

Mini-CEX Oriented Attending Physician Rounds (Mini-CEX-APR): A New Teaching Model for Standardized Residency Training

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Abstract

Background: Mini-CEX is a multifunctional tool to accurately evaluate and improve the clinical competence of residents. It is crucial to explore an appropriate way to combine mini-CEX and clinical practice in order to achieve wide application of mini-CEX in Chinese residency training programs.

Objectives: This study was designed to explore the value of mini-CEX oriented attending physician rounds in residency training for cardiology and gastroenterology residents.

Design: Single-blind, RCT.

Methods: Participants were randomly assigned into the traditional and the mini-CEX-APR group. The traditional group received regular training required by the education department, while the mini-CEX-APR group received additional mini-CEX oriented attending physician rounds on the basis of routine training. The attending physicians in the mini-CEX-APR group conducted real-time evaluation of residents in the process of ward rounds based on the mini-CEX, and provided timely feedback and targeted guidance every 2 weeks. All subjects accepted final mini-CEX assessment when they finished the cardiology or gastroenterology training.

Results: The mini-CEX scores of the mini-CEX-APR group was significantly higher than that of the traditional group (50.05 ± 3.19 vs 45.65 ± 3.14 , $P < 0.001$), especially in history taking (7.54 ± 0.63 vs 6.60 ± 0.62 , $P < 0.001$) and integrated capacity parts (7.46 ± 0.60 vs 6.61 ± 0.59 , $P < 0.001$), their satisfaction levels are also higher than those in traditional group (8.81 ± 0.77 vs 7.28 ± 0.67 , $P < 0.001$). The overall teaching effect of the mini-CEX-APR was better than traditional teaching methods regardless of in the Grade III-A (51.35 ± 2.69 vs 46.76 ± 2.77 , $P < 0.001$) or Grade III-B hospitals (48.67 ± 3.14 vs 44.50 ± 3.12 , $P < 0.001$).

Conclusion: The mini-CEX-APR model that integrates evaluation and feedback organically can enhance the scientific nature of the clinical evaluation, and especially promote the elevation of residents' clinical capabilities. Its excellent reliability, validity, versatility and convenience will be a renewed push for incorporating the mini-CEX-APR into residency training.

Background

Population ageing is a momentous phenomenon for China, and exerts heavy demands on the healthcare system. The Chinese government struggles to meet the ever-increasing demand for qualified physicians, and launched the standardized residency training program in 2015.[1, 2] The program requires medical graduates to receive systematic and standardized clinical training in different departments within 3 years, which is a pivotal time in the development of a physician. The assessment of clinical competences is a key component of standardized residency training program, and the mini-Clinical Evaluation Exercise (mini-CEX) is recommended as an evaluation tool in this program because of its excellent reliability, validity, versatility and convenience.[2, 3] The mini-CEX was proposed by the American Board of Internal

Medicine in the 1990s[4], including the observation and evaluation of the knowledge, skills, attitudes, etc. of the residents, as well as timely feedback from the attending physicians after evaluation[5]. Mini-CEX was proven to be a reliable and effective evaluation tool by various researchers and institutions[6–8], moreover, it was also considered as a powerful teaching tool for improving residents' clinical achievement relying on its' feedback parts[9, 10].

However, the application of Mini-CEX has not been widely promoted in Chinese residency training[11], while it is generally used in foreign countries[9, 10]. The most probable reason may be that the Mini-CEX evaluation system fails to integrate with Chinese clinical practice system. It is urgent to seek the model combining Mini-CEX with current clinical training, which can dramatically enhance the clinical skill of residents. Ward rounds remain a core part of residency training, and the attending physician who plays a crucial role in rounds is the best clinical teacher for residents.[12] Besides, the attending physician is most familiar with the work of the resident around him, and the resident's clinical capability is best to be assessed by him. During ward rounds, residents will receive targeted training, if the attending physician can provide mini-CEX oriented assessment, feedback and correction, then repeat the above process appropriately. Therefore, the mini-CEX oriented attending physician rounds (mini-CEX-APR) are convenient, repeatable and timesaving, and appear to be a new teaching model that combines the mini-CEX with Chinese clinical practice.

There are few researches or reports on the mini-CEX-APR teaching model, the value of this new model in residency training is unclear temporarily. This study is intended to explore the value of mini-CEX-APR in the course of residency training among the cardiology and gastroenterology trainees, and to provide reference for resident training in these two departments.

Methods

Modified mini-CEX scale

After special modification to the original format, a mini-CEX scale (*Appendix I*) that is more suitable for Chinese internal medicine was developed. The modified mini-CEX scale consists of 7 domains corresponding to 7 dimensions of clinical performance in history taking, physical examination, medical record writing, clinical thinking, medical operation, clinical expertise and integrated capacity, respectively. Each domain is classified into three grades based on its mini-CEX score: ineligible (1–3), eligible (4–6) and excellent (7–9). At the final part of the scale, we also added the trainee's satisfaction score, which is rated on three levels: dissatisfied (1–3), general (4–6), satisfied (7–9).

Participants and procedure

This study was performed in four certified residency training institutions including two Grade III-A hospital hospitals and two Grade III-B hospitals from 2018 to 2020. As two of the major units of internal medicine, the cardiology and gastroenterology departments were chosen to conduct this research. To ensure the validity and reliability of this study, as well as exert the didactic function of the mini-CEX, attending

physicians with comprehensive clinical teaching experience were selected as evaluators and trainers. The selected attending physicians were introduced to the concept, criteria and procedure of the mini-CEX, also were trained to give instructive feedback to the resident base on individual mini-CEX. Participants were residents accepting training in these two departments of above four hospitals, and the duration of their training was two or three months. The subjects were randomly assigned into two groups: the traditional group and the mini-CEX-APR group. Residents in the traditional group were trained as required by the education department, they got assessment only when leaving the department; Residents in the mini-CEX-APR group received the mini-CEX-APR on the basis of regular teaching, they additionally got real-time evaluation, timely feedback and appropriate guidance referring to their latest mini-CEX evaluation, and the frequency was once every 2 weeks. Trainers of two groups were the leading attending physician in the ward, being the one who understand residents' situation best, they undertook the teaching task naturally and took different teaching models accordingly. At the end of the training of cardiology or gastroenterology, all trainees were required to undergo the ultimate mini-CEX assessment and rate their satisfaction level. Residents of these two groups were mixed up before they were assessed by the unified examiner who is not familiar with them and is blind to the classification of teaching models. The final mini-CEX score and satisfaction level of the two groups were compared.

Data analysis

All data were double-entered through Epidata software, and the database was built after being checked the consistency and accuracy. Normality was verified using the D'Agostino & Pearson normality test. Continuous variables were expressed as mean \pm standard deviation (SD), statistical comparisons were made using the independent sample *t*-test, statistical analysis was conducted using SPSS version 22.0 software. P values < 0.05 ($P < 0.05$) were considered statistically significant.

Results

The final total sample of this study was 113, including 36 men (31.90%) and 77 women (68.10%), and the mean age \pm SD was 23 ± 1.80 . Rates of response were 100%. We contrasted the final mini-CEX scores and satisfaction levels between the traditional and the mini-CEX-APR group, and compared the total mini-CEX scores of these two groups in different hospitals and departments, respectively. There did exist significant differences between the two groups' mini-CEX scores.

Comparison of mini-CEX scores and satisfaction rating between the two groups

Figure 1 indicates that the mini-CEX-APR group acquired higher scores than the traditional group in all units of mini-CEX assessment, including history taking, physical examination, medical record writing, clinical thinking, medical operation, clinical expertise and integrated capacity. Figure 2 provides descriptive statistics for residents' scores on every item of mini-CEX evaluation and their satisfaction rating. Among above, the history taking (7.54 ± 0.63 vs 6.60 ± 0.62 , $P < 0.001$) and integrated capacity

(7.46 ± 0.60 vs 6.61 ± 0.59 , $P < 0.001$) parts were the most significant ones. The satisfaction level of the mini-CEX-APR group was also higher than the traditional group (8.09 ± 0.77 vs 7.28 ± 0.67 , $P < 0.001$).

Comparison of total mini-CEX scores between the two groups in the Grade III-A and Grade III-B hospitals

Figure 3 analyses the total mini-CEX scores of two groups in the Grade III-A and III-B hospitals. In the Grade III-A hospitals, the mini-CEX-APR group's total mini-CEX score was higher than the traditional group (51.35 ± 2.69 vs 46.76 ± 2.77 , $P < 0.001$), and scenario is the same in the Grade III-B hospitals (48.67 ± 3.14 vs 44.50 ± 3.12 , $P < 0.001$).

Comparison of total mini-CEX scores between the two groups in the cardiology and gastroenterology departments

Figure 4 reveals that the mini-CEX-APR group's total mini-CEX score was higher than the traditional group in the cardiology (45.07 ± 3.26 vs 50.17 ± 3.29 , $P < 0.001$) and gastroenterology departments (46.17 ± 2.98 vs 49.91 ± 3.12 , $P < 0.001$). To sum up, mean score \pm SD of the mini-CEX-APR group for total mini-CEX score was 50.05 ± 3.19 , which was significantly higher than that of the traditional group (45.65 ± 3.14 , $p < 0.001$).

Discussion

This study explored the role of a new teaching model in residency training, called the mini-CEX-APR. The results reveal that the mini-CEX-APR on the basis of regular training is conducive to improving the overall clinical performance of residents (Fig. 2), and this new teaching model is more effective and more satisfactory than the traditional teaching way (Fig. 1). Besides, the excellent teaching effect of the mini-CEX-APR cannot be affected by hospitals of different grades (Fig. 4), and these results are applicable in both cardiology and gastroenterology departments (Fig. 3).

The mini-CEX is multifunctional, it is not simply an evaluation tool, but also an instructive teaching method. The mini-CEX mainly includes two constituents: evaluation and feedback. In evaluation part, residents have 15–20 minutes for history taking, physical examination, diagnosis and differential diagnosis, as well as formulation of diagnosis and treatment plan, then the attending physician will rate their mini-CEX scale according to their performance. In feedback part, attending physicians offer immediate feedback and instruction to residents to help them pinpoint their strengths and weaknesses based on latest mini-CEX assessment.[9] Previous studies have shown, trainers and trainees all agreed that Mini-CEX can truly reflect the clinical ability of trainees, and they admitted that mini-CEX benefit both of them via putting forward refined feedback or accepting targeted feedback.[13] It is worth mentioning that mini-CEX is a mini-type evaluation system, which can be carried out at any time during clinical routine work, saving time and effort. Owing to its feasibility, convenience, and effectiveness, the mini-CEX

is regarded as one of the most powerful formative assessment methods[7] and deserves to be promoted in residency training.

The standardized training system for Chinese residents has been widely implemented in China, however, the conventional evaluation of residents' clinical ability still uses a single form such as written and oral exams.[14] An essential cause of this status quo is that Mini-CEX fails to integrate with the current clinical practice system. On the one hand, using Mini-CEX only as an assessment tool, clinical trainers and trainees need to extra time to perform Mini-CEX assessment alone, which is time-consuming and laborious, making it more difficult for Mini-CEX to be widely implemented in the clinical training process. On the other hand, despite the fact that some hospitals have begun to use Mini-CEX to assess the ability of residents, the clinical ability of residents is not markedly improved because of the inapposite timing and frequency of taking Mini-CEX. Residents in these hospitals usually took part in the departmental evaluation (Mini-CEX evaluation) when their training in this department is about to end, and they will leave there soon after the evaluation. Therefore, the residents have no time to correct the problems reflected in the mini-CEX assessment, so its feedback effect is not completely utilized. In addition, the assessment may not be accurate if the Mini-CEX is performed only once during the examination, because the condition of the patient and evaluators alters between each assessment, which may lead to assessment deviations. When the mini-CEX can be performed repeatedly, it will reflect the residents' capabilities more accurately, as having been pointed out by previous studies, the preferable frequency is at least 4 times[4]. Consequently, a new model combining mini-CEX with clinical practice is warranted to improve the quality of residency training.

Attending physicians are the backbone in every department, who not only have the ability to solve clinical problems, but also have clinical teaching capabilities to cultivate the residents.[12] The attending physician who has the closest connection with his residents is the perfect evaluator and trainer for residents. Attending physician rounds are pivotal components of the third-level physician rounds system, also are supposed to be the ideal time to educate, observe and evaluate the residents. The mini-CEX-APR expects that attending physicians provide mini-CEX oriented assessment and feedback timely to residents, and repeat above process moderately. By this means, residents can acquire targeted clinical correction and guidance, which is of great significance for them to raise their self-awareness, self-examination and self-improvement. As the new teaching model that fully organically integrates the mini-CEX and the attending physician rounds, the mini-CEX-APR can stimulate to from a positive feedback effect through accurate evaluation, timely feedback, corrective training and continuous improvement. In conclusion, followings are the advantages of mini-CEX-APR teaching model: firstly, the mini-CEX-APR can be carried out simultaneously with clinical routine work every 2 weeks, and its repeated assessment and feedback help residents keep improving, avoiding having no time to correct the problem discovered at the final exam. Secondly, the attending physician is the perfect evaluator who ought to observe residents most carefully and discover their problems most thoroughly. Thirdly, repeated mini-CEX assessment may enhance the psychological quality of residents, helping them to make full preparations for final exams. Lastly, the mini-CEX-APR can improve the teaching awareness of attending physicians, also standardize

rounds and improve training quality. Each above will be a renewed push for incorporating the mini-CEX-APR into residency training.

The main limitation of our study lies in the deficiencies of the number of departments, the function of mini-CEX-APR in other departments of the internal medicine system and even in the surgical system remains to be tested and awaits further research.

Conclusions

In this study, we found that residents accepting the mini-CEX-APR on the basis of regular teaching performed significantly better than those being trained only by the regular method in all items of mini-CEX scale especially in history taking and integrated capacity, they were more satisfied with this new teaching model as well. We also discovered that the overall teaching effect of the mini-CEX-APR was better than traditional teaching methods no matter in the Grade III-A or III-B hospitals. Taken together, during attending physician rounds, the mini-CEX-oriented teaching that is performed by attending physicians at least once every 2 weeks can enhance the scientific nature of the clinical evaluation, and especially promote the elevation of residents' clinical capabilities through timely feedback and targeted instruction.

Abbreviations

Mini-CEX-APR: Mini-CEX oriented attending physician rounds

SD: standard deviation

Declarations

Ethics approval and consent to participate

This study was conducted in adherence to the international guidelines and regulations including those in the Declaration of Helsinki. All participants were given written informed consent and they were voluntary. This study was approved by the Research Ethics Committee of the Third Hospital of Peking University (Registration Number M2018028).

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

HYL carried out the study, analyzed the data. XL interpreted the results, wrote the first draft of the paper, and critically revised the manuscript. WXX guided the study design and concept, assisted in the interpretation of the results and revision of the paper. All authors read and approved the manuscript.

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Figures

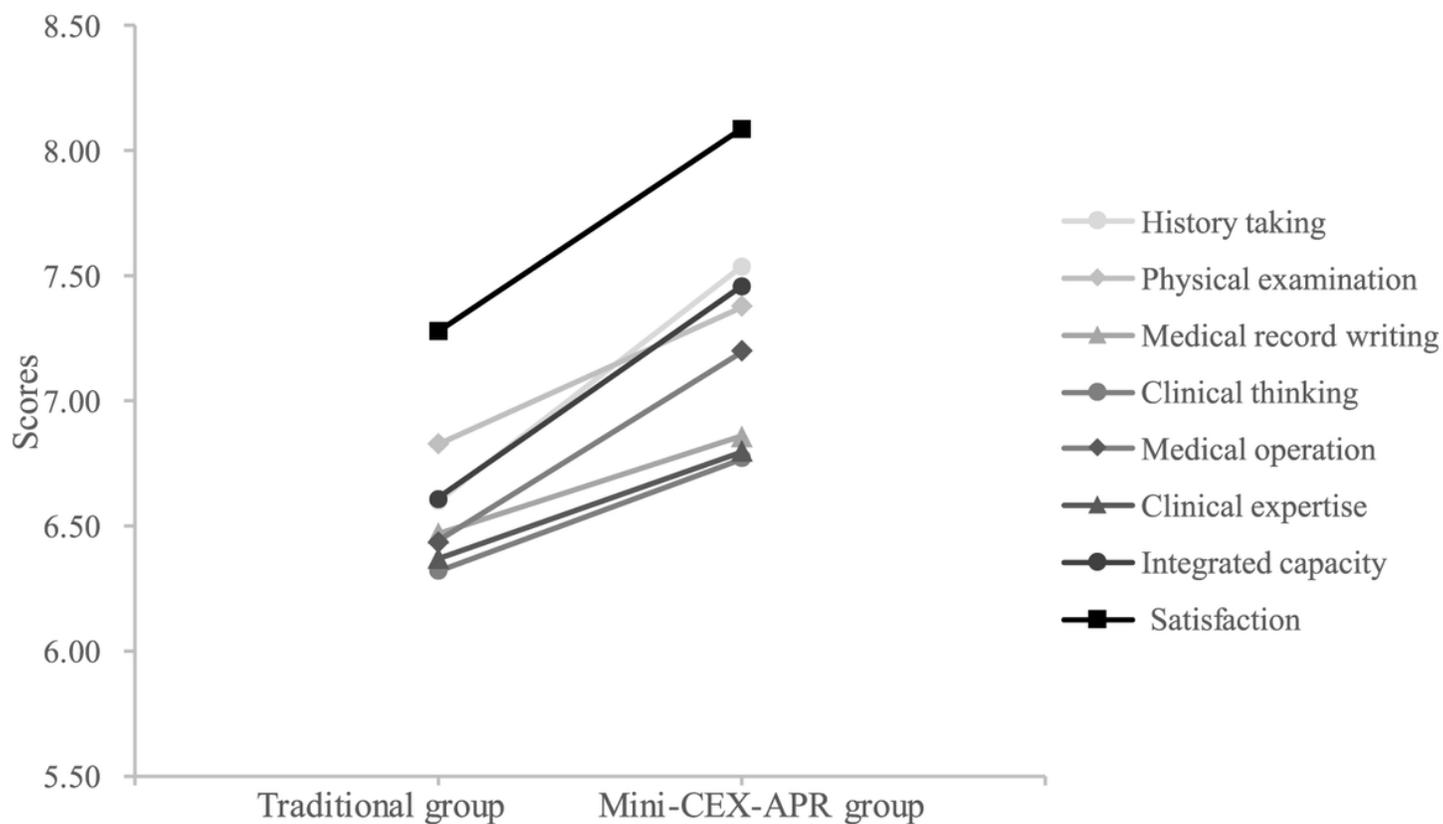


Figure 1

The contrast of mini-CEX scores and satisfaction rating between the traditional and the mini-CEX-APR groups

	miniCEX-APR		Traditional (n=57)		Mean Difference		P
	Mean	SD	Mean	SD	(95%CI)		
History taking	7.54	0.63	6.60	0.62	0.94(0.71, 1.17)		<0.001**
Physical examination	7.38	0.62	6.83	0.47	0.55(0.35, 0.76)		<0.001**
Medical record writing	6.86	0.67	6.47	0.71	0.38(0.13, 0.64)		0.004*
Clinical thinking	6.77	0.60	6.32	0.74	0.45(0.20, 0.70)		0.001*
Medical operation	7.20	0.70	6.44	0.63	0.76(0.51, 1.01)		<0.001**
Clinical expertise	6.80	0.72	6.37	0.70	0.44(0.17, 0.70)		0.002*
Integrated capacity	7.46	0.60	6.61	0.59	0.85(0.63, 1.07)		<0.001**
Satisfaction	8.09	0.77	7.28	0.67	0.81(0.54, 1.08)		<0.001**

Note: * P<0.05, **P<0.001

Figure 2

Every item of mini-CEX assessment and satisfaction level between the traditional and the mini-CEX-APR groups

	miniCEX-APR		Traditional		Mean Difference (95%CI)	P
	Mean(n)	SD	Mean(n)	SD		
Grade III-A hospitals(n=58)	51.35(29)	2.69	46.76(29)	2.77	4.59(3.15, 6.02)	<0.001**
Grade III-B hospitals(n=55)	48.67(28)	3.14	44.50(27)	3.12	4.17(2.47, 5.86)	<0.001**
Total(n=113)	50.05(56)	3.19	45.65(57)	3.14	4.40(3.23, 5.58)	<0.001**

Note: * P<0.05, **P<0.001

Figure 3

Total mini-CEX scores of the traditional and mini-CEX-APR groups in the Grade III-A and Grade III-B hospitals

	miniCEX-APR (n=56)		Traditional (n=57)		Mean Difference (95%CI)	P
	Mean(n)	SD	Mean(n)	SD		
Cardiology(n=57)	50.17(27)	3.29	45.07(30)	3.26	5.09(3.35, 6.83)	<0.001**
Gastroenterology(n=56)	49.92(30)	3.12	46.17(26)	2.98	3.76(2.12, 5.39)	<0.001**
Total(n=113)	50.05(56)	3.19	45.65(57)	3.14	4.40(3.23, 5.58)	<0.001**

Note: * P<0.05, **P<0.001

Figure 4

Total mini-CEX scores of the traditional and mini-CEX-APR groups in the cardiology and gastroenterology departments

Supplementary Files

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- [Appendix1.pdf](#)