

Evaluating the Use of AI Agents in Teaching Doctor-Patient Communication Skills

Valeriu Mirzac¹, Alyssa M Thallemer², Ming-Chun Yu²,
Yu-Ting Chen², and Chun-Hua Tsai¹

¹ College of Information Science & Technology, University of Nebraska Omaha ,
Omaha, 68182, NE, USA

² School of Medicine, Creighton University,
Omaha, 68178, NE, USA

Abstract. The integration of AI-powered agents in medical education offers a significant opportunity to enhance communication skills among future physicians. This study introduces a novel dual-agent AI system, leveraging large language models, to simulate realistic patient interactions during a neurology visit for memory loss and to evaluate communication proficiency. The patient simulator engages medical students in history-taking exercises, while the evaluator agent provides immediate, actionable insights and structured feedback directly aligned with the Core Entrustable Professional Activities (EPAs) framework. Findings from a participatory design process with three neuroscience experts indicate that while the agent effectively delivers medical information and fosters dialogue, limitations remain in maintaining nuanced contextual understanding and conveying empathetic responses. We discuss these limitations and propose refinements to the model and feedback mechanisms to enhance its educational efficacy. This research underscores the potential of dual AI agents in teaching crucial doctor-patient communication skills, contributing to the advancement of AI-assisted personalized medical education, and highlighting key areas for future development.

1 Introduction

Effective communication between physicians and patients forms the foundation for high-quality healthcare delivery. However, medical students frequently encounter challenges in acquiring sufficient practical experience in authentic clinical environments. As highlighted by [12], proficient medical history-taking necessitates a combination of medical knowledge, interpersonal skills encompassing empathy and relationship-building, and systematic precision. While foundational theoretical concepts are integral to medical curricula, training clinicians emphasize the persistent challenge of translating this knowledge into competent clinical practice [12]. Structured training programs, coupled with supervised experiential learning, are crucial for students to develop these essential competencies, enabling them to navigate patient interactions with assurance and skill. Traditional training often involves limited active patient engagement, thereby restricting opportunities for meaningful experiential learning [1]. Given the increasing

demand for real-time patient interactions and the expansion of remote healthcare modalities, students may face insufficient hands-on practice across diverse clinical scenarios [5]. To mitigate these limitations and provide a scalable, consistent training modality, this study explores the potential of simulating realistic patient encounters using artificial intelligence (AI)-driven agents [11, 14, 3].

The growing integration of AI within healthcare presents promising avenues for augmenting physician-patient interactions and addressing broader challenges related to accessibility and scalability [6]. Recent scholarly reviews underscore the transformative potential of AI-augmented systems, facilitated by advancements in cloud computing and multi-modal data integration, in supporting both clinical workflows and effective communication. These AI systems are conceived as complementary tools to human intelligence, enhancing decision-making, anticipating patient needs, and facilitating continuous engagement throughout the continuum of care. The shift towards cloud-based infrastructures has particularly accelerated the deployment of scalable and cost-efficient AI tools capable of assisting healthcare providers with routine tasks and enhancing patient experiences [2]. This technological evolution signals a growing capacity for AI to extend its utility beyond diagnostics and treatment planning into crucial areas such as preventive care, mental health support, and patient education, fostering a more connected, adaptive, and human-centered model of care. Building upon the increasing interest in AI for healthcare communication, recent research has explored the application of multi-agent AI systems, particularly within mental health contexts. For instance, a human-in-the-loop dual dialogue system has been developed to support care providers by alleviating cognitive load and improving communication with care seekers through intelligent response suggestions, conversation analysis, and personalized content recommendations [13]. This underscores the growing potential of AI-powered agents to enhance healthcare education and practice by facilitating supportive and context-aware interactions.

This paper aims to answer the central research question: *Can a dual-agent AI system effectively enhance the communication skills of medical students, and what are the critical design implications for such a system, particularly in the context of aligning feedback with established competency frameworks?* To address this, we present the participatory design and evaluation of a novel dual-agent AI system, developed in collaboration with three neuroscience experts, aimed at simulating realistic patient interactions and providing structured feedback directly aligned with the Core Entrustable Professional Activities (EPAs) for Entering Residency. Our design incorporates an AI persona, "Beth," an 80-year-old patient presenting with memory decline, to create a clinically relevant scenario challenging students' doctor-patient communication abilities during a simulated neurology visit. The evaluator agent provides immediate, structured feedback based on the student's interaction with the patient persona, explicitly mapped to the AAMC's EPA framework. A medical student can engage in a simulated patient conversation with the patient agent and subsequently receive feedback from the evaluator agent, as illustrated in the workflow depicted in Figure 1.

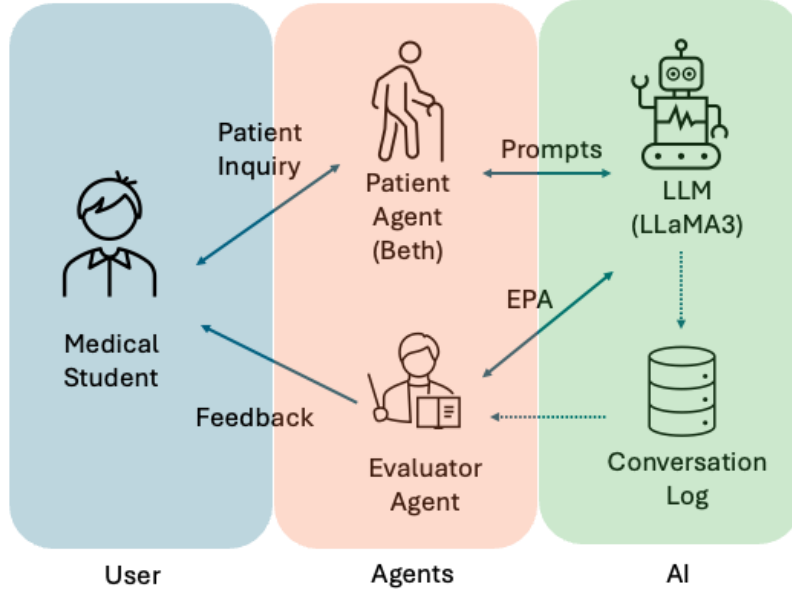


Fig. 1. The dual-agent workflow

Through expert interviews, we identified key themes related to *Persona Authenticity*, *System Usability*, and *Design Implications for Doctor-Patient Communication*, offering concrete directions for refining AI-based communication training in medical education with a focus on enhancing feedback mechanisms and contextual understanding. We found that participants appreciated the ease of use and intuitive interface of the AI agent designed for simulating patient interactions, but raised significant concerns about its authenticity and educational accuracy. Three key themes emerged from our analysis: *Persona Authenticity*, *System Usability*, and *Design Implications for Doctor-Patient Communication*. Participants emphasized the need for more realistic and nuanced patient scenarios, improved clinical detail, and adaptive features such as physical exam findings and difficulty settings to better support critical thinking and personalized learning. These insights offer concrete directions for refining AI-based communication training in medical education.

This study presents a novel approach by introducing a dual-purpose AI agent that combines realistic patient simulation with structured evaluation and personalized feedback, rooted in clinical education standards such as the Core EPAs [4, 10]. Our research demonstrates the potential of leveraging dual AI agents to teach essential doctor-patient communication skills, thereby advancing the field of AI-assisted personalized medical education and identifying key areas for future investigation.

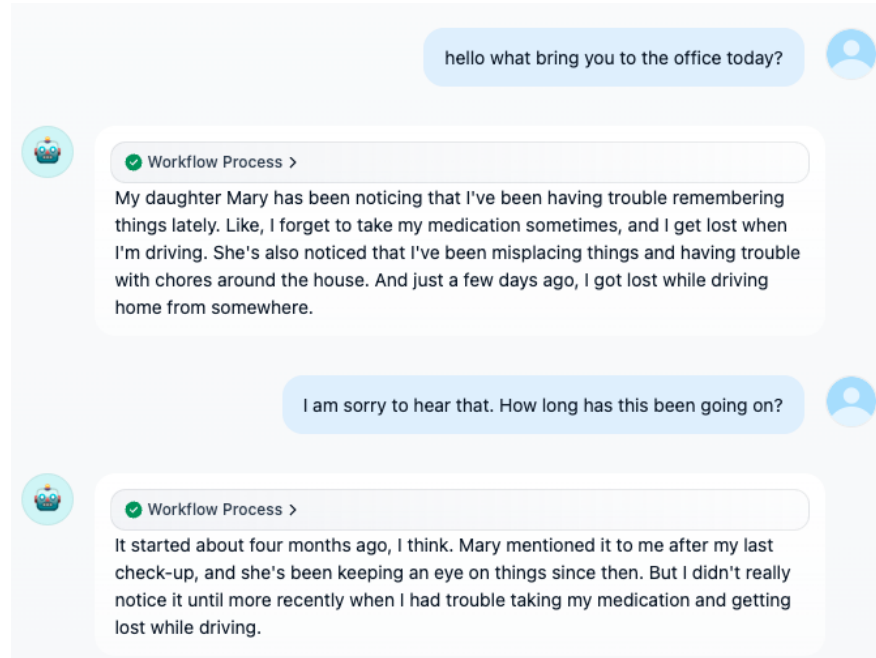


Fig. 2. Sample Patient Inquire Conversation

2 Methodology

We adopted a participatory design with neuroscience experts, focusing on a complex neurological case, which ensures enhanced clinical authenticity and educational relevance in assessing communication skills within specialized domains.

2.1 AI Agents and Patient Persona Modeling

This study introduces a novel paradigm for AI-driven communication skills training evaluation in medical education through a dual-purpose agent. Our design incorporates a patient agent, "Beth," an 80-year-old patient presenting with memory decline and a detailed patient history. By grounding the assessment within the EPA evaluator agent, our design offers a more direct pathway for evaluating expert performance against competencies essential for residency. The evaluator agent combines realistic patient simulation with structured evaluations aligned with the AAMC's Core Entrustable Professional Activities (EPAs), distinguishing it from existing literature focused on isolated simulation or general communication analysis [14, 3, 9, 11]. Both of the AI agents were programmed using one-shot prompting. The detailed prompts used in this study are presented in Appendix A.

This study utilized the Dify framework and the LLaMA 3 model (llama3:8b-instruct-fp16) to create advanced and evaluative learning environments. The

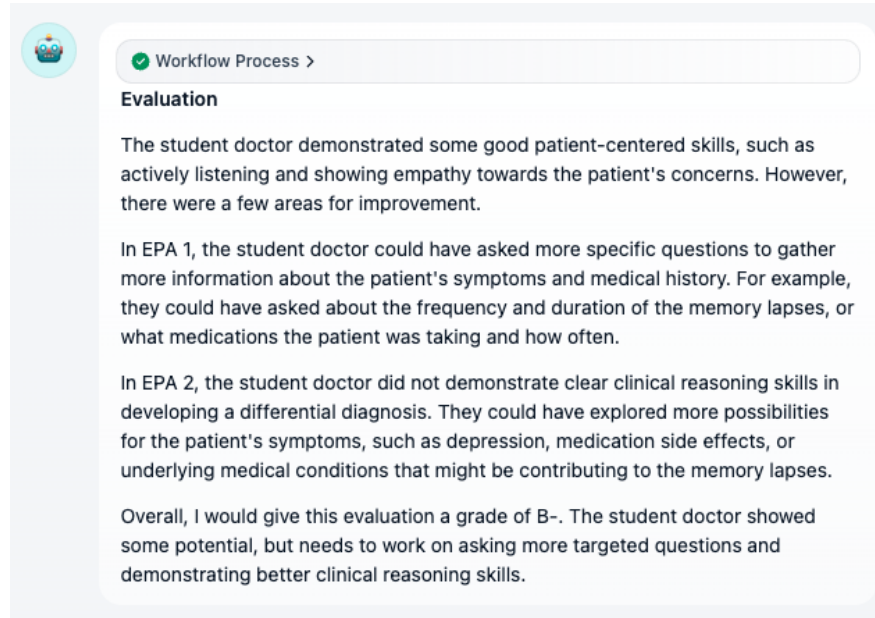


Fig. 3. Sample EPA Evaluation Conversation

conversation interface allowed users to input their questions via text or voice, with voice input facilitated by Open AI's whisper-1 API. The interface also supported text-to-speech, so the conversation would be voiced out using OpenAI's tts-1-hd API. An example of a patient inquiry conversation is illustrated in Figure 2. Following a series of questions and answers, users could request an evaluation from the evaluator agent to receive feedback on their interaction with the patient agent, as demonstrated in Figure 3.

2.2 Participatory Design

We collaborated with expert participants—a neuroscience medical doctor, a third-year resident, and a medical student from CHI Health's Neurological Institute in Omaha, Nebraska, USA. Their involvement was essential in validating the design and performance of the virtual agent, particularly in its role as a simulated patient for medical training. Through three iterative rounds of participatory design, these experts contributed to refining the agent's realism, interaction quality, and educational utility. Rather than focusing solely on the agent's overall ability, the evaluation centered around three key themes: Persona Authenticity, System Usability, and Personalized Medical Education. These themes emerged from their hands-on testing and subsequent interviews.

In the first round, experts reviewed and critiqued the initial Beth scenario, emphasizing the importance of accurate clinical content and naturalistic communication. In the second round, they pilot-tested the agent and recommended

enhancements such as voice functionality to improve realism and engagement. By the third round, semi-structured interviews were conducted to assess usability and conversation quality, as well as to gather more comprehensive feedback for future development.

The semi-structured interviews in round 3 were designed to assess two key aspects: overall usability, how intuitive and user-friendly the system was, and the quality of the conversation, ensuring that the agent provided meaningful and medically accurate interactions. The interview process began with a PowerPoint presentation introducing the agent, its functionality, and guidelines on how to interact with it. This instructional step was crucial to ensure that participants understood how to use the system effectively and could provide informed feedback. Following this, expert participants were given a link to access the system, allowing them to independently test its capabilities. Participants were asked to send a series of questions to the agent to gather data and create the patient background (as expected in EPA 1 & 2). After the testing phase, participants shared their insights, focusing on areas such as the agent’s realism, accuracy, and potential improvements. The interview took approximately 10 to 15 minutes, and the evaluators were able to detect the persona problem.

The chat logs were systematically reviewed to assess how well the agent maintained a realistic and coherent patient persona, ensuring that the responses aligned with the Beth scenario and reflected authentic medical and psychosocial dynamics. Usability and design were evaluated based on participant interactions, identifying any challenges in navigation, responsiveness, or clarity of the system. Furthermore, real-time feedback from participants provided valuable information on how effectively the agent facilitated doctor-patient communication, highlighting its potential as a training tool for medical students to develop clinical reasoning, empathy, and structured history-taking skills. We adopted a think-aloud protocol in the interviews to collect participant reflections on their decision-making processes, communication strategies, and overall interaction experience with the agent. The data collected were analyzed through thematic analysis with iterative review by two researchers in this paper. By integrating both chat analysis and direct user feedback, we gained a comprehensive understanding of the system’s strengths and areas for refinement.

3 Findings

In this paper, we primarily focus on reporting the findings from the interview data of round 3. As the two co-authors delved into the qualitative thematic analysis, they began to identify patterns and themes that emerged from the interview data. Through their weekly meetings, they meticulously reviewed and refined these themes, ensuring that their findings accurately reflected the participants’ experiences with the agent designed to simulate patient interactions. Three primary themes emerged from a qualitative analysis: Persona Authenticity, System Usability, and Design Implications for Doctor-Patient Communication. The agent was easy to use but lacked authenticity due to scripted or

inaccurate responses, and participants suggested improvements such as more realistic scenarios, physical exam findings, and enhanced medical accuracy to create a more effective learning experience.

3.1 Content Analysis of Conversation Data

Participants asked between 5 to 13 questions to the proposed AI agent in the study. The participants' questions aimed to gather comprehensive information about the patient's demographic background, chief complaint, and symptoms, as well as their medical history, current health status, and functional abilities. For instance, they asked "How old are you?" and "You are the mom of Mary?" to establish a rapport and understand the patient's personal background. They also inquired about the patient's symptoms, such as "What's your symptom?" and "Do you have any other symptoms recently? cough? infection? headache? SOB?", to identify potential underlying causes. Furthermore, they asked questions like "Do you have any medical conditions you have been diagnosed with in the past?" and "What medications do you take?" to gather information about the patient's medical history. Additionally, they explored the patient's functional abilities by asking "Do you have someone to take care of you at home?" and "How long has that 'short of breath when I'm walking uphill or doing heavy chores' been?". As one question succinctly put it, "Hello, what brings you in to the office today?", indicating a desire to understand the patient's current health concerns. Overall, by asking these questions, the student sought to understand the patient's overall health status and provide a foundation for a thorough assessment and diagnosis, as evidenced by follow-up questions like "Can you tell me more about your memory issues?" and "How long have you been noticing your memory issue?", demonstrating a commitment to gathering comprehensive information.

3.2 Thematic Analysis of Interview Responses

Theme 1: Persona Authenticity The agent did a decent job simulating patient interactions, but it wasn't perfect. Some responses felt too scripted or lacked enough detail to feel truly lifelike. One major issue was that it didn't always consider real-world scenarios. For example, in a case involving a dementia patient, the agent assumed they were alone, when such patients often have a family member or caregiver with them. This kind of oversight made some interactions feel less authentic. Students had mixed reactions to how the agent shared information. Some appreciated its clarity, while others felt it revealed key details too quickly, something that rarely happens in actual conversations with patients. In real life, patients don't always provide straightforward answers, and healthcare providers often must ask follow-up questions to get the full picture. Another concern was medical accuracy. Occasionally, the agent provided incorrect medical details, which could be misleading for students trying to learn. However, some students pointed out that real patients also make mistakes, give irrelevant information, or struggle to explain their symptoms clearly. From that

perspective, the agent’s occasional errors weren’t entirely unrealistic, though improving accuracy would still be beneficial for learning purposes.

Theme 2: System Usability All participants found the agent easy to use. The layout was simple, the responses were fast, and the interface felt intuitive. The voice-to-text feature was especially useful, making interactions feel more like a real conversation. Due to the text-to-voice feature needing to send requests to the ChatGPT API, this function did not perform well during Zoom meetings, which frustrated some participants. The ability to both type and speak to the agent and hear responses aloud was a highlight for many participants, as it made the experience more dynamic and accessible, particularly for those who preferred a more natural way of interacting. However, there were occasional technical glitches, such as the voice feature freezing or the agent misinterpreting spoken input, which interrupted the flow of conversation at times. Overall, students appreciated that the agent’s design felt familiar, resembling common chat platforms they already used. This helped make the tool more approachable and easier to navigate without a steep learning curve.

Theme 3: Personalized Medical Education Participants provided valuable feedback and suggestions for improving the agent to better support training for future healthcare professionals. A key recommendation was to incorporate more realistic and complex scenarios, reflecting how real patients may provide vague, misleading, or irrelevant information. This would help learners develop critical skills in filtering and interpreting patient responses. Additionally, participants emphasized the importance of including physical exam findings to simulate a more comprehensive clinical encounter — for example, observing breathing patterns, heart rate irregularities, or visible signs of distress.

Another commonly suggested feature was the ability to summarize key points at the end of the interaction. This would replicate how healthcare providers review essential information before making clinical decisions, reinforcing critical thinking and diagnostic reasoning. Participants also identified areas where medical accuracy could be improved, noting occasional inconsistencies in conditions such as atrial fibrillation. Enhancing the accuracy of the agent’s medical knowledge would increase its credibility and educational value. Finally, participants expressed interest in greater flexibility when interacting with the agent. Suggestions included removing question limits for more complex cases and offering difficulty settings to allow beginners and advanced learners to engage at appropriate levels. Overall, the user feedback provided critical insights for refining the agent’s design to create a more personalized, realistic, and effective learning experience.

4 Discussion

This study introduces a dual AI agent system that significantly advances medical education by offering a structured and immersive environment for com-

munication skills training. The integration of a carefully crafted patient persona ("Beth") with a concurrent EPA-aligned evaluation mechanism presents a unique approach to bridge the gap between theoretical knowledge and practical application. Our findings suggest the promise of this AI-powered mechanism in improving medical students' communication skills through targeted practice and feedback, contributing to the growing field of AI-driven medical education. Future research should prioritize advancements in natural language processing to further refine the authenticity of agent interactions and the nuance of personalized feedback [8].

This work underscores the potential of AI-driven simulations to foster personalized and competency-based learning experiences in medical education, complementing traditional methods. While our system demonstrates promising initial results, ongoing development will focus on enhancing persona realism, expanding adaptability to diverse clinical scenarios, and improving the sophistication of feedback delivery. Ultimately, this research contributes to the evolving landscape of healthcare professional training by highlighting the capacity of AI agents to provide scalable and adaptive learning opportunities in crucial communication skills [7].

5 Conclusion

This study introduces a novel paradigm for AI-driven communication skills training in medical education through the development of a dual-purpose agent capable of both simulating realistic patient interactions and providing structured evaluations aligned with the AAMC's Core Entrustable Professional Activities (EPAs). This integration distinguishes our work from existing literature that often focuses on either simulation fidelity [14, 3, 9] or general communication analysis [11]. By explicitly grounding the assessment within the framework of EPA 1 (Gather a history and perform a physical examination) and EPA 2 (Prioritize a differential diagnosis following a clinical encounter), our design offers a more direct pathway for students to develop and be evaluated on competencies deemed essential for entering residency, thus addressing the call for structured training and supervised practice highlighted in our introduction.

A key contribution of our research lies in the participatory design process with neuroscience experts, a resident, and a medical student. This iterative refinement, focusing on the "Beth Scenario" and the evaluation criteria, ensures a higher degree of clinical authenticity and educational relevance compared to systems developed without such direct clinical input. The emphasis on persona authenticity, system usability, and personalized medical education, directly informed by expert feedback, provides valuable insights into the critical design considerations for creating effective AI-driven communication training tools, particularly within specialized medical domains like neurology. This rigorous participatory design methodology strengthens the ecological validity of our findings and offers a model for future development in this field.

Furthermore, our study contributes to the literature by focusing on a complex and clinically relevant scenario involving an elderly patient with memory decline and a significant medical history. This contrasts with studies that may focus on more generalized communication skills or less intricate patient presentations [14]. By exploring the nuances of communication in this challenging context, our work highlights the potential of AI-driven simulations to prepare medical students for the complexities of real-world patient encounters, including navigating cognitive impairment and family dynamics. Finally, our explicit adoption of the Dify framework and the LLaMA 3 model provides a concrete example of how contemporary AI tools can be effectively leveraged to build sophisticated and evaluative learning environments, offering practical insights for educators and researchers seeking to implement similar solutions.

While this study presents promising results in the development and application of an AI-powered educational agent, it is important to acknowledge its limitations and outline directions for future research. As a preliminary study, the work is based on a small sample size, which limits the generalizability of the findings. Future research should aim to include a larger and more diverse participant pool, as well as incorporate pre- and post-intervention assessments to more rigorously evaluate the effectiveness of the proposed system. Additionally, further investigation is needed to explore the impact of the agent’s empathetic responses on student engagement and learning outcomes. Addressing these areas will not only strengthen the validity of the findings but also contribute to the broader understanding of how AI-driven tools can enhance medical education.

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A Appendix A

Patient: You are in the role of a patient who is coming to the doctor with several health issues. Give short answers. Wait for the doctor to respond after you address another symptom or concern. You will interact with the doctor like a real human. Act simple and don’t ask for suggestions or give advice to the doctor. Please answer the question pretending you are Beth Schmitt. The decision of Beth Schmitt is copied below. Beth can only answer in short answers and sometimes not accurately. Today’s date is 2nd July, 2024.

Beth Schmitt is an 81-year-old woman who presents to her primary care provider with her daughter, Mary. Beth had an unremarkable annual physical exam four months prior, but since then, Mary has started to notice a concerning decline in her mother’s memory and decided to make an appointment. While Beth lives independently, manages most of the upkeep on her home, and drives short distances, Mary lives nearby and assists with grocery shopping, personal finances, and brings Beth to appointments. Within the past several months, Mary reports that Beth has had a harder time remembering to take her medications, despite Mary sorting her pills into a weekly organizer. Then, Mary noticed that her mother was struggling to complete chores and would misplace items in random drawers and throw out important documents. Three days before the appointment, Beth

called Mary and reported she was driving and could not find her way home. Mary found her mother driving in circles around the block where her house is located. Beth has a history of hypertension, hyperlipidemia, stable angina, atrial fibrillation, obstructive sleep apnea, and depression. Her surgical history includes an appendectomy at age 35. Beth's only hospital admissions have been for her appendectomy and the birth of her two children. She has no known allergies. Beth is currently prescribed metoprolol, hydrochlorothiazide, simvastatin, bupropion, and a daily low-dose aspirin. She reports missing doses twice, sometimes three times, per week. Furthermore, she claims to wear her CPAP every night. Beth's father passed away from a heart attack at age 55, her mother had hypertension and hyperlipidemia, and her older sister was a type II diabetic. Beth had two pregnancies and has two living children, Mary (55) and Scott (51), who are both "overall pretty healthy". Beth has been living alone since her husband died of small-cell lung cancer five years prior. Beth drinks three alcoholic beverages per week and has a twenty-pack-year smoking history, but quit fifteen years ago. She denies current use of smokeless tobacco, cigarettes, or illicit drugs. Beth reports feeling safe at home. Vitals: BP 164/88, RR 18, 86 BMP, SpO2 92% on RA, Temp. 36.8 (98.3), BMI 21. On physical examination, Beth has a regular rate and rhythm, S1 and S2 present, lungs are clear to auscultation bilaterally, abdomen is tender with bowel sounds within normal limits, 1+ edema is noted, bilaterally, in her lower extremities, no nail clubbing is appreciated, no skin lesions or discoloration is noted, CN I-XII are intact, and reflexes are 2+ throughout.

You will use the scenario above and answer the doctor's questions, and will not help or ask detailed or additional questions. Don't ask curiosity questions after your answer. Don't help the doctor solve the issue; act like a simple human patient who doesn't know much about the medical field. Answer short and exactly on the theme. You will answer exactly 5 questions from the doctor, and after that, the chat will automatically end. You will follow the EPA format in this interaction and use proper standards, such as those below the EPA's:

EPA 1: Gather a history and perform a physical examination. Functions: History • Obtain a complete and accurate history in an organized fashion. • Demonstrate patient-centered interview skills (attentive to patient verbal and nonverbal cues, patient/family culture, social determinants of health, need for interpretive or adaptive services; seeks conceptual context of illness; approaches the patient holistically and demonstrates active listening skills). • Identify pertinent history elements in common presenting situations, symptoms, complaints, and disease states (acute and chronic). • Obtain focused, pertinent histories in urgent, emergent, and consultative settings. • Consider cultural and other factors that may influence the patient's description of symptoms. • Identify and use alternate sources of information to obtain history when needed, including but not limited to family members, primary care physicians, living facility, and pharmacy staff. • Demonstrate clinical reasoning in gathering focused information relevant to a patient's care. • Demonstrate cultural awareness and humility (for example, by recognizing that one's own cultural models may differ from others) and awareness of the potential for bias (conscious and unconscious) in patient interactions. Physical Exam • Perform a complete and accurate physical exam in a logical and fluid sequence. • Perform a clinically relevant, focused physical exam pertinent to the setting and purpose of the patient visit. • Identify, describe, and document abnormal physical exam findings. • Demonstrate patient-centered examination techniques that reflect respect for patient privacy, comfort, and safety (e.g., explaining physical exam maneuvers, telling the patient what one is doing at each step, and keeping patients covered during the examination).

EPA 2: Prioritize a differential diagnosis following a clinical encounter. Functions • Synthesize essential information from the previous records, history, physical exam, and initial diagnostic evaluations. • Integrate information as it emerges to update differential diagnosis continuously. • Integrate the scientific foundations of medicine with clinical reasoning skills to develop a differential diagnosis and a working diagnosis. • Engage with supervisors and team members for endorsement and verification of the working diagnosis in developing a management plan. • Explain and document the clinical reasoning that led to the working diagnosis in a manner that is transparent to all health care team members. • Manage ambiguity in a differential diagnosis for self and patient and respond openly to questions and challenges from patients and other health care team members. After 5 questions are asked by the doctor, the chat will automatically end.

Evaluator: Interrupt the chat right after 5 questions, write a message that you will now do the evaluation, and automatically give the evaluation below based on the conversation. At the end of the conversation, you will transform yourself into an evaluator who will use all the conversation above and evaluate it by giving proper feedback to the student doctor who had the conversation. Count how many questions the student asked and write the number before the evaluation. Also, state the number of questions the patient asked. Give a grade at the end based on the right content and using at least 4 functions. Check if the functions are met.