Press Release

National Quantum Computing Centre

National Quantum Computing Centre launches Insights Paper exploring quantum computing's transformative potential in healthcare and pharmaceuticals

25 March 2025, Oxfordshire, UK – Today, the National Quantum Computing Centre (NQCC) launched its first Insights Paper, "*The convergence of healthcare and pharmaceuticals with quantum computing: A new fronter in medicine"*, exploring how quantum computing could enable a step-change in medicine and healthcare delivery over the coming decades.

The paper examines the potential of quantum computing to address some of the most complex and pressing challenges facing healthcare systems, both nationally and globally. While quantum computing remains an emerging technology, with most applications currently at the research and development stage, early evidence from proof-of-concept studies highlights its potential to transform areas where conventional computing may reach its limits.

Drawing on extensive engagement with stakeholders across the healthcare and life sciences sectors - including workshops, bilateral consultations, and expert interviews – alongside deep technical analysis, the paper provides a comprehensive review of the current landscape. It identifies near-term opportunities and long-term challenges associated with the adoption of quantum computing in healthcare and pharmaceuticals and reflects key insights and recommendations gathered from a diversity of sector stakeholders.

"Our engagement with the sector highlights a growing appetite for coordinated, mission-led initiatives to unlock the potential of quantum computing in healthcare and pharmaceuticals," said Dr Simon Plant, Deputy Director for Innovation, NQCC. *"This paper provides actionable insights for industry leaders, policymakers, and funders to realise the opportunities that quantum computing presents for patient outcomes and healthcare innovation."*

Healthcare challenges and quantum opportunities

Conventional computing has already enabled remarkable advances in healthcare – today artificial intelligence aids diagnostics, high-performance computing accelerates drug development, and machine learning supports personalised treatment. However, bottlenecks remain for solving increasingly complex computational problems, with a need for ever greater speed, accuracy and efficiency.

Quantum computing offers an opportunity to surpass these barriers in the future – providing new ways to tackle biological complexity and high-dimensional data – areas where traditional computing methods struggle to scale. The paper highlights that more than 40 proof-of-concept use cases have already been explored in the literature, indicating promising areas for future development, including:

- Drug discovery and molecular simulations – accelerating the identification and optimisation of novel therapeutics, including treatments for cancer and antimicrobial resistance (AMR)
- Diagnostics and early disease detection – improving the accuracy and timeliness of diagnoses, particularly in underserved areas such as rare diseases and women's health
- Personalised medicine and genomics – enabling tailored treatments through advanced analysis of genomic, clinical, and real-world data
- Healthcare system optimisation – enhancing efficiency in resource allocation, clinical trial design, and healthcare logistics.

These opportunities align with national priorities set-out in the NHS Long Term Plan and support the objectives of the UK National Quantum Strategy – particularly Mission 1 (Quantum Computing) and the Quantum Healthcare Mission, which seeks to integrate quantum-enabled solutions into every NHS Trust by 2030.

Grand challenges and collaboration

The report highlights the sector's appetite in pursuing large-scale, international Grand Challenges – similar in ambition to the Human Genome Project – as a mechanism to coordinate effort, accelerate progress, and deliver real-world impact from quantum healthcare applications.

Overcoming the challenges ahead

While the opportunities are considerable, the report identifies several critical challenges that must be addressed to realise quantum computing's potential in healthcare, including:

- Technology maturity and scalability – further advances are needed in quantum hardware, error correction, and scalable quantum algorithms, developed in parallel
- Hybrid approaches and digital integration – quantum solutions will need to complement classical systems and integrate with existing healthcare digital infrastructure
- Workforce readiness and skills development – cross-disciplinary expertise combining quantum science, healthcare, and life sciences will be essential to support adoption and innovation.

As the field evolves, regulatory and ethical considerations will also become increasingly important, including data privacy, regulatory compliance, and the responsible use of quantum-enhanced healthcare decision-making systems.

The Insights Paper underscores the importance of early engagement with healthcare stakeholders – particularly end-users, as well as the development of open innovation forums and dedicated testbeds to foster knowledge exchange and the co-development of quantum healthcare solutions. Identification of near-term impactful use-cases remains a priority with the sector emphasising collaboration as a key mechanism for progress.

Next steps and global momentum

The publication comes at a time of growing global momentum. Leading initiatives – such as the Cleveland Clinic's partnership with IBM, which established the world's first quantum computer dedicated to healthcare research, and the Wellcome Leap Quantum for Bio (Q4Bio) programme – are pioneering the use of quantum technologies in drug discovery, genomics, and precision medicine. These efforts complement partnerships announced by leading quantum computing developers and pharmaceutical companies worldwide, focused on addressing practical healthcare challenges.

As quantum hardware and algorithms continue to advance, the NQCC anticipates a shift from proof-of-concept demonstrations to real-world impact, with the prospect of accelerating drug development, enhancing diagnostics, personalising treatments, and optimising healthcare operations in the future.

Download the Insights Paper here.

About the NQCC

The NQCC is the UK's national lab for quantum computing, dedicated to accelerating the development of quantum computing by addressing the challenges of scaling up the technology. The centre is working with businesses, government, and the research community to deliver quantum computing capabilities for the UK and support the growth of the emerging industry.

The NQCC's programme is being delivered jointly by UKRI's research councils, EPSRC and STFC. It is a part of the National Quantum Technologies Programme (NQTP) to develop and deliver quantum technologies across the areas of sensing, timing, imaging, communications and computing.

The centre is headquartered in a purpose-built facility on STFC's Rutherford Appleton Laboratory site at the Harwell Campus in Oxfordshire.

Visit **nqcc.ac.uk** for more information.

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