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The state of quantum computing applications in health and medicine

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Abstract

Medicine, including fields in healthcare and life sciences, has seen a flurry of quantum-related activities and experiments in the last few years (although biology and quantum theory have arguably been entangled ever since Schrödinger's cat). The initial focus was on biochemical and computational biology problems; recently, however, clinical and medical quantum solutions have drawn increasing interest.

In this presentation, clinical and medical proof-of-concept quantum computing applications are summarized. These consist of over 40 experimental and theoretical studies. The use case areas span genomics, clinical research and discovery, diagnostics, and treatments and interventions. Quantum machine learning (QML) in particular has rapidly evolved and shown to be competitive with classical benchmarks in some studies. Near-term QML algorithms have been trained with diverse clinical and real-world data sets. This includes studies in generating new molecular entities as drug candidates, diagnosing based on medical image classification, predicting patient persistence, forecasting treatment effectiveness, and tailoring radiotherapy. The presentation covers how such advances help pave the way towards the long-term goals of cell-centric therapeutics and precision medicine. An outlook on medicine in the quantum era, including technical and ethical challenges, is provided.