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Impacts of Quantum Computing in the Healthcare Industry

All medical specialties and interdisciplinary professionals will eventually use quantum computing in daily tasks.

Highlights:

- Exponential data growth in healthcare is increasing the need for more powerful tools to solve complex problems
- Quantum computing uses the rules of quantum physics to manipulate information far more quickly than classic computing
- Researchers are working to resolve design flaws in quantum computing and to address security concerns
- Healthcare IT leaders need to know which complex challenges and business problems quantum computing can solve

Executive summary

The healthcare industry is adopting innovative technology tools such as 3-D printing, augmented reality (AR), virtual reality (VR), digital twins (DT), artificial intelligence (AI) and machine learning (ML). Another new technology with great promise for healthcare is quantum computing.

Industry trends

The exponential accumulation of data is increasing the need for sophisticated tools to help with rapidly analyzing the data and applying insights to solve problems. "Today, approximately 30% of the world's data volume is being generated by the healthcare industry. By 2025, the compound annual growth rate of data for healthcare will reach 36%."[1] However, we have reached the limit of speed and power for conventional computers today.

"International Data Corporation (IDC) published its forecast for the worldwide quantum computing market, projecting customer spend for quantum computing to grow from $1.1 billion in 2022 to $7.6 billion in 2027."[2] There are many companies globally that offer quantum computing services, chips, tools, hardware, and other capabilities, for example AWS, Google, Intel, Kyndryl, Microsoft, Nvidia, and Oracle.

The computer systems commonly used in all segments of the healthcare industry today, (provider, payer, pharmaceutical, and medical technology), are classic computers that use bits (0 or 1) to process information. This is also true of computers in other industries and for personal use. Industries such as aerospace, climate, energy, financial, manufacturing, supply chain, and transportation are a few exploring quantum computing today. It is not unusual for new technology to be adopted in industries outside of healthcare prior to being embraced by the healthcare industry; this will hold true for quantum computing as well.

Quantum computing uses qubits, not bits. Qubits can be in many states of 0s and 1s at the same time, which makes it very fast. Quantum computers use the rules of quantum physics to manipulate information much more quickly than classic computers. It can help make AI more powerful. Quantum algorithms (QA) will use quantum features to solve multifaceted problems more efficiently and quantum-enhanced machine learning (QML) will accommodate increased complexity at very fast speeds.

Before quantum computing can be widely adopted, however, there are some obstacles to overcome. For instance, qubits are vulnerable to interference or noise that leads to the generation of errors. Error correction must be resolved prior to the practical use of quantum computing. Multiple companies are focused on various solutions to overcome this challenge.

Security is also an issue because the healthcare industry faces constant cybersecurity threats and breaches. Bad actors using quantum computing will inevitably breach data stored in a classic computer system. The National Institute of Standards and Technology (NIST) is working with industry leaders to standardize algorithms that can be incorporated into classic computer systems prior to the adoption of quantum computers. Additionally, the industry needs to protect the data stored in quantum computers, so security protocols for the quantum computing age continue to be defined.

Use cases and potential applications for quantum computing

As researchers work to resolve the noise and errors of quantum computing, and address security concerns, they continue to make advances during this pilot phase. All medical specialties and interdisciplinary professionals will eventually use quantum computing in daily tasks. For example, researchers will use quantum computing to better understand the complexity of cellular disease processes that impact life expectancy. A sampling of potential use case applications for quantum computing by selected industry segment follows.

Provider market

- Disease identification: Quantum-powered AI algorithms can quickly and accurately diagnose diseases by analyzing images and complex data points. Moreover, they can efficiently search through extremely large amounts of data related to multi-complex diseases that are hard to identify.
- Prediction of disease based on personalized data: Quantum computing can quickly analyze data from wearable devices, personal health records, pictures, geographic, environmental, and climate trends, to anticipate sickness before symptoms appear. It can also suggest treatment options and customized health care plans that suit the individual.
- DNA sequencing: Sequencing can be done much faster with AI algorithms that use quantum computing.
- Imaging: More precise imaging, with lower doses than used today, can reveal blood vessel patency, identify gout, or determine the type of a kidney stone.

Payer market

- Fraud and abuse: Subtle patterns of fraud in payment transactions can be identified.
- Manage cost and effectiveness: Simulation of multiple treatment protocols can help identify the most effective and cost beneficial treatment.
- Risk assessment for contracting: Quantum computing can create multiple scenarios and models based on a population to determine the probability of a disease state. It can then apply risk and pricing models to the data to predict the impact.

Pharmaceutical market

- Drug creation: Many molecular interactions can be simulated simultaneously, with a high degree of accuracy, to help discover new drugs and predict how proteins will fold to make protein-based drug design easier.
- Virtual screening: Uses physically precise modeling of drug-target interactions and quickly screens huge data sets to perform virtual screening accurately and effectively.
- Clinical trials: Quicker simulations could reduce the need for vitro (lab) testing by enhancing in silico (computer) screening and validation.

Medical technology market

- Research and design of new products and improvements to existing products: Quantum computing can very quickly simulate models representing multiple design variations to forecast probability of most effective and efficient design and product uses.

How healthcare industry leaders can prepare for quantum computing

While quantum computing is on the boundary of great things to come, healthcare IT leaders are appropriately focused on daily operational challenges. At the same time, leaders need to prepare their organizations for the future.

> ***“. . . it’s not that people are going to have to go out there and start buying quantum computers—most of it is going to be delivered, integrated with existing systems, and for particular types of problems you will go to a cloud-based service that will deliver an answer for a specific problem using quantum technology.” [3]***
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> – ***Paul Bromelow,*** *Quantum Business Leader and Global Sales Leader, Kyndryl*

Healthcare IT leaders don’t need to understand all the science behind quantum computing or add staff with deep quantum computing expertise. Instead, they need to know which complex challenges and business problems quantum computing may solve. They can consider using a partner who is experienced in quantum computing, while identifying opportunities and building knowledge around which issues quantum computing can address.

The healthcare industry can benefit from quantum computing by solving challenges that are beyond the capabilities of today’s computers. As research advances, the quantum computing field is heading towards changing all industries, including healthcare, just as generative AI does now.

About Kyndryl

Kyndryl is the world's largest provider of IT infrastructure services serving thousands of enterprise customers in more than 60 countries. As a focused, independent company, we're building on our foundation of excellence by bringing in the right partners, investing in our business, and working side-by-side with our customers to unlock their potential.

For more information:

Learn more about Healthcare and Data and AI services at Kyndryl. Visit kyndryl.com

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