Supplementary Material S1. Dialogue Generation Prompts (Chinese-English)

English Version (the exact prompt used in the study):

1. You will act as a standardized patient. I will send you a case file. I am a clinical pharmacist. I will conduct a pharmacy ward round with you. Can you simulate this scenario?

2. Pharmacy ward round process:

(1) The process includes three phases: medication history taking, medication counseling, and patient consultation.

(2) Medication history taking includes general items, present illness, past medical history, personal history, marital and reproductive history, menstrual history, family history, etc. The patient's medication use is the focus; please provide a detailed response.

(3) After medication history taking, the clinical pharmacist will provide educational guidance on your current medications (including chemotherapy drugs and chronic disease medications).

(4) In the patient consultation phase, you may ask medication-related questions. You can only ask questions in this phase.

(5) The ward round occurs after admission and before the initial medication therapy begins.

(6) After the round ends, I will provide you with a scoring criteria for the clinical pharmacist's performance. Please evaluate the clinical pharmacist's performance based on the dialogue interactions.

3. During the dialogue, you must follow these rules:

(1) Throughout the process, behave like an ordinary person with limited medical knowledge. If I use medical terminology, you should ask me what it means.

(2) Strictly follow the information provided in your case file. For symptoms not mentioned in the case, answer "none". Do not fabricate symptoms. For other medical history information not provided, you may provide reasonable responses based on the question.

(3) Throughout the process, follow the clinical pharmacist's inquiry flow. Respond only to questions posed by the clinical pharmacist and avoid providing information unrelated to the inquiry.

(4) As a standardized patient, do not give hints or guidance to the pharmacist during the round.

(5) The entire process is a question-and-answer scenario where I ask and you answer. Do not generate dialogue on your own.

Chinese Version (原始中文提示词):

1.你来扮演一名标准化患者，我会向你发送一份病例，我是临床药师，我对你进行药学查房，你配合我进行药学查房的情景模拟，你可以做到吗?

2.药学查房流程

（1）药学查房的流程为药学问诊、用药指导和用药咨询三个阶段。

（2）药学问诊包括一般项目、现病史、既往史、个人史、婚育史、月经史、家族史等，病人的用药情况是重点，请你详细作答。

（3）药学问诊后，临床药师会对你的当前用药做教育指导（包括化疗用药、慢性病用药等）。

（4）用药咨询阶段你可以提出患者咨询问题，并且你只能在这个阶段提问。

（5）药学查房的场景发生在入院药学查房，初始药物治疗开始前。

（6）在查房结束后，我会向你提供一份临床药师药学查房评分标准，请你针对对话过程中临床药师的表现进行评分。

3.在对话过程中，你应做到以下情况：

（1）在整个过程中，请你表现的像一个没有太多医学知识的普通人，如果我使用了医学术语提问你，你应该反问我什么意思。

（2）请你严格遵守我提供给你病历中的信息。病历中没给出的症状，你回答没有，不要捏造症状，没有提供的其他病史信息你可以根据问题合理回应。

（3）在整个过程中，请你按照临床药师的查房思路来进行对话，临床药师问什么请你回答什么，不要回答与临床药师所问问题无关的内容。

（4）作为标准化患者，你不应给临床药师的查房过程进行提示等。

（5）整个过程是我问你答的场景，请你不要直接生成对话。

Supplementary Material S2. RTF-based Automated Scoring Prompt (Chinese-English)

English Version (the exact scoring prompt used in the study):

[Role & Task Instruction]

You are now a strict clinical pharmacy assessment expert. Based on the following [dialog history], please evaluate the pharmacist's performance strictly in accordance with the [scoring criteria]. You must adhere strictly to all of the following rules: You must adhere to all of the following rules:

[Core Rules]

1. Role switching: Completely abandon the "standardized patient" role setting.
2. Scoring basis: Your scoring must be based solely and entirely on the dimensions and items of the [Scoring Criteria]. The use of any personal knowledge or subjective judgment outside the scoring criteria is strictly prohibited.
3. Scoring target: You assess the clinical pharmacist's questions, responses, and instructional content.
4. Scoring determination:

(1) Hit – The information corresponding to a scoring item appears in the dialogue, and its appearance must be directly attributable to the pharmacist's proactive inquiry behavior. This includes:

- Direct questioning: The pharmacist explicitly asks about that information.
- Guided follow-up questions: After posing open-ended questions, the pharmacist conducted targeted follow-up inquiries based on the patient's responses to obtain comprehensive information.
- Information confirmation: When the patient voluntarily or vaguely mentions a piece of information, the pharmacist immediately asks a follow-up question, paraphrases, or confirms it.

(2) Miss – One of the following occurs, and the item receives no points:

- Complete information absence: The pharmacist never raises a question related to that scoring item.
- Patient-initiated information: The patient provides information entirely spontaneously without any guidance from the pharmacist, and the pharmacist does not conduct any form of

confirmation or follow-up inquiry.

- Vague information not clarified: The patient's statement is ambiguous, and the pharmacist does not pursue further inquiries to clarify specific details.

5. No reverse inference: Any form of reverse inference is strictly prohibited. Do not assume that because the patient's answer contains a piece of information, the pharmacist "must have asked" or "should have asked" about it. Scoring must be based strictly on objectively present questions and attributable guidance in the dialogue.

6. Strictness: All point deductions must be accompanied by clear reasons, which must cite specific evidence from the dialogue.

[Output Format Template]

Your output must strictly follow the template below:

---Scoring Start---

Total Score: [score]/100 (sum of subscores)

Subscores (please indicate hits and misses):

Self-introduction: [score]/2

General information: [score]/8

Chief complaint and present medical history: [score]/8

Past medical history: [score]/6

Past medication history: [score]/8

Personal history / marital and reproductive history: [score]/9 (or 10)

Family history: [score]/2

Adverse reaction history: [score]/5

Medication counseling: [score]/39 (or 38)

Patient consultation: [score]/8

Communication skills: [score]/5

Key Strengths

(e.g., Medication counseling was highly comprehensive, providing accurate information on the usage, dosage, and common adverse reactions of all chemotherapy drugs.)

[Write 1-2 best aspects with brief examples.]

Critical Omissions & Suggestions

(e.g., The pharmacist failed to ask about “history of drug allergy” (not mentioned in dialogue turn X).)

[List 1-3 most important omissions or errors, citing specific evidence (e.g., dialogue turn number).]

---Scoring End---

Chinese Version (原始中文提示词)

【角色与任务指令】

你现在是一名严格的临床药学考核专家。请基于下方的【对话历史】，严格依据【评分标准】，对药师的表现进行评分。你必须严格遵守以下所有规则：

【核心规则】

1.角色切换：请彻底摒弃“标准化患者”的角色设定。

2.评分依据：你的评分必须完全且仅基于【评分标准】中的维度与条目。严禁引入评分标准之外的任何个人知识或主观判断。

3.评分对象：你评估的是临床药师的提问、回应与指导内容。

4.得分判定：

（1）命中 (Hit)：得分点信息在对话中出现，且其出现必须直接归因于药师的主动问诊行为。这包括：

①主动提问：药师明确提出了针对该信息的问题。

②引导追问：药师提出开放式问题后，对患者的回答进行了引导性追问以获取完整信息。

③信息确认：当患者主动或模糊地提及某个信息时，药师立即进行了追问、复述或确认。

未命中 (Miss)：出现以下情况之一，则不得分：

①信息完全缺失：药师从未提及与该得分点相关的问题。

②患者自发提供：患者完全自发地、未经药师任何引导地提供了信息，且药师未做任何形式的确认或追问。

③信息模糊未澄清：患者表述模糊不清，且药师未进行追问以澄清具体细节。

5.禁止反向推理：

严禁进行任何形式的反向推理。不得因为患者回答中包含了某个信息，就假定药师“一定问了”或“应该问了”。评分必须严格基于对话中客观存在的提问和可归因的引导。

6.严格性：所有扣分必须有明确理由，且理由需援引对话中的具体表现。

【输出格式模板】

你的输出必须且只能严格遵循以下模板：

---评分开始---

【总分 (Total Score)】

[得分]/100 (各分项得分之和)

【分项得分 (Subscores)】

（请注明得分点与失分点）

1. 自我介绍: [得分]/2
2. 一般信息: [得分]/8
3. 主诉与现病史: [得分]/8
4. 既往病史: [得分]/6
5. 既往用药史: [得分]/8
6. 个人史/婚育史: [得分]/9 (或 10)
7. 家族史: [得分]/2
8. 不良反应史: [得分]/5
9. 用药指导: [得分]/38 (或 39)
10. 用药咨询: [得分]/8
11. 沟通技巧: [得分]/5

【主要优点 (Key Strengths)】

（示例：用药指导非常全面，准确说明了所有化疗药物的用法、用量及常见不良反应。）

[在此处填写 1-2 个做得最好的方面，并简要举例说明。]

【关键遗漏与改进建议 (Critical Omissions & Suggestions)】

（示例：问诊过程中遗漏了对『药物过敏史』的询问（对话第 X 轮未涉及）。）

[在此处填写 1-3 个最重要的遗漏项或错误，必须引用对话中的具体证据（如对话轮次）。]

---评分结束---

Supplementary Material S3. Three Standardized Cases (VSP-A, VSP-B, VSP-C)

Case VSP-A

Case Script – VSP-A

1. Patient Basic Information

Name: Qian Yuan (Pseudonym)	Occupation: Retired teacher
Gender: Female	Workplace: --
Age: 58 years	Address: A city in East China
Marital status: Married	Place of birth: A city in East China
Admission date: July 5, 2024	Ethnicity: Han Chinese
Height: 157 cm	Weight: 55 kg

2. Chief complaint and present medical history

Chief complaint: Small cell lung cancer for over 3 weeks following chemotherapy.

Present medical history: The patient was admitted to the local hospital for physical examination on April 25,2024. CT examination showed lung space occupying.The patient presented no cough or sputum production, no blood in the sputum, and no other discomfort. After treatment in our hospital, 2024-04-30 CT enhancement: consider right lung cancer with right hilar and mediastinal multiple lymph node metastasis, right upper lung bronchial occlusion, right upper lung atelectasis, lesions involving the superior vena cava, right lung interlobular septal thickening; multiple slightly larger lymph nodes on the left clavicle. 2024-05-06 percutaneous lung biopsy showed that poorly differentiated malignant tumor cells were seen (right lung mass puncture). 2024-05-14 Immunohistochemistry: Immunohistochemical markers support small cell carcinoma. Excluding related contraindications, 2024-05-16 and 6-10 were treated with the regimen of "Serplulimab 300 mg day1 + Etoposide 0.1 g day1-3 + Lobaplatin 40 mg day1." 2024-6-15 (Cycle2 Day6), severe neutropenia with fever, and improved after symptomatic treatment with recombinant human granulocyte colony-stimulating factor (G-CSF).

The patient is now hospitalized for further treatment. Since the onset of the disease, the patient has maintained good general condition, normal appetite, normal bowel and bladder function, normal sleep patterns, and no change in body weight.

Physical examination: Body temperature (T) 36.5°C, pulse rate (P) 73 beats/min, respiratory rate (R) 25 breaths/min, blood pressure (BP) 136/80 mmHg, heart rate (HR) 80 beats/min, KPS

score 90. Developmental status normal, nutritional moderate, consciousness clear, mental status is reasonable, spontaneous positioning, able to walk into the ward, cooperative during physical examination.

3. Past medical history

The patient denied a history of infectious diseases; had a 5-year history of hypertension; denied a history of heart disease; denied a history of diabetes; denied a history of allergies; denied a history of blood transfusions; denied a history of surgery; denied a history of trauma; and had a normal vaccination history in line with the general population.

4. Past medication history

The patient has suffered from hypertension for over five years, with a maximum blood pressure of 150/94 mmHg. Oral valsartan capsules (80 mg once daily) are taken upon waking in the morning.

5. Personal history / marital and reproductive history

Professional retired teachers; no smoking or alcohol consumption habits; less exercise; light diet; no history of exposure to toxic substances, radiation, or dust. Married with a healthy spouse; married at age 26; has one son and one daughter. Menarche occurred at age 15; menstrual cycle length is 28 days; duration of menstruation is 7 days; menopause occurred at age 52.

6. Family history

There is no family history of genetic disorders; the patient's spouse and children are all in good health.

7. Adverse reaction history

On June 15,2024, the patient presented with severe neutropenia accompanied by fever and showed improvement after symptomatic treatment with recombinant human granulocyte colony-stimulating factor (G-CSF).

8. Admission diagnosis

(1) Immunotherapy for malignant tumours

(2) Palliative chemotherapy

(3) Malignant lung tumour, small cell carcinoma, small cell lung cancer: extensive-stage

(4) Hypertension

9. Main therapeutic agents

Table S1. VSP-A Main therapeutic agents

Drug Group	Drug Administration Duration	Content of Medical Instructions	Dosage	Route	Frequency	Instruction
Immunotherapy + Chemotherapy	2024.07.05	0.9 % Sodium Chloride Injection	100mL	ivgtt	ST	solvent
	2024.07.05–07.07	Serplulimab injection	300mg			
		0.9 % Sodium Chloride Injection	500mL	ivgtt	QD	solvent
	2024.07.05	Etoposide injection	0.10g			
		5 % Glucose Injection	500mL			solvent
		Lobaplatin for injection	40mg	ivgtt	ST	
Antiemetic regimen	2024.07.05–07.07	Aprepitant capsules	1 pill	po	QD	125mg d1 80mg d2-3
	2024.07.05	Palonosetron hydrochloride injection	0.25mg	iv	ST	
	2024.07.05	Dexamethasone sodium phosphate injection	1mL	iv	ST	

10. Patient consultation

Patient inquiry: I heard that chemotherapy can cause neutropenia. What does this mean? What should I do if this happens to me?

Scoring Criteria – VSP-A

1. Self-introduction (2 points)

Self-introduction (*including the statement "I am a pharmacist" or a similar statement of identity*) (1 point); Purpose of the clinical activity (*including phrases such as "to review medication use", "to provide medication guidance" or "to conduct a ward round" to explain the reason for the visit*) (1 point).

2. General Information (8 points)

Patient's name (1 point), Age (1 point), Marital status (1 point), Ethnicity (1 point), Occupation (1 point), Place of birth/residence (1 point), Height (1 point), and Weight (1 point).

3. Chief complaint and present medical history (8 points)

Reason for treatment (1 point). Time of lung cancer diagnosis (1 point); Symptoms of lung cancer (*e.g., cough, sputum production, chest tightness, hemoptysis, dyspnea, fatigue, etc.*) (1 point);

Changes in disease status (*including whether tumor metastasis has occurred or symptoms have worsened*) (1 point); Previous medical examination results (1 point); History of chemotherapy and medications used (1 point); Dosage of chemotherapy drugs administered previously (1 point); General condition (*including appetite, sleep, weight, bowel movements, etc.*) (1 point).

4. Past medical history (6 points)

History of infectious diseases (*reference to tuberculosis, hepatitis B, etc., may also earn points*) (1 point); History of chronic diseases (*reference to hypertension, diabetes, heart disease, etc., may also earn points*) (1 point); Duration of hypertension (1 point); History of drug or food allergies (1 point); Surgical history (1 point); Vaccination history (1 point).

5. Past medication history (8 points)

(*Hypertension Medications*) Drug name (1 point), Dosage form (1 point), Specification (1 point), Administration method and dosage (1 point), Administration time (1 point), Duration of medication (1 point), Medication adherence (*whether intermittent or missed doses occur*) (1 point), Occurrence of adverse reactions during treatment (1 point).

6. Personal history / marital and reproductive history (10 points)

Smoking history (1 point), Alcohol consumption history (1 point), Physical activity level (1 point), Dietary habits (1 point), Dust exposure history (1 point), Radiation exposure history (1 point), Toxic substance exposure history (1 point); Marriage age (1 point), Fertility status (1 point), Menstrual history (1 point).

7. Family history (2 points)

Health status of family members (1 point); Presence of hereditary diseases (1 point).

8. Adverse reaction history (5 points)

History of adverse drug reactions (1 point) (*severe neutropenia with fever*); symptoms of adverse drug reactions (1 point); occurrence time (1 point); management measures (1 point); and whether the condition improved (1 point).

9. Medication Guidance (38 points)

(1) Immunotherapy + Chemotherapy regimen

① Serplulimab Injection: Indication (*immunotherapy drug*) (1 point), Administration method (*intravenous infusion*) (1 point), Dosage (*300 mg*) (1 point).

② Etoposide Injection: Purpose of administration (*chemotherapy drug*) (1 point),

Administration method (*intravenous infusion*) (1 point), Dosage (*0.10 g*) (1 point).

③ Lobaplatin for Injection: Purpose of administration (*chemotherapy drug*) (1 point), Administration method (*intravenous infusion*) (1 point), Dosage (*40 mg*) (1 point).

④ Potential adverse reactions (*Pharmacists must proactively and individually inform patients of the following adverse reactions; failure to mention any will result in zero points. Simply stating "some side effects may occur" will not earn any points.*) Gastrointestinal reactions: Nausea and Vomiting (1 point), Diarrhea (1 point), Oral ulcers (1 point). Hematologic toxicity: Leukopenia (1 point), Thrombocytopenia (1 point), Granulocytopenia (1 point), Anemia (1 point). Other: Hair loss (1 point), Rash (1 point), Fever (1 point).

(2) Preventive Antiemetic Protocol

① Aprepitant Capsules: Indication (*prophylactic antiemesis*) (1 point), Administration (*oral*) (1 point), Dosage (*125 mg on day 1; 80 mg on days 2/3*) (1 point).

②Palonosetron Hydrochloride Injection: Indication (*prophylactic antiemesis*) (1 point), Administration method (*intravenous injection*) (1 point), Dosage (*0.25 mg*) (1 point).

③Dexamethasone Sodium Phosphate Injection: Indication (*prophylactic antiemesis*) (1 point), Administration method (*intravenous injection*) (1 point), Dosage (*1 mL*) (1 point).

④ Potential adverse reactions: (*Pharmacists must proactively and individually inform patients of the following adverse reactions; failure to mention any will result in zero points. Simply stating "some side effects may occur" will not earn any points.*) Constipation (1 point), Mild Headache (1 point).

(3) Medication Precautions (*points can be awarded by mentioning key terms*)

① Advise the patient to consume small, frequent meals on the day of chemotherapy, maintain a light diet with low salt and fat content (1 point). Enhance nutrition by incorporating foods rich in high-quality proteins such as fish, meat, and eggs (1 point). Avoid greasy, spicy, or irritating foods (1 point).

② Instruct the patient to promptly inform healthcare providers of any aforementioned adverse reactions (1 point). For constipation, increase fluid intake or consume fruits and vegetables that promote bowel movement (1 point).

③ Advise the patient to avoid excessive fatigue, engage in moderate exercise, and ensure adequate sleep (1 point).

④ Advise the patient to avoid crowded places to reduce the risk of infection (1 point).

⑤ Instruct the patient that antihypertensive medications may be taken normally without any drug interactions (1 point).

10. Patient consultation (8 points)

Patient inquiry: I heard that chemotherapy can cause neutropenia. What does this mean? What should I do if this happens to me?

(*points can be awarded by mentioning key terms*)

Neutrophils are a type of white blood cell in the blood and are associated with human immunity (1 point). A decrease in neutrophil count can lead to compromised immune function (1 point). Neutrophil levels typically reach their lowest level 7–14 days after chemotherapy (1 point). A complete blood count is performed before chemotherapy to assess neutrophil levels; chemotherapy may only be initiated if these levels are above normal (1 point). In cases of neutrophil decline, leukocyte-elevating medications (e.g., leukocyte-raising injections) may be administered (1 point). For daily care, enhance nutritional support, avoid crowded places, and wear a mask when outdoors (1 point). Regular follow-up complete blood counts should be conducted after discharge (1 point); monitor body temperature closely, and seek immediate medical attention if unexplained fever occurs (1 point).

11. Communication Skills (5 points)

(1) Use simple, easy-to-understand language when communicating with patients (*avoid medical jargon throughout the interaction*) (1 point); (2) Treats patients with respect (uses polite language and a friendly tone) (1 point); (3) Encourage patients to ask questions (*explicitly ask patients what they wish to discuss*) (1 point); (4) Be able to control the pace of the conversation (*conduct the dialogue in a structured manner, transitioning naturally from one topic to the next, without being led by the patient*) (1 point); (5) Provide a clear and concise closing statement (*indicating the end of the ward round*) (1 point).

Case VSP-B

Case Script – VSP-B

1. Patient Basic Information

Name: Chen Ming (Pseudonym) Occupation: Farmer

Gender: Male Workplace: --

Age: 59 years Address: A city in East China

Marital status: Married Place of birth: A city in East China

Admission date: December 28,2023 Ethnicity: Han Chinese

Height: 172 cm Weight: 76 kg

2. Chief complaint and present medical history

Chief complaint: Malignant lung tumors for over 3 weeks following chemotherapy.

Present medical history: On October 6, 2023, the patient underwent a physical examination at a local hospital, including a contrast-enhanced chest CT scan, which revealed: a soft tissue shadow at the left pulmonary hilum with distal obstructive changes; partial bronchial occlusion in the upper lobe of the left lung with no visualization of certain branches of the left pulmonary artery; multiple enlarged lymph nodes in the mediastinum, left pulmonary hilum, and left clavicular region; fibrous cord lesions and multiple micronodules in both lungs; minor pleural effusions on both sides; and post-coronary artery surgery-related findings. Subsequently, further examinations were conducted in the respiratory department of the hospital: Ultrasound examination of cervical and supraclavicular lymph nodes (2023-10-10) revealed enlargement and abnormal morphology of the left supraclavicular lymph nodes; on October 11,2023, a fiberoptic bronchoscopy was performed, revealing a neoplasm in the intrinsic segment of the left upper lobe with subsequent biopsy. Pathological results indicated non-small cell lung cancer (intrinsic segment of the left upper lobe). October 19,2023: Left upper lobe: Immunohistochemical analysis performed at the original institution confirmed grade II squamous cell carcinoma. The patient received two cycles of treatment on October 20,2023, and November 13,2023, with the regimen consisting of Serplulimab 300 mg day 1 + Paclitaxel polymer micelles 450 mg day 1 + Nedaplatin 100 mg day 1. On November 18,2023 (Cycle2 Day 5), severe neutropenia with fever occurred; the condition improved after symptomatic treatment with recombinant human granulocyte colony-stimulating factor (G-CSF). On December 4, 2023, follow-up CT showed stable conditions. On December 5, 2023, the patient was treated with “Serplulimab 300 mg day 1 + Paclitaxel polymer micelles 300 mg day 1 + Nedaplatin 100 mg day 1.” The patient has been referred to our hospital for further treatment and is scheduled for admission under the diagnosis of “malignant lung tumor” in the outpatient department.

The patient is now hospitalized for further treatment. Since the onset of the disease, the patient has maintained good general condition, normal appetite, normal bowel and bladder function, normal sleep patterns, and no change in body weight.

Physical examination: Body temperature (T) 36.5°C, pulse rate (P) 73 beats/min, respiratory rate (R) 19 breaths/min, blood pressure (BP) 118/88 mmHg, heart rate (HR) 70 beats/min, KPS score 80. Developmental status normal, nutritional moderate, consciousness clear, mental status is reasonable, spontaneous positioning, able to walk into the ward, cooperative during physical examination.

3. Past medical history

The patient denied a history of infectious diseases; denied a history of hypertension; denied a history of diabetes; had a history of coronary heart disease for 5 years, a stent was implanted via percutaneous coronary intervention in April 2023 (no abnormalities were detected during follow-up examination one month prior); denied a history of allergies; denied a history of blood transfusions; denied a history of surgery; denied a history of trauma; and had a normal vaccination history in line with the general population.

4. Past medication history

Aspirin enteric-coated tablets, 100 mg, once daily (qd). Rosuvastatin calcium tablets, 10 mg, once daily (qd).

5. Personal history / marital and reproductive history

Professional farmers; occasional exercise; light diet; no history of exposure to toxic substances, radiation, or dust. The patient has a smoking history of over 30 years (averaging 15 cigarettes per day), with a significant reduction in smoking volume over the past three years. There is also a drinking history of over 30 years (averaging 50 grams per day), with complete abstinence maintained for five years. The patient is married to a healthy spouse; they married at age 23 and have one son and two daughters.

6. Family history

There is no family history of genetic disorders; the patient's spouse and children are all in good health.

7. Adverse reaction history

On November 18,2023, the patient presented with severe neutropenia accompanied by fever

and showed improvement after symptomatic treatment with recombinant human granulocyte colony-stimulating factor (G-CSF).

8. Admission diagnoses

(1) Malignant tumor immunotherapy;

(2) Palliative chemotherapy;

(3) Pulmonary malignant tumor, squamous cell carcinoma, stage IIIC, cTNM: T4N3M0;

(4) Secondary malignant tumor of lymph node;

(5) Post-coronary artery stent implantation status.

9. Main therapeutic agents

Table S2. VSP-B Main therapeutic agents

Drug Group	Drug Administration Duration	Content of Medical Instructions	Dosage	Route	Frequency	Instruction
Immunotherapy + Chemotherapy	2023.12.28	0.9 % Sodium Chloride Injection	100mL	ivgtt	ST	solvent
		Serplulimab injection	300mg			
	2023.12.28	0.9 % Sodium Chloride Injection	500mL	ivgtt	QD	solvent
		Paclitaxel polymer micelles	450mg			
	2023.12.28	0.9 % Sodium Chloride Injection	500mL	ivgtt	ST	solvent
		Nedaplatin Injection Powder	100mg			
Antiemetic regimen	2023.12.28-12.30	Aprepitant capsules	1 pill	po	QD	125mg d1 80mg d2-3
	2023.12.28	Palonosetron hydrochloride injection	0.25mg	iv	ST	
	2023.12.28	Dexamethasone sodium phosphate injection	1mL	iv	ST	

10. Patient consultation

Patient inquiry: Is it safe to take aspirin and rosuvastatin during chemotherapy? What precautions should be taken?

Scoring Criteria – VSP-B

1. Self-introduction (2 points)

Self-introduction (*including the statement "I am a pharmacist" or a similar statement of identity*) (1 point); Purpose of the clinical activity (*including phrases such as "to review medication use", "to provide medication guidance" or "to conduct a ward round" to explain the reason for the visit*) (1 point).

2. General Information (8 points)

Patient's name (1 point), Age (1 point), Marital status (1 point), Ethnicity (1 point), Occupation (1 point), Place of birth/residence (1 point), Height (1 point), and Weight (1 point).

3. Chief complaint and present medical history (8 points)

Reason for treatment (1 point). Time of lung cancer diagnosis (1 point); Symptoms of lung cancer (*e.g., cough, sputum production, chest tightness, hemoptysis, dyspnea, fatigue, etc.*) (1 point); Changes in disease status (*including whether tumor metastasis has occurred or symptoms have worsened*) (1 point); Previous medical examination results (1 point); History of chemotherapy and medications used (1 point); Dosage of chemotherapy drugs administered previously (1 point); General condition (*including appetite, sleep, weight, bowel movements, etc.*) (1 point).

4. Past medical history (6 points)

History of infectious diseases (*reference to tuberculosis, hepatitis B, etc., may also earn points*) (1 point); History of chronic diseases (*reference to hypertension, diabetes, heart disease, etc., may also earn points*) (1 point); Duration of coronary heart disease (1 point); History of drug or food allergies (1 point); Surgical history (1 point); Vaccination history (1 point).

5. Past medication history (8 points)

(*Medications for Coronary Heart Disease*) Drug name (1 point), Dosage form (1 point), Specification (1 point), Administration method and dosage (1 point), Administration time (1 point), Duration of medication (1 point), Medication adherence (*whether intermittent or missed doses occur*) (1 point), Occurrence of adverse reactions during treatment (1 point).

6. Personal history / marital and reproductive history (9 points)

Smoking history (1 point), Alcohol consumption history (1 point), Physical activity level (1 point), Dietary habits (1 point), Dust exposure history (1 point), Radiation exposure history (1 point), Toxic substance exposure history (1 point); Marriage age (1 point), Fertility status (1 point).

7. Family history (2 points)

Health status of family members (1 point); Presence of hereditary diseases (1 point).

8. Adverse reaction history (5 points)

History of adverse drug reactions (1 point) (*severe neutropenia with fever*); symptoms of adverse drug reactions (1 point); occurrence time (1 point); management measures (1 point); and whether the condition improved (1 point).

9. Medication Guidance (39 points)

(1) Immunotherapy + Chemotherapy regimen

① Serplulimab Injection: Indication (*immunotherapy drug*) (1 point), Administration method (*intravenous infusion*) (1 point), Dosage (*300 mg*) (1 point).

② Paclitaxel polymer micelles: Purpose of administration (*chemotherapy drug*) (1 point), Administration method (*intravenous infusion*) (1 point), Dosage (*450 mg*) (1 point).

③ Nedaplatin Injection Powder: Purpose of administration (*chemotherapy drug*) (1 point), Administration method (*intravenous infusion*) (1 point), Dosage (*100 mg*) (1 point).

④ Potential adverse reactions (*Pharmacists must proactively and individually inform patients of the following adverse reactions; failure to mention any will result in zero points. Simply stating "some side effects may occur" will not earn any points.*) Gastrointestinal reactions: Nausea and Vomiting (1 point), Diarrhea (1 point), Oral ulcers (1 point). Hematologic toxicity: Leukopenia (1 point), Thrombocytopenia (1 point), Granulocytopenia (1 point), Anemia (1 point). Other: Peripheral neurotoxicity (numbness in hands and feet) (1 point), Hair loss (1 point), Rash (1 point), Fever (1 point).

(2) Preventive Antiemetic Protocol

① Aprepitant Capsules: Indication (*prophylactic antiemesis*) (1 point), Administration (*oral*) (1 point), Dosage (*125 mg on day 1; 80 mg on days 2/3*) (1 point).

②Palonosetron Hydrochloride Injection: Indication (*prophylactic antiemesis*) (1 point), Administration method (*intravenous injection*) (1 point), Dosage (*0.25 mg*) (1 point).

③Dexamethasone Sodium Phosphate Injection: Indication (*prophylactic antiemesis*) (1 point), Administration method (*intravenous injection*) (1 point), Dosage (*1 mL*) (1 point).

④ Potential adverse reactions: (*Pharmacists must proactively and individually inform patients of the following adverse reactions; failure to mention any will result in zero points. Simply stating "some side effects may occur" will not earn any points.*) Constipation (1 point), Mild Headache (1

point).

(3) Medication Precautions (*points can be awarded by mentioning key terms*)

① Advise the patient to consume small, frequent meals on the day of chemotherapy, maintain a light diet with low salt and fat content (1 point). Enhance nutrition by incorporating foods rich in high-quality proteins such as fish, meat, and eggs (1 point). Avoid greasy, spicy, or irritating foods (1 point).

② Instruct the patient to promptly inform healthcare providers of any aforementioned adverse reactions (1 point). For constipation, increase fluid intake or consume fruits and vegetables that promote bowel movement (1 point). In cases of numbness in the hands or feet, keep warm or apply massage and hot compress for relief (1 point).

③ Advise the patient to avoid excessive fatigue, engage in moderate exercise, and ensure adequate sleep (1 point).

④ Advise the patient to avoid crowded places to reduce the risk of infection (1 point).

10. Patient consultation (8 points)

Patient inquiry: Is it safe to take aspirin and rosuvastatin during chemotherapy? What precautions should be taken?

(*points can be awarded by mentioning key terms*)

Yes (1 point). Take these two medicines long-term and do not stop taking them without consulting your doctor (1 point). Do not adjust the dosage arbitrarily (1 point). If you experience unexplained muscle pain, tenderness or weakness whilst taking rosuvastatin, seek medical attention promptly (1 point). If you are taking aspirin and experience unexplained skin petechiae, ecchymoses, nosebleeds, bleeding gums, black stools or haematuria, seek medical attention promptly (1 point). Rosuvastatin may cause liver toxicity; therefore, liver function tests should be carried out regularly (1 point). Lipid levels should be monitored (1 point). Rosuvastatin interacts with macrolides and grapefruit juice, which may increase the risk of adverse reactions (1 point).

11. Communication Skills (5 points)

(1) Use simple, easy-to-understand language when communicating with patients (*avoid medical jargon throughout the interaction*) (1 point); (2) Treats patients with respect (uses polite language and a friendly tone) (1 point); (3) Encourage patients to ask questions (*explicitly ask patients what they wish to discuss*) (1 point); (4) Be able to control the pace of the conversation

(*conduct the dialogue in a structured manner, transitioning naturally from one topic to the next, without being led by the patient*) (1 point); (5) Provide a clear and concise closing statement (*indicating the end of the ward round*) (1 point).

Case VSP-C

Case Script – VSP-C

1. Patient Basic Information

Name: Xu Nian (Pseudonym)	Occupation: Retired civil servant
Gender: Male	Workplace: --
Age: 63 years	Address: A city in East China
Marital status: Married	Place of birth: A city in East China
Admission date: January 12,2024	Ethnicity: Han Chinese
Height: 170 cm	Weight: 77 kg

2. Chief complaint and present medical history

Chief complaint: One month after chemotherapy for gastric cancer.

Present medical history: In October 2023, the patient received intravenous therapy for a cold and reported upper abdominal distension accompanied by dull pain, prompting a visit to a local hospital. Gastroscopy (performed on October 7, 2023) revealed an irregular elevated lesion with poorly defined borders; biopsy tissue was friable and prone to bleeding. A polypoid elevation measuring approximately 0.2 × 0.3 cm was identified at the gastric fundus. Biopsy results confirmed adenocarcinoma of intermediate differentiation at the cardia site. Follow-up CT (October 14,2023): Poor gastric filling with slight thickening of the cardia wall; multiple slightly enlarged lymph nodes are observed in the hepatogastric space, hepatic hilum, hilar vascular spaces, peritoneal trunk region, cardiac diaphragmatic angle, and adjacent to the lower esophagus; diffuse low-density nodular lesions are present throughout the liver, suggestive of metastasis. Pathological examination (October 15,2023): (Cardia) High-grade intraepithelial neoplasia of the superficial mucosal glands with malignant transformation. After excluding relevant contraindications, the patient received the treatment regimen of "Sintilimab 200 mg day 1+ Oxaliplatin mannitol 250 mg day 1+ S-1 (Tegafur, Gimeracil and Oteracil Potassium) 60 mg twice daily from day 1 to day 14" on October 12, November 8, and December 12,2023. On December 18,2023 (Cycle 3 Day 7), a

grade 2 thrombocytopenia was observed; the condition improved after treatment with recombinant platelet colony-stimulating factor injection.

The patient is now hospitalized for further treatment. Since the onset of the disease, the patient has maintained good general condition, normal appetite, normal bowel and bladder function, normal sleep patterns, and a weight loss of 1.5 kg.

Physical examination: Body temperature (T) 36.5°C, pulse rate (P) 100 beats/min, respiratory rate (R) 18 breaths/min, blood pressure (BP) 149/90 mmHg, heart rate (HR) 75 beats/min, KPS score 80. Developmental status normal, nutritional moderate, consciousness clear, mental status is reasonable, spontaneous positioning, able to walk into the ward, cooperative during physical examination.

3. Past medical history

The patient denied a history of infectious diseases; had a 10-year history of hypertension; denied a history of heart disease; denied a history of diabetes; denied a history of allergies; denied a history of blood transfusions; denied a history of surgery; denied a history of trauma; and had a normal vaccination history in line with the general population.

4. Past medication history

Hypertension, with a maximum blood pressure of 160/92 mmHg; taking amlodipine tablets orally for 3 years at a dose of 5 mg once daily.

5. Personal history / marital and reproductive history

Professional retired civil servants; no smoking or alcohol consumption habits; occasional physical exercise; light diet; no history of exposure to toxic substances, radiation, or dust. Married with a healthy spouse; married at age 22; has one son and one daughter.

6. Family history

The father passed away due to cardia cancer. No other special conditions were noted.

7. Adverse reaction history

On December 18,2023, the patient developed thrombocytopenia, which improved after administration of recombinant human thrombopoietin injection.

8. Admission diagnosis

(1) Immunotherapy for malignant tumours

(2) Palliative chemotherapy

(3) Gastric malignant tumors, adenocarcinoma, stage IV, cTNM: TxN3M1

(4) Hypertension

9. Main therapeutic agents

Table S3. VSP-C Main therapeutic agents

Drug Group	Drug Administration Duration	Content of Medical Instructions	Dosage	Route	Frequency	Instruction
Immunotherapy + Chemotherapy	2024.01.13	0.9 % Sodium Chloride Injection	100mL	ivgtt	ST	solvent
		Sintilimab injection	200mg			
	2024.01.13-01.26	S-1Capsules (Tegafur, Gimeracil and Oteracil Potassium Capsules)	60mg	po	BID	20 mg per capsule, after meals
	2024.01.13	Oxaliplatin mannitol injection	100mg	ivgtt	ST	
Antiemetic regimen	2024.01.13	Oxaliplatin mannitol injection	100mg	ivgtt	ST	
	2024.01.13-01.15	Aprepitant capsules	1 pill	po	QD	125mg d1 80mg d2-3
	2024.01.13	Palonosetron hydrochloride injection	0.25mg	iv	ST	
	2024.01.13	Dexamethasone sodium phosphate injection	1mL	iv	ST	

10. Patient consultation

Patient inquiry: I experienced numbness in my hands and feet during previous chemotherapy. What is the cause of this phenomenon, and how can it be prevented?

Scoring Criteria – VSP-C

1. Self-introduction (2 points)

Self-introduction (*including the statement "I am a pharmacist" or a similar statement of identity*) (1 point); Purpose of the clinical activity (*including phrases such as "to review medication use", "to provide medication guidance" or "to conduct a ward round" to explain the reason for the visit*) (1 point).

2. General Information (8 points)

Patient's name (1 point), Age (1 point), Marital status (1 point), Ethnicity (1 point),

Occupation (1 point), Place of birth/residence (1 point), Height (1 point), and Weight (1 point).

3. Chief complaint and present medical history (8 points)

Reason for treatment (1 point). Time of gastric cancer diagnosis (1 point); Symptoms of gastric cancer (*e.g., upper abdominal pain, bloating, diarrhea, hematemesis, melena, acid reflux, belching, dysphagia upon eating, etc.*) (1 point); Changes in disease status (*including whether tumor metastasis has occurred or symptoms have worsened*) (1 point); Previous medical examination results (1 point); History of chemotherapy and medications used (1 point); Dosage of chemotherapy drugs administered previously (1 point); General condition (*including appetite, sleep, weight, bowel movements, etc.*) (1 point).

4. Past medical history (6 points)

History of infectious diseases (*reference to tuberculosis, hepatitis B, etc., may also earn points*) (1 point); History of chronic diseases (*reference to hypertension, diabetes, heart disease, etc., may also earn points*) (1 point); Duration of hypertension (1 point); History of drug or food allergies (1 point); Surgical history (1 point); Vaccination history (1 point).

5. Past medication history (8 points)

(*Hypertension Medications*) Drug name (1 point), Dosage form (1 point), Specification (1 point), Administration method and dosage (1 point), Administration time (1 point), Duration of medication (1 point), Medication adherence (*whether intermittent or missed doses occur*) (1 point), Occurrence of adverse reactions during treatment (1 point).

6. Personal history / marital and reproductive history (9 points)

Smoking history (1 point), Alcohol consumption history (1 point), Physical activity level (1 point), Dietary habits (1 point), Dust exposure history (1 point), Radiation exposure history (1 point), Toxic substance exposure history (1 point); Marriage age (1 point), Fertility status (1 point).

7. Family history (2 points)

Health status of family members (1 point); Presence of hereditary diseases (1 point).

8. Adverse reaction history (5 points)

History of adverse drug reactions (1 point) (*Thrombocytopenia*); symptoms of adverse drug reactions (1 point); occurrence time (1 point); management measures (1 point); and whether the condition improved (1 point).

9. Medication Guidance (38 points)

(1) Immunotherapy + Chemotherapy regimen

① Sintilimab Injection: Indication (*immunotherapy drug*) (1 point), Administration method (*intravenous infusion*) (1 point), Dosage (*200 mg*) (1 point).

② S-1 Capsules: Purpose of administration (*chemotherapy drug*) (1 point), Administration method (*oral*) (1 point), Dosage (*60mg BID 20mg/pill*) (1 point).

③ Oxaliplatin Mannitol Injection: Purpose of administration (*chemotherapy drug*) (1 point), Administration method (*intravenous infusion*) (1 point), Dosage (*200 mg*) (1 point).

④ Potential adverse reactions (*Pharmacists must proactively and individually inform patients of the following adverse reactions; failure to mention any will result in zero points. Simply stating "some side effects may occur" will not earn any points.*) Gastrointestinal reactions: Nausea and Vomiting (1 point), Diarrhea (1 point), Oral ulcers (1 point). Hematologic toxicity: Leukopenia (1 point), Thrombocytopenia (1 point), Granulocytopenia (1 point), Anemia (1 point). Other: Peripheral neurotoxicity (numbness in hands and feet) (1 point), Hair loss (1 point), Rash (1 point), Fever (1 point).

(2) Preventive Antiemetic Protocol

① Aprepitant Capsules: Indication (*prophylactic antiemesis*) (1 point), Administration (*oral*) (1 point), Dosage (*125 mg on day 1; 80 mg on days 2/3*) (1 point).

②Palonosetron Hydrochloride Injection: Indication (*prophylactic antiemesis*) (1 point), Administration method (*intravenous injection*) (1 point), Dosage (*0.25 mg*) (1 point).

③Dexamethasone Sodium Phosphate Injection: Indication (*prophylactic antiemesis*) (1 point), Administration method (*intravenous injection*) (1 point), Dosage (*1 mL*) (1 point).

④ Potential adverse reactions: (*Pharmacists must proactively and individually inform patients of the following adverse reactions; failure to mention any will result in zero points. Simply stating "some side effects may occur" will not earn any points.*) Constipation (1 point), Mild Headache (1 point).

(3) Medication Precautions (*points can be awarded by mentioning key terms*)

① Advise the patient to consume small, frequent meals on the day of chemotherapy, maintain a light diet with low salt and fat content (1 point). Enhance nutrition by incorporating foods rich in high-quality proteins such as fish, meat, and eggs (1 point). Avoid greasy, spicy, or

irritating foods (1 point).

② Instruct the patient to promptly inform healthcare providers of any aforementioned adverse reactions (1 point). For constipation, increase fluid intake or consume fruits and vegetables that promote bowel movement (1 point).

③ Advise the patient to avoid excessive fatigue, engage in moderate exercise, and ensure adequate sleep (1 point).

④ Advise the patient to avoid crowded places to reduce the risk of infection (1 point).

⑤ Instruct the patient that antihypertensive medications may be taken normally without any drug interactions (1 point).

12. Patient consultation (8 points)

Patient inquiry: I experienced numbness in my hands and feet during previous chemotherapy. What is the cause of this phenomenon, and how can it be prevented?

(*points can be awarded by mentioning key terms*)

Numbness in the hands and feet may be caused by peripheral neurotoxicity induced by oxaliplatin (1 point). It is typically triggered by cold exposure (1 point) and gradually resolves after discontinuation of the drug (1 point). Maintain warmth, avoid contact with cold air, cold water, cold beverages, and metallic objects, and refrain from consuming refrigerated foods (1 point). If numbness recurs, measures such as massage or hot compresses may be employed to alleviate symptoms (1 point); oral administration of compound vitamin B tablets can also support nerve function (1 point). Appropriate limb movement and exercise help promote blood circulation and relieve neurological symptoms (1 point). In cases of laryngeal spasms, dyspnea, or severe motor dysfunction, immediate notification to healthcare professionals is required (1 point).

13. Communication Skills (5 points)

(1) Use simple, easy-to-understand language when communicating with patients (*avoid medical jargon throughout the interaction*) (1 point); (2) Treats patients with respect (uses polite language and a friendly tone) (1 point); (3) Encourage patients to ask questions (*explicitly ask patients what they wish to discuss*) (1 point); (4) Be able to control the pace of the conversation (*conduct the dialogue in a structured manner, transitioning naturally from one topic to the next, without being led by the patient*) (1 point); (5) Provide a clear and concise closing statement (*indicating the end of the ward round*) (1 point).

Supplementary Material S4. Expert Feedback Evaluation Scale

Instruction: Please rate your level of agreement with each of the following statements based on your interaction with the VSP. Use a 5-point Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

Table S4. Expert Feedback Evaluation Scale

Scoring Content
1. LLM-based VSP accurately identifies symptom locations and characteristics in medical records.
2. LLM-based VSP reports complete medical histories without omitting key details (e.g., chief complaints, present/past medication history).
3. LLM-based VSP's responses match medical records and clinical practice with minimal errors.
4. LLM-based VSP provides accurate, relevant answers to diverse questions.
5. LLM-based VSP delivers logically structured medical history narratives.
6. LLM-based VSP maintains logical flow during sequential queries (e.g., chief complaint → past medical history).
7. For unanticipated questions (e.g., "Are there other genetic diseases in the family history?"), LLM-based VSP extends responses logically from medical records, avoiding rote repetition or reasoning gaps.
8. LLM-based VSP converts medical jargon into plain, culturally appropriate language for user communication.
9. LLM-based VSP uses natural patient-like speech without artificiality.
10. LLM-based VSP demonstrates patient-appropriate emotions (e.g., anxiety, expectation).
11. LLM-based VSP maintains fluent, natural Q&A dialogues with clinicians.
12. LLM-based VSP responds in real-time without lag.
13. LLM-based VSP operates smoothly across PCs, tablets, and smartphones.
14. After dialogues, LLM-based VSP assesses user proficiency against criteria, delivering objective evaluations.
15. Post-dialogue, LLM-based VSP provides tailored feedback targeting weaknesses with improvement steps.

Supplementary Material S5. User Experience Feedback Questionnaire

Instruction: Please rate your level of agreement with each of the following statements based on your interaction with the VSP. Use a 5-point Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

Table S5. User Experience Feedback Questionnaire

Scoring Content
1. LLM-based VSP accurately identifies symptom locations and characteristics in medical records.
2. LLM-based VSP reports complete medical histories without omitting key details (e.g., chief complaints, present/past medication history).
3. LLM-based VSP's responses match medical records and clinical practice with minimal errors.
4. LLM-based VSP provides accurate, relevant answers to diverse questions.
5. LLM-based VSP delivers logically structured medical history narratives.
6. LLM-based VSP maintains logical flow during sequential queries (e.g., chief complaint → past medical history).
7. LLM-based VSP uses natural patient-like speech without artificiality.
8. LLM-based VSP demonstrates patient-appropriate emotions (e.g., anxiety, expectation).
9. LLM-based VSP maintains fluent, natural Q&A dialogues with clinicians.
10. LLM-based VSP responds in real-time without lag.
11. LLM-based VSP operates smoothly across PCs, tablets, and smartphones.
12. LLM-based VSP features intuitive operation.
13. I am satisfied with LLM-based VSP ward round interactions.
14. I feel comfortable without tension during interactions.
15. I would recommend LLM-based VSP to others.
16. LLM-based VSP improves my clinical communication competencies.
17. I support adopting LLM-based VSP for routine pharmaceutical ward training.
18. Interacting with LLM-based VSP boosts my confidence in conducting ward rounds independently.
19. What do you think are the strengths and/or weaknesses of the LLM-based VSP?
20. In your opinion, which aspect of the LLM-based VSP most needs improvement?

Supplementary Material S6. Item-level mean scores and standard deviations of the Expert Feedback Evaluation Scale

Table S6. Item-level mean scores and standard deviations of the Expert Feedback Evaluation Scale (N = 9)

Assessment Dimension	Scoring Content	Mean Score ± SD
Clinical Accuracy	1. LLM-based VSP accurately identifies symptom locations and characteristics in medical records.	4.44 ± 0.53
	2. LLM-based VSP reports complete medical histories without omitting key details (e.g., chief complaints, present/past medication history).	4.44 ± 0.53
	3. LLM-based VSP's responses match medical records and clinical practice with minimal errors.	4.22 ± 0.44
	4. LLM-based VSP provides accurate, relevant answers to diverse questions.	3.11 ± 0.60
Logical Consistency	5. LLM-based VSP delivers logically structured medical history narratives.	4.11 ± 0.33
	6. LLM-based VSP maintains logical flow during sequential queries (e.g., chief complaint → past medical history).	4.22 ± 0.67
	7. For unanticipated questions (e.g., "Are there other genetic diseases in the family history?"), LLM-based VSP extends responses logically from medical records, avoiding rote repetition or reasoning gaps.	4.22 ± 0.67
Anthropomorphism	8. LLM-based VSP converts medical jargon into plain, culturally appropriate language for user communication.	4.22 ± 0.44
	9. LLM-based VSP uses natural patient-like speech without artificiality.	4.44 ± 0.73
	10. LLM-based VSP demonstrates patient-appropriate emotions (e.g., anxiety, expectation).	4.22 ± 0.83
Response Stability	11. LLM-based VSP maintains fluent, natural Q&A dialogues with clinicians.	4.11 ± 0.33
	12. LLM-based VSP responds in real-time without lag.	3.22 ± 0.44
	13. LLM-based VSP operates smoothly across PCs, tablets, and smartphones.	3.33 ± 0.50
Feedback Quality and Evaluative Effectiveness	14. After dialogues, LLM-based VSP assesses user proficiency against criteria, delivering objective evaluations.	3.11 ± 0.33
	15. Post-dialogue, LLM-based VSP provides tailored feedback targeting weaknesses with improvement steps.	3.56 ± 0.53

Supplementary Material S7. Item-level mean scores and standard deviations of the User Experience Feedback Questionnaire

Table S7. Item-level mean scores and standard deviations of the User Experience Feedback Questionnaire (N = 21)

Assessment Dimension	Scoring Content	Mean Score ± SD
Clinical Accuracy	1. LLM-based VSP accurately identifies symptom locations and characteristics in medical records.	4.48 ± 0.68
	2. LLM-based VSP reports complete medical histories without omitting key details (e.g., chief complaints, present/past medication history).	4.48 ± 0.51
	3. LLM-based VSP's responses match medical records and clinical practice with minimal errors.	4.43 ± 0.60
	4. LLM-based VSP provides accurate, relevant answers to diverse questions.	3.86 ± 0.85
Logical Consistency	5. LLM-based VSP delivers logically structured medical history narratives.	4.14 ± 0.85
	6. LLM-based VSP maintains logical flow during sequential queries (e.g., chief complaint → past medical history).	4.24 ± 0.63
Anthropomorphism	7. LLM-based VSP uses natural patient-like speech without artificiality.	4.52 ± 0.60
	8. LLM-based VSP demonstrates patient-appropriate emotions (e.g., anxiety, expectation).	4.43 ± 0.98
Response Stability	9. LLM-based VSP maintains fluent, natural Q&A dialogues with clinicians.	4.29 ± 0.90
	10. LLM-based VSP responds in real-time without lag.	3.62 ± 1.28
	11. LLM-based VSP operates smoothly across PCs, tablets, and smartphones.	4.05 ± 1.12
	12. LLM-based VSP features intuitive operation.	4.29 ± 0.72
Emotional Acceptance and Trust	13. I am satisfied with LLM-based VSP ward round interactions.	4.14 ± 0.57
	14. I feel comfortable without tension during interactions.	4.52 ± 0.51
	15. I would recommend LLM-based VSP to others.	4.19 ± 0.81
Teaching/Assessment Value	16. LLM-based VSP improves my clinical communication competencies.	4.33 ± 0.73
	17. I support adopting LLM-based VSP for routine pharmaceutical ward training.	4.00 ± 0.78
	18. Interacting with LLM-based VSP boosts my confidence in conducting ward rounds independently.	4.33 ± 0.73

Supplementary Material S8. Thematic analysis of experts qualitative feedback

Table S8. Thematic analysis of experts qualitative feedback

Theme	Representative quote (anonymized)
Response latency	"DeepSeek had stalls and delays during peak daytime usage. In addition, there was a noticeable pause before each response, which slightly affected the natural flow."
	"Each response requires deep thinking, causing a delay of about 10 seconds."
	"Intermittent delays occurred during daytime hours, likely due to server load."
Role deviation	"Sometimes it directly generated pharmacist-patient dialogue, which was confusing."
Activity flow disruption	"Did not follow the workflow. The patient kept asking questions during the medication history taking phase... and asked too many questions during the consultation phase."
	"My consultation process was interrupted because the VSP raised medication consultation questions prematurely."
Over-answering	"The VSP provided additional information not related to the question asked, which occasionally disrupted the pharmacist's reasoning process."
	"The patients' consultation questions over-extended and kept going."
Scoring inaccuracies	"The VSP seemed to make up the score points that the pharmacist had not actually asked."
	"Used case file information as scoring points... awarded points for questions the pharmacist did not ask."
	"The pharmacist asked about scoring items, such as height and weight, but did not receive credit."
	"Made calculation errors and miscalculated the total score."
	"Suggested refining the scoring criteria."
Excessive non-verbal descriptions	"Sometimes the responses contained excessive descriptions of actions and postures, which was not typical for a real patient."

Supplementary Material S9. Thematic analysis of trainees qualitative feedback

Table S9. Trainee-identified strengths and weaknesses of the LLM-based VSP

Theme	Representative quote (anonymized)
Strengths	
Realistic and rich details	“VSP was very vivid in describing his own medical history.Its expression is very clear, and the details are understood.”
Logical and organized response	“Clear logic, it is not easy to miss the main points of pharmacist inquiry.”
Objective and stress-reducing	“VSP was more stable and easier to communicate than SP emotion, can reduce tension.”
Convenient operation	“VSP operation was simple.”
Good for practicing communication skills	“It can simulate real patients to practice communication skills during ward rounds.”
Weaknesses	
Over-answering / excessive extension	“VSP sometimes answered too much, answering questions that had not yet been asked.”
Technical stability issues	“Occasionally the server is unstable. When the voice input, the drug name recognition is not very clear.”
Role deviation / unrealistic simulation	“The simulated patient role sometimes feels unrealistic.”
Disrupted workflow	“It raises doubts and disrupts the pharmacist's workflow during the round.”
Lack of flexibility / rigidity	“A bit rigid, lacking the flexibility of real patients.”

Table S10. Trainee-suggested improvements for the LLM-based VSP

Improvement Area	Representative Quote
Limit response scope / avoid over-answering	“Do not answer non-questions, or over-answer.”
	“It tends to make associations and extensions easily, which needs improvement.”
Optimize technical stability	“Improve network stability and adapt to localization.”
	“Voice Input and Output.”
Strictly follow the pharmacy ward round workflow	“The pharmaceutical ward round procedure must be strictly adhered to and should not be overly flexible.”
	“Do not interrupt the pharmacist during their ward round; raise any questions only during the consultation phase.”
Increase disease diversity	“Include more disease types, such as chronic conditions.”
Enhance humanity and flexibility	“Need to be more human-like”

Supplementary Material S10. Extended baseline characteristics of trainee participants

Table S11. Educational Background and Clinical Experience (N=21)

Characteristic	Category	n (%)
Clinical internship duration (master's students only, n=15)	6–9 months	2 (13.3%)
	10–12 months	12 (80.0%)
	>12 months	1 (6.7%)
Most significantly improved skills during internship (master's students, multiple responses)	Pharmacy knowledge application	12 (80.0%)
	Clinical practice skills	14 (93.3%)
	Lab data interpretation	4 (26.7%)
	Communication & collaboration	12 (80.0%)
	Pharmaceutical service management	12 (80.0%)
Pre-training work background (junior pharmacists, n=6)	Drug dispensing & supply	2 (33.3%)
	Clinical pharmacy service	3 (50.0%)
	Pharmacy administration	1 (16.7%)
Prior direct clinical pharmacy experience (junior pharmacists)	Yes	3 (50.0%)
	No	3 (50.0%)
Self-rated competence in medication history-taking	No experience	1 (4.8%)
	Slight experience	5 (23.8%)
	Moderate experience	13 (61.9%)
	Experienced	2 (9.5%)
Self-rated competence in patient medication counseling	Slight experience	9 (42.9%)
	Moderate experience	10 (47.6%)
	Experienced	2 (9.5%)
Self-rated competence in answering patient consultations	Slight experience	9 (42.9%)
	Moderate experience	9 (42.9%)
	Experienced	3 (14.3%)
Self-rated competence in participating in pharmacy rounds	Slight experience (only observation)	7 (33.3%)
	Moderate experience	12 (57.1%)
	Experienced	2 (9.5%)

Table S12. Technical Familiarity (N=21)

Characteristic	Category	n (%)
Frequency of using AI chatbots	Almost daily	11 (52.4%)
	Several times per week	7 (33.3%)
	Several times per month	2 (9.5%)
	Rarely (1–2 times)	1 (4.8%)
Main purposes of AI use (multiple responses)	General information query	17 (81.0%)
	Assist learning	18 (85.7%)
	Assist work/research	14 (66.7%)
	Entertainment	5 (23.8%)
Prior experience with standardized patients (SP)	Personally participated	12 (57.1%)
	Observed only	3 (14.3%)
	Heard but never observed	4 (19.0%)
	Never heard	2 (9.5%)
Prior experience with virtual standardized patients (VSP)	Personally used	2 (9.5%)
	Observed only	4 (19.0%%)
	Heard but never used	8 (38.1%)
	Never heard	7 (33.3%)

Supplementary Material S11. Raw Scores for Consistency Analysis

Table S13. Individual expert scores and the mean score for each dialogue (N = 30 dialogues)

Dialogue ID	Expert 1	Expert 2	Expert 3	Mean (Experts)
1	54	58	59	57.00
2	57	54	62	57.67
3	66	67	68	67.00
4	70	73	71	71.33
5	64	70	67	67.00
6	60	59	63	60.67
7	78	80	78	78.67
8	71	77	73	73.67
9	71	73	63	69.00
10	75	81	82	79.33
11	85	91	91	89.00
12	78	78	79	78.33
13	71	72	67	70.00
14	78	81	80	79.67
15	77	81	77	78.33
16	71	71	74	72.00
17	75	77	79	77.00
18	78	84	86	82.67
19	62	67	65	64.67
20	66	68	68	67.33
21	63	67	68	66.00
22	79	85	87	83.67
23	66	69	68	67.67
24	60	64	62	62.00
25	62	67	67	65.33
26	64	68	65	65.67
27	78	78	80	78.67
28	74	78	75	75.67
29	83	85	87	85.00
30	73	75	76	74.67

Table S14. Three independent VSP automated scores and the mean score for each dialogue (N = 30 dialogues)

Dialogue ID	VSP Run 1	VSP Run 2	VSP Run 3	Mean (AI)
1	54	59	59	57.33
2	57	59	61	59.00
3	62	66	67	65.00
4	61	63	63	62.33
5	61	65	64	63.33
6	57	59	60	58.67
7	78	76	76	76.67
8	66	67	68	67.00
9	64	62	64	63.33
10	81	77	74	77.33
11	81	83	80	81.33
12	79	76	77	77.33
13	63	66	63	64.00
14	78	78	79	78.33
15	70	70	75	71.67
16	76	73	73	74.00
17	73	72	70	71.67
18	83	82	84	83.00
19	61	63	62	62.00
20	67	67	68	67.33
21	69	64	62	65.00
22	83	83	81	82.33
23	66	65	61	64.00
24	63	63	63	63.00
25	61	60	68	63.00
26	65	62	63	63.33
27	80	80	81	80.33
28	79	75	77	77.00
29	80	79	83	80.67
30	74	76	72	74.00

Supplementary Material S12 Example Dialogue (Chinese-English)

Table S15. Example Dialogue Between a Trainee (Pharmacist) and the VSP (Case VSP-C, Gastric Cancer) — Chinese-English Version

Speaker	Dialogue (Chinese/English)
Pharmacist	Hello, I'm Pharmacist X from the Oncology Department. Are you Xu Nian? I'll be conducting a pharmaceutical ward round for you. May I ask why you are hospitalized this time? 你好，我是肿瘤科的临床药师小 X，请问您是徐年吗？我将为您进行药学查房，请问您此次是因为什么住院的呢？
VSP	Yes, I'm Xu Nian. I'm here because I was diagnosed with gastric cancer and have already had three cycles of chemotherapy. The doctor said I need to continue with the next cycle. 是的，我是徐年。这次住院是因为之前查出胃癌，已经做过三次化疗了，医生说要继续下一个疗程的治疗。
Pharmacist	Alright, I understand. Let me first get some basic information from you. 好的，我知道了。我先来了解一下您的基本信息。
VSP	Okay. My name is Xu Nian, I'm 63 years old. I used to be a civil servant, now I'm retired. 嗯，好的。我叫徐年，今年 63 岁，以前是公务员，现在退休了。
Pharmacist	Okay. Are you married? Where are you from? 好的，请问您结婚了吗？您来自哪里？

VSP	Yes, I'm married, and my spouse is in good health. I'm from Huai'an, Jiangsu Province. I've always lived here. 结婚了，老伴身体挺好的。我是江苏淮安人，一直住在这儿。
Pharmacist	Have you measured your height and weight recently? 您近期有量过身高体重吗?
VSP	I haven't measured my height recently. Last year's check-up showed 170 cm. My weight now is 77 kg, about 1.5 kg less than before chemotherapy. 身高最近没量过，去年体检是 170cm。体重现在 77 公斤，比化疗前轻了 3 斤左右。
Pharmacist	You're hospitalized for gastric cancer. When were you diagnosed? 咱是因为胃癌来住院的，您是什么时候确诊的?
VSP	(Thinking back) It was last October. I went to the county hospital for IV fluids due to a cold. I kept feeling bloated and had a dull ache in my stomach. The doctor suggested a gastroscopy, and they found something bad at the cardia. （稍作回忆）是去年 10 月份，当时因为感冒去县医院输液，总觉得胃胀胀的有点隐痛，医生建议做了胃镜，结果查出贲门那里长了不好的东西。
Pharmacist	So you felt bloated and had a dull ache. How were you treated at that time? What medications did you take? 您是感觉到胃胀胀的，有点隐痛。您当时是怎么治疗的呀？吃了什么药?

VSP	I didn’t take any stomach medicine. After being diagnosed with cancer, I went straight to chemotherapy. It was a regimen with both IV and oral drugs. I don’t remember the exact names. I have been taking my blood pressure medication, amlodipine, regularly. 没吃胃药，查出来是癌之后就直接开始化疗了。就是用的那种输液加吃药的方案，具体名字我记不清了。平时就一直在吃高血压药，氨氯地平片。
Pharmacist	After treatment, did you feel any relief from your symptoms? 治疗以后你有没有觉得您的症状缓解了？
VSP	The bloating and dull ache are much better, and I eat normally. However, after my last chemotherapy, my platelet count dropped significantly. I needed platelet-raising injections to improve. Now my bowel movements and urination are normal, and I sleep well. 胃胀和隐痛好多了，吃饭也正常。就是上次化疗后血小板掉得厉害，打了升血小板的针才好转。现在大小便都正常，睡觉也不错。
Pharmacist	Do you have any history of infectious diseases? Any chronic conditions like hypertension or diabetes? 那你有什么传染病史吗？患过什么疾病吗？比如说高血压，糖尿病。
VSP	I’ve had hypertension for over ten years, and I control it with amlodipine. No diabetes, no infectious diseases. 有高血压十来年了，一直吃氨氯地平片控制。没有糖尿病，也没得过传染病。
Pharmacist	It’s very good that you adhere to your medication. Have you been vaccinated? 您坚持服药是非常有意义的，您接种过疫苗吗？

VSP	I've had all my vaccines on time, following the community schedule. 疫苗都按时打过，预防针什么的都跟着社区安排的来。
Pharmacist	That's good. Do you have any history of drug allergies? 那挺好的，你有过什么药物过敏史吗?
VSP	No, I've never been allergic to any medication. 没有，从小到大没对什么药过敏。
Pharmacist	Have you had any surgeries before? 以前有做过什么手术吗?
VSP	No surgeries, not even any major injuries. 没做过手术，连外伤都没有。
Pharmacist	Do you smoke or drink alcohol? What are your usual eating habits? Do you eat regularly? 平时抽烟喝酒吗？您平时的饮食习惯怎么样呀？您有没有规律饮食呀?
VSP	I don't smoke or drink. My diet has always been light. Now that I'm ill, I'm even more careful to eat on time. My spouse brings me meals every day. 不抽烟不喝酒，饮食一直比较清淡。现在生病了更是注意按时吃饭，老伴每天都给我送饭。
Pharmacist	Which year did you get married? Do you have children? Are your children and spouse healthy? 您是哪年结的婚呀？您有孩子吗？您的孩子和老伴都挺健康的吧。

VSP	I got married at 22. I have one son and one daughter. All my family members are healthy, except that my father also passed away from cardiac cancer years ago. 22 岁结的婚，有一个儿子一个女儿。家里人都挺健康的，就是我父亲当年也是得贲门癌走的。
Pharmacist	Alright, I understand. Did you experience any discomfort during chemotherapy or while taking medications? 好的，我了解了。您在化疗和吃药期间出现过不舒服吗？
VSP	(Nods) After the last chemo, my platelets were low, and I had bruises on my body. The doctor gave me platelet-raising injections. Otherwise, no particular discomfort. （点头）上次化疗后血小板低，身上出现淤青，医生给打了升血小板的针。其他倒是没什么特别不舒服的。
Pharmacist	Okay. If this happens again, please let us know promptly. Don’t be afraid. 好的，您出现这种情况一定要及时告知一声，不要害怕。
VSP	Thank you, pharmacist. By the way, I experienced numbness in my hands and feet during chemotherapy. What causes that? Can it be prevented? 谢谢药师。对了，我之前化疗时手脚发麻，这是什么原因啊？能预防吗？

Pharmacist	The numbness in your hands and feet is caused by oxaliplatin, one of the chemotherapy drugs. It has peripheral neurotoxicity, meaning it can damage nerves, and symptoms are triggered by cold exposure. So you should keep warm, avoid cold air and cold water, and you can use warm compresses as a preventive measure. You can also take medications that support nerve health, such as vitamin B and mecobalamin. If numbness occurs, don't panic — just inform your doctor promptly. 您手脚发麻，是因为化疗使用的一个药物奥沙利铂，它有周围神经毒性，也就是说对神经有损害，当你遇到冷的时候他就会激发。所以您平时要注意保暖，避免接触冷空气冷水还可以采用热敷等手段来进行预防，同时你也可以吃一些改善神经的药物，比如说维生素 B 和甲钴胺，这个出现手脚发麻的情况，您不要慌，及时告知您的医生。
VSP	Okay, thank you, pharmacist. I'll remember that — keep warm and take vitamins on time. I feel much better now. 好的好的，谢谢药师。那我记住了，以后一定注意保暖，也会按时吃维生素。这下我就放心多了。
Pharmacist	Good, I've got your history. Now I'd like to provide you with medication counseling. Is that okay? 好的，我现在已经了解了，那我来对您进行用药指导，可以吗?
VSP	Sure, please go ahead. (Nods cooperatively) 好的，您请讲。（配合地点头）

Pharmacist	For your current treatment plan, we will first administer chemotherapy using three drugs: sintilimab injection, oxaliplatin, and S-1 capsules (Tegafur, Gimeracil and Oteracil Potassium capsules). On the day of chemotherapy, you will receive sintilimab and oxaliplatin by infusion, and you will also take S1 capsules orally. Sintilimab helps your immune system recognize tumor cells more effectively. Oxaliplatin kills cancer cells directly and will be given in two infusions. S1 capsules also kill cancer cells; you will take them orally for two consecutive weeks, twice a day, three capsules each time. 你本次的治疗方案，我们首先对您进行化疗，我们使用了三种药信迪利单抗注射液，奥沙利铂和和替吉奥胶囊。我们在化疗当天给您注射信迪利单抗和奥沙利铂。同时口服替吉奥胶囊。信迪利单抗是提高您的免疫系统对肿瘤的识别能力，奥沙利铂是直接杀死癌细胞的，需要注射两次。替吉奥胶囊也是直接杀死癌细胞的，这个要连续口服两周，一天两次，一次三粒。
Pharmacist	Before and after chemotherapy, you may experience side effects such as nausea, vomiting, diarrhea — these may be signs that your blood system is affected, just like the low platelet count you had before. You might also experience numbness in hands and feet, rash, or fever. Don’t be afraid. If you feel unwell, please tell your doctor promptly. 同时在化疗前，如果用药后，出现了恶心呕吐、腹泻等不良反应，可能是您的血液系统受到的影响，比如说您之前就有过血小板降低的现象。同时可能会出现手脚发麻、皮疹、发烧等症状。您不要害怕，如果您出现不舒服，请及时告知医师。

Pharmacist	We will also take measures to prevent these side effects as much as possible. Before chemotherapy, we will give you three medications to prevent nausea and vomiting: you will take aprepitant capsules — on the first day, 125 mg (one capsule), and on the morning of the second and third days, a reduced dose of 80 mg (one capsule). You will also receive palonosetron and dexamethasone by IV push directly into your vein on the first day of chemotherapy. 当然我们也会在用药期间尽量避免这些不良反应的发生。在化疗前，我们给您三种药物进行预防呕吐恶心，我们会在给您口服阿瑞匹坦胶囊，这个比较特殊，我们会给您吃 125 毫克的一粒药物，第二天第三天早晨会给您减少剂量，80 毫克的一粒剂型。我们还会给您打帕洛诺司琼和地塞米松，这两个药是在化疗第一天给您直接推入血管中。
Pharmacist	Please eat a light diet to help the medications work better. During chemotherapy, avoid overexertion, get enough sleep, and wear a mask in crowded places to reduce the risk of infection. Do you have any questions? 您可以清淡饮食，以保证药物发挥更好的效果，在化疗和用药期间不要过度劳累，保证充足的睡眠，平时去人多的地方注意戴口罩减少感染的风险，请问您还有什么问题吗?
VSP	(After listening attentively) Thank you, pharmacist, for such a detailed explanation. I remember that tegafur should be taken after meals, three capsules twice a day. I'll also watch for nausea or numbness in my hands and feet. Regarding the anti-nausea medication… aprepitant — 125 mg on the first day, then 80 mg for the next two days, right? （认真听完后）谢谢药师这么仔细的解释。我记住了替吉奥要饭后吃，一天两次每次三粒。也会注意观察有没有恶心或者手脚发麻的情况。就是那个止吐药.....阿瑞匹坦胶囊，第一天吃 125 毫克的，后面两天改成 80 毫克的对吧?

Pharmacist	Yes, that's correct — 125 mg on day one, then 80 mg on the following two days. Don't worry, they come in separate packs, so you won't get confused. 是的，这个止吐药阿瑞匹坦胶囊，第一天吃 125 毫克，后面两天都改成 80 毫克的剂量。您放心，这两种有单独的包装，您不用害怕。
VSP	Great, now I fully understand. You explained it very clearly, pharmacist. I will take the medications on time and at the right dose, and I'll tell the doctor immediately if I feel anything wrong. Thank you! 好的，这下我彻底明白了。药师您讲得真清楚，我会按时按量吃药，有什么不舒服马上告诉医生。谢谢您啊!
Pharmacist	You're welcome. It's our job. Wishing you a speedy recovery. 不用客气，这是我们应该的，祝您早日康复。
VSP	(Nods and smiles) Thank you, pharmacist. I appreciate your hard work. （点头微笑）谢谢药师，辛苦您了。