory medicine posting participated in the educational intervention. A total of 94 paired Mini-CEX assessment records were available for analysis. The educational intervention followed a structured sequence integrating clinical teaching, direct observation, feedback and reassessment. During the initial phase, students participated in interactive, case-based discussions and bedside teaching covering focused respiratory history taking, systematic respiratory examination, chest radiograph interpretation, basic arterial blood gas analysis, and introductory spirometry and its interpretation. On day 10, each student underwent an individual Mini-CEX assessment involving direct observation during a clinical encounter with a patient, followed by structured feedback from the assessor. Targeted teaching was subsequently provided on days 11 to 13 to address learning gaps identified during the initial assessment. On day 14, students underwent a second Mini-CEX encounter involving a different patient, with assessment of the same competency domains. The posting concluded with a group debriefing and collection of structured feedback from students and assessors on last day of posting.

Assessment tool and study outcomes

An adapted Mini-CEX assessment proforma was used to evaluate six clinical competency domains: medical interviewing skills, physical examination skills, humanistic qualities and professionalism, clinical judgement and management plan, counselling and communication skills, and organisation and efficiency. Each domain was rated on a nine-point scale, with scores of 1–3 indicating unsatisfactory performance, 4–6 satisfactory performance and 7–9 superior performance. A seventh rating assessed overall clinical competence. A 'not observed or applicable' option was available where appropriate. Assessors also documented the clinical setting, patient diagnosis and case complexity, categorised as low, average or high. The first and second encounters were paired using student identifiers, which were excluded from the analytical dataset.

The primary outcome was the change in the composite Mini-CEX score between the first and second encounters, calculated as the mean of the six individual competency-domain scores. Secondary outcomes included changes in

individual domain scores and overall clinical competence ratings, the distribution of scores across performance categories, student and assessor perceptions of Mini-CEX, and qualitative feedback regarding its educational value and feasibility.

Student perceptions were assessed using a structured questionnaire comprising six statements rated on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The statements addressed clarity of posting objectives, perceived improvement in history-taking and examination skills, usefulness of faculty feedback, confidence in approaching respiratory patients, feasibility within a short posting and willingness to recommend continuation of Mini-CEX. Two open-ended questions explored the most useful aspects of the intervention and suggested improvements. Assessor perceptions were evaluated using a five-item Likert-scale questionnaire addressing feasibility, assessment of core clinical competencies, ease of administration and scoring, usefulness of feedback discussions, and willingness to recommend continuation. Two additional open-ended questions explored implementation challenges and suggestions for improving feasibility. Four assessors, comprising three faculty members and one senior resident, provided feedback.

Statistical analysis

Data obtained from paper-based assessment forms were entered into a spreadsheet and analysed using Python version 3, with the SciPy and stats models libraries. Continuous variables were summarised using means and standard deviations or medians and interquartile ranges, as appropriate. The distribution of paired differences was assessed using the Shapiro–Wilk test. The composite score difference was approximately normally distributed and was analysed using a paired t-test, with the mean difference and 95% confidence interval reported. Changes in individual competency-domain scores and overall clinical competence ratings were analysed using the Wilcoxon signed-rank test, with paired t-tests performed as sensitivity analyses. Holm adjustment was applied to the six domain-level comparisons. Standardised effect sizes were calculated as Cohen's d_z , defined as the mean paired difference divided by the standard deviation of the paired differences.

Student and assessor Likert-scale responses were summarised descriptively using means and standard deviations, medians and

interquartile ranges, and the proportion of respondents selecting agree or strongly agree. Internal consistency of the student questionnaire was assessed using Cronbach's alpha. Exploratory analyses examined variation in score changes across assessment cycles, the association between baseline composite scores and subsequent improvement, differences in change according to case complexity, and sensitivity of the findings to the inclusion of repeated posting cycles. Open-ended responses were reviewed and grouped inductively into recurring themes relating to educational value, feedback, implementation challenges and suggested improvements. All statistical tests were two-sided, and a p -value below 0.05 was considered statistically significant.

Ethical considerations

The study received approval from the Institutional Ethics Committee of Dr. B. R. Ambedkar State Institute of Medical Sciences, Mohali (AIMS/IEC-HR/2025/146). Student identifiers were excluded from the analytical dataset to maintain confidentiality.

RESULTS

A total of 94 paired Mini-CEX assessment sets were analysed. Most encounters occurred in the inpatient setting (97.9% at the first encounter and 96.8% at the second), and cases of average complexity accounted for 79.8% and 89.4% of the respective encounters. Obstructive airway disease was the most frequently recorded clinical presentation at both encounters, accounting for 46.8% of first encounters and 40.4% of second encounters. Tuberculosis accounted for 25.5% and 18.1%, respectively, while pneumonia or lung abscess accounted for 2.1% of first encounters and 12.8% of second encounters. The distribution of other clinical presentations is shown in Table 1.

Mini-CEX scores

Mean scores increased between the first and second encounters across all six competency domains (Table 2). The mean difference ranged from 0.39 points for medical interviewing skills to 0.59 points for organisation and efficiency. Counselling and communication skills and physical examination skills showed mean increases of 0.50 and 0.49 points, respectively. The unadjusted Wilcoxon signed-rank test showed statistically significant differences across all six domains, with p -values ranging from 0.004 to 0.044. (Figure 1)

The overall clinical competence score increased from a mean of 4.79 ± 0.95 at the first encounter to 5.25 ± 1.36 at the second encounter, with a reported mean difference of 0.46 points ($p = 0.004$). The composite score, calculated as the mean of the six competency-domain scores, was the primary outcome and showed a statistically significant difference between encounters on paired t -test analysis ($p = 0.004$).

Student and faculty perceptions

Student responses to the six perception statements are summarised in Table 3. Agreement or strong agreement ranged from 90.4% for the feasibility of Mini-CEX within the short posting to 96.8% for clarity of posting objectives and the usefulness of faculty feedback. A total of 92.6% of students agreed or strongly agreed that Mini-CEX helped improve their history-taking and examination skills, while 93.6% reported increased confidence in approaching respiratory patients and supported its continuation in future batches.

All four faculty respondents agreed or strongly agreed that Mini-CEX was feasible within routine clinical postings, assessed core clinical competencies, was easy to administer and score, and should be continued. All four strongly agreed that feedback discussions were useful for student learning.

DISCUSSION

This study evaluated Mini-CEX as a formative assessment tool during a short undergraduate respiratory medicine posting. Mean scores increased between the first and second encounters across all six competency domains, and the composite score showed a statistically significant difference ($p = 0.004$). Student and faculty perceptions were also favourable. These findings support the feasibility and acceptability of incorporating structured clinical observation and feedback into a short posting. The greatest mean increase was observed in organisation and efficiency, followed by counselling and communication and physical examination skills. These domains reflect different aspects of clinical performance that can be observed during patient encounters. Mini-CEX facilitates direct observation followed by feedback on specific strengths and areas requiring improvement. Nevertheless, the second assessment involved a different patient and followed targeted teaching over a short interval. Consequently, the observed changes may reflect a combination of learning,

familiarity with the assessment, differences in case difficulty and assessor-related variation rather than a definitive improvement in clinical competence.

The findings are broadly consistent with published literature. A systematic review and meta-analysis by Lörwald et al. reported a small positive effect of Mini-CEX on trainee performance, while highlighting the influence of implementation characteristics on educational impact [8]. Hejri et al. similarly described Mini-CEX as a useful workplace-based assessment approach but noted variation in feedback quality and assessment practices. However, evidence of educational benefit is not uniform. In a randomised study, Martinsen et al. found no statistically significant differences between Mini-CEX and usual ad hoc feedback in selected educational outcomes [10]. Undergraduate studies in other clinical specialties have reported improvements in selected competency domains, alongside practical challenges related to time, logistics and feedback documentation. A recent study of medical interns in respiratory medicine also reported improvements in Mini-CEX scores, although differences in learner groups and study designs limit direct comparison [13,14,15-17].

Student perceptions in the present study were predominantly favourable. Agreement or strong agreement ranged from 90.4% to 96.8% across the six statements, with high ratings for clarity of objectives and the usefulness of faculty feedback. Most students also reported perceived improvements in clinical skills and confidence. These findings indicate good acceptability in the local educational setting. However, self-reported confidence and satisfaction are not equivalent to objectively demonstrated competence or long-term retention. Future studies should combine learner feedback with independent performance assessments and delayed reassessment.

Feedback is an important component of Mini-CEX because it provides an opportunity to discuss observed performance and identify specific learning needs. Although students in this study rated faculty feedback favourably, its duration, content and specificity were not formally assessed. Therefore, the contribution of feedback to the observed score changes cannot be determined independently. Effective implementation should emphasise specific, actionable feedback and opportunities for learners to address identified gaps during subsequent clinical encounters.

All four faculty respondents rated Mini-CEX favourably, including its feasibility, assessment of core competencies, ease of administration and potential for continuation. All four considered feedback discussions useful for student learning. These findings are encouraging but should be interpreted in view of the small faculty sample. Mini-CEX requires time for observation, documentation and feedback, which may be challenging alongside routine clinical responsibilities. Advance scheduling, brief faculty orientation, standardised documentation and protected time for feedback may facilitate implementation. Previous literature has similarly identified time requirements as an important consideration in workplace-based assessment [4,6,12].

This study has several strengths, including its conduct in a real undergraduate clinical posting, use of a structured assessment form covering multiple competency domains, paired assessment encounters, targeted teaching between assessments, and feedback from both students and faculty. However, several limitations should be acknowledged. First, the single-centre, uncontrolled design limits causal inference. Second, different patients were assessed at the two encounters, and variation

in case complexity may have influenced scores. Third, assessor variation and inter-rater reliability were not established. Fourth, the short interval between assessments precluded evaluation of long-term retention or transfer of learning.

Future studies should include multiple encounters over a longer period, trained assessors with recorded assessor identity, and evaluation of inter-rater reliability. Where feasible, a comparison group and objective outcomes, such as structured clinical examination performance and delayed reassessment, would help clarify the educational impact of Mini-CEX. Individual progress decisions should be based on multiple observations rather than a limited number of encounters.

CONCLUSION

Mini-CEX was associated with higher scores at the second encounter across all six competency domains and received favourable feedback from students and faculty. The findings support its feasibility as a formative assessment approach during a short undergraduate respiratory medicine posting, while further controlled studies are required to establish its effect on sustained clinical competence.

Table 1. Characteristics of the cohort, assessment cycles and encounters.

Characteristic	First encounter n (%)	Second encounter n (%)
Encounter characteristics		
Setting: inpatient	92 (97.9)	91 (96.8)
Setting: outpatient	2 (2.1)	3 (3.2)
Case complexity: low	7 (7.4)	2 (2.1)
Case complexity: average	75 (79.8)	84 (89.4)
Case complexity: high	12 (12.8)	8 (8.5)
Clinical cases presented (as recorded by the assessor)		
Obstructive airway disease	44 (46.8)	38 (40.4)
Tuberculosis	24 (25.5)	17 (18.1)
Post-TB lung disease	6 (6.4)	5 (5.3)
Pneumonia / lung abscess	2 (2.1)	12 (12.8)
Pleural effusion	1 (1.1)	4 (4.3)
Interstitial lung disease	1 (1.1)	3 (3.2)
Overlap / other / Not recorded	16 (17.0)	15 (16.0)

Percentages for encounter characteristics use 94 paired assessments as the denominator.

Table 2. Mini-CEX scores at the first and second encounters (n = 94 paired assessments unless stated).

Domain (1–9 scale)	First encounter Mean ± SD	Second encounter Mean ± SD	Mean difference (95% CI)	Wilcoxon p
Medical interviewing skills	4.66 ± 1.08	5.05 ± 1.21	0.39 (0.08 to 0.71)	0.034
Physical examination skills	4.53 ± 1.15	5.02 ± 1.36	0.49 (0.14 to 0.84)	0.012
Humanistic qualities / professionalism	4.79 ± 1.12	5.22 ± 1.50	0.44 (0.06 to 0.82)	0.032
Clinical judgement and management plan	4.55 ± 1.10	5.01 ± 1.60	0.46 (0.06 to 0.85)	0.044
Counselling and communication skills	4.72 ± 1.10	5.22 ± 1.43	0.50 (0.15 to 0.85)	0.011
Organization / efficiency	4.51 ± 1.31	5.10 ± 1.38	0.59 (0.20 to 0.97)	0.004
Overall clinical competence	4.79 ± 0.95	5.25 ± 1.36	0.46 (0.05 to 0.70)	0.004

Scores range from 1 to 9. SD, standard deviation; CI, confidence interval. Domain-level p-values are from the Wilcoxon signed-rank test; paired t-test p-values were 0.002–0.025 before adjustment.

Table 3. Student and faculty perceptions of the mini-CEX in the respiratory medicine posting.

Statement (5-point Likert scale)	Agree / strongly agree n (%)	Neutral, n (%)	Disagree/strongly disagree, n (%)
Students perception (n=94)			
The objectives of the posting were clear	91 (96.8)	1 (1.1)	2 (2.1)
Mini-CEX helped me improve my history-taking and examination skills	87 (92.6)	6 (6.4)	1 (1.1)
Feedback from faculty was constructive and helpful	91 (96.8)	2 (2.1)	1 (1.1)
Mini-CEX increased my confidence in approaching respiratory patients	88 (93.6)	4 (4.3)	2 (2.1)
The process was feasible within a short posting	85 (90.4)	5 (5.3)	4 (4.3)
I would recommend continuing mini-CEX for future batches	88 (93.6)	5 (5.3)	1 (1.1)
Faculty perception (n=4)			
Mini-CEX is feasible within routine clinical postings	2 / 2 (100)	-	-
It effectively assesses core clinical competencies	2 / 2 (100)	-	-
The tool is easy to administer and score	2 / 2 (100)	-	-
Feedback discussions were useful for student learning	0 / 4 (100)	-	-
I would recommend continuing mini-CEX assessments	2 / 2 (100)	-	-

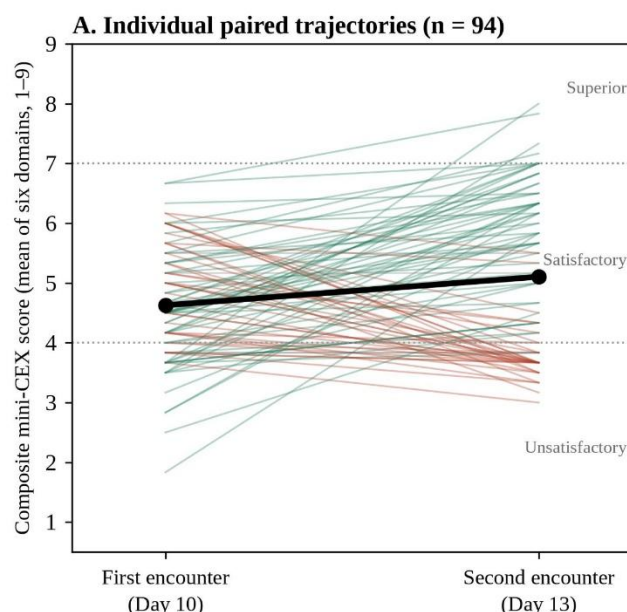


Figure 1. Individual paired composite mini-CEX scores (mean of six domains; 1-9 scale) at the first and second encounters for 94 assessments. Green, red and grey lines denote improvement (n = 55), decline (n = 34), and no change (n=5). Black bold line shows the group mean.

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