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Editorial

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

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**Abstract**
Cardio-oncology is a specialized field focused on delivering effective cancer therapies while minimizing cardiotoxicity. It also involves strategies for the timely identification and appropriate management of cardiovascular complications arising from cancer treatment. Cancer patients have the highest mortality from cardiovascular disease, underscoring the critical importance of the field of cardio-oncology. Currently, data on the outcomes of specialized cardio-oncology services are limited, highlighting a pressing need to establish a comprehensive and standardized Cardio-Oncology Registry (COR). Implementation of the COR would play a significant role in providing caregivers and medical staff with a cardiovascular health profile of patients after their diagnosis and treatment.

**Keywords:**
cardio-oncology; cardiotoxicity; artificial intelligence; machine learning; registry

## 1. Artificial Intelligence in Cardio-Oncology

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). Moreover, relevant radiological images can be analyzed using AI-assisted software to identify and report patterns of adverse outcomes related to cardiovascular events [1]. 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, due to the manual workload and potential errors in data entry, AI can identify relevant datasets for the registry, streamlining data input and enabling better organization and more effective tracking of cardiac health in cancer patients.

To develop an effective AI-powered Cardio-Oncology Registry, appropriate software and hardware are essential. Python, with its extensive 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

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R is useful for statistical analysis. For data storage and retrieval, SQL/NoSQL databases are essential, 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 such as 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, employing integrated sensors, could continuously record key variables in real time and systematically store them in the registry [2]. The role of such integration would be to monitor and analyze changes in patients' cardiac health, providing insights into adverse outcomes associated with cardio-oncology. When data deviates from healthy baselines, AI-powered alarms may alert physicians, warning them of potential cardiac malfunction. The integration of such complex AI algorithms is a crucial step toward building a comprehensive COR that could revolutionize the field.

The first Global Cardio-Oncology Registry (G-COR) is a multinational prospective cohort study that commenced its international phase in 2023 and is anticipated to conclude 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]. To date, no such Cardio-Oncology Registry (COR) has been established in Pakistan, underscoring the urgent need to develop 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 such as 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.

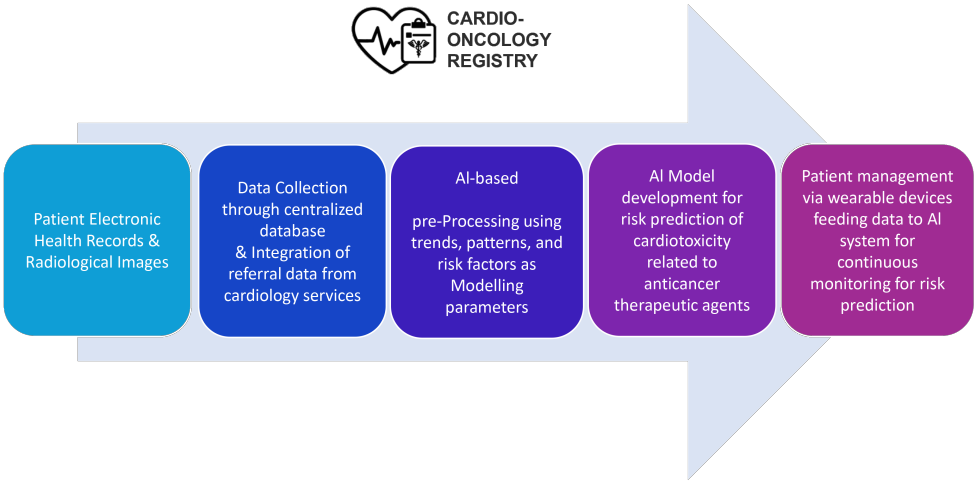


**Figure 1:** Visual Flow diagram illustrating the key application of artificial intelligence in the implementation and development of the Cardio-Oncology registry.

Although AI holds tremendous potential for this purpose, low- and middle-income countries (LMICs) such as Pakistan are often constrained by limited resources and underdeveloped 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 un-

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derstand that incorporating AI is challenging in LMICs, it is not impossible. With dedicated efforts to recognize the significance of cardio-oncology, it would be possible to establish such a cutting-edge registry and harness AI to improve patient outcomes (Figure 1). Therefore, this manuscript presents a scalable framework for establishing an AI-assisted Cardio-Oncology Registry (COR) to facilitate early cardiotoxicity detection and improve cardiac care in resource-limited settings.

## 2. Conclusions

An AI-assisted Cardio-Oncology Registry represents a critical initiative with the potential to enhance patient management and risk prediction. Such registries, particularly in resource-constrained countries, could improve health outcomes and reduce the cardiovascular burden associated with cancer.

## List of Abbreviations

| | |
|---|---|
| ACS | Acute Coronary Syndrome |
| CNNs | Convolutional Neural Networks |
| COR | Cardio-Oncology Registry |
| EHR | Electronic Health Records |
| G-COR | Global Cardio-Oncology Registry |
| ML | Machine Learning |

## Author Contributions

R.H.S.: Conceptualization, Methodology, Software, Data Curation, Writing---Original Draft, Writing---Review & Editing, Visualization, Project administration. A.R.: Conceptualization, Methodology, Software, Data Curation, Writing---Original Draft, Writing---Review & Editing, Visualization, Supervision, Project administration. S.R.K.: Conceptualization, Methodology, Software, Data Curation, Writing---Original Draft, Writing---Review & Editing, Visualization, Supervision, Project administration. All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

The authors declare no conflicts of interest.

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