Agent Hospital

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Challenges Facing Healthcare

- The current healthcare system is confronting multiple complex challenges.

Workforce Shortages

Lack of healthcare professionals to meet demand

Aging Population

Growing elderly demographic requiring more healthcare

Health Disparities

Unequal access to healthcare among different groups

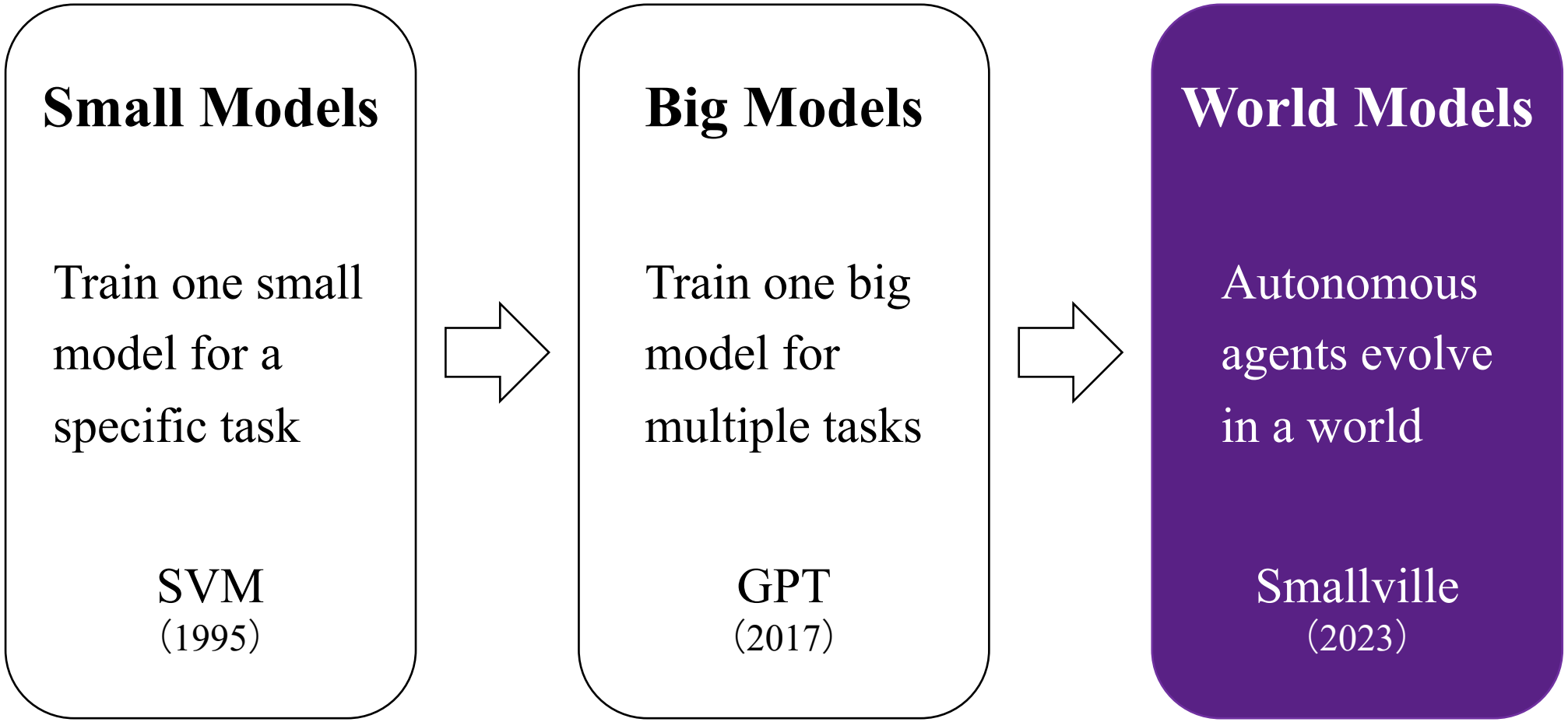
Rising Costs

Increasing expenses impacting affordability

AI Develops Rapidly

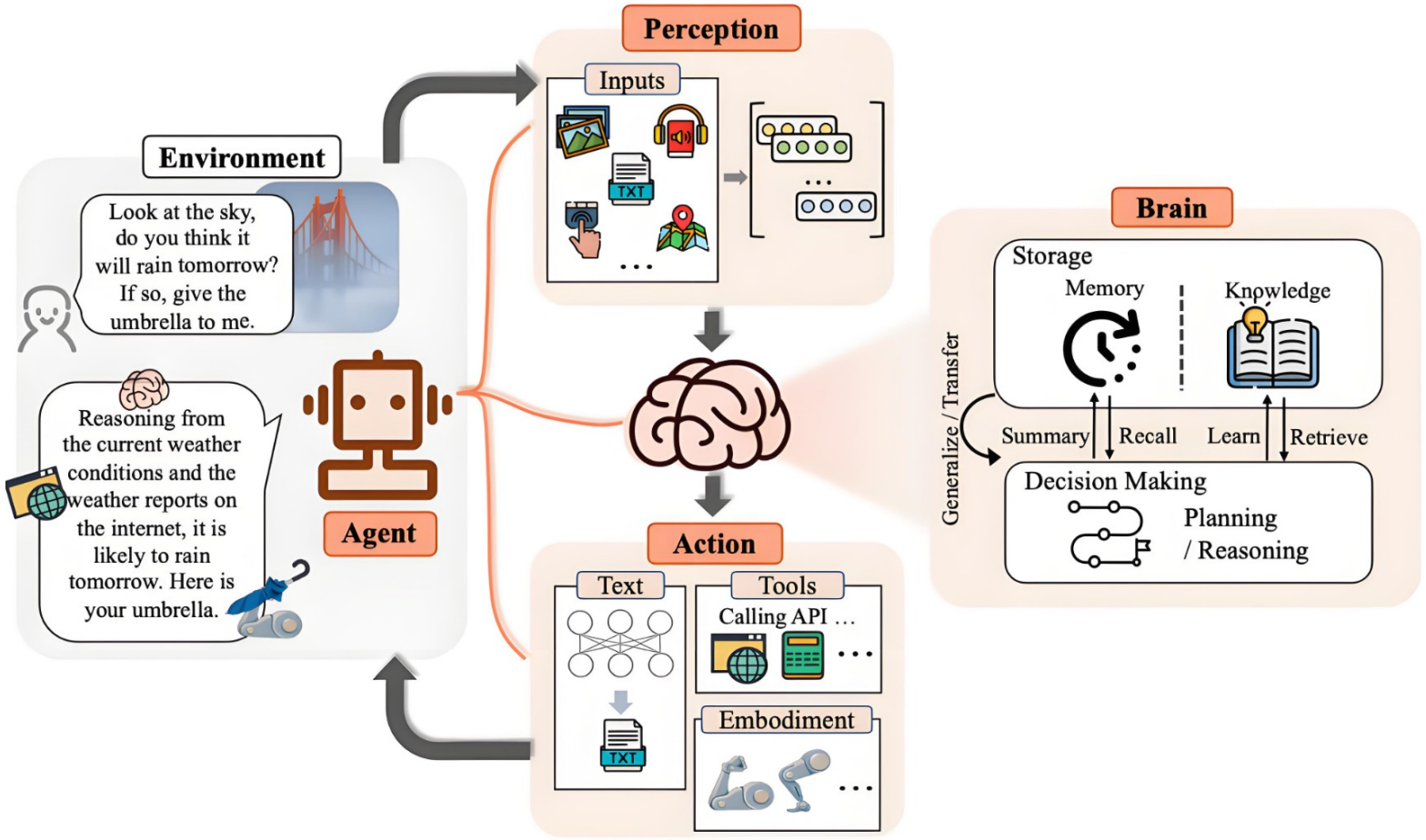
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- The past decade has witnessed the rapid development of artificial intelligence.



Agent

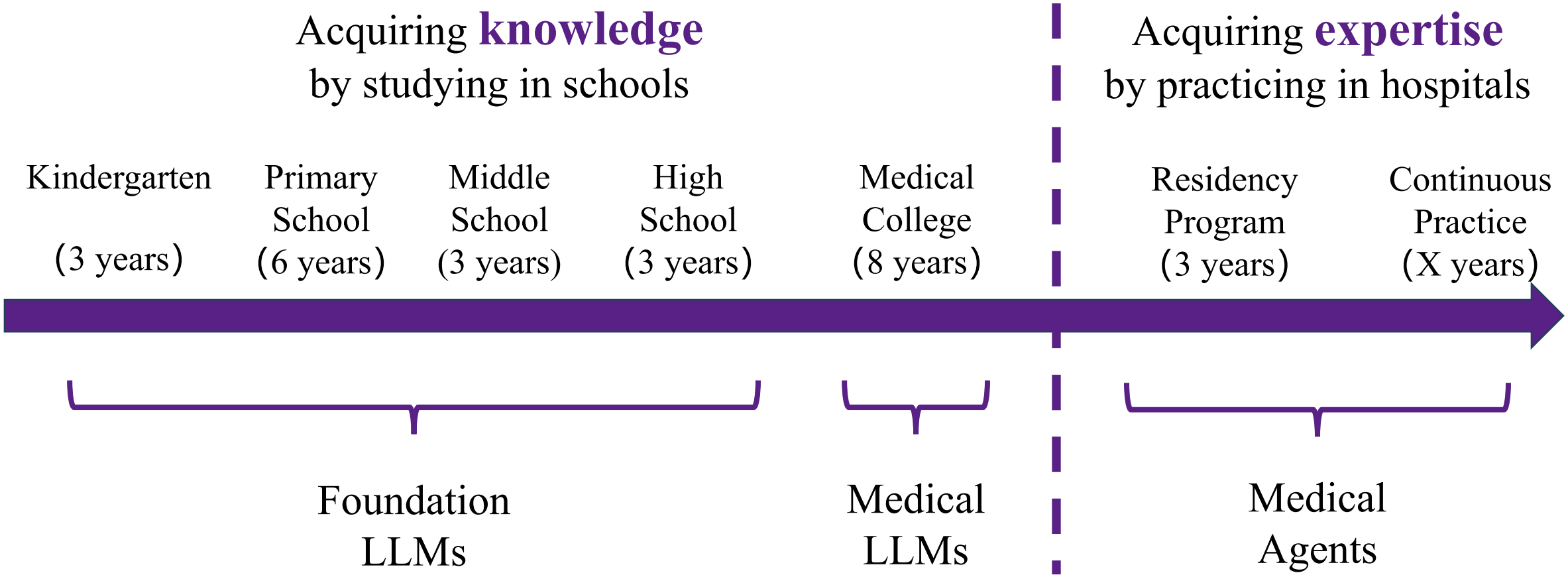
- Autonomous agents have the potential to explore the world like humans.



Xi et al. 2023. The Rise and Potential of Large Language Model Based Agents: A Survey. arXiv:2309.07864.

Road to Becoming a Physician

- Becoming a doctor is a long journey, which can be divided into two phases.

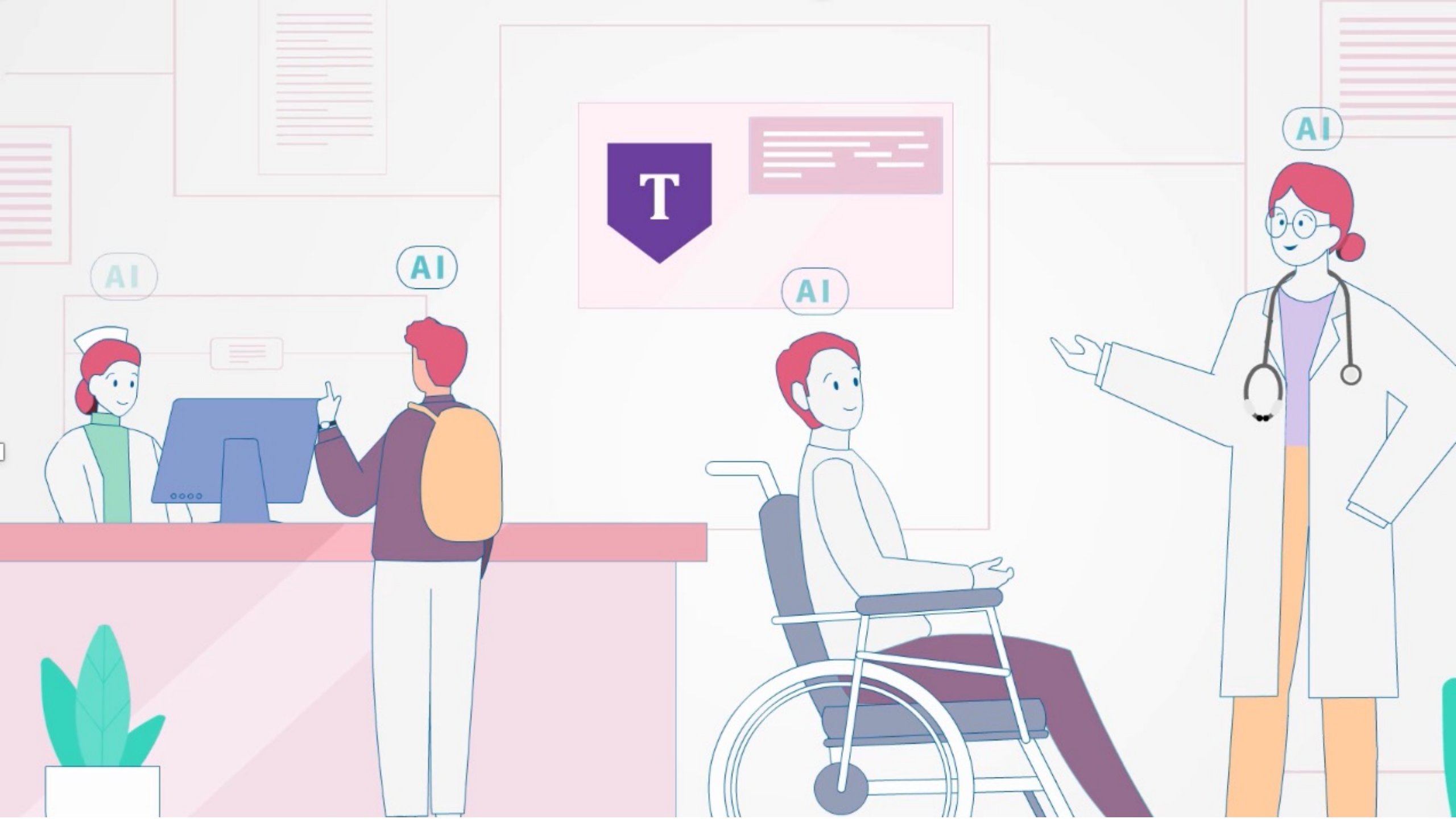


Evolvability of Agents

- Agents can evolve in a complex environment over a long timespan.

Features	Human		AI	
	Study	Work	LLMs	Agents
Environment	Static	Dynamic	Static	Dynamic
Data	Limited	Unlimited	Limited	Unlimited
Supervision	Direct	Indirect	Direct	Indirect
Lifespan	Limited		Unlimited	
Inheritance	Gene duplication		Model parameter copying	

AI evolves faster than human.


AI
AI
AI
AI

Agent Hospital

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- Goal: To enable AI doctors to evolve over time by building a virtual world.



Roles in Agent Hospital

- We distinguish between two major types of LLM-powered agents.

A simulacrum of human patient in the virtual world. She can communicate with the doctor: describe the symptoms, ask for advice, etc.



Patient Agent



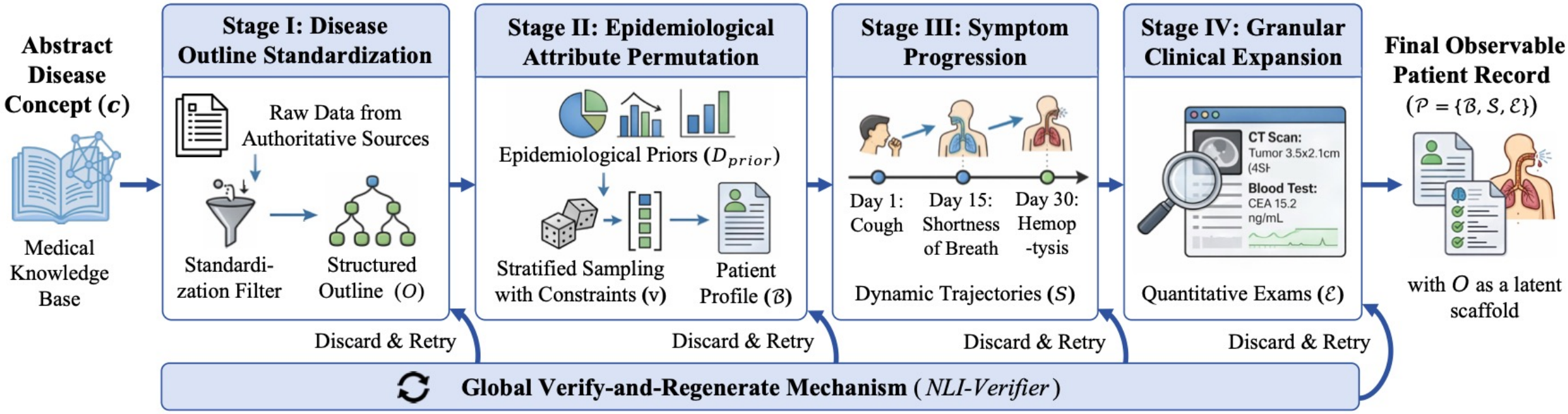
Doctor Agent

A simulacrum of human doctor in the virtual world. He can chat with patients, make decisions, reflect to gain experience, and use external tools.

Li et al. 2024. Agent Hospital: A Simulacrum of Hospital with Evolvable Medical Agents. arXiv:2405.02957.

Patient Agents

- We propose constructing synthetic medical agents using LLMs.
  - The pipeline decomposes patient generation into a four-stage causal chain.

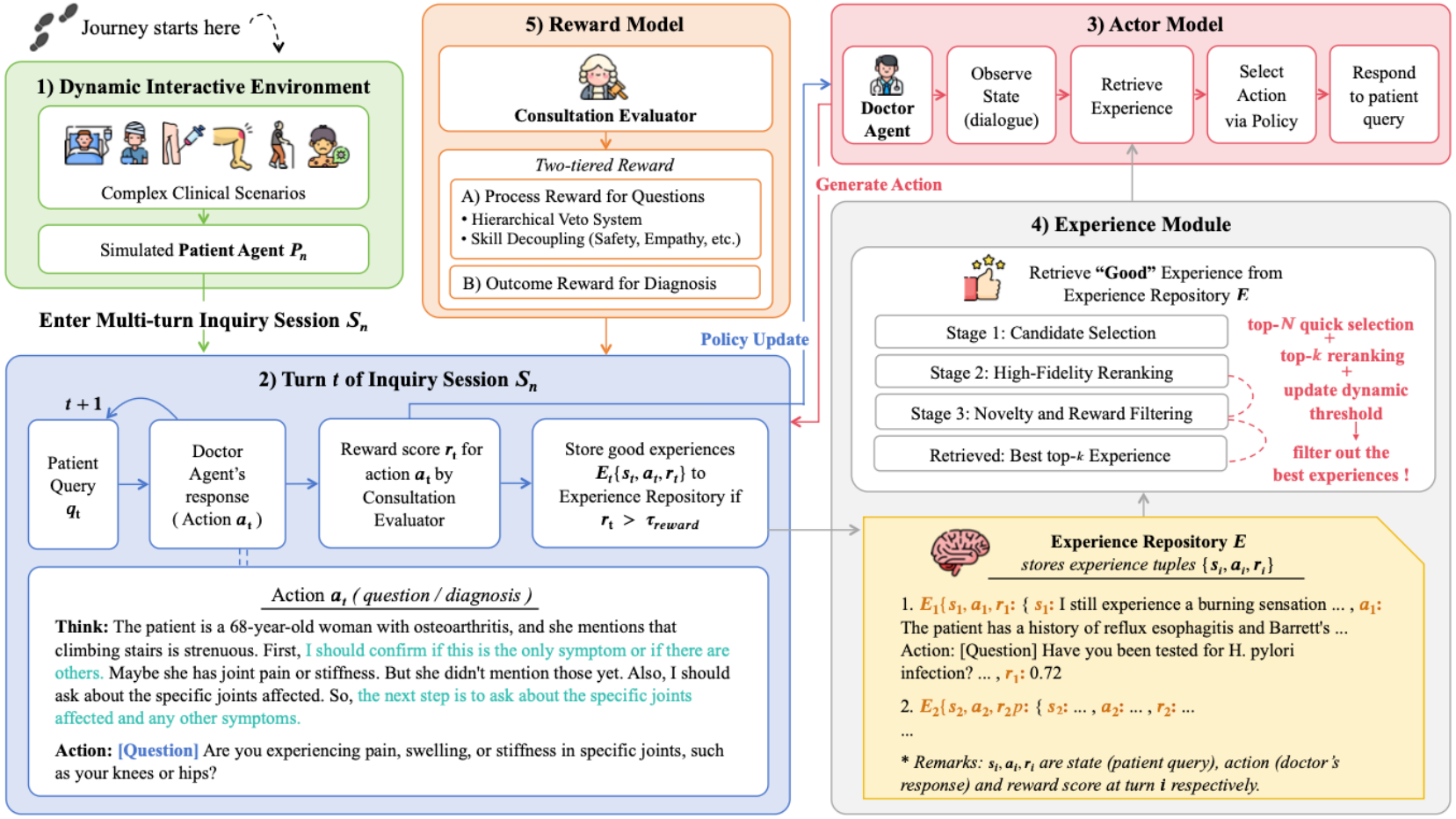


  - A dual-track cognitive memory mechanism is introduced to support coherent dialogue: semantic (static) and episodic (dynamic) memory.

Lai et al. 2025. Patient-zero: A unified framework for real-record-free patient agent generation. arXiv:2509.11078.

Doctor Agents — Medical Inquiry

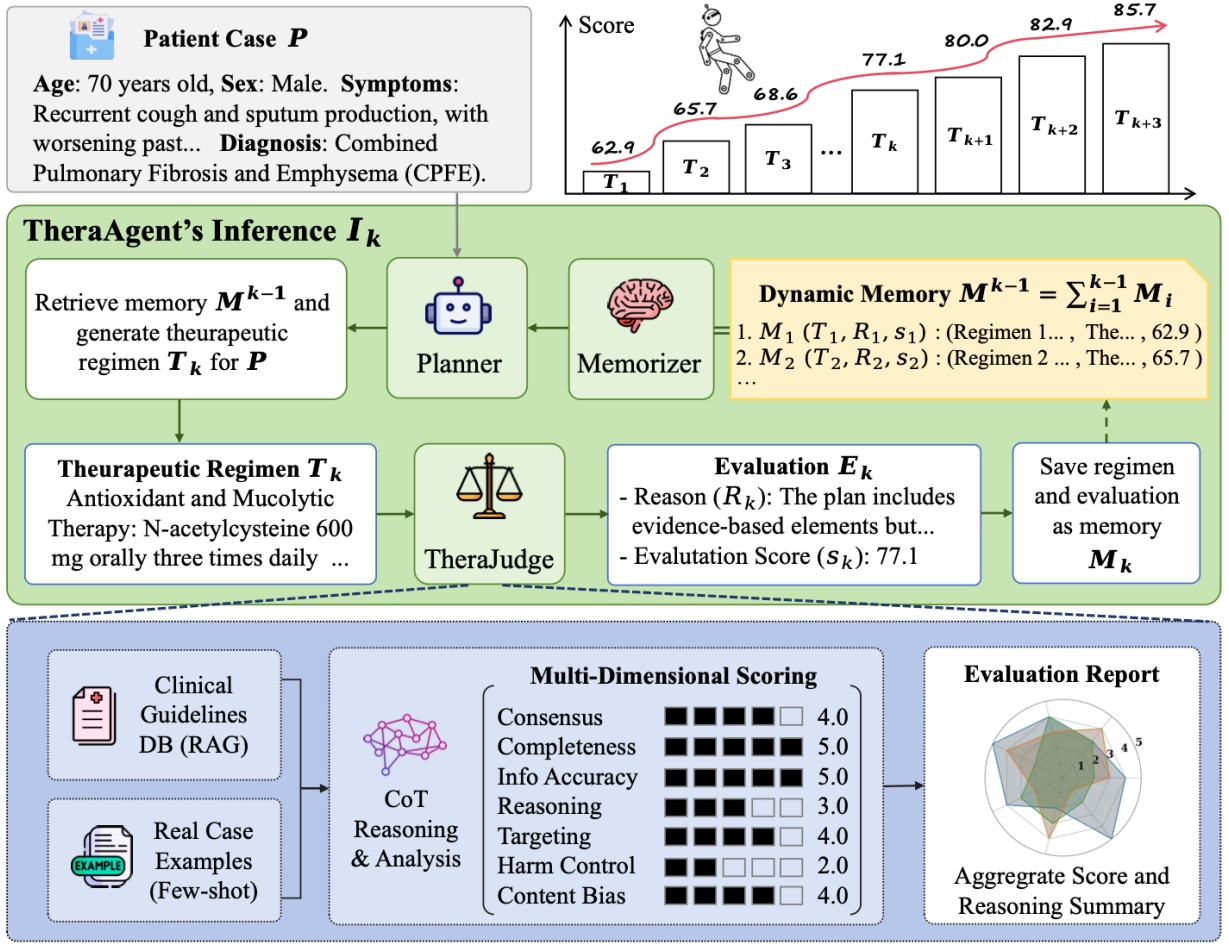
- We propose Doctor-R1, an RL-based self-evolution method for medical inquiry.
  - The doctor agent learns by interacting with virtual patients.
  - Medical reasoning, empathy, and safety are all taken into consideration.
  - Each doctor agent accumulates its own private experience.



Lai et al. 2026. Doctor-R1: Mastering Clinical Inquiry with Experiential Agentic Reinforcement Learning. ICLR 2026 (Accepted)

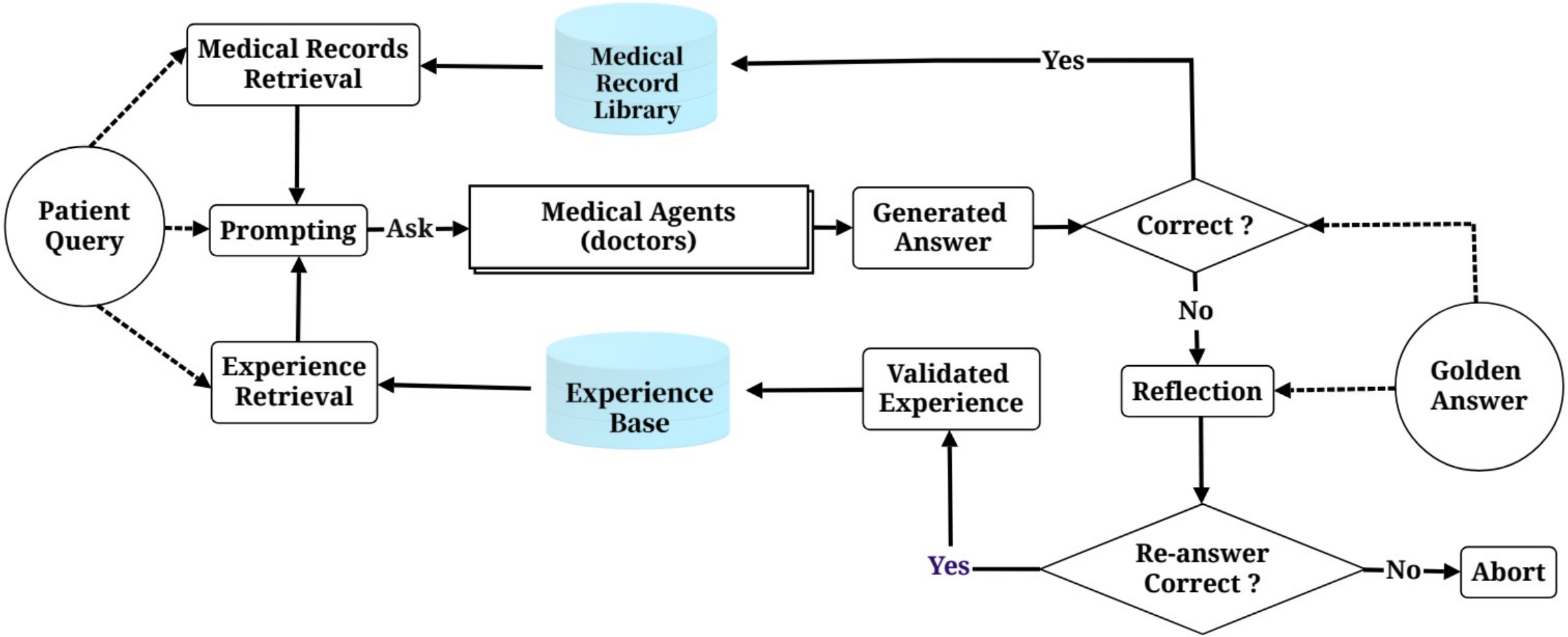
Doctor Agents — Medical Treatment

- The medical treatment plan can also be iteratively refined by self-evolution.
  - A TheraJudge agent is designed to assess the quality of the current treatment plan.
  - A treatment planner equipped with a dynamic memory module is used to refine the output.
  - The refinement process continues until no further improvement can be achieved.



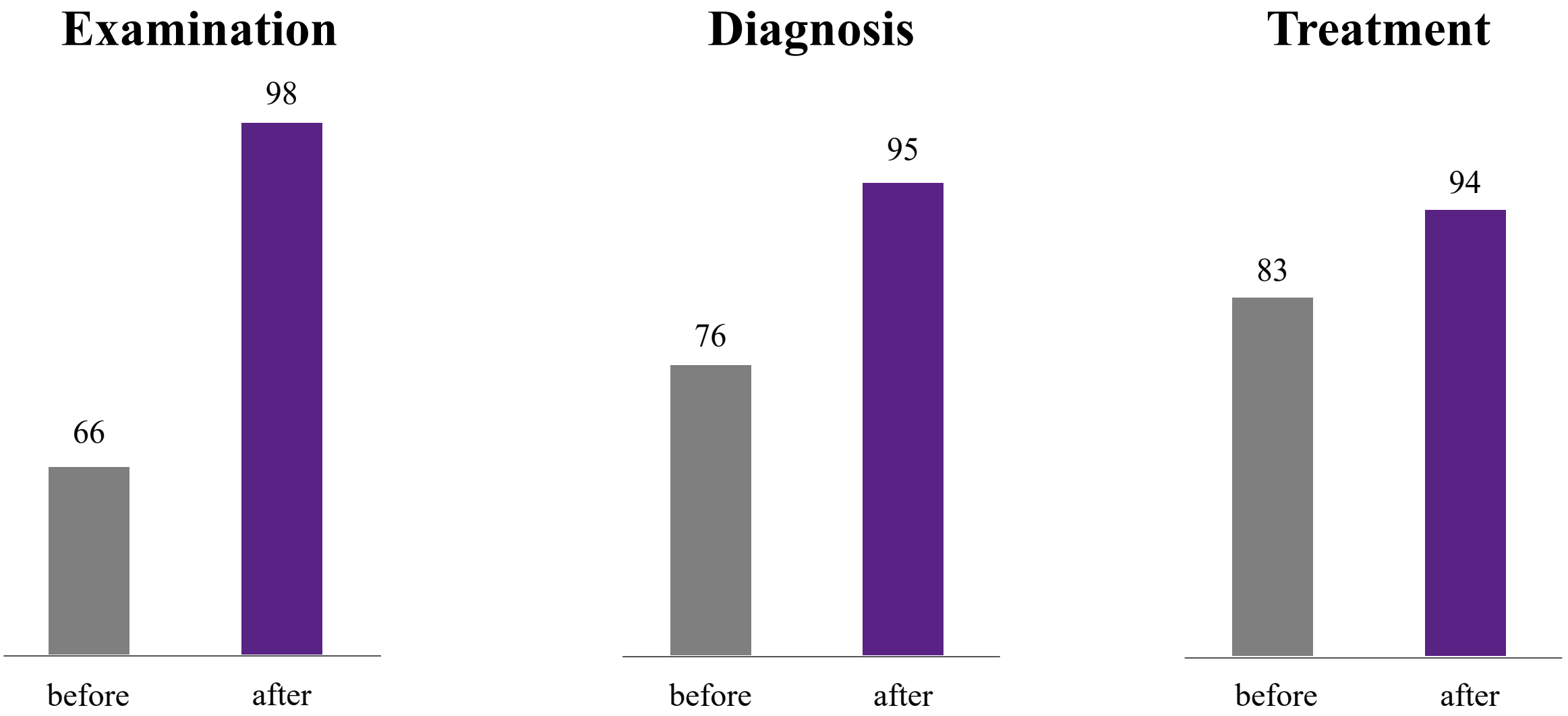
Core Technique: MedAgent-Zero

- Doctor agents keep learning by treating patient agents, either successfully or not.



Li et al. 2024. Agent Hospital: A Simulacrum of Hospital with Evolvable Medical Agents. arXiv:2405.02957.

Effect of Evolution



Li et al. 2024. Agent Hospital: A Simulacrum of Hospital with Evolvable Medical Agents. arXiv:2405.02957.

Applications

- The use of patient and doctor agents may lead to various applications.

Patient	Doctor	Application
AI	Human	Medical Education
Human	AI	Health Consultation Assistant
AI	AI	Public Health Event Simulation
Human + AI	Human + AI	Healthcare Ecosystem

Li et al. 2024. Agent Hospital: A Simulacrum of Hospital with Evolvable Medical Agents. arXiv:2405.02957.

Medical Training with Patient Agents



AI patient

Medical background,
Personal lifestyle,
Character traits, etc

Force value,
Location value

Medical students

Ask questions
Perform palpation

Close-loop learning

Performance report

Work in progress. Joint work with Prof. Lim Chwee Teck of NUS.

Agent-powered Healthcare Ecosystem

- Agents could bring transformational changes to the healthcare ecosystem.

Virtual AI Hospital



patient
avatar
agent



AI
patient
agent



AI
doctor
agent



doctor
avatar
agent

offline services

online services

Physical AI Hospitals



Redesigning Medical Services







Human Patient

Human Doctor

Redesigning Medical Services

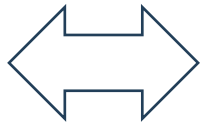
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AI











Human Patient

Doctor Avatar Agent

Human Doctor

Redesigning Medical Services

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AI

AI









郭玉山

Human Patient

Patient Avatar Agent

Doctor Avatar Agent

Human Doctor

Redesigning Medical Services

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AI

AI









Human Patient

Patient Avatar Agent

Doctor Avatar Agent

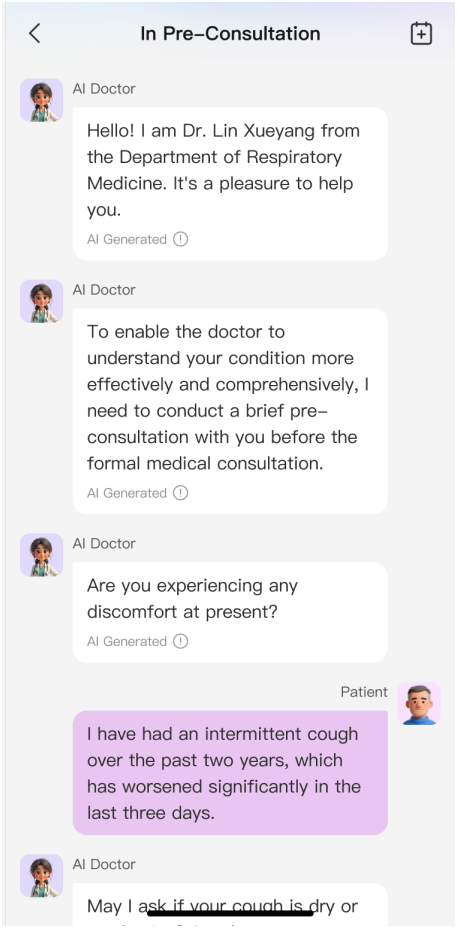
Human Doctor

System Client: Patient

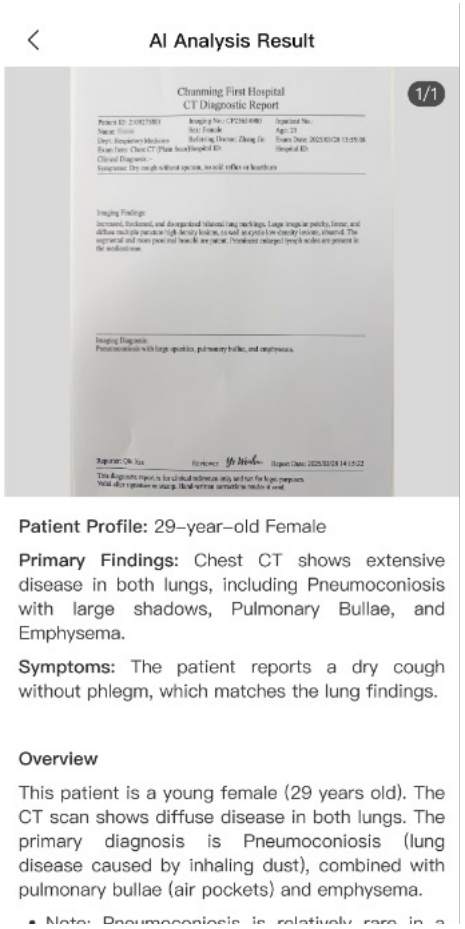
- Patients can use mobile phones to access high-quality services conveniently.



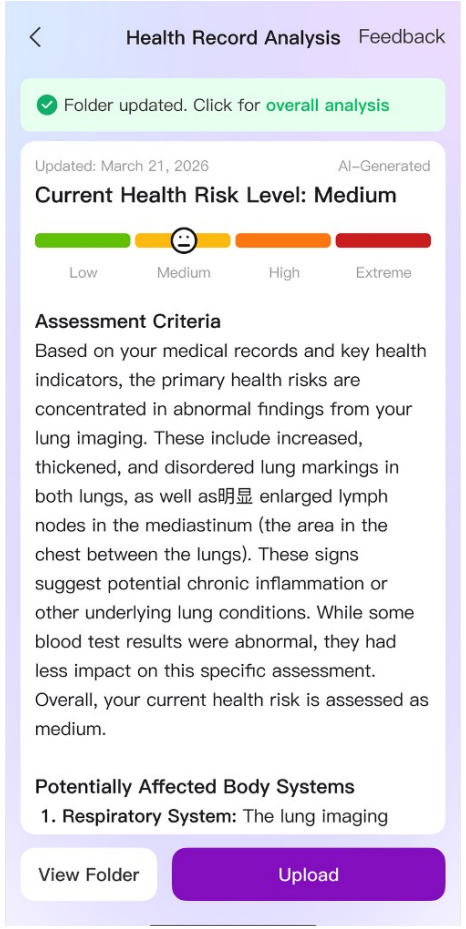
Yuanyuan Fang



Pre-consultation



Analysis

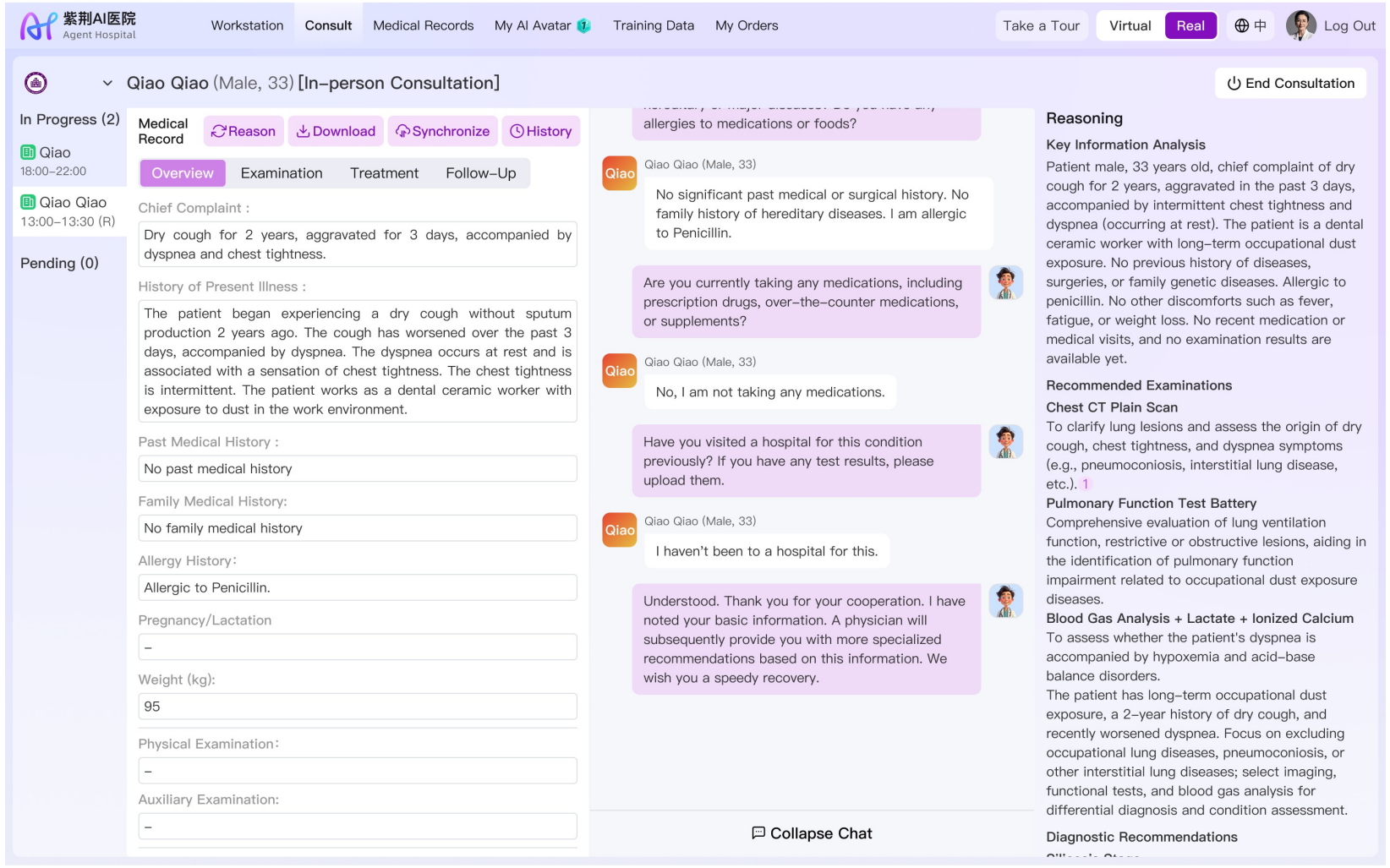


Alert

System Client: Doctor

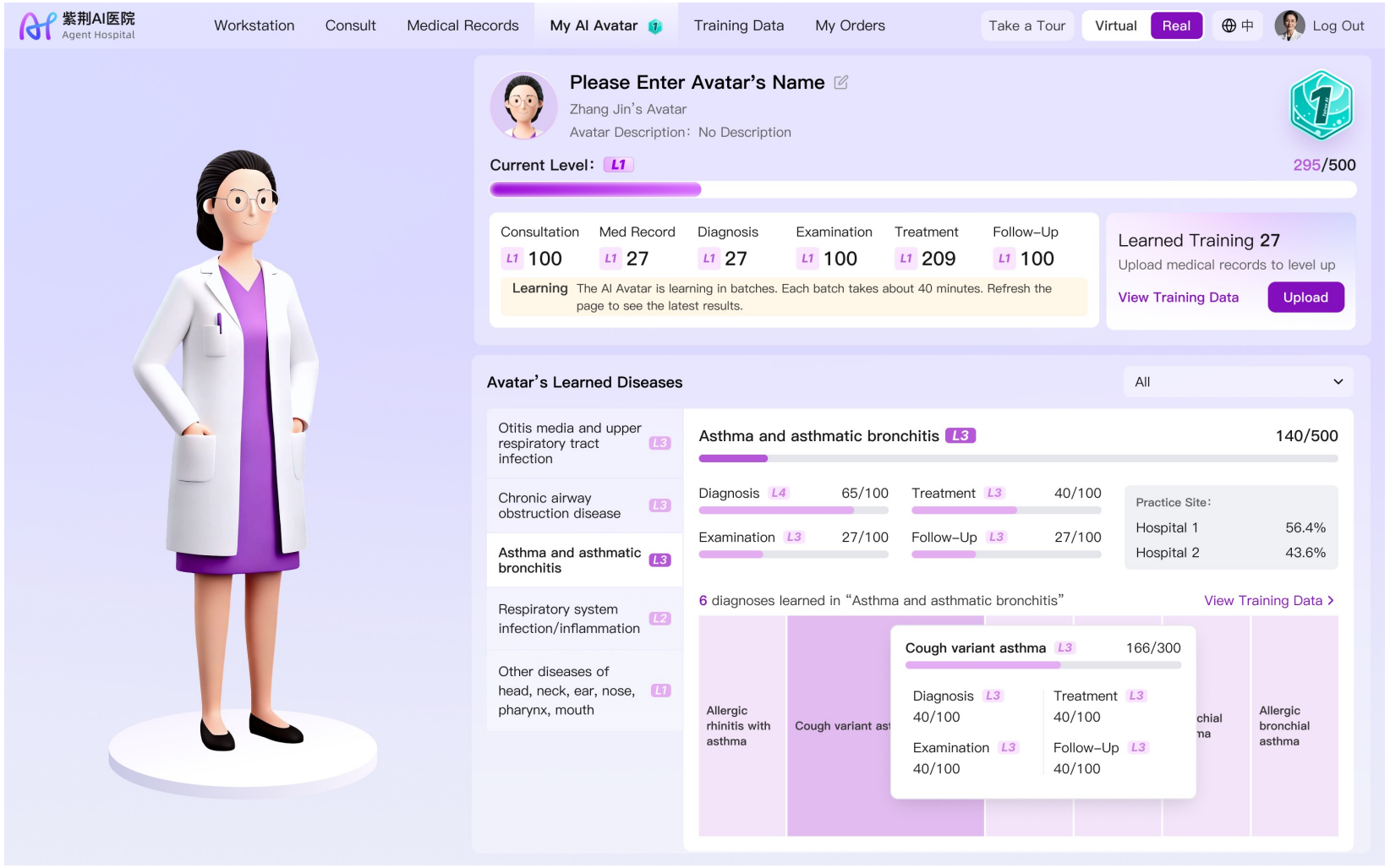
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- Avatar agents help doctors reduce workload and improve efficiency.



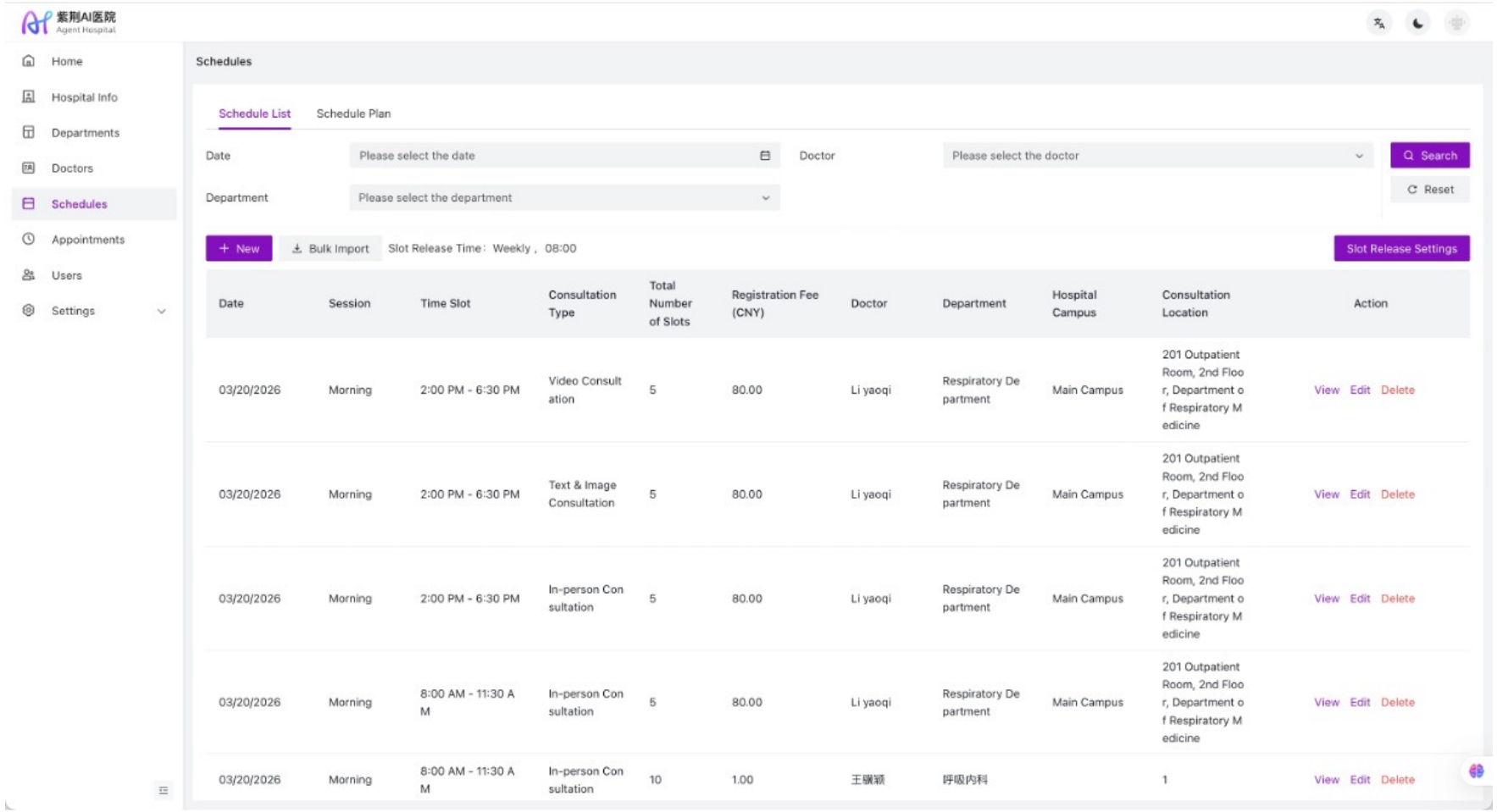
System Client: Doctor

- Doctors can train and manage their own avatar agents.



System Client: Hospital

- Hospitals can connect to the virtual world and manage their avatars.



System Testing

- The system is being tested at 8 hospitals in Beijing and Guangxi.

Feedback on Patient Client

"It has continuous, easy access to personalized health insights and follow-up care, and that is what we want the most. This is a feature traditional hospitals seldom offer."

---- Patient surnamed Wang

Statistics at Doctor Client

The average number of edits that human doctors made to the suggested decisions of avatar agents reduced from 9.00 to 4.67, indicating that avatar agents had kept evolving.



System testing at Tsinghua University Hospital

Paradigm Shift

- AI Hospital has the potential to revolutionize the healthcare industry.

Physical Hospital (1000-2000)	Internet Hospital (2000-2024)	AI Hospital (2024-)
Define the Basic Form	**Break Space-Time Limits**	**Reshape Underlying Logic**
Patient： Human	Patient: Human	Patient: Human + AI
Doctor: Human	Doctor: Human	Doctor: Human + AI
Service: Offline	Service: Offline + Online	Service: Offline + Online

Thanks