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Editorial

Revolutionizing Cardio-Oncology: Utilizing Artificial Intelligence to Build a Cutting-edge Cancer Registry in Pakistan

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Keywords

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Abstract:
Cardio-oncology is a specialized field dedicated to providing effective cancer treatment with minimal cardiotoxicity. This field also encompasses ways to ensure timely identification and appropriate treatment of cardiovascular disease caused by cancer treatment. Cancer patients experience the highest mortality from cardiovascular disease [1]. This signifies the importance of this field. Currently, the data on the outcomes of specialized cardio-oncology services is limited; there is a pressing need to start establishing a comprehensive and standardized Cardio-Oncology Registry (COR). Implementation of the COR would play an instrumental role in providing a

cardiovascular health profile of patients to caregivers and medical staff after their diagnosis and treatment.

Main Text:

The use of artificial intelligence can provide a distinctive advantage in the implementation and development of the Cardio-Oncology Registry, as it can help to integrate patient data sets with extensive detailing from electronic health records (EHR). In addition to this, relevant radiological images can be analyzed by AI-assisted software to understand and report patterns in adverse outcomes related to cardiovascular events. On the other hand, the use of advanced machine learning (ML) techniques can play a significant role in running complex analysis, which can not only identify subtle patterns and associations between variables but also uncover risk factors that have previously not been identified through standard methods. In addition, keeping in perspective the toxicities associated with cancer treatments, AI could play an instrumental role in predicting cardiotoxicity-related adverse events. The authors believe that given the manual work and errors related to data entry, AI can identify specific data sets relevant for the registry, thus streamlining data entry for better data organization and effective tracking of cardiac health in patients undergoing cancer treatment.

To develop an effective AI-powered Cardio-Oncology Registry, appropriate software and hardware are essential. Python, with its rich libraries, is ideal for data preprocessing and EHR integration, while TensorFlow and PyTorch are suited for building deep learning models. MATLAB can assist in signal processing for wearable data, and R is useful for statistical analysis. For data storage and retrieval, SQL/NoSQL databases are needed, and large-scale processing may require tools like Apache Spark. On the hardware side, high-performance workstations with GPUs (e.g., NVIDIA RTX 3090 or A100), 64–128 GB RAM, and SSD storage are necessary for training models. Edge devices like Raspberry Pi or NVIDIA Jetson Nano can collect real-time data from sensors. Cloud platforms such as AWS, Google Cloud, or Azure provide scalable infrastructure and secure EHR integration.

The COR can also be integrated with AI-powered machine learning algorithms, for instance, in a wearable device format. Such a device, with the help of sensors, could record important variables in real time and store them in the registry [2]. The role of such integration would be to record and decipher changes in the patient's cardiac health and would provide insights into certain unfavorable outcomes associated with Cardio-Oncology. When data deviate from healthy baselines, AI-powered alarms may notify the physicians, warning them of potential cardiac malfunction. Integration of such complex AI algorithms is undoubtedly the gateway to building a highly comprehensive COR that could revolutionize the field.

The first Global Cardio-Oncology Registry (G-COR) is a multinational prospective cohort study that began its international phase in 2023 and is expected to be completed in 2027. Its goal is to collect clinical, laboratory, imaging, demographic, and socioeconomic data to identify potential risk factors associated with therapy-related cardiovascular toxicity. The study will involve 124 hospitals across 24 countries [3]. Additionally, the BRAVADO cancer registry in Brazil focuses on cancer patients with acute coronary syndrome (ACS) and is still recruiting patients [4]. The

CONFUCIUS COR is a single-center prospective registry in Paris, France, currently recruiting all patients referred for cardio-oncology assessment [5]. So far, no such COR has been established in Pakistan, highlighting an urgent need to establish one.

A multidisciplinary steering committee comprising oncologists, cardiologists, data scientists, and bioethicists could oversee data quality, ethical compliance, and governance of the registry. The AI workflow may involve mapping EHR data to risk modelling, imaging to cardiotoxicity detection using convolutional neural networks (CNNs), and wearable data to real-time anomaly detection via models like LSTMs. Privacy safeguards should include de-identification, encrypted storage, and role-based access controls. A phased rollout could begin with a single-center proof-of-concept, followed by gradual expansion to additional sites. One key lesson from existing registries such as G-COR is the importance of clinician engagement, which could be supported through feedback loops, training, and accessible data dashboards.

While there is monumental potential to utilize AI for this purpose, it is unfortunate that low- and middle-income countries (LMICs) such as Pakistan are often constrained by limited resources and poor health infrastructure. In a 2019 Global Burden of Disease study, Pakistan's age-adjusted incidence of cardiovascular disease was 918.18 per 100,000 people (compared to the global average of 684.33 per 100,000) [6]. These values depict the immense cardiovascular burden in our population, which is only further exacerbated by cancer therapies. While the authors understand that incorporating AI is difficult in LMICs, it is not impossible. If dedicated efforts are made to recognize cardio-oncology and its importance, then it would be possible to build such a cutting-edge registry and leverage AI to improve health outcomes (Figure 1). Therefore, our manuscript provides a scalable blueprint for establishing an AI-assisted COR to enable early cardiotoxicity detection and enhanced cardiac care in resource-limited settings.

Conclusion:

AI-assisted cardio-oncology registry is a critical initiative that could lead to better patient management and risk prediction. Such registries, especially in resource constrained countries could improve health outcomes and reduce cancer associated cardiovascular burden.

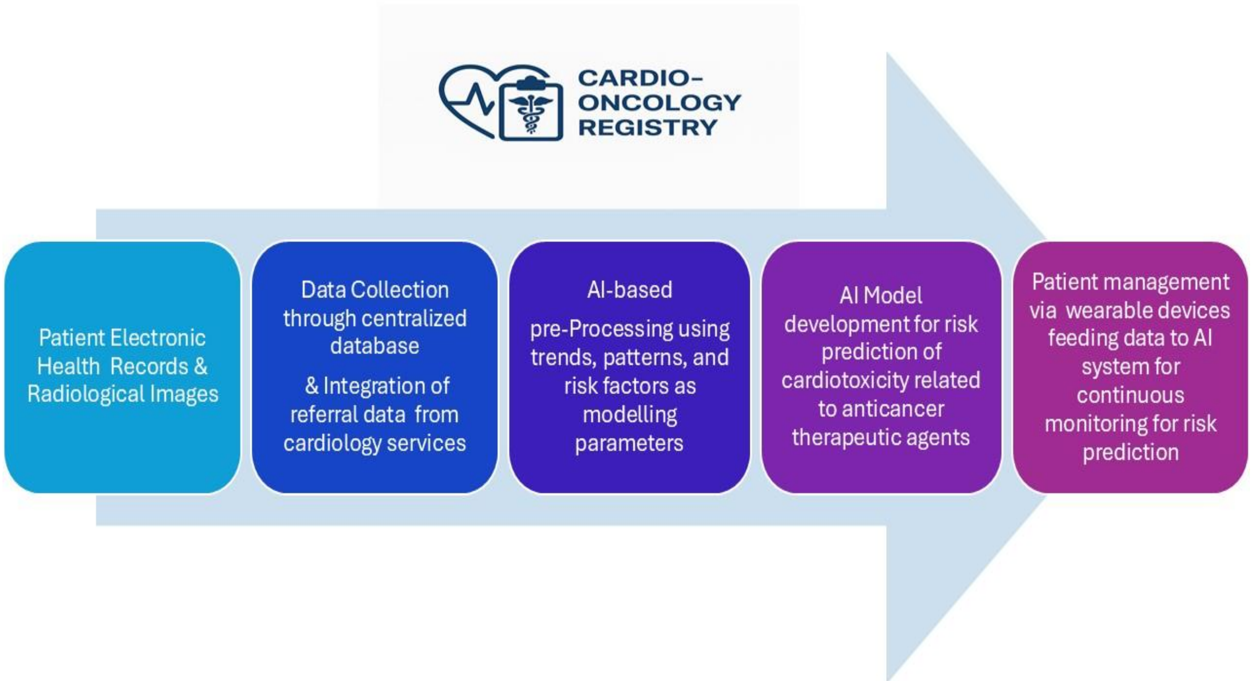

Figure 1: Visual Flow diagram illustrating the key application of artificial intelligence in the implementation and development of the Cardio-Oncology registry.

List of Abbreviations:

COR: Cardio-Oncology Registry

EHR: Electronic Health Records

ML: Machine Learning

G-COR: Global Cardio-Oncology Registry

CNNs: Convolutional Neural Networks

ACS: Acute Coronary Syndrome

Author Contributions

RHS: Conceptualization, Methodology, Software, Data Curation, Writing - Original Draft, Writing - Review & Editing, Visualization, Project administration.
AR: Conceptualization, Methodology, Software, Data Curation, Writing - Original Draft, Writing - Review & Editing, Visualization, Supervision, Project administration.
SRK: Conceptualization, Methodology, Software, Data Curation, Writing - Original Draft, Writing - Review & Editing, Visualization, Supervision, Project administration.

Conflicts of interest

The authors declare no conflict of interest.

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