INNOVAPATH™
The Premier Journal Bridging Discovery & Innovation

Letter to the Editor
https://doi.org/10.63501/f1z4w933

Artificial Intelligence for Early Detection of Subclinical Atherosclerosis: A New Frontier in Preventive Cardiology

Laiba Fatima[1,2], Anam Haleem[1], Ali Ahmad Khan[3], Neiha Khalid[4], Muhammad Ali[1]

[1]Quaid-e-Azam Medical College, Bahawalpur, Pakistan

[3]Shahida Islam Medical and Dental College, Lodhran

[4]Allama Iqbal Medical College, Lahore, Pakistan

[2]Corresponding Author Email: laibafatima1285@gmail.com

Dear Editor,

Cardiovascular disease (CVD), the leading cause of mortality worldwide, often progresses silently for years until manifesting as symptomatic ischemia or infarction (1,2). Subclinical atherosclerosis, defined here as a coronary artery calcium (CAC) score > 0, carotid intima–media thickness (CIMT) above the 75th percentile, or the presence of non-obstructive plaque, typically remains undetected until significant structural or functional damage occurs. While conventional diagnostic tools like coronary CT angiography (CCTA) are resource-intensive and operator-dependent, artificial intelligence (AI) offers a transformative opportunity to bridge this gap using routine clinical and imaging data.

Recent advances in deep learning (end-to-end convolutional neural networks) and radiomics (hand-crafted feature extraction) have demonstrated remarkable precision in quantifying plaque burden. For example, AI-enhanced CCTA algorithms now enable fully automated CAC scoring with near-human accuracy ($r = 0.97$) in cohorts of 500+ patients, validated against expert readers across multiple cardiac and non-cardiac chest CT protocols (1,2). Similarly, CNNs applied to carotid ultrasound have achieved >90% sensitivity in identifying plaque morphology and stratifying stroke risk in studies of 200–300 patients (3). Machine-learning models that integrate non-imaging predictors, such as lipid profiles and ECG parameters, further refine risk estimation and outperform traditional ASCVD scores (4,5).

Future Directions and Regional Implementation:

In South Asia, where the CVD burden is high, proactive prevention is urgently needed. However, access to CCTA is limited in many primary-care and rural settings. Here, simple, scalable AI approaches—such as ECG-based models or smartphone-based retinal imaging—may provide practical, community-level screening. Opportunistic algorithms can also extract CAC scores from routine chest CT scans obtained for non-cardiac indications, expanding surveillance without additional radiation or cost (1,2).

Implementation considerations include:

1. Overdiagnosis and False Positives: Incidental low-risk findings may induce patient anxiety and trigger unnecessary downstream testing.

https://doi.org/10.63501/f1z4w933

2. Infrastructure and Cost: Limited digital infrastructure, high AI tool costs, and the need for workforce training may hinder adoption in low-resource environments.
3. Regulatory and Medico-Legal Aspects: Clear frameworks are required to define responsibility when AI output conflicts with clinician judgment.
4. Algorithmic Bias: AI models trained primarily on Western populations may underperform in South Asian or multi-ethnic cohorts due to differing plaque morphology. Future research should prioritize the use of ethnically diverse datasets.

A three-year prospective multicenter study in South Asia could evaluate AI-assisted detection against standard assessments, focusing on primary clinical outcomes such as statin prescription rates and long-term event prevention. Time-bound objectives would include dataset assembly and external validation within 12–18 months, followed by clinical evaluation and outcomes tracking. By leveraging AI, cardiology can shift from reactive intervention to proactive prevention, improving precision, accessibility, and ultimately CVD outcomes in high-risk populations.

Ethical Approval

Not applicable (no new human or animal subjects were involved; this narrative is based on published data). Data governance laws, including local regulations in Pakistan, should be respected in future studies.

Abbreviations:

- CAC: Coronary Artery Calcium
- CCTA: Coronary CT Angiography
- CIMT: Carotid Intima-Media Thickness
- CVD: Cardiovascular Disease
- AI: Artificial Intelligence

Conflict of Interest:

None

Ethical Consideration:

Not applicable (no new human or animal subjects were involved; this narrative is based on published data). Data governance laws, including local regulations in Pakistan, should be respected in future studies.

Declaration of AI Use:

This letter was drafted and revised with the assistance of an AI language model (ChatGPT, GPT-5, OpenAI) for grammar refinement, structural reorganization, and clarity enhancement. All intellectual content, interpretation, and final approval of the text are solely the responsibility of the authors.

Funding:

None

REFERENCES :

1. van Velzen, S. G. M., Lessmann, N., Velthuis, B. K., Bank, I. E. M., van den Bongard, D. H. J. G., Leiner, T., de Jong, P. A., Veldhuis, W. B., Correa, A., Terry, J. G., Carr, J. J., Viergever, M. A., Verkooijen, H. M., & Išgum, I. (2020). Deep Learning for Automatic Calcium Scoring in CT: Validation Using Multiple Cardiac CT and Chest CT Protocols. *Radiology*, *295*(1), 66–79. https://doi.org/10.1148/radiol.2020191621
2. Lin, A., Kolossváry, M., Motwani, M., Išgum, I., Maurovich-Horvat, P., Slomka, P. J., & Dey, D. (2021). Artificial Intelligence in Cardiovascular Imaging for Risk Stratification in Coronary Artery Disease. *Radiology. Cardiothoracic imaging*, *3*(1), e200512. https://doi.org/10.1148/ryct.2021200512
3. Jain, P. K., Dubey, A., Saba, L., Khanna, N. N., Laird, J. R., Nicolaides, A., Fouda, M. M., Suri, J. S., & Sharma, N. (2022). Attention-Based UNet Deep Learning Model for Plaque Segmentation in Carotid Ultrasound for Stroke Risk Stratification: An Artificial Intelligence Paradigm. *Journal of cardiovascular development and disease*, *9*(10), 326. https://doi.org/10.3390/jcdd9100326
4. Ambale-Venkatesh, B., Yang, X., Wu, C. O., Liu, K., Hundley, W. G., McClelland, R., Gomes, A. S., Folsom, A. R., Shea, S., Guallar, E., Bluemke, D. A., & Lima, J. A. C. (2017). Cardiovascular Event Prediction by Machine Learning: The Multi-Ethnic Study of Atherosclerosis. *Circulation research*, *121*(9), 1092–1101. https://doi.org/10.1161/CIRCRESAHA.117.311312
5. Poplin, R., Varadarajan, A. V., Blumer, K., Liu, Y., McConnell, M. V., Corrado, G. S., Peng, L., & Webster, D. R. (2018). Prediction of cardiovascular risk factors from retinal fundus photographs via deep learning. *Nature biomedical engineering*, *2*(3), 158–164. https://doi.org/10.1038/s41551-018-0195-0