

Improving medical interviewing skills in medical students through simulation-based training with pediatric patient models

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Abstract

Background:

Although medical interviews and examinations are extremely important skills that are directly linked to the diagnosis, training in these skills with pediatric patients is difficult, and it is inappropriate for medical students to start right away clinical training with pediatric patients and their parents.

Methods:

We conducted prospective educational intervention through simulation training for 25 groups of 93 medical students (4th and 5th grade). The supervising physician, a specialist, played the role of the parent, while the students divided into groups of three or four and worked together to conduct the medical interview and physical examination, without time limitation. Training was conducted three times consecutively, with presentations and feedback from the supervising physicians along the way. The primary endpoint was an increase in the number of essential interviews and examination items completed. As secondary endpoints, we quantitatively examined the number of questions asked, proportion of open-ended questions, effective examination rate, and points to consider during examinations. Statistical analysis was performed using the Repeated Measures ANOVA method with statistical significance defined as $p < 0.05$.

Results:

The number of essential examination items in the interview examination completed increased from an average of 9.2 to 12.0 from the first to the third case ($p < 0.001$). Although the number of questions asked increased, there were no significant changes in the proportion of open questions or the effective examination rates. The score of consideration points during the examinations increased from an average of -5.6 to -0.3 from the first to the third case ($p < 0.001$). Although the students' medical interviews were unprofessional at the first of the training, there was a marked improvement in the third case.

Conclusion:

Although there have been many reports of similar simulation-based education for medical students, no other reports have quantitatively evaluated such education. By quantitatively evaluating interviewing techniques, we demonstrate the effectiveness of this method in scoring the improvement in medical students' abilities relevant to real-world clinical practice, and it is proving to be very useful.

Introduction

Medical history-taking and physical examination are extremely important skills and are directly linked to diagnosis¹⁾. Improving these skills requires extensive practice, and many studies have examined how to teach them to medical students^{2–6)}. However, the medical education system in Japan is very different from the systems that exist in Europe and the United States^{7,8)}. Due to limited human and material resources, the number of training sessions using simulated patients (SP) is extremely limited until medical school graduation. Furthermore, interviews and examinations in the pediatric patients are sensitive and difficult, and it is frequently inappropriate for medical students to suddenly start practicing with real pediatric patients and their parents during their clinical training^{9,10)}. Therefore, simulation-based education is extremely important and effective in solving this problem^{11,12)}. We have developed a virtual reality objective structured clinical examination training software program (VR OSCE) and are actively using VR simulation for education (Fig. 1a,b)¹³⁾.

Many studies have evaluated the effectiveness of simulation-based education using questionnaire surveys^{2–4,7,14,15)}. However, these evaluations did not quantitatively assess the actual abilities of the subjects (students or trainee doctors). In this study, we conducted education and research on medical examination simulations for medical students (4th and 5th grade year). An actual clinician was trained to act as a patient, and the contents of their medical interview training were recorded, transcribed, and analyzed to quantitatively evaluate changes in their ability. It is therefore considered to be appropriate for medical students of these grades to receive this type of simulation training^{11,16)}.

Methods

Study design and participants

We conducted prospective educational intervention through simulation training for 25 groups of 93 medical students (4th and 5th grade).

Simulation-based training

A research physician (one person) conducted medical examination simulation training for one group (3–4 students). The cases were children, and the research physician played the role of their parent. Medical students interviewed, examined, and presented three times consecutively and received feedback after each presentation (Fig. 2).

The monitor displays only the patient's chief complaint, brief information, and vital signs, and the medical interview is conducted without a time limit. Three or four medical students in a group worked together to conduct the medical interview, and the research physician played the role of the parent and answered all the questions (Fig. 3). To ensure that all questions were answered in the same way, the research physician memorized all the detailed information about all five cases (medical information, birth information, home environment, lifestyle history, family history, and physical examination findings).

During a one-year trial prior to the study, the research physician underwent approximately 50 hours of patient role-playing training.

All medical consultations were audio recorded, transcribed, anonymized, and analyzed with the consent of all students. The transcription was commissioned to mocomoco inc. (Tokyo, Japan), and at the same time, the mocoVoice© medical model was refined using AI learning.

Patient scenarios (Suppl. 1–5)

Five patient scenarios were prepared, two of which were easy cases (intussusception and Hirschsprung's disease) and three of which were normal difficulty cases (hypertrophic pyloric stenosis, acute appendicitis, and neuroblastoma). The first case was selected from easy cases, the second was selected freely, and the third was selected from normal difficulty cases. All cases had the same level of difficulty as those asked in the Japanese national medical examination.

Outcome measures

The primary endpoint was an increase in the number of essential interviews and examination items completed. Prior to this study, the researcher conducted a one-year trial of similar training with students and pediatric surgeons. During this trial, we devised a method to set 15 essential interview and examination items for each patient. These 15 items consisted of basic matters that doctors must confirm with parents, disease-specific findings, and findings important for differential diagnosis. A specialist could cover all 15 items almost without exception and make a proper differential diagnosis. However, inexperienced medical students often miss out on medical history and examination, resulting in insufficient information. Therefore, we used the number of times these 15 items could be completed without errors as the primary endpoint and as a quantitative evaluation of the quality of the medical interview.

As secondary endpoints, the number of questions in the medical interview, the proportion and distribution of open-ended questions (OQs) among the number of questions in the medical interview, the effective examination rate (number of examinations with required medical interview and examination items / (number of questions in the medical interview + number of examination items)), and consideration points during examinations were quantified and analyzed. As a consideration point, of the 10 items on the Liverpool Undergraduate Communication Assessment Scale (LUCAS), items that matched this study (A, B, C, E, F, H, and I) were selected as assessment items to assess the communication skills perceived by the patient role¹⁷⁾. For example, empathetic comments were given positive points, whereas prolonged silence, inappropriate language, and rude behavior were given negative points.

Statistical analysis

Since this study examined the training effects on a group, statistical analysis was performed on a group basis, not on an individual student basis. In 25 groups, the changes in each endpoint from Case 1 to Case 2 and Case 3 were statistically examined. A statistical analysis was performed using Repeated Measures ANOVA, with statistical significance defined as $p < 0.05$. JMP was used for statistical analysis. Post-hoc analysis was not performed.

Ethical considerations

This study was conducted in accordance with the principles of the Declaration of Helsinki. This study was approved by the Ethics Committee of Hiroshima University Hospital (approved number: E2024-0184). Informed consent for participation and publication was obtained from all students.

Results

A total of 25 groups (93 students) were included in this analysis. All students agreed to participate in the study.

Primary endpoint

As the study progressed from Case 1 to Case 2 and then Case 3, the number of essential interviews and examination items completed increased significantly, from an average of 9.2 to 12.0 from the first to the third case, $F(2, 71) = 14.69$, $p < 0.001$ (Fig. 4a). A specialist can obtain almost all 15 essential interview and examination items. Furthermore, obtaining approximately 12 of the 15 items allows for a fairly accurate differential diagnosis. Although the conditions were lenient, namely that everyone in the group cooperate and that was no time limit, the medical interview training enabled the students to conduct medical interviews at a satisfactory level.

Secondary endpoints

As a secondary endpoint, the number of questions asked during the medical interview significantly increased from an average of 21.8 to 27.7 from the first to the third case, $F(2, 71) = 4.78$, $p = 0.0113$ (Fig. 4b). In contrast, the OQ and effective examination rates gradually increased, although the difference was not statistically significant (Fig. 4c,d). In interviews conducted by experienced specialists, the percentage of OQs increased at the beginning of the interview, but no significant changes were observed in the three training sessions in this study (Fig. 4e). The points of consideration during medical examinations showed a dramatic improvement from an average of -5.6 to -0.3 from the first to the third case, $F(2, 71) = 28.35$, $p < 0.001$ (Fig. 4f).

Discussion

There have been many reports on training medical students in medical interview techniques^{2-6,18}), as well as reports on simulation education methods^{2,3,5,11,19}). However, most studies have focused on

student surveys and changes in awareness^{2-4,14,15}). How has their diagnostic ability improved? There have been no quantitative reports on changes in the quality of questions asked during medical interviews or changes in the points of consideration. Rather, these are important as actual clinical skills. The ability to listen to patients, determine which questions/examinations are necessary from the many items, and make appropriate selections, as well as the ability to examine patients without being rude. These are the skills required for clinical practice. In this study, we quantitatively evaluated two points: the ability to select non-exhaustive medical interview items according to the chief complaint and whether or not a considerate medical interview was conducted. To our knowledge, few studies have quantitatively evaluated such skills.

Regarding case setting, clinicians conducted training with cases drawn from real practice, each including detailed background information. Training emphasized 15 essential interview and examination items required for an accurate diagnosis. This patient setting combines the best SPs and actual patients (volunteers), making it more clinically relevant²⁰).

Beginners often overlook essential medical history and examination items during medical interviews. In this study, the number of essential interview items significantly increased from the first to third case. This was largely due to the fact that the number of questions asked increased significantly as students became more familiar with the interview process. However, the effective examination rate increased only slightly. This is known as "the more you try, the more likely you are to succeed." In clinical practice, a correct differential diagnosis must be made within a limited time frame, and more clinical experience is needed to hone this ability.

Regarding patient considerations, this study numerically evaluated unprofessional behaviors perceived by the parents of patients. When the students examined the first and second cases, many unprofessional behaviors were observed, such as inappropriate behavior and examinations that were out of order. However, by the third case, they had become more considerate, and their medical interviews had improved to a level at which they would not be rude when examining actual patients. Previous reports have shown that the impression evaluation of SPs is very important in evaluating students^{21,22}). However, the quantification of evaluations has been difficult because SPs are not actual clinicians. In this study, the investigator conducted trials for one year as preparation and trained in the role of patients for approximately 50 hours. The entire training process was recorded and transcribed, and actual clinicians evaluated and judged it, allowing for an accurate quality assessment. This study demonstrated that simulation training for three consecutive cases with feedback significantly reduced the risk of unprofessional behavior. The results of this quantitative evaluation of medical interview training will be of great use in developing future training software.

What is even more unique about this study is that immediate feedback and multiple consecutive training sessions resulted in extremely high learning outcomes in the present study. Although feedback is crucial in medical interview training, it is often not provided immediately on the spot¹⁴). In this study, immediate feedback was provided after medical interviews and presentations. In addition, medical interview

training was conducted again immediately after the feedback with three consecutive cases. A recent review also reported that rapid feedback and multiple training sessions are important in simulation-based education²⁾. It would be extremely beneficial for medical students to undergo this type of training multiple times in various departments.

We developed a VR OSCE software program and reported its training effectiveness¹³⁾. Incorporating quantitative evaluation into the software allows creation of a medical interview simulator distinguished by VR's immersive realism, rapid feedback mechanisms, and the capacity for multiple self-directed training sessions.

Conclusion

By quantitatively evaluating interviewing techniques, we demonstrate the effectiveness of this method in scoring the improvement in medical students' abilities relevant to real-world clinical practice, and it is proving to be very useful.

Limitations

This study was not a two-group comparative study; rather, it examined the effects of training in a single group.

The training was conducted in groups of 3–4 students and did not assess the individual abilities of each student.

The method of quantifying essential medical interview questions is a unique approach. Although this method was not evaluated using the Delphi method, it is a clinically practical approach. This is not applicable to all diseases, however it may assist in differential diagnosis in simple disease models, such as those used in national examinations. In actual clinical settings, situations are more complex; nevertheless, this method is useful for measuring medical students' interviewing skills.

Abbreviations

OSCE	Objective Structured Clinical Examination
SP	simulated patient
OQ	Open-ended question

Declarations

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The transcription of the medical interview recordings in this study was commissioned by mocomoco Inc. (Tokyo, Japan).

Authors contributions

IS: study conception, design, data acquisition, analysis, manuscript drafting

SK, SH and TS: analysis, manuscript revision

MH, YN and NH: guidance on medical education, study design, manuscript revision

EH, ST: instruction in statistical analysis, manuscript revision

All authors have reviewed and agreed on the manuscript content.

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Availability of data and materials

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

Ethical approval and consent to participate

This study was approved by the Ethics Committee of Hiroshima University Hospital (approved number: E2024-0184).

Consent for publication

Informed consent for publication was obtained from all students.

Competing interests

The authors declare no conflicts of interest in association with the present study.

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Figures

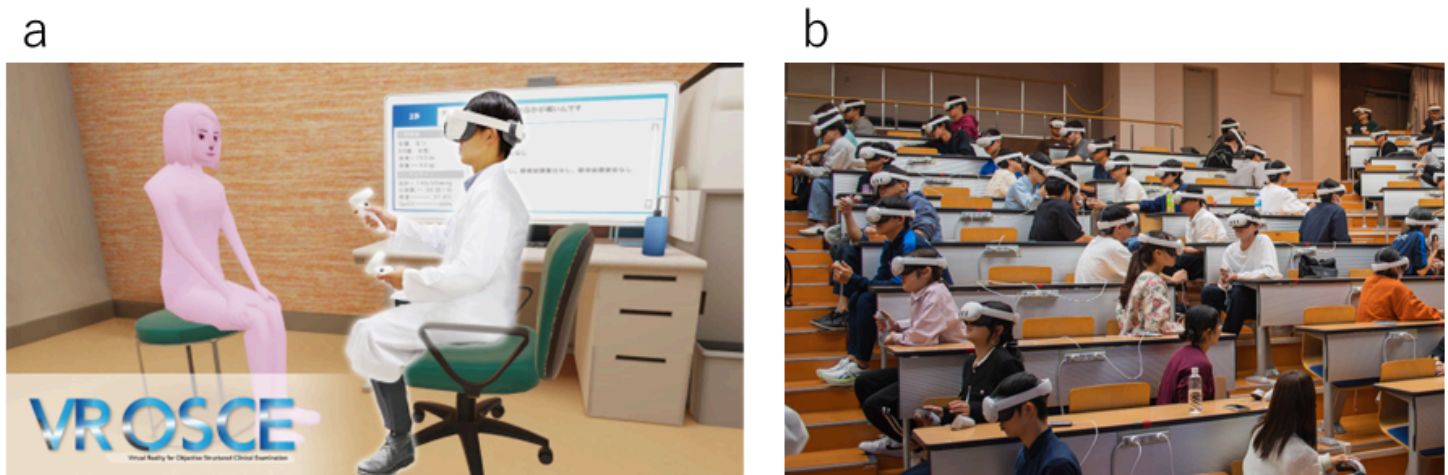


Figure 1

VR OSCE

a: VR OSCE is a software program that allows students to simulate medical examinations in VR.

b: Hiroshima University uses VR OSCE for group lessons.

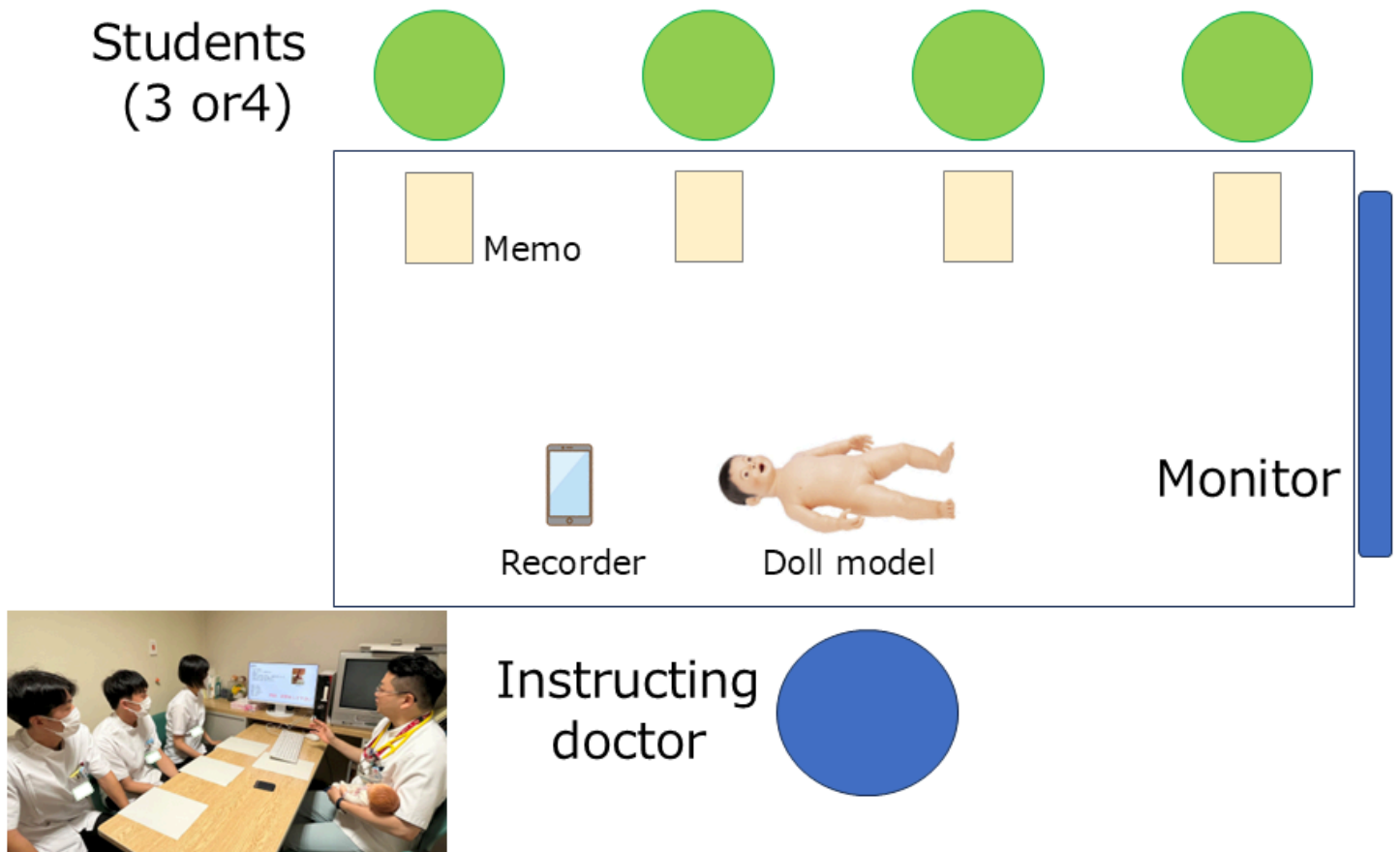


Figure 2

Research schematic illustration

The medical students interviewed, examined, and presented three times consecutively and received feedback after each presentation. Five patient scenarios were prepared, two of which were easy cases and three of which were normal difficulty cases.

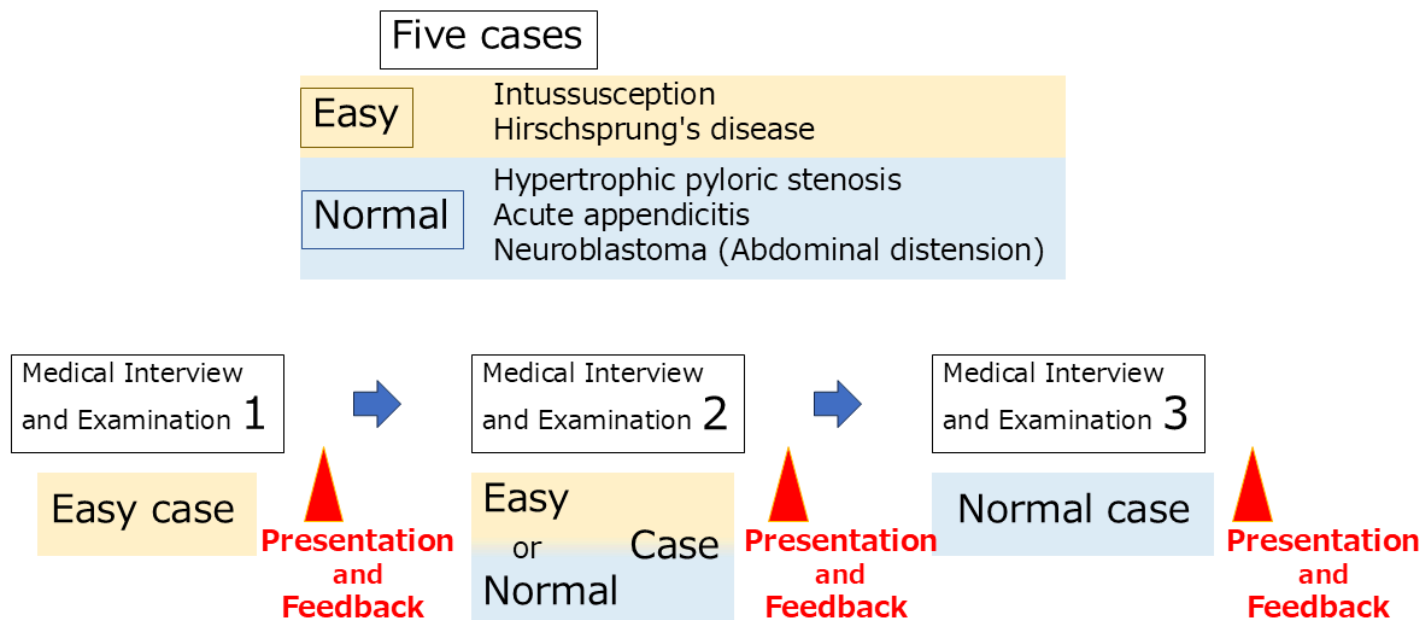


Figure 3

Training session

The research physician played the role of the parent. No time limit was set.

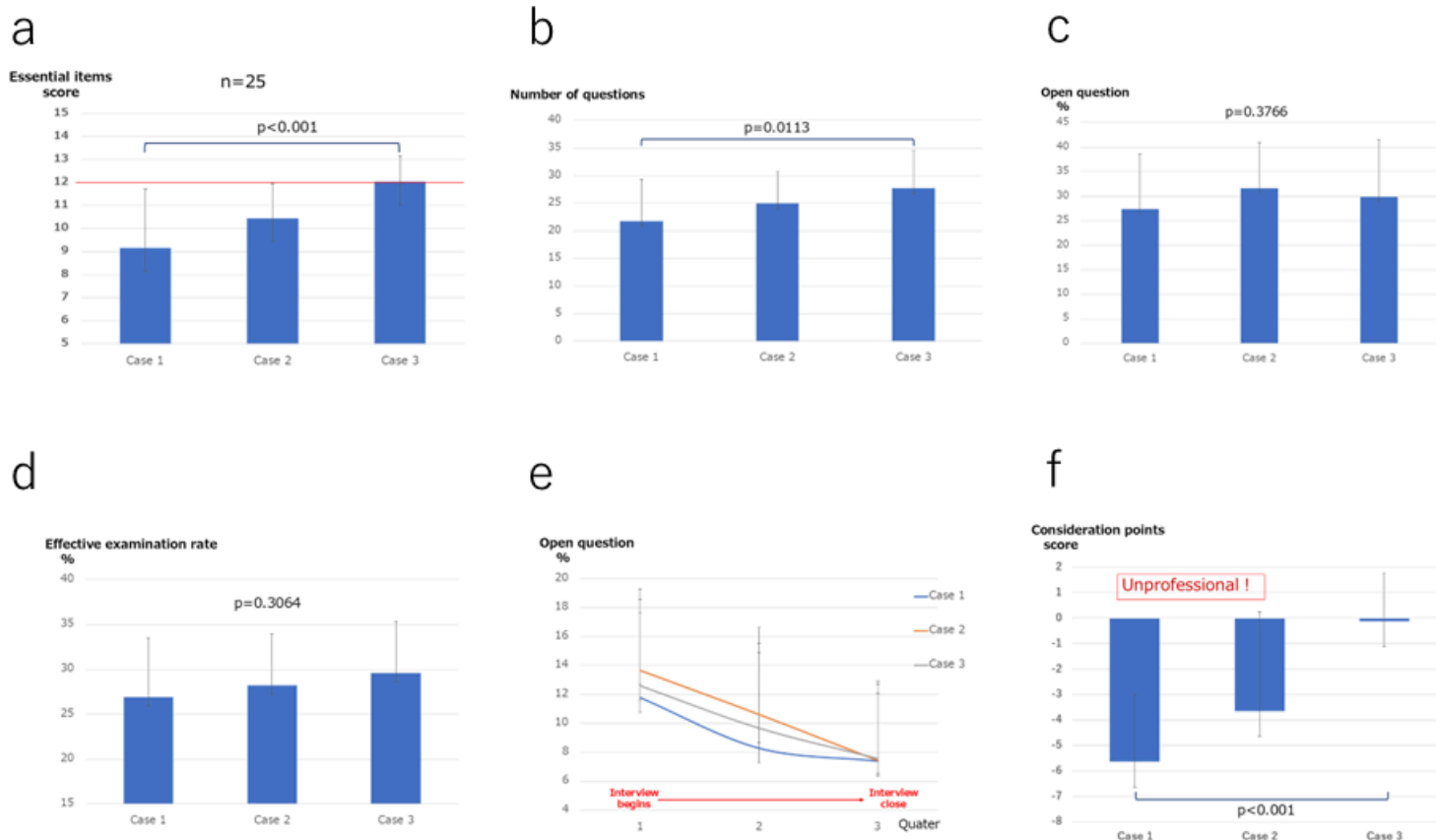


Figure 4

Training results

- a: The number of essential interviews and examination items completed increased significantly ($p < 0.001$).
- b: The number of questions asked during the medical interview significantly increased in each case.
- c: The OQ rate gradually increased.
- d: The effective examination rate (number of examinations with required medical interview and examination items / (number of questions in the medical interview + number of examination items)) gradually increased.
- e: No change was observed in the percentage of open questions during medical interviews in this training.
- f: The points of consideration during medical examinations showed a dramatic improvement ($p < 0.001$).

Supplementary Files

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