

OSCEai: personalized interactive learning for undergraduate medical education

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Abstract

Background: This study aims to evaluate the effectiveness of the OSCEai, a large language model-based platform that simulates clinical encounters, in enhancing undergraduate medical education.

Methods: A web-based application, OSCEai, was developed to bridge theoretical and practical learning. Following use, medical students from the University of Calgary Class of 2026 completed an anonymized survey on the usability, utility, and overall experience of OSCEai.

Results: A total of 37 respondents answered the anonymized survey. The OSCEai platform was highly valued for its ability to provide data on demand (33/37), support self-paced learning (30/37), and offer realistic patient interactions (29/37). The ease of use and medical content quality were rated at 4.73 (95% CI: 4.58 to 4.88) and 4.70 (95% CI: 4.55 to 4.86) out of 5, respectively. Some participants (8/37) commented that few cases were not representative and needed clarification about app functionality. Despite these limitations, OSCEai was favorably compared to lecture-based teaching methods, with an overall reception rating of 4.62 (95% CI: 4.46 to 4.79) out of 5.

Interpretation: The OSCEai platform fills a gap in medical training through its scalable, interactive, and personalized design. The findings suggest that integrating technologies, like OSCEai, into medical curricula can enhance the quality and efficacy of medical education.

Résumé

Résumé français à venir.

Introduction

Novel pedagogical methods have been created within undergraduate medical education (UME) to optimize student learning and clinical competence. Lecture-based teaching, once the cornerstone of medical education, have been complemented or supplanted by more interactive methods like problem-based learning (PBL), case-based learning (CBL), and simulations.¹⁻³ These pedagogical methods share a common goal—to help people to learn and thereby bridge the gap between theoretical knowledge and its practical application in clinical settings.⁴ Integral to this approach is the importance of patient interaction, which helps students develop communication skills and empathy while applying their theoretical knowledge in real-world scenarios.^{4,5} Examples of teaching patient-oriented communications include standardized patients and the Harvey mannequin.⁶ There is a growing preference for these interactive methods among medical students, as they foster deeper learning of medical concepts and more effectively prepare students for clinical practice.^{7,8} Despite their benefits, implementation costs and feasibility are significant challenges to the use of interactive methods, especially when used for individualized tailored learning. While personalized and adaptive education has great potential to improve learning outcomes significantly, it requires substantial resources, including skilled facilitators, access to specialized equipment, and a considerable time investment in planning and execution.^{9,10}

Large language models (LLMs), which can understand and generate human-like texts, present a novel solution to these challenges by simulating clinical encounters and offering personalized feedback, thereby creating a dynamic learning environment that adapts to the learner's pace and style.^{11,12} The natural language capabilities of LLMs have led to their use in other domains such as finance, research, and law. LLMs have been successfully employed in other domains such as finance,¹³ research,^{14,15} and law.¹⁶ In medicine, there has been an increase in the use of LLMs, like ChatGPT, in creating differential diagnoses, interactive practice cases and multiple-choice question reviews.¹⁷⁻²⁰ However, integrating such technology must be approached with caution, considering the potential pitfalls in the authenticity of simulated patient interactions.

This study focuses on the incorporation of a novel LLM-based app called OSCEai (<https://osceai.ca/>, Figure. 1) into the University of Calgary Cumming School of Medicine's Re-Imagining Medical Education curriculum.²¹ This paper uses survey-based methodology and thematic analysis to compare the effectiveness of OSCEai in undergraduate

medical education for taking interactive patient histories, especially compared to lecture-based teaching modes of teaching. Named after the Objective Structured Clinical Examination (OSCE), a critical tool for assessing clinical skills, OSCEai provides an immersive and interactive platform for clinical scenario training.^{22,23} Through a collection of simulated cases that mirror real-life patient encounters, trainees can practice history taking, physical examination, clinical reasoning, and decision-making skills (Figure 2). The app offers instant, personalized feedback based on the trainees' inputs, facilitating a tailored learning process that enhances practical skill development and prepares students for real-world clinical challenges. By providing a scalable, flexible, and cost-effective solution, it holds the promise of significantly improving the quality and efficacy of medical education, preparing a new generation of physicians for the complexities of modern healthcare.

Methods

Technical design

OSCEai is a web-based application developed to support undergraduate medical education by simulating clinical cases (Figure 1). It combines a front-end interface developed with ReactJS for user interaction and a NestJS backend server for processing these interactions. The application utilizes the OpenAI GPT-4 application programming interface (API) alongside the Meta Llama-3-70B model²⁴ to generate textual responses. It then uses the OpenAI text-to-speech API to convert these responses into audio. Both the users and the app interact via text and audio.

The platform enables users to select from various medical scenarios, difficulty levels, and interaction types (e.g., interaction with a patient, physician, or interviewer). Users can request additional clinical information (i.e., physical exam findings, imaging results), decide on management strategies, simulate how their management plan affects their patients, interact with patients in follow-up appointments, and answer multiple-choice questions about the case after the scenario ends. As users navigate the cases, their interactions are recorded, allowing for the generation of detailed feedback reports and medical documentation after each session, with feedback based on the Calgary-Cambridge model for medical interviews.⁵ OSCEai enables downloading these sessions in both transcript and audio formats, and students can pose follow-up questions for further clarification. All user inputs are destroyed after the user leaves or refreshes the website, and no data is used for training LLMs.

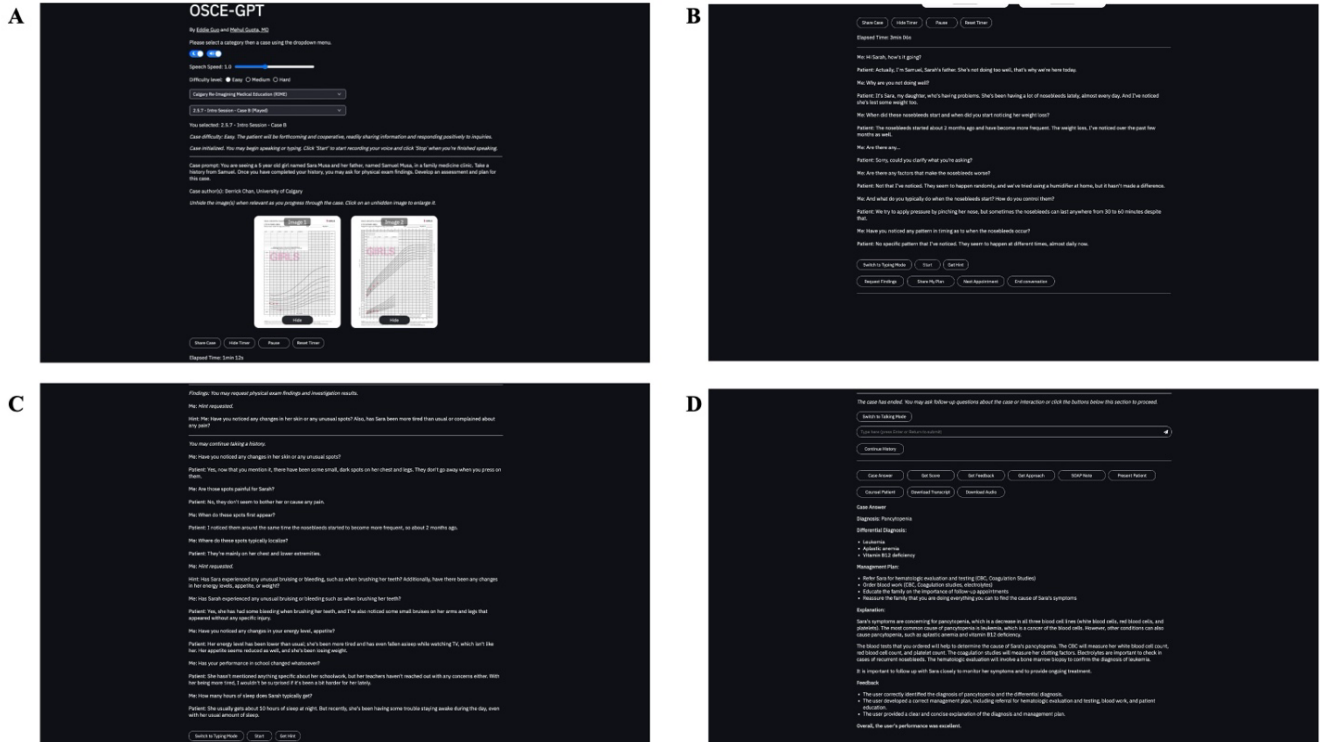


Figure 1. Interaction overview of a typical OSCEai case. After users select a difficulty, category, and case, they begin speaking or typing to the app, which responds with written and audio outputs. A) Case Opening, B) Typical Interaction for History Taking in Voice or Text Mode, C) Example of Hint Feature for Continuing History Taking, D) Case Answer and Feedback Options, Concluding with Future Activities.

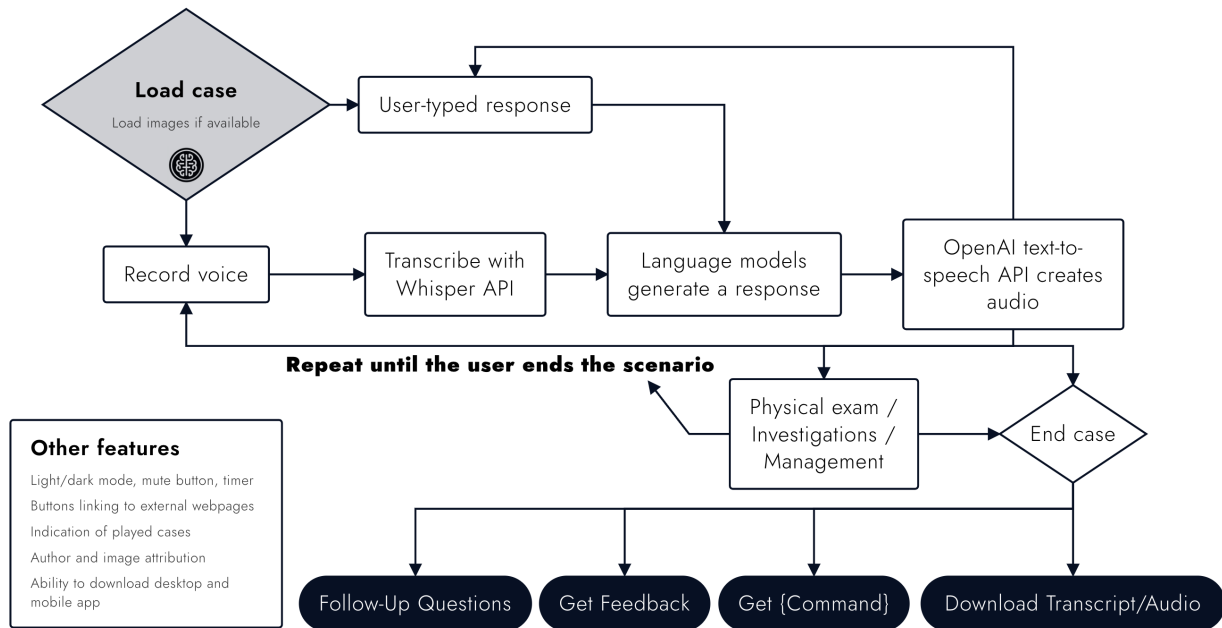


Figure 2. Data flow diagram illustrating the functionality of the OSCEai application. The app is designed for users to interact naturally with voice and typing, and generative AI algorithms create outputs that the user can respond to.

Survey design

First-year medical students, all with previous experiences with OSCEs, from the University of Calgary Class of 2026 Re-imagining Medical Education (RIME) curriculum engaged with the OSCEai platform in class on February 20, 2024, and were invited to complete an anonymized survey (Table 1) designed to gather their feedback on the app's usability, educational impact, and overall experience. The survey was made available to first-year students through PowerPoint slides during the February 20 class and was announced in-class as a voluntary activity. The checklist for reporting results of internet e-surveys (CHERRIES) guideline for survey design was used.²⁶ The survey was provided within the class PowerPoint presentation, had voluntary completion without incentives, and included no demographic information fields. The survey was delivered through Google Forms with duplicate responses set to not permitted without randomization of questions. All users were permitted to review their responses. All Likert and multiple select response fields were set to mandatory response before submission was permitted.

The platform was accessible through any standard web browser on both mobile and computer devices via the URL (<https://osceapt.com>). Additionally, an app version of OSCEai was made available for download on mobile and laptop devices directly from the platform's website. The survey deployed in this study aimed to gather both quantitative and qualitative insights from the participants. It featured various sections evaluating different facets of the students' experience with OSCEai. Employing a mix of Likert scale questions from a scale of 1 to 5, where 1 was the lowest and 5 was the highest score (specific descriptors are in Table 1), for quantifiable data and open-ended questions for in-depth responses, the survey was structured to assess the platform's impact on medical education thoroughly. Quantitative data from the Likert scale questions were visualized with bar graphs. All errors were reported as 95% confidence intervals unless otherwise stated. For questions relating to comparison of OSCEai against lecture-based teaching methods (Table 1), we first checked normality with the Shapiro-Wilk test and proceeded with the Wilcoxon signed-rank test if the results deviated significantly from a normal distribution at an alpha of 0.05. Given these questions set a value of 3 as the midpoint between preferring lecture-based teaching methods and OSCEai, we set three as the mean value for the signed-rank test. Data visualization and statistical computation were performed using Python 3.9.16 with the

matplotlib, pandas, and numpy packages. Given the sample size and short responses to open-ended questions, qualitative answers were analyzed based on their corresponding section in the survey, i.e., benefits, limitations, overall assessment (Table 1).

Table 1. Survey to evaluate the effectiveness of OSCEai as a medical education tool.

Item	Questions
Background Information	Where is your training program? What is your level of training (e.g., PGY-1)? Which OSCEai scenario(s) did you play?
Platform Interaction	How would you rate the ease of use of the OSCEai website? (1 = very poor, 5 = very good) How would you rate the medical content in the scenarios you played? (1 = very poor, 5 = very good)
Benefits	How would you rate the feedback received after each scenario? (1 = very poor, 5 = very good) What aspect(s) of the OSCEai platform did you find most beneficial for your learning? Do you feel the OSCEai platform fills a gap in your current medical training? If so, how?
Limitations	Were there any scenarios or elements of the platform that you found confusing or not representative of real-life practice? If you answered yes to the previous question, could you please explain? What improvements would you suggest for the OSCEai platform?
Comparison to Lecture-based Teaching Methods	How would you rate OSCEai in comparison to lecture-based learning methods (e.g., flipped classroom lectures, patient presentations)? (1 = much worse, 5 = much better) How did the feedback received after each scenario compare to feedback received in lecture-based learning outlets (e.g., flipped classroom lectures, patient presentations)? (1 = much worse, 5 = much better)
Overall Assessment	How would you rate the OSCEai as a learning tool? (1 = very poor, 5 = very good) How likely would you recommend OSCEai to others? (1 = very unlikely, 5 = very likely) Please provide any additional comments or insights regarding OSCEai.

Ethics

This study received an ethics exemption from the Research Ethics Board Review from the Conjoint Health Research Ethics Board at the University of Calgary. The project was determined to be a quality assurance study that was intended to review an educational intervention for the purpose of improving program delivery within the University of Calgary Cumming School of Medicine Undergraduate Medical Education office.

Results

Effectiveness of OSCEai as an educational tool

Users were asked to select or type the feature they valued most in an educational app like OSCEai. 33/37 participants highlighted the ability to request data, such as physical exam findings and lab results; 30/37 respondents selected self-paced learning (i.e., able to complete the cases whenever and wherever they desire); 29/37 participants selected realistic patient interactions, with supporting comments noting that “OSCEai allows students to get realistic interactions and think on the spot.” The ability to share management plans and the platform’s feedback mechanism were selected by 28/37 and 25/37 participants, respectively. Additionally, 24/37 respondents valued the ability to hear a patient speak. 19/37 participants selected case variety of the app as a benefit.

The respondents rated the platform’s ease of use and medical content quality as 4.73 (95% CI: 4.58 to 4.88) and 4.70 (95% CI: 4.55 to 4.86) out of 5, respectively (Figure 3A and 3B). Students’ narrative feedback provided insights into the platform’s influence on their learning. Many emphasized the importance of practicing communication skills and taking patient histories in a simulated environment, with one respondent noting, “It allows me to practice communications on my own time.” The sentiment that the platform allows for “a more structured, realistic manner” of practicing OSCE cases was a common theme.

Valued Features of OSCEai

The platform’s feedback quality was rated at an average of 4.41 (95% CI: 4.19 to 4.62) out of 5 (Fig. 3C). All respondents affirmed that the OSCEai platform filled a gap in their medical training. One student remarked, “Yes, it allows me to practice communications on my own time,” capturing the sentiment of many who noted the flexibility to engage with clinical cases independently. Another student emphasized the value of realistic interactions, stating, “Yes! The ability to practice speaking to a person to gain information rather than just reading about cases. You get to understand how real people would communicate their symptoms and experiences.”

Students noted the direct application of medical knowledge in a structured, realistic manner, with one noting, “It helps me to have more interactive cases for conditions that I have learned about in class but may not have really understood how it would present in real life” and another stating “I believe it’s a very realistic simulation of a clinical context, and therefore help me feel more comfortable when I enter into a clinic setting.”

Limitations of OSCEai

In assessing the OSCEai platform, a subset of users highlighted specific limitations that affected their learning experience. Eight of 37 respondents reported scenarios or elements that they found confusing or not representative of real-life practice. For instance, one participant mentioned, “The patient remained way too calm even when I made outlandish claims for the nosebleed (iron deficiency anemia, not cancer) scenario.” Concerns were also raised about the platform’s guidance on clinical procedures, with one user stating, “I wasn’t sure what tests or investigations I could ask for.” In addition, another limitation is static image inclusion, whereby images are loaded when the case begins rather than being dynamically loaded on user request.

Comparison to other teaching methods

Students were asked to compare OSCEai to the other teaching methods they have experienced (e.g., flipped classroom lectures, patient presentations) to evaluate the effectiveness of the app in a broader educational context. The OSCEai platform was rated favorably against lecture-based teaching methods of learning (e.g., flipped classroom lectures, patient presentations) with an average rating of 4.14 (95% CI: 3.94 to 4.33) out of 5 ($P < 0.0001$, Fig. 3D). Furthermore, the feedback that OSCEai provided was favoured over common outlets of learning (Fig. 3E), with an average rating of 4.03 (95% CI: 3.74 to 4.32) out of 5 ($P < 0.0001$).

Overall

The overall reception of OSCEai as a learning tool received a rating of 4.62 (95% CI: 4.46 to 4.79) out of 5 (Fig. 3F). Furthermore, the likelihood of students recommending the platform was 4.78 (95% CI: 4.62 to 4.94) out of 5 (Fig. 3G).

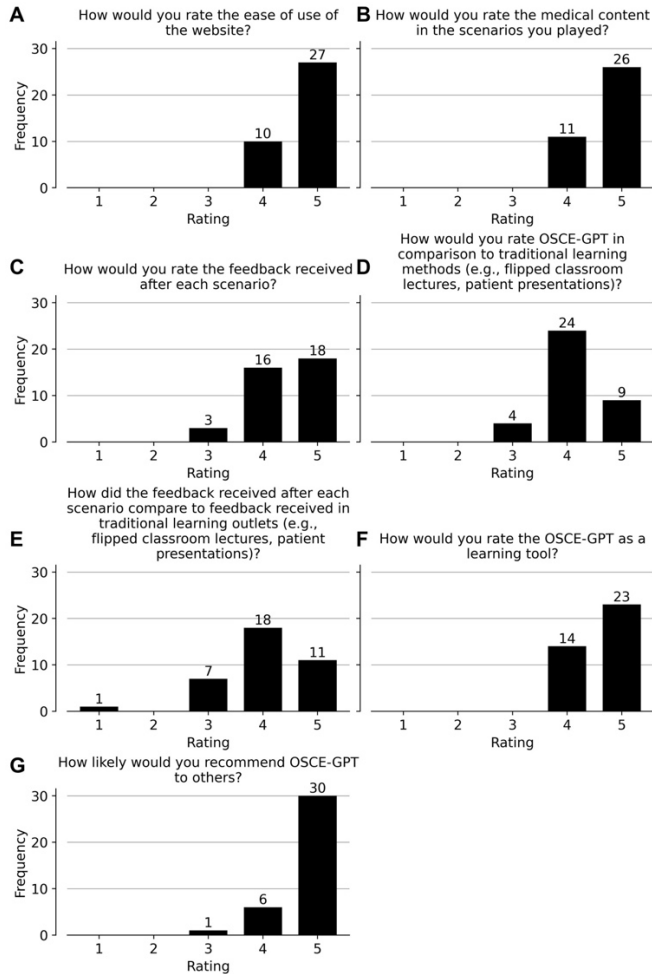


Figure 3. Quantitative user experience questions for the OSCEai app (n = 37). After interacting with OSCEai cases, first-year medical students at the University of Calgary answered a Likert survey to evaluate the effectiveness of the app.

Discussion

In this study, we introduce the use of an interactive LLM platform called OSCEai into the University of Calgary Cumming School of Medicine's curriculum for students to take interactive patient histories. The most valued feature of OSCEai by users in this study was the ability to request data, highlighted by 33 out of 37 participants, and self-paced learning, selected by 30 out of 37 respondents. Notably, all respondents affirmed that OSCEai addressed a critical need for more interactive and practical learning experiences. Comments from participants like "It allows me to practice communications on my own time" and "Yes! The ability to practice speaking to a person to gain information rather than just reading about cases" illustrate the platform's role in facilitating a deeper understanding of patient care. Moreover, OSCEai was favoured over lecture-based teaching methods, such as flipped classroom lectures and patient presentations, with a rating of 4.14

(95% CI 3.93 to 4.33) out of 5 as an overall rating and 4.03 (95% CI: 3.74 to 4.32) out of 5 for its feedback mechanism.

This study's findings align with existing literature that highlights the growing preference among medical students for interactive and student-centered learning strategies over more common and less interactive teaching approaches.^{27,28} Similar to the benefits observed with PBL and CBL, the OSCEai platform facilitates active learning, critical thinking, and the application of knowledge in clinical settings. However, unlike most methods, which often require significant resources, OSCEai offers a scalable and cost-effective solution to personalized education, addressing a critical gap identified in previous studies.²⁹ This is particularly relevant considering the resource constraints many medical schools face, including time, standardized patient availability, and financial limitations.^{29,30} OSCEai helps streamline OSCE preparations and provides a viable alternative to resource-intensive methods.

The positive feedback regarding the platform's ability to simulate realistic patient interactions and provide personalized feedback supports the notion that technology-enhanced learning tools can effectively enhance clinical competence. This is consistent with the findings of studies such as that by McGaghie et al.,³¹ which emphasize the value of simulation in medical education for improving clinical skills without risking patient safety. That is, simulation-based education allows students to engage in realistic clinical scenarios, making critical decisions in a controlled environment where mistakes can become learning opportunities without adverse consequences.³² OSCEai's emphasis on self-paced learning and the variety of cases aligns with the educational theories underpinning adult learning principles, suggesting that learner autonomy and exposure to a broad range of clinical scenarios are crucial for deep learning.^{33,34} These aspects are vital in preparing medical students for real-world clinical environments, where the ability to adapt and apply knowledge independently is essential.

While the study highlights the substantial benefits of the OSCEai platform, it also identifies areas for improvement, particularly regarding the realism of patient interactions and guidance for those unfamiliar with the app interface. To address realism, future updates to OSCEai may include fine-tuning a LLM to better simulate real patient behaviours, emotional responses, and variability in symptom presentation. Additionally, the integration of virtual or augmented reality could create more immersive and interactive learning environments.³⁵ To address usability, providing detailed, context-specific instructions during simulations, including visual aids, real-time feedback, and post-case questions to test and reinforce concepts can significantly enhance the educational value of the platform. Furthermore, integrating multidisciplinary scenarios that require collaboration with other healthcare professionals could address the limitations highlighted by respondents and align with current trends toward interprofessional education in medical curricula.³⁶ Systematic limitations of this study include a potential self-selection bias, as the survey was completed on a voluntary basis. Given the proportion of positive to negative feedback regarding the tool, generalizability may be limited given disproportionate representation of the sample of students who used the tool versus responded to the survey.

Conclusion

The OSCEai platform represents a technology-based innovation in medical education, offering a flexible, interactive, and cost-effective tool for enhancing clinical training. Its alignment with contemporary educational theories and its potential to overcome logistical and financial barriers associated with lecture-based teaching pedagogical methods position it as a valuable addition to medical curricula. As medical education continues to evolve, the integration of technology-enhanced learning tools like OSCEai will aid in preparing future physicians to meet the challenges of modern healthcare.

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