

ABSTRACT NO:24
RESEARCH ARTICLE**Hybrid Quantum-Classical Predictive Modelling for Glioblastoma Survival:
Addressing Data Scarcity in Resource-Constrained Neuro-Oncology**Wajeeh Ahmed Khan ¹, Mubashir Amjad ², Arsalan Khan ³, Fawad Sarwar ⁴, Haroon Ahmed ⁵.**Abstract**

Objective: A hybrid quantum-classical machine learning framework was proposed to evaluate whether quantum mechanics could extract high-dimensional patterns from small, localized patient registries, bypassing the small-data bottleneck entirely.

Methods: An algorithmic pipeline bridging classical preprocessing with quantum state manipulation was designed. Eight core features comprising four structural MRI parameters (tumour volume, oedema index, necrotic core ratio, and perfusion intensity) and four molecular markers were mapped into a low-dimensional Hilbert space using quantum amplitude encoding. A parameterized quantum circuit utilizing entangling layers (CNOT gates) was implemented to capture complex, non-local feature interactions simultaneously. The architecture was evaluated on a simulated retrospective cohort of fifty patients (N=50), computationally derived using open-access anonymized neuro-oncology repositories (The Cancer Imaging Archive / TCGA-GBM database), to mirror local clinical constraints.

Results: While standard classical models (multi-layer perceptrons and random forests) failed to generalize due to severe overfitting on the small training sample, the HQCNN pipeline demonstrated robust convergence. The quantum-enhanced model achieved an evaluation area under the receiver operating characteristic curve (AUC-ROC) of 0.94 in classifying 1-year survival rates and potential chemotherapy resistance.

Conclusion: This framework demonstrates that shifting the clinical focus from massive data accumulation to quantum-inspired algorithmic efficiency offers a scalable, low-cost path to personalized neuro-oncological care. By deploying such models via cloud-based quantum networks, local institutions across Pakistan can leverage existing, small-scale patient volumes to generate accurate, personalized treatment pathways.

Keywords: (Glioblastoma Prognosis ,Quantum Machine Learning ,Data Scarcity In Resource Constrained Settings)

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