



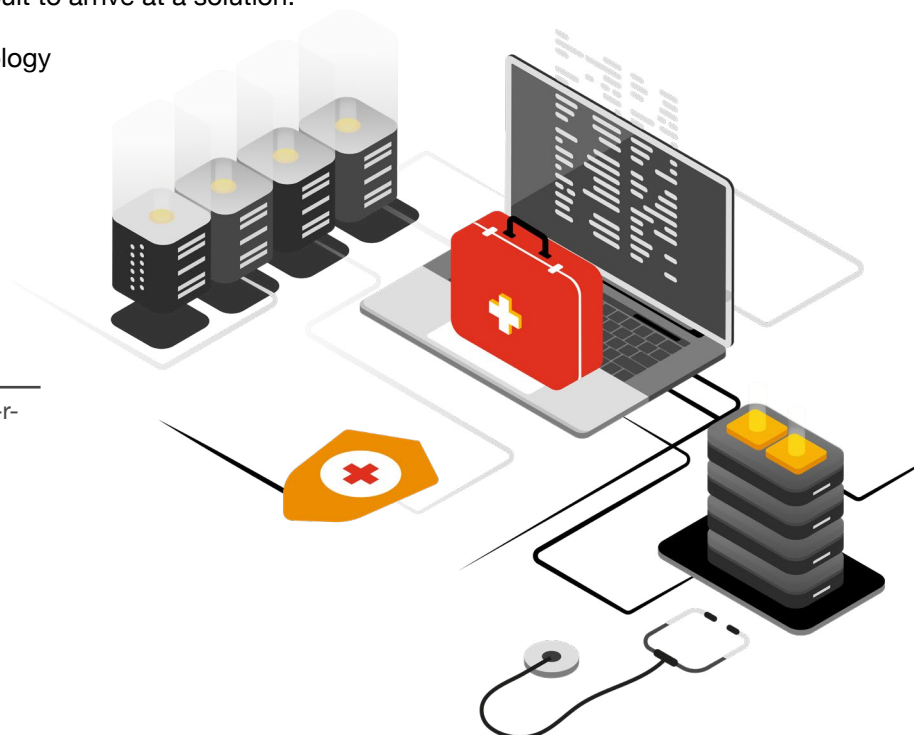
# Making medical diagnosis better with quantum computing

Quantum computing is the next revolution in computational systems that operates and processes digital data on the principles that nature operates on, i.e. quantum mechanics. Quantum computing is growing at a rapid pace across many fields and healthcare is one of them.

The healthcare sector has grown significantly over the last few decades. It is a sector that has seen major expansion in terms of employment and revenue generation, and is perhaps one of the domains where demand will never be an issue. However, the healthcare sector has been gathering renewed interest owing to the devastating effects of the COVID-19 pandemic. The global R&D spending on pharma is expected to reach over USD 250 billion by 2026.<sup>1</sup>

Diagnostics is a predominant function in healthcare and a diagnosis is the result of how a healthcare provider perceives the various symptoms and underlying causes. Even with growing relevance to using data science in healthcare, classical computing systems are barely able to handle the processing of these multiple variables which have a high degree of correlation, making it difficult to arrive at a solution.

The advancement in quantum computing technology has the scope to provide solutions that will have a positive impact on healthcare providers and consumers. These include use cases like personalising medicines, better diagnosis and prognosis, and price optimisation. The field of quantum computing will act as a lever to better utilise machine learning (ML) to solve the issues in the healthcare sector.



<sup>1</sup> <https://www.statista.com/statistics/309466/global-r-and-d-expenditure-for-pharmaceuticals/>

# Role of quantum computing in healthcare

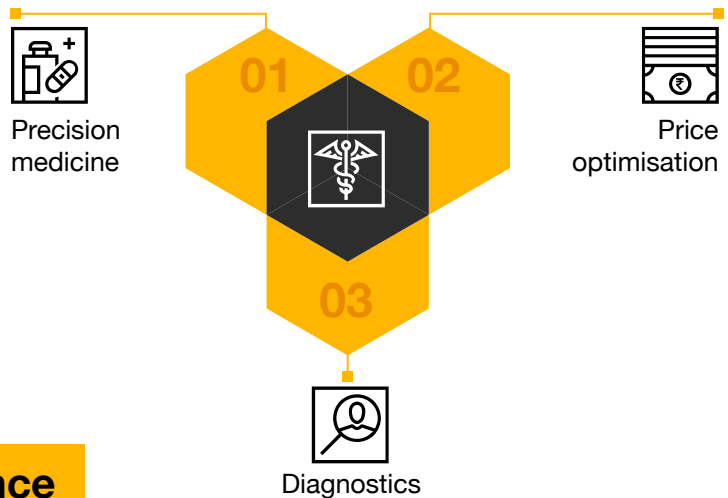
Healthcare data is growing at a rapid CAGR of 36%.<sup>2</sup> Such growth also expands the potential to use quantum and classical computing to better the industry, be it in terms of saving more lives or making healthcare more affordable to the masses. Healthcare has been an industry that has always been keen to adopt new technologies, although amidst a very regulated and complex ecosystem, intending to provide better services, lower costs and better experiences to patients, and improve the work lives of healthcare professionals.

The industry has been investing to get the requisite insights from the data that is being generated. However, the volume of data that is being generated on a day-to-day basis is overwhelming the classical computing systems and that's where quantum computing comes into play. The parallel computing ability that quantum systems provide helps in better computational speeds over classical computing and this advantage increases exponentially with the amount of data to be processed.

This opens up a new realm of possibilities for healthcare professionals, providers, and consumers. Some of the areas where quantum computing has potential scope in the healthcare sector are:

- 1. Precision medicine** – personalising medicines
- 2. Price optimisation** – for insurance premiums and medicine pricing
- 3. Diagnostics** – early and accurate diagnostics of patients

## Areas to focus on for quantum computing in healthcare



## Diving into diagnostic assistance

Like the adage prevention is better than cure, early diagnosis is better than a late prognosis. There are many use cases in healthcare where quantum computing is promising ground breaking results like optimising radiation levels for cancer patients and helping find a cure for diseases like Alzheimer's or Parkinson's. All of this is dependent on machines to a large extent. However, diagnostics is a part of modern medicine that is very human driven. Even with modern healthcare, there are possibilities of patients not knowing about the effect of the treatment that they are undergoing, sometimes not even for months. Quantum computing is bringing about a major change in this field.

## Image analytics

When it comes to diagnostics, imaging tools like Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) are crucial, and have been used by the healthcare industry and practitioners from the time of their invention. They have been helpful and life-saving tools. But the images that are processed out of these are noisy, irreplicable, and of low resolution. There are many reasons for these issues and quantum computing looks like a promising solution.

Edge detection is the processing technique of finding the edge or boundary of requisite items in images. Another image processing technique is image matching which is used to find patterns that are existing in an image. Quantum image processing through these techniques could analyse the images obtained from traditional imaging methods more efficiently.

Through these methods, quantum computing can bring to the table a precise manner of diagnostics where the process of diagnosing can be automated with minimal human supervision from individuals who supervise these models and create a database of a large number of these patterns and stored images. This will make the process of diagnosis faster, reliable and also avoid repetitive procedures that are invasive.

<sup>2</sup> <https://healthitanalytics.com/news/big-data-to-see-explosive-growth-challenging-healthcare-organizations>

## Classification

Classification is one of the ML techniques used to classify data points into clear sets. In the healthcare industry, the classification of different types of cells based on many characteristics – which can be both physical and biochemical – is an issue. The number of characteristics of these cells increases the number of features in the classification problem, which in turn makes it complex and time-consuming to solve. These classifications are important in many cases and are even used to classify normal cells and cancer cells in the human body. Quantum computing aids ML in cases like these and helps boost the classification model and improve diagnostics as a whole.

With the growing number of data points each day, there are a lot of ‘omics’ datasets, including proteomics and genomics, which are increasingly complex. The complexity is again due to the number of features each of these datasets capture. Most of these features are not independent of each other and have some sort of correlation between them. Classical computing lacks the horsepower to process such datasets and find patterns in them and this is where quantum computing holds an edge. These could potentially help identify biomarkers in individuals which can indicate the presence of an abnormality that can lead to the diagnosis of a disease in future. This identification could also aid in the treatment of individuals.

## Advantages

Quantum computing through these methods ensure quick diagnosis and patients will be able to know the effectiveness of their treatments in a much more useful timeframe. It will also help in better monitoring of individual health.

Quantum computing could also significantly reduce the expenditures involved for healthcare providers in terms of treatment costs by reducing the number of tests required periodically. It can even aid them to find the right future treatment for individuals based on early diagnosis and help reduce costs even further.

## How we can help you?

### Understand how the technology can benefit you

PwC has a robust structure in place to help you understand the impact of technology on various business areas.

Through our **tinkering workshops**, we bring together consultants and industry professionals to understand the technology and chalk your organisation’s quantum road map.

We can work with you to identify and prioritise quantum application cases based on their potential for generating business value.

### Rapid prototyping

Through our Technology Tinkering Lab, we help you explore potential applications – demonstrations of the technology applied to real-world use cases.

Join us at the Tinkering Lab to co-create impactful solutions for the healthcare industry.

We have the skills to identify problem areas and offer insights, guidance and solutions to address the complex challenges multiple players are facing in the healthcare field.



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## Contact us

### Ashootosh Chand

Partner, Digital and Emerging Technologies  
PwC India  
[ashootosh.chand@pwc.com](mailto:ashootosh.chand@pwc.com)

### Debankur Ghosh

Director, Digital and Emerging Technologies  
PwC India  
[debankur.ghosh.in@pwc.com](mailto:debankur.ghosh.in@pwc.com)

### Contributors

Vignesh Venkataraman  
Avneesh Narang  
Tanvi Vakil

## pwc.in

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