ASIA UNIVERSITY

QUANTUM

Newsletter

issue 5-2025, Nov. 7, 2025

AI and Quantum Research Center (AIQRC), Asia University, Taiwan

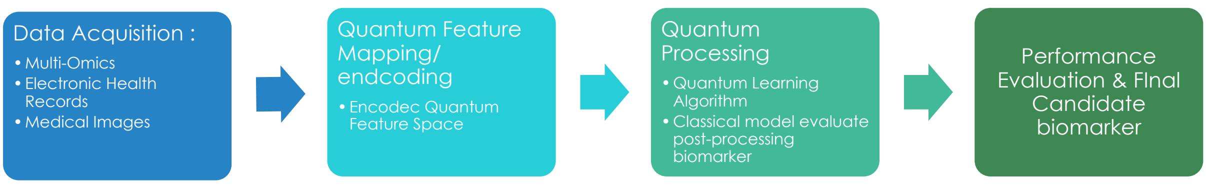
Activity
Time/Place: Nov. 13-14, 2025, Asia University, Taichung
Title: INTERNATIONAL SYMPOSIUM ON QUANTUM AI & THE FUTURE OF LIFE
Registration is Free. Use this link to register: https://shorturl.at/nv0Cx

Unlocking the Quantum Future of Precision Medicine: Biomarker Discovery in the Age of QML

The new generation of Quantum Machine Learning (QML) is reshaping how we process complex biological data. As highlighted by Flöther et al. (2025), QML offers the ability to handle exponentially large data states, enabling deeper exploration of multi-omics datasets such as genomics, proteomics, and metabolomics more efficiently. By mapping biological features into quantum space, QML allows information processing that can reveal hidden correlations among biomarkers, providing a foundation for next-generation precision medicine.

Recent studies have shown how QML can make real progress in precision medicine. For example, Nguyen (2024) used a quantum neural network to find hidden gene patterns linked to immune response, while Priyadharshini et al. (2025) applied a hybrid quantum–classical approach to predict drug sensitivity from proteomics data. Both studies highlight that quantum circuits can capture complex biological relationships better than traditional models, showing how QML may help scientists uncover meaningful biomarkers and improve personalized treatments..

Conceptually, a QML-based precision medicine workflow can be visualized step-by-step, following the logic described by Flöther et al. (2025):



This workflow shows how quantum and classical methods can work together to make sense of large, complex datasets in a way that would be difficult for traditional machine learning alone.

However, QML still faces several important challenges. Current quantum hardware is affected by noise, has a limited number of qubits, and struggles to scale for very large datasets. In addition, benchmarking against classical machine learning is inconsistent, and results can vary across different quantum platforms. Adopting QML in clinical practice will take time, because its effectiveness in real-world digital health applications has not been consistently proven (Gupta et al., 2025).

Despite these challenges, the potential of QML is very promising and increasingly inevitable. As quantum hardware improves and hybrid quantum–classical methods develop, QML could play a key role in discovering biomarkers, predicting drug responses, and integrating multi-omics data. The field is gradually moving from theory to real-world applications, paving the way for a quantum-powered future in precision medicine.

References

1. Flöther, F. F., Blankenberg, D., Demidik, M., Jansen, K., Krishnakumar, R., Krishnakumar, R., Laanait, N., Parida, L., Saab, C. Y., & Utro, F. (2025). How quantum computing can enhance biomarker discovery. *Patterns (New York, N.Y.)*, *6*(6), 101236. https://doi.org/10.1016/j.patter.2025.101236
2. Nguyen P. N. (2024). Biomarker discovery with quantum neural networks: a case-study in CTLA4-activation pathways. *BMC bioinformatics*, *25*(1), 149. https://doi.org/10.1186/s12859-024-05755-0
3. Priyadharshini, M., Raju, B. D., Banu, A. F., Kumar, P. J., Murugesh, V., & Rybin, O. (2025). A quantum machine learning framework for predicting drug sensitivity in multiple myeloma using proteomic data. *Scientific reports*, *15*(1), 26553. https://doi.org/10.1038/s41598-025-06544-2
4. Gupta, R. S., Wood, C. E., Engstrom, T., Pole, J. D., & Shrapnel, S. (2025). A systematic review of quantum machine learning for digital health. *NPJ digital medicine*, *8*(1), 237. https://doi.org/10.1038/s41746-025-01597-z

---

Prepared by
Ezra B. Wijaya [1,2]
[1]Reproductive Health Center, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, Taiwan; ezrabw@tzuchi.com.tw
[2]Department of Physiotherapy, Faculty of Health Science and Technology, Binawan University, Jakarta. ezra.bwijaya@binawan.ac.id
Edited by
Ka-Lok Ng [3,4]
[3]Vice Director, AIQRC
[4]Distinguish Professor, Department of Bioinformatics and Medical Engineering, Asia University, Taiwan

AI and Quantum Research Center (AIQRC)

Room A110, Asia University, No. 500, LiuFeng Rd., WuFeng Dist., Taichung City 41354 Taiwan.

Email: qphys.qcomp@gmail.com   Office: 04-23323456 ext. 6631

Web: https://quantum.asia.edu.tw/