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Trustworthy implementation of artificial intelligence in cardiology: a roadmap of the European Society of Cardiology

Folkert W. Asselbergs [1,2,3,]* and Thomas F. Lüscher [4,5,6,7]

[1]Department of Cardiology, Amsterdam University Medical Center, University of Amsterdam, Amsterdam, The Netherlands; [2]Health Data Research UK and Institute of Health Informatics, University College London, London, UK; [3]The National Institute for Health Research University College London Hospitals Biomedical Research Centre, University College London, London, UK; [4]Cardiac Unit, Royal Brompton and Harefield Hospitals, London, UK; [5]National Heart and Lung Institute, Imperial College London, UK; [6]Cardiovascular Academic Group, King's College, London, UK; and [7]Center for Molecular Cardiology, University of Zurich, Wagistrasse 12, 8952 Schlieren, Zurich, Switzerland

Artificial intelligence (AI) is set to revolutionize cardiology, offering transformative advancements in diagnosis, treatment, and patient outcomes.[1] However, the integration of AI into clinical practice must be approached with precision and caution to ensure that these technologies are trustworthy, evidence-based, and ultimately beneficial for patients. Recognizing this, the European Society of Cardiology (ESC) has recently established the Digital Cardiology and Artificial Intelligence (DCAI) Committee. This committee is dedicated to developing a comprehensive roadmap as illustrated in *Figure 1* for the responsible implementation of AI in cardiology, ensuring the highest standards of patient care.

Objectives of the AI implementation roadmap

Ensuring data quality and integrity

High-quality data are the foundation of effective AI in healthcare. The roadmap will establish the standards and protocols necessary to ensure that the data used in AI systems are consistent, reliable, and free from bias.[2] This includes addressing potential biases in data collection and processing, as well as establishing robust data governance practices that prioritize patient privacy and data security.[3]

Standardising disease definitions and outcomes

For AI to be effectively integrated into cardiology, the consistent use of standardized, computable definitions for diseases and clinical outcomes is essential.[4] The roadmap will support the creation of these standardized definitions, ensuring that they are easily integrated into AI algorithms and can support clinical decision-making across various clinical settings. Our ambition is to provide a phenotype library with data-computable phenotype and outcome definitions. This standardisation will be key in advancing research, the development of computable guidelines, and ensuring that AI tools are applied consistently and accurately.

Creating a robust evaluation framework and establishing evidence requirements for clinical trials

A comprehensive framework for evaluating AI tools is crucial for ensuring their safety, effectiveness, and ethical soundness. The number of proper trials within the field of cardiovascular disease (CVD) and application of AI is too limited to provide the evidence level we need for the ESC Guidelines.[5] The roadmap will—in close collaboration with European Agencies (e.g. European Medical Agency, notified bodies)—establish criteria for assessing AI algorithms, focusing on accuracy, transparency, and fairness. It will emphasize the importance of independent third-party evaluations to provide unbiased assessments of AI tools before they are integrated into clinical practice and adopted by clinical guidelines. In conjunction with this, the roadmap will outline the evidence requirements for validating AI tools through clinical trials and develop evidence levels for the ESC Guidelines. This includes the need for rapid-cycle trials embedded within routine clinical care which allow for timely innovation while maintaining rigorous evidence standards. By defining appropriate short-term outcome measures for AI validation, the roadmap will balance the need for robust evidence with the urgency of implementing new technologies.

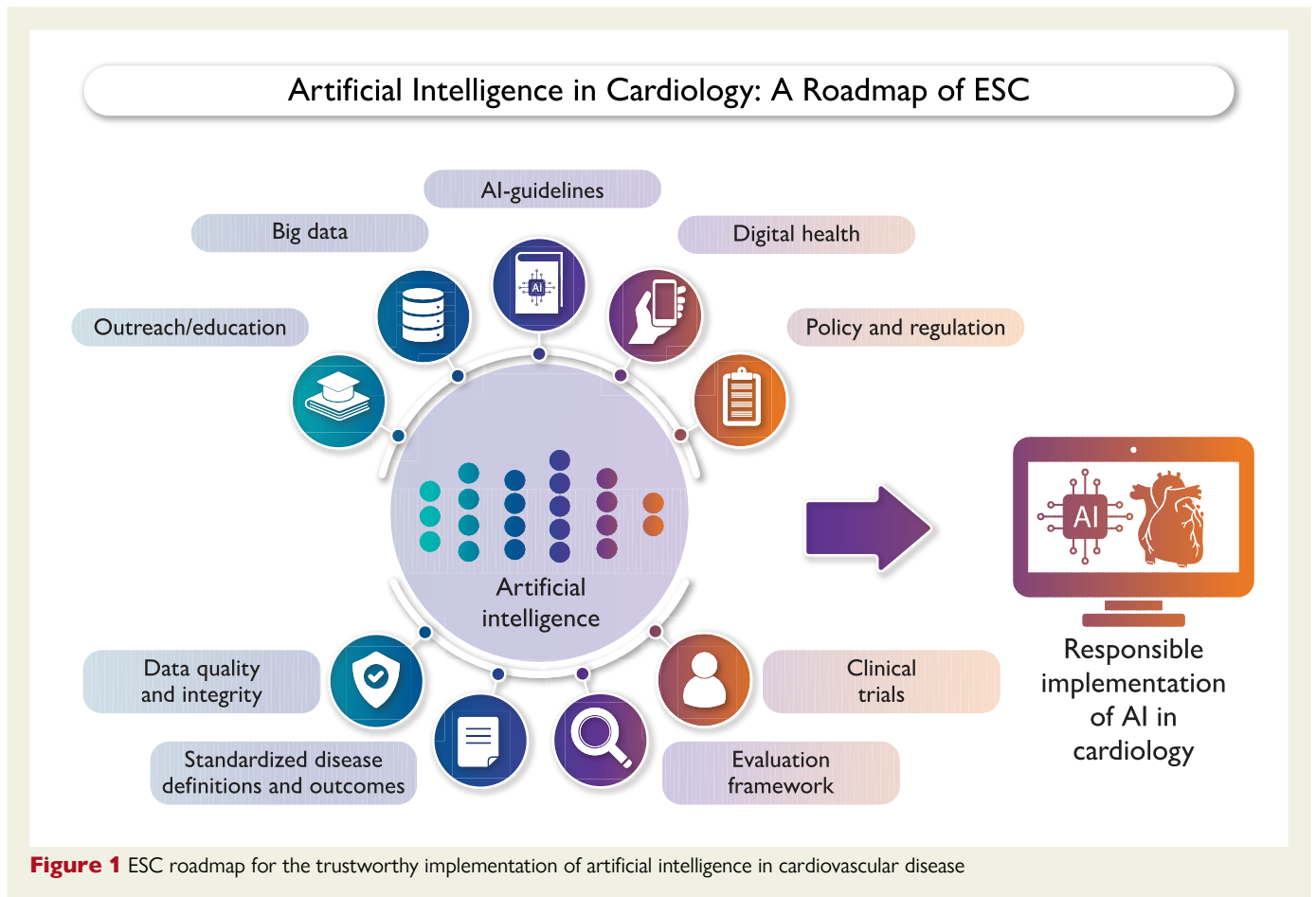* Corresponding author. Email: f.w.asselbergs@amsterdamumc.nl

Figure 1 ESC roadmap for the trustworthy implementation of artificial intelligence in cardiovascular disease

Sub-themes within the DCAI committee

To successfully achieve its objectives, the DCAI Committee has identified several critical sub-themes.

Outreach, education, and stakeholder engagement

Empowering the cardiology workforce to understand, evaluate, and adopt AI is essential. The roadmap will include comprehensive educational initiatives such as the organisation of workshops and teaching modules that will help healthcare professionals to understand the underlying methodology and evaluate the generated evidence of presented studies.[6] Furthermore, domain-specific educational activities will be coordinated in collaboration with the relevant ESC Associations.

The success of AI implementation hinges on the active involvement of all relevant stakeholders including regulators, professional societies, patients, notified bodies, and the medical industry. The roadmap will facilitate ongoing dialogue among these groups through the organisation of collaborative events, including an annual ESC Digital & AI Summit, to foster cooperation and address regulatory, ethical and legal issues that limit the implementation of evidence-based AI.

Big data

The roadmap will promote the establishment of a network of centres of excellence with high data maturity to share best practices and provide the needed evidence for AI integration and mutual validation. This network will work to harmonize CVD definitions in close collaboration with the ESC Data Science Committee, guiding trial inclusion and outcome criteria and enabling integration of future clinical-decision support tools. Finally, this network will be dedicated to AI evaluation through pragmatic clinical trials within routine-care settings. By creating a cohesive and standardized approach to data and AI evaluation, the roadmap aims to enhance the reliability and effectiveness of AI-driven solutions in cardiology.

AI-guidelines development

Professional guidelines are the cornerstone of our society that provides evidence-based recommendations to our stakeholders. A framework to evaluate the evidence needed before implementation of AI algorithms within routine care is currently lacking and guidance is urgently needed. Therefore, close collaboration with the ESC Guideline Committee will be crucial in developing AI-specific guidelines including the levels of evidence required for AI tools. The roadmap will also explore how AI itself can contribute to future guideline development and user-friendly applications, ensuring that the integration of AI into clinical practice is guided by the latest evidence and best practices.

Policy and regulation

Engagement with regulators and health-technology assessment bodies is essential to influence policy and to ensure ethical, effective integration of AI into healthcare. The roadmap will align with the ESC Advocacy Group to address these challenges, advocating for policies that support the safe and responsible use of AI in cardiology.[7]

Digital health

The roadmap will also consider the role of emerging technologies such as wearables and robotics which are increasingly relevant in cardiology as important data providers for clinically useful algorithms. Indeed, these technologies can be significantly enhanced through AI, offering new possibilities for patient care and monitoring. By integrating AI with these digital health tools, the roadmap aims to push the boundaries of what is possible in cardiology.

Conclusion

AI holds tremendous potential to transform cardiology, but its integration must be carefully managed to ensure that these advancements are trustworthy and genuinely beneficial for patients. The ESC's DCAI Committee is committed to developing a comprehensive roadmap that addresses the challenges and opportunities of AI in cardiology. By focusing on critical areas such as data quality, evaluation frameworks, stakeholder engagement, and continuous collaboration, the ESC aims to lead the way in the safe and effective use of AI in cardiology. This roadmap will serve as a vital guide for cardiologists, ensuring that AI is integrated into clinical practice in a manner that improves patient outcomes and maintains the highest standards of care.

Declarations

Disclosure of Interest

Nothing to declare.

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