SCMPCR Newsletter

General Article

The Evolution of Healing: From Ancient Remedies to Quantum Artificial Intelligence

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Tracing the journey of medicine from historical practices to the frontiers of Agentic AI, AlphaFold, and Quantum Computing.

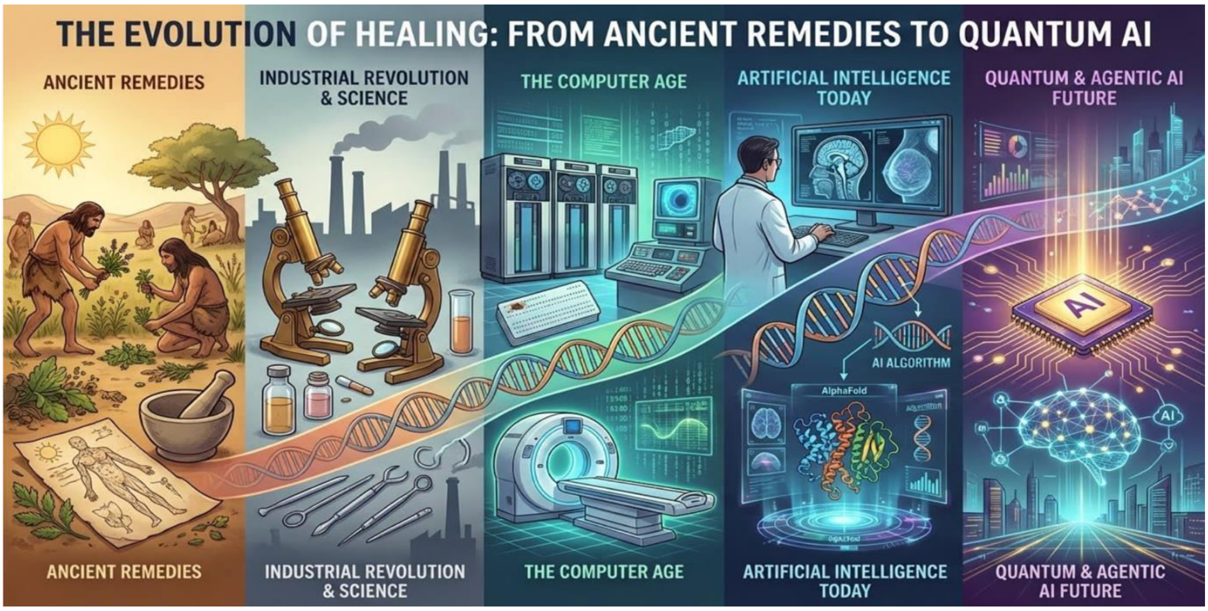


Fig.1: A visualization tracing healthcare's remarkable chronological transformation, from historical remedies and early standardization to the frontiers of Agentic Systems, AlphaFold, and Quantum Artificial Intelligence.

Healthcare is one of the most remarkable stories of human progress. From our earliest ancestors gathering medicinal leaves in the wild to modern supercomputers simulating molecular structures, our quest to cure diseases and extend life has never stopped. Today, we stand on the edge of a new era powered by Artificial Intelligence (AI) and quantum computing. To understand where healthcare is going, we must first look at how far we have come.

The Ancient Period: Survival and the Dawn of Medicine

In the ancient world, human survival was an everyday struggle against predators, harsh environments, and mysterious diseases. Early medical treatment was based on trial, error, and deep observation of nature. Ancient healers discovered that certain herbs, roots, and barks could relieve pain or stop bleeding. Over time, ancient civilizations in Egypt, Greece, India, and China began to document these practices. Medicine was often intertwined with spiritual beliefs, but it laid the essential foundation of observing symptoms and applying treatments to help the body heal.

Fig.2: A historical illustration showing trepanning, an ancient surgical technique. [Source: Wikimedia Commons / Public Domain] Link

The Industrial Revolution: The Shift to Modern Science

The Industrial Revolution in the 18th and 19th centuries transformed society and radically changed how we treated illness. As people moved into crowded cities, the rapid spread of diseases forced a shift in medical thinking. This era gave birth to the germ theory, proving that microscopic organisms caused infections. Mass manufacturing allowed for the widespread production of medical instruments like stethoscopes, syringes, and microscopes. Hospitals became standardized, sanitation was prioritized, and the first vaccines and anaesthetics were developed. Medicine evolved from a local, natural practice into a structured, science-based discipline.

The Computer Age: Formulas and Algorithms The next major leap occurred in the late 20th century with the invention of computers. As technology improved, the healthcare industry began using machines to store patient records and manage hospital operations. Medical researchers developed mathematical formulas and early algorithms to assist in diagnostics.

Machines like CT scanners and MRIs use complex calculations to let doctors see inside the human body without surgery. Healthcare became data-driven, relying on vast electronic databases and evidence-based medicine to standardize patient care across the globe.

Fig.3: A historical illustration showing a vintage surgical table and tools. [Source: iStock / Royalty-Free] Link

The Present: What Artificial Intelligence Can Do Today

Today, Artificial Intelligence is no longer just a futuristic concept; it is an active, life-saving partner in clinics and hospitals. As of 2025 and 2026, AI breakthroughs are fundamentally reshaping patient care:

1. **Early Detection:** AI models can now analyze medical imaging with incredible precision. For example, AI tools deployed in intensive care units can predict the onset of life-threatening conditions like sepsis hours before human doctors can spot the clinical symptoms. Similarly, AI in mammography can detect breast cancer far earlier than traditional methods.

2. **Solving Rare Diseases:** Generative AI models, such as the recently developed "PopEVE," are being used to analyze human genomes to pinpoint harmful genetic mutations. This is helping doctors solve rare genetic diseases that previously left families searching for answers for years.

Fig.4: A historical photo of the first CT scanner prototype being operated by its inventor, Godfrey Hounsfield. [Source: Wikipedia / Public Domain] Link

3. **Unlocking Biology with AlphaFold 3:** AI has unlocked the very building blocks of life. Google DeepMind's recent release of **AlphaFold 3** has fundamentally changed structural biology. While earlier versions solved the "protein folding problem" for single proteins, AlphaFold 3 can accurately predict how proteins interact with DNA, RNA, and small drug molecules (ligands). It models the entire "cellular soup" simultaneously, giving researchers an incredibly accurate 3D map of how diseases function at the molecular level.

4. **Clinical Companions:** AI-powered decision-support tools are acting as real-time assistants for doctors. They instantly search millions of medical journals to provide evidence-based treatment recommendations, ensuring doctors have the latest research at their fingertips.

5. **Agentic AI:** Autonomous AI agents are taking over heavy administrative burdens, from clinical coding to patient scheduling. This reduces burnout among nurses and doctors, giving them more time to focus on actual patient care.

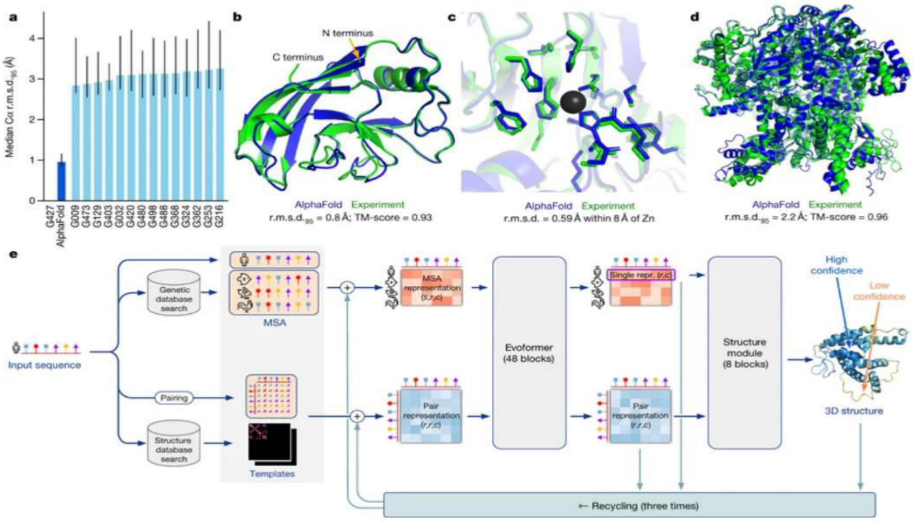


Fig.5: A graph and molecular diagrams showing the breakthrough accuracy performance of AlphaFold on the protein structure problem. [Source: Jumper, et al. (2021) / Licensed under CC BY 4.0] [(Check full reference) LINK]

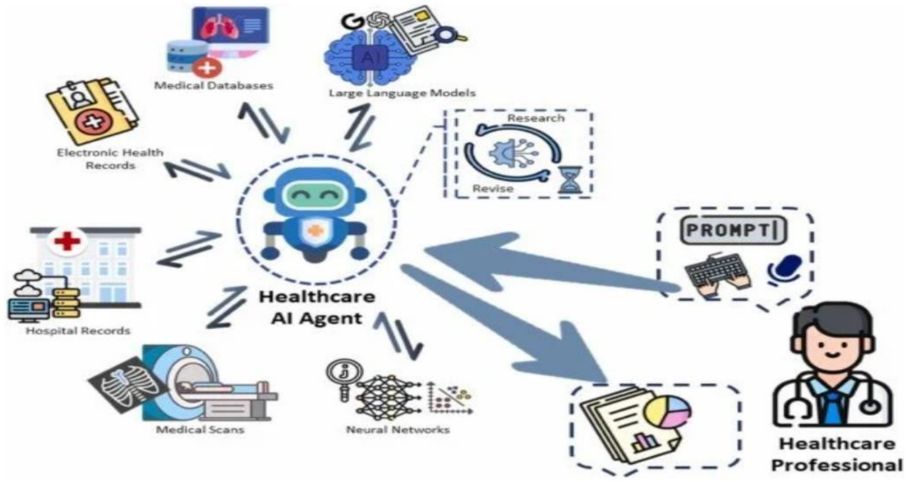


Fig.6: A diagram illustrating a conceptual multi-modal Healthcare AI Agent workflow. [Source: ResearchGate / Licensed under CC BY 4.0] Link

Perhaps the most groundbreaking development happening right now is the convergence of Large Language Models (LLMs), Agentic AI, and advanced computer vision frameworks like the Segment Anything Model (SAM) in medical imaging. Traditionally, diagnosing complex oncology cases like lung cancer required a radiologist to manually evaluate hundreds of slices from a CT scan. Today, we are seeing the rise of **Agentic workflows,** autonomous AI systems capable of multi-step clinical reasoning.

In practice, a medical vision model utilizing SAM can instantly isolate and segment a lung nodule down to the exact pixel, regardless of its irregular shape. To mathematically measure the accuracy of these AI segmentations, researchers rely on the Dice Similarity Coefficient (DSC), which calculates the exact pixel overlap between the AI's prediction (X) and the actual ground truth of the tumor (Y):

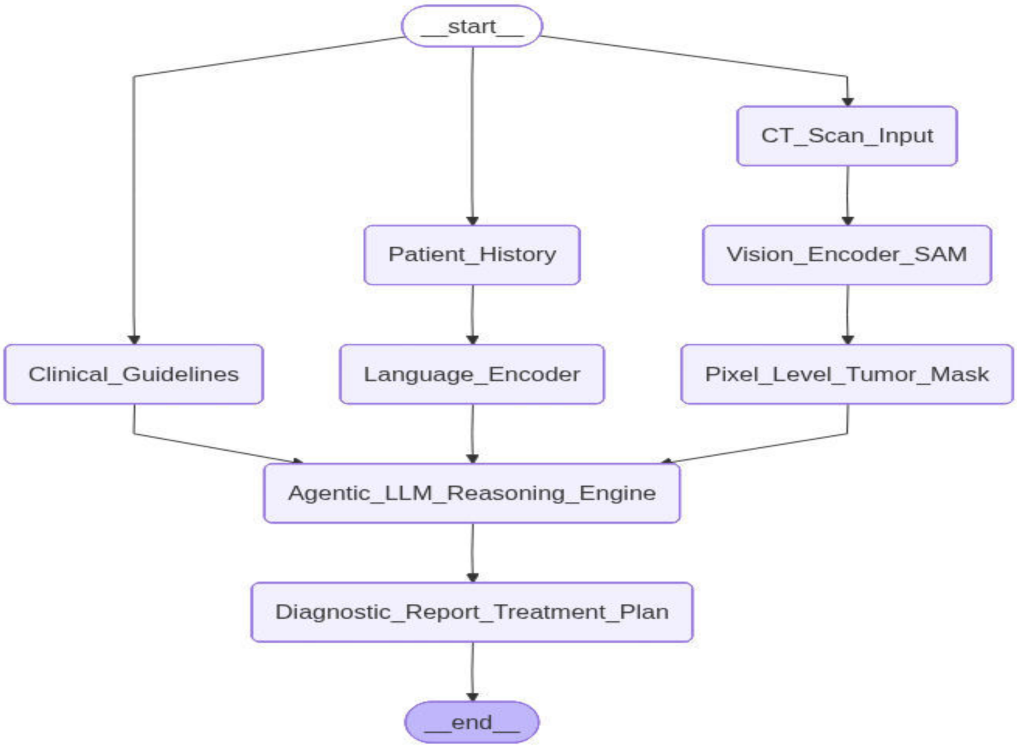
$$DSC = \frac{2|X \cap Y|}{|X| + |Y|}$$

Once isolated, this highly precise visual data is passed directly to a specialized LLM. Utilizing advanced data mining techniques, the LLM acts as a central reasoning engine, cross-referencing the tumor's visual characteristics with millions of historical clinical records.

Simplified Architecture of an Agentic Medical AI

```
builder = StateGraph(MedicalAIState)

builder.add_node("CT_Scan_Input", ct_scan_input)

builder.add_node("Vision_Encoder_SAM", vision_encoder_sam)

builder.add_node("Pixel_Level_Tumor_Mask", pixel_level_tumor_mask)

builder.add_node("Patient_History", patient_history)

builder.add_node("Language_Encoder", language_encoder)

builder.add_node("Clinical_Guidelines", clinical_guidelines)

builder.add_node("Agentic_LLM_Reasoning_Engine", agentic_llm_reasoning_engine)

builder.add_node("Diagnostic_Report_Treatment_Plan", diagnostic_report_treatment_plan)

builder.add_edge(START, "CT_Scan_Input")

builder.add_edge("CT_Scan_Input", "Vision_Encoder_SAM")

builder.add_edge("Vision_Encoder_SAM", "Pixel_Level_Tumor_Mask")

builder.add_edge("Pixel_Level_Tumor_Mask", "Agentic_LLM_Reasoning_Engine")

builder.add_edge(START, "Patient_History")

builder.add_edge("Patient_History", "Language_Encoder")

builder.add_edge("Language_Encoder", "Agentic_LLM_Reasoning_Engine")
```

```
builder.add_edge(START, "Clinical_Guidelines")

builder.add_edge("Clinical_Guidelines", "Agentic_LLM_Reasoning_Engine")

builder.add_edge("Agentic_LLM_Reasoning_Engine",
"Diagnostic_Report_Treatment_Plan")

builder.add_edge("Diagnostic_Report_Treatment_Plan", END)

graph = builder.compile()

print(graph.get_graph().draw_mermaid())
```



Instead of simply highlighting a potential mass on a screen, this combined system generates a comprehensive, evidence-based diagnostic report and suggests personalized treatment pathways.

The Future: AI Meets Quantum Computing

While AlphaFold 3 is a masterpiece of classical AI, quantum computing will take drug discovery to an entirely new dimension. Because traditional computers process information in standard bits (0s and 1s), quantum computers use “qubits,” which can exist in multiple states at once. This allows them to perform complex calculations millions of times faster than our best supercomputers. When you combine this immense processing power with AI (creating “Quantum AI”), the possibilities for healthcare are staggering:

- **Instant Drug Discovery:** Developing a new drug usually takes over a decade of expensive laboratory trials. Quantum AI can simulate how drugs interact with human proteins at the atomic level in a matter of seconds. This will drastically accelerate the creation of cures for complex diseases like Alzheimer's and cancer.
- **Hyper-Personalized Medicine:** Quantum AI will be able to instantly process a patient's entire genetic code, medical history, lifestyle, and environment to create highly personalized treatment plans. Instead of a "one-size-fits-all" approach, medicines will be tailored specifically to your unique biology.

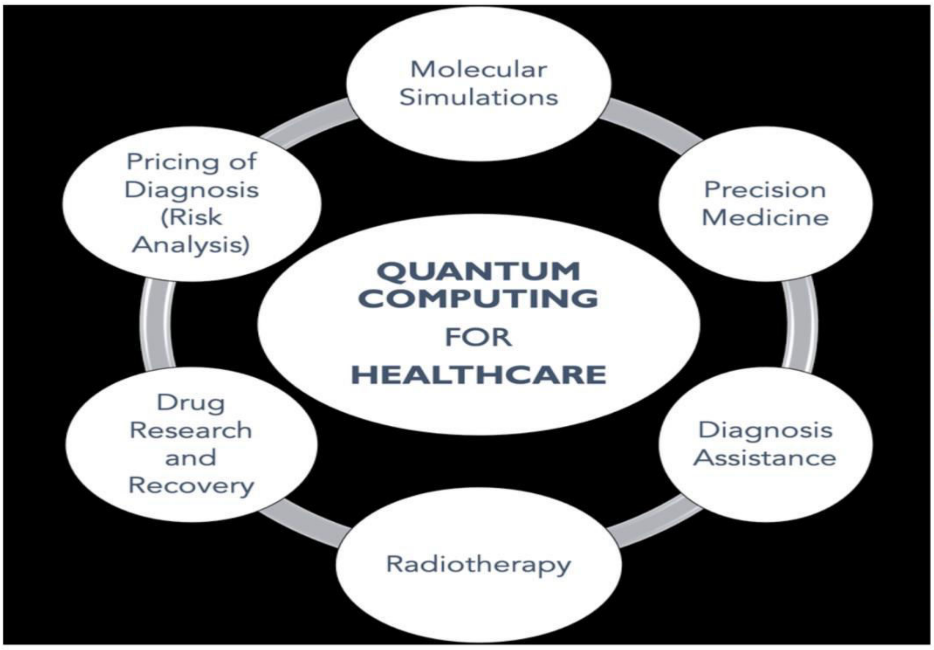


Fig.7: A conceptual diagram of potential applications of quantum computing in healthcare. [Source: ResearchGate / Licensed under CC BY 4.0] Link

The Ethics and Data Privacy Challenges of "Healing AI

As we integrate these immense computational powers into healthcare, we may face unprecedented ethical challenges. Despite its incredible promise, the combination of quantum computing and AI brings severe ethical challenges and security threats that society must address:

- **The Threat to Data Privacy ("Q-Day"):** Quantum computers are so powerful that they could eventually break the encryption methods currently used to protect sensitive global data. In healthcare, this means personal health records could be exposed to cyberattacks unless we urgently transition to "quantum-resilient" security systems.

- **The "Black Box" Problem:** Classical AI is already criticized for being a "black box" meaning it is hard to tell how the machine arrived at its conclusion. Quantum algorithms are even more complex and probabilistic. If a Quantum AI system makes an error that results in an incorrect medical diagnosis, figuring out why it made that error, and who is legally responsible, will be incredibly difficult.
- **Amplifying Bias:** If AI models are trained on biased data, they produce biased results. The massive scale of quantum computing could amplify these biases, potentially leading to unequal healthcare treatments for marginalized communities.
- **Regulatory Gaps:** Current medical laws are struggling to keep up with traditional AI, let alone Quantum AI. Policymakers face the immense challenge of creating global regulations that ensure these powerful systems are safe, transparent, and equitable, without stifling innovation.

Conclusion

From ancient herbs to quantum algorithms, humanity's goal has remained the same: to heal, protect, and extend life. The convergence of Agentic AI workflows, predictive models like AlphaFold, and quantum computing offers the most powerful toolkit we have ever possessed to achieve this goal. However, as we step into this new frontier, we must ensure that our moral frameworks, data privacy laws, and ethical standards evolve just as quickly as our technology. If guided responsibly, the future of healthcare will be more precise, personalized, and equitable than ever before.

References

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World Economic Forum (2025). How quantum computing is changing molecular drug development. * **Recent Preprints (2025–2026).** Research on MedAgent-Pro and Agentic workflows demonstrating the integration of Multi-modal Large Language Models (MLLMs) with Vision Encoders for autonomous medical diagnosis.