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editorial-office@sciformat.ca

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ARTIFICIAL INTELLIGENCE IN CARDIOLOGY: APPLICATIONS ACROSS ELECTROCARDIOGRAPHY AND CARDIOVASCULAR IMAGING

Radosław Gryko *(Corresponding Author, Email: r-gryko@wp.pl)*
Copernicus Memorial Hospital, Pabianicka 62, 93-513 Lodz, Lodzkie, Poland
ORCID ID: 0009-0002-8215-7011

Paulina Jarząbek
Medical University of Lodz, Lodz, Lodz Voivodeship, Poland
ORCID ID: 0009-0003-9859-1362

Norbert Grabias
Karol Jonscher Municipal Medical Center, Milionowa 14, 93-113 Lodz, Lodzkie, Poland
ORCID ID: 0009-0009-3681-5096

Bernard Myszewski
Copernicus Memorial Hospital, Pabianicka 62, 93-513 Lodz, Lodzkie, Poland
ORCID ID: 0009-0000-0027-0789

Maria Rajkowska
Copernicus Memorial Hospital, Pabianicka 62, 93-513 Lodz, Lodzkie, Poland
ORCID ID: 0009-0005-2822-0595

Anna Kinga Tejchma
University Clinical Hospital No. 2 of the Medical University of Lodz, ul. S. Żeromskiego 113, 90-549 Lodz, Lodzkie, Poland
ORCID ID: 0009-0007-7322-5517

Łukasz Dominik Woźniak
Medical University of Lodz, Lodz, Lodz Voivodeship, Poland
ORCID ID: 0009-0007-5634-3810

Aleksandra Włodarczyk
Copernicus Memorial Hospital, Pabianicka 62, 93-513 Lodz, Lodzkie, Poland
ORCID ID: 0009-0007-5456-6703

Jędrzej Piotrowski
Copernicus Memorial Hospital, Pabianicka 62, 93-513 Lodz, Lodzkie, Poland
ORCID ID: 0000-0001-8044-5496

Julia Weronika Mieszkowska
Healthcare Complex in Łęczyca, Zachodnia 6, 99-100 Łęczyca, Poland
ORCID ID: 0009-0001-7699-9880

ABSTRACT

Objective: The objective of this narrative review was to summarize and critically appraise current clinical applications of artificial intelligence (AI) in cardiology, with particular emphasis on arrhythmia detection and cardiovascular imaging modalities.
Methods: A selective narrative review of peer-reviewed literature published between 2015 and 2025 was performed using PubMed, Scopus, and Web of Science. Studies were selected based on clinical relevance, validation methodology, and reported diagnostic or prognostic performance in human populations.
Results: AI-based algorithms demonstrate diagnostic performance comparable to expert interpretation in atrial fibrillation (AF) detection as well as across echocardiography, coronary computed tomography angiography (CCTA), cardiac magnetic resonance imaging (CMR), and intravascular optical coherence tomography (OCT). Beyond diagnostic accuracy, AI has been shown to reduce analysis time and interobserver variability in controlled and retrospective study settings. However, the majority of available studies are retrospective, rely on curated datasets, and lack prospective validation demonstrating a direct impact on clinical outcomes.
Conclusions: AI constitutes a valuable decision-support tool in contemporary cardiology, enhancing diagnostic efficiency and risk stratification across multiple imaging and electrophysiological modalities. Nevertheless, broader clinical adoption will require rigorous external validation, improved model interpretability, and prospective outcome-driven studies. This review uniquely integrates evidence across electrophysiology and multiple imaging modalities to identify shared translational challenges and near-term clinical opportunities for AI in cardiology.

KEYWORDS

Artificial Intelligence, Machine Learning, Cardiology, Atrial Fibrillation, Cardiovascular Imaging

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Methods

This study was conducted as a narrative review aimed at synthesizing clinically relevant evidence on the application of AI in cardiology. The review design was chosen to allow a critical and integrative discussion of heterogeneous study types rather than a formal quantitative synthesis.

Study design

A narrative, descriptive review approach was applied. The focus was placed on real-world clinical applications of AI in electrocardiography and cardiovascular imaging, with emphasis on diagnostic performance, prognostic value, and workflow implications.

Data sources and collection

A structured literature search was performed using PubMed, Scopus, and Web of Science. Peer-reviewed articles published between January 2015 and January 2025 were considered. Search terms included combinations of: *artificial intelligence*, *machine learning*, *deep learning*, *electrocardiography*, *atrial fibrillation*, *echocardiography*, *coronary computed tomography angiography*, *cardiac magnetic resonance*, and *optical coherence tomography*. Reference lists of key review articles and original studies were manually screened to identify additional relevant publications.

Study selection

Studies were eligible if they: involved human subjects; evaluated AI-based methods applied to ECG or cardiovascular imaging; and reported clinically interpretable outcomes, such as diagnostic accuracy metrics, prognostic associations, or workflow-related measures. Technical studies without clinical data, conference abstracts, case reports, and non-English publications were excluded.

Data analysis and synthesis

For each included study, information on study population, AI methodology, clinical modality, reference standard, and principal outcomes was extracted. Due to substantial heterogeneity in study designs, datasets, and AI architectures, no meta-analysis was performed. Instead, findings were analyzed qualitatively and synthesized thematically according to clinical application domains. Particular attention was given to validation strategy, generalizability, and potential sources of bias.

Introduction

Cardiovascular diseases remain the leading cause of morbidity and mortality worldwide, placing a substantial and growing burden on healthcare systems. Contemporary cardiology increasingly relies on data-intensive diagnostic modalities, including electrocardiography and advanced cardiovascular imaging, to support diagnosis, risk stratification, and therapeutic decision-making. While these technologies provide rich anatomical and functional information, their interpretation is often time-consuming, resource-intensive, and subject to significant interobserver variability. Unlike prior reviews that focus on individual applications or single diagnostic modalities, this review adopts a cross-modality perspective to examine shared translational challenges of AI across electrophysiology and cardiovascular imaging. The rising volume and complexity of cardiovascular data have therefore intensified interest in AI as a means to augment clinical workflows and support, rather than replace, expert clinical judgment.

AI techniques, particularly machine learning (ML) and deep learning (DL), enable automated pattern recognition and quantitative analysis of large-scale datasets. In cardiology, AI has been applied across a wide spectrum of clinical tasks, including arrhythmia detection, image segmentation, functional quantification, plaque characterization, and outcome prediction. Numerous studies report high diagnostic accuracy and strong technical performance across these applications. Even so, impressive algorithmic metrics do not necessarily translate into clinical benefit, and the real-world relevance, generalizability, and safety of AI-based tools require careful and critical evaluation within routine clinical settings.

Existing reviews of AI in cardiology have often focused on individual applications or single diagnostic modalities, such as AF detection from electrocardiograms or automated analysis of specific imaging techniques. While these modality-specific perspectives provide valuable insights, they may overlook broader translational patterns that extend across electrophysiology and cardiovascular imaging. Emerging evidence suggests that many barriers to clinical adoption—such as reliance on retrospective and curated datasets, limited external validation, challenges related to interpretability, and uncertainty regarding impact on patient outcomes—are shared across AI applications, regardless of modality.

A cross-modality perspective may therefore offer additional insight into where AI is most likely to deliver near-term clinical value and where important gaps remain. By examining AI applications across arrhythmia detection and multiple imaging domains, it becomes possible to identify common strengths, limitations, and implementation barriers that are not apparent when modalities are considered in isolation. Such an integrated approach may also help clarify whether AI primarily enhances diagnostic accuracy, improves efficiency and reproducibility, or supports new paradigms of risk stratification within contemporary cardiology.

Accordingly, this narrative review critically examines current clinical applications of AI in AF detection and major cardiovascular imaging modalities, including echocardiography, CCTA, CMR imaging, and intracoronary imaging**.** By integrating evidence across electrophysiology and imaging, this review aims to identify shared translational challenges and to clarify the clinical contexts in which AI-based tools are most likely to provide meaningful and scalable decision support in c ontemporary cardiology.

Clinical Applications of Artificial Intelligence in Cardiology

1. Artificial Intelligence in Atrial Fibrillation Detection and Prediction

AF is the most common sustained cardiac arrhythmia and represents a major contributor to global cardiovascular morbidity and mortality. The arrhythmia promotes the formation of intracardiac thrombi, which in turn increases the risk of ischemic stroke, myocardial infarction, pulmonary embolism, and peripheral arterial thrombosis. These complications are closely associated with increased mortality and long-term disability. Importantly, AF does not always cause immediate or recognizable symptoms such as chest pain, dyspnea, or palpitations. As a result, many individuals remain unaware of the arrhythmia and are exposed to preventable thromboembolic risk, highlighting the need for improved strategies for early detection and risk stratification. [Freedman et al., 2021]

AI has emerged as a promising approach to address these diagnostic challenges by enabling automated analysis of large-scale electrocardiographic data. By leveraging ML and DL techniques, AI-based systems can identify complex patterns and subtle electrophysiological signatures associated with AF risk that are not apparent to human readers. This section summarizes current clinical applications of AI in AF detection and prediction, with particular emphasis on sinus rhythm ECG analysis, AI-guided screening strategies, enhancement of rhythm monitoring devices, and potential prognostic and preventive implications. [Freedman et al., 2021]

1.1 AI-based detection of atrial fibrillation from sinus rhythm ECGs

One of the most extensively studied applications of AI in cardiology is the detection of AF from standard 12-lead electrocardiograms recorded during sinus rhythm. DL models have demonstrated the ability to identify subtle ECG features associated with prior or future AF episodes, including variations in atrial conduction and P-wave morphology, which are not detectable using conventional ECG interpretation. This capability represents a conceptual shift from arrhythmia detection toward risk prediction based on latent electrical remodeling. [Attia et al., 2019; Raghunath et al., 2021]

Large retrospective studies using datasets comprising hundreds of thousands to millions of ECG recordings have reported area under the receiver operating characteristic curve (AUC) values typically ranging from 0.84 to 0.90 for AF detection or prediction. These performance metrics are comparable to expert interpretation and have been replicated across multiple cohorts. Collectively, these findings suggest that AI-based ECG analysis may enable earlier identification of individuals at increased risk of AF and AF-related complications, including ischemic stroke, potentially extending the clinical value of routinely acquired ECGs. [Attia et al., 2019; Melzi et al., 2021; Raghunath et al., 2021]

Although these results are promising, important limitations must be acknowledged. Most studies in this domain are retrospective and rely on highly curated datasets derived from single healthcare systems, raising concerns regarding external validity and generalizability. Furthermore, model performance has been shown to depend on age distribution, comorbidity burden, and baseline AF prevalence within the training population. These factors indicate that population-specific calibration and careful clinical validation will be required prior to widespread clinical implementation. [Freedman et al., 2021]

1.2 AI-guided screening and monitoring strategies for atrial fibrillation

Beyond single ECG interpretation, AI has been applied to guide AF screening strategies that incorporate repeated ECG recordings, wearable devices, and prolonged rhythm monitoring. AI-driven risk stratification enables identification of individuals most likely to benefit from intensified screening, potentially improving efficiency compared with opportunistic or population-wide screening approaches. Such strategies are particularly relevant in populations at elevated risk of stroke, where early AF detection may have direct therapeutic implications. [Noseworthy et al., 2022; Khera et al., 2024]

Prospective and retrospective studies demonstrate that AI-guided screening approaches increase AF detection rates compared with standard care. Integration of AI algorithms with prolonged rhythm monitoring and device-based recordings enhances sensitivity for short, paroxysmal, or intermittent AF episodes that may otherwise remain undetected using conventional monitoring strategies. This body of evidence suggest that AI may support more targeted and efficient screening pathways by optimizing the allocation of monitoring resources. [Noseworthy et al., 2022; Khera et al., 2024]

However, increased detection sensitivity may come at the cost of overdiagnosis, particularly of brief or low-burden AF episodes with uncertain clinical significance. The prognostic relevance of such episodes and their implications for anticoagulation decisions remain incompletely defined. This uncertainty underscores the need for prospective, outcome-driven studies to determine clinically meaningful thresholds for AI-detected AF and to guide evidence-based management strategies. [Freedman et al., 2021]

1.3 AI enhancement of implantable and wearable rhythm monitoring

AI has also been applied to improve the diagnostic performance of implantable loop recorders and wearable rhythm monitoring devices by reducing false-positive detections. Conventional device algorithms frequently misclassify noise, ectopic beats, or motion artifacts as AF, particularly during short-duration episodes, leading to unnecessary alerts and increased clinician workload. [Mittal et al., 2021]

Deep neural network (DNN)–based filtering and classification algorithms substantially improve the positive predictive value of device-detected AF, especially for short episodes commonly misclassified by traditional approaches. These improvements may reduce the burden of manual adjudication, increase clinician confidence in device-generated alerts, and enhance the feasibility of large-scale rhythm monitoring in routine clinical practice. [Mittal et al., 2021]

Nevertheless, validation studies remain limited in size and duration, and most analyses rely on expert adjudication rather than hard clinical outcomes as reference standards. Whether improved algorithmic accuracy translates into better patient management, more appropriate therapeutic decisions, or improved clinical outcomes has yet to be conclusively demonstrated. [Mittal et al., 2021]

1.4 Prognostic and preventive implications of AI-based AF prediction

Several studies have explored the prognostic potential of AI-based ECG analysis to identify individuals at increased risk of developing AF-related complications, including ischemic stroke. Simulation analyses suggest that AI-guided screening may enable targeted monitoring strategies, potentially improving efficiency compared with population-wide screening approaches and supporting earlier preventive interventions. [Raghunath et al., 2021]

Although these theoretical benefits are well recognized, real-world implementation remains challenging. The balance between screening intensity, healthcare resource utilization, and clinical benefit has not been fully established, and randomized trials evaluating AI-guided AF prevention strategies are currently lacking. At present, across modalities, the most consistent near-term value of AI appears to lie in workflow optimization, standardized quantification, and clinical decision support in high-volume diagnostic settings, rather than in fully autonomous clinical decision-making. [Freedman et al., 2021; Khera et al., 2024]

2. Artificial Intelligence in Echocardiography

Echocardiography is the most commonly used non-invasive method for assessing cardiac morphology and function, providing key prognostic information across a wide range of cardiovascular diseases. *Nonetheless*, manual interpretation is time-consuming and requires extensive experience and a high level of operator expertise. These limitations have driven the development of artificial intelligence–based approaches aimed at automating image interpretation while preserving clinical reliability.

Lau et al. developed a DL framework based on a three-dimensional convolutional neural network (CNN) capable of automatically classifying standard echocardiographic views and quantifying key structural and functional parameters, including left atrial size, left ventricular (LV) wall thickness, chamber dimensions, and left ventricular ejection fraction (LVEF), without the need for manual image segmentation. The model was trained on more than 64,000 echocardiograms from a large multicenter retrospective cohort and validated both in a primary care population and an external dataset, demonstrating stable performance beyond the training environment. The algorithm achieved excellent accuracy in view classification (AUC > 0.97 for apical four-chamber, apical two-chamber, and parasternal long-axis views) and showed moderate-to-high agreement with clinically reported quantitative measurements ($R^2 = 0.53–0.91$). Importantly, AI-derived measures of LV structure and function were strongly associated with long-term clinical outcomes. A one standard deviation decrease in AI-derived LVEF was independently associated with increased risks of heart failure, all-cause mortality, AF, and myocardial infarction, underscoring the prognostic relevance of fully automated echocardiographic assessment. These findings suggest that DL–based echocardiography can provide clinically meaningful risk stratification in large patient populations. [Lau et al., 2023]

In addition to global cardiac function, AI has also been applied to the automated assessment of regional wall motion abnormalities (RWMAs), a key marker of ischemic heart disease that is particularly prone to observer variability. Kusunose et al. evaluated a deep CNN trained on two-dimensional echocardiographic images from patients with prior myocardial infarction and healthy controls. The model demonstrated excellent diagnostic performance for RWMA detection (AUC 0.99) and accurate localization of coronary territories, achieving results comparable to expert readers and significantly outperforming less experienced operators. External validation confirmed good generalizability of the algorithm. These results highlight the potential of AI-assisted echocardiography to standardize RWMA assessment and improve diagnostic consistency, particularly in clinical settings with limited expert availability. [Kusunose et al., 2020]

The assessment of systolic and diastolic function represents another area where AI may reduce variability and improve efficiency. In a large multicenter, multicohort study, Tromp et al. developed and validated a DL algorithm for fully automated interpretation of LV systolic and diastolic function using standard two-dimensional echocardiography. The model was trained and tested on more than 40,000 examinations derived from diverse populations across Europe, North America, and Asia, including both core-laboratory and real-world datasets. AI-based assessment demonstrated high agreement with expert interpretation for the identification of reduced LVEF and elevated filling pressures, with AUC values ranging from 0.90 to 0.96 across validation cohorts. Notably, automated measurements exhibited lower variability than manual expert measurements and maintained consistent performance across external datasets. The present evidence supports the feasibility of AI-driven echocardiographic interpretation as a rapid, reproducible, and clinically reliable tool for routine assessment of cardiac function. [Tromp et al., 2022]

Taken together, current evidence indicates that artificial intelligence can substantially enhance echocardiographic interpretation by automating view classification, quantitative functional assessment, and detection of regional abnormalities while maintaining prognostic value. Although most studies remain retrospective, the demonstrated consistency across large and diverse datasets suggests that AI-assisted echocardiography may play an important role in reducing operator dependency and supporting scalable cardiovascular imaging in routine clinical practice.

3. Artificial Intelligence in Coronary Computed Tomography Angiography

CCTA plays a central role in the contemporary non-invasive evaluation of coronary artery disease (CAD), offering high-resolution anatomical visualization of the coronary tree and detailed assessment of atherosclerotic plaque burden. Over the past decade, advances in scanner technology and acquisition protocols have established CCTA as a first-line diagnostic modality in patients with suspected stable CAD. Even so, conventional interpretation of CCTA remains highly dependent on reader expertise and is associated with substantial interobserver variability, particularly in the presence of extensive coronary calcification, complex lesion morphology, small vessel caliber, or multivessel disease. These limitations, combined with increasing imaging volumes and growing demand for CCTA in clinical practice, have driven interest in artificial intelligence (AI)–based solutions aimed at improving diagnostic consistency, efficiency, and scalability of CCTA interpretation. [Khera et al., 2024]

A growing body of evidence from systematic reviews and meta-analyses indicates that deep learning–based analysis of CCTA achieves high diagnostic accuracy for the detection of clinically significant coronary artery stenoses. Pooled analyses typically report sensitivities and specificities exceeding 85–90% for the identification of ≥50% and ≥70% luminal stenoses, with area under the receiver operating characteristic curve (AUC) values approaching 0.95–0.98. These performance metrics are comparable to expert visual assessment and, in selected settings, superior to less experienced readers. Importantly, AI-assisted CCTA appears less susceptible to false-positive findings in heavily calcified vessels, a well-recognized limitation of conventional CCTA interpretation that often leads to overestimation of stenosis severity and unnecessary downstream testing. [Du, He, Liu & Yuan, 2025; Tu, Deng, Chen & Luo, 2024]

Beyond the assessment of luminal narrowing, AI-based CCTA analysis has expanded toward comprehensive characterization of atherosclerotic plaque composition and morphology. Advanced deep learning models enable automated identification and quantification of calcified, non-calcified, and low-attenuation plaques, as well as detection of high-risk plaque features such as positive remodeling, spotty calcification, and low-attenuation cores. Agreement between AI-derived plaque measurements and expert reader assessments is generally high across clinically relevant thresholds. Importantly, plaque characteristics provide incremental prognostic information beyond stenosis severity alone, supporting the concept that AI-enabled plaque phenotyping may enhance individualized risk stratification and improve identification of patients at elevated risk for future coronary events. [Ihdayhid et al., 2024]

The integration of plaque analysis into routine CCTA interpretation represents a meaningful shift from purely anatomical assessment toward a more biologically informed evaluation of coronary artery disease. In this context, AI offers particular advantages by enabling standardized and reproducible plaque quantification across large datasets, reducing subjective variability inherent to manual analysis. Such standardization may be especially relevant for longitudinal monitoring of disease progression or therapeutic response, where small changes in plaque burden or composition may carry clinical significance. [Ihdayhid et al., 2024]

From a workflow perspective, AI-assisted CCTA analysis provides substantial efficiency gains. Automated coronary segmentation, stenosis grading, and plaque quantification significantly reduce post-processing and interpretation time compared with manual or semi-automated approaches. Several studies report reductions in analysis time exceeding 60–70%, potentially facilitating broader adoption of CCTA in high-volume clinical environments and mitigating dependence on highly specialized readers. In addition to time savings, AI-driven reporting frameworks may improve interinstitutional consistency, streamline communication of findings, and support more standardized clinical decision-making across diverse healthcare settings. [Ihdayhid et al., 2024]

A particularly clinically relevant extension of AI-based CCTA analysis is the non-invasive estimation of fractional flow reserve (FFR). While invasive FFR remains the reference standard for assessing the hemodynamic significance of coronary stenoses, its routine use is limited by procedural risk, cost, and patient burden. AI-derived FFR techniques leverage coronary anatomy extracted from CCTA datasets to estimate lesion-specific ischemic potential without additional imaging or pharmacologic stress. Studies evaluating AI-based FFR demonstrate strong correlations with invasively measured FFR values, supporting the feasibility of functional assessment directly from routinely acquired CCTA images. Quantitative agreement between AI-derived and invasive FFR measurements suggests that AI-FFR may reliably identify functionally significant lesions that warrant revascularization while reducing the need for invasive pressure-wire assessment. [Li, Zhang, Wang & Xu, 2024]

Importantly, AI-based FFR assessment appears to retain diagnostic reliability in clinically challenging patient populations, including individuals with diabetes mellitus, who frequently present with diffuse coronary atherosclerosis and microvascular dysfunction. Observed differences in functional lesion severity between diabetic and non-diabetic patients further highlight the potential role of AI-FFR in personalized clinical decision-making. Although the majority of available evidence remains retrospective, these findings suggest that AI-derived functional assessment may complement anatomical CCTA interpretation and support more tailored management strategies in selected patient subgroups. [Li, Zhang, Wang & Xu, 2024]

AI-assisted CCTA has also demonstrated promising performance in the detection and characterization of complex coronary lesion subsets, such as chronic total occlusions (CTOs). CTOs pose a diagnostic challenge for non-invasive imaging due to long lesion length, heavy calcification, and limited visualization of distal vessel segments. DL–based CCTA analysis achieves diagnostic accuracy for CTO detection comparable to expert interpretation while substantially reducing analysis time. In addition, AI-driven assessment of lesion morphology and collateral circulation may aid procedural planning and improve patient selection for invasive coronary angiography and revascularization. [Yang et al., 2024]

In spite of these advances, several limitations constrain the clinical translation of AI-assisted CCTA. Most studies to date are retrospective and rely on curated datasets acquired under standardized imaging protocols, which may not fully reflect real-world practice. Variability in scanner technology, acquisition parameters, contrast protocols, and reconstruction techniques may affect algorithm performance across institutions. Furthermore, external validation across diverse populations and healthcare systems remains limited, and prospective trials evaluating the impact of AI-assisted CCTA on clinical decision-making and hard cardiovascular outcomes are largely lacking. [Khera et al., 2024]

In summary, artificial intelligence has substantially expanded the diagnostic and functional capabilities of CCTA by enabling automated assessment of stenosis severity, plaque morphology, and lesion-specific ischemia. While current evidence supports high diagnostic accuracy and meaningful workflow benefits, further prospective, outcome-driven studies are required to establish the incremental clinical value of AI-assisted CCTA and to define its optimal role within routine cardiovascular care pathways. [Khera et al., 2024]

4. Artificial Intelligence in Cardiac Magnetic Resonance Imaging

CMR provides highly accurate and reproducible assessment of LV structure and function and serves as a reference standard for myocardial tissue characterization. However, conventional CMR analysis remains time-consuming and is associated with interobserver variability, particularly in quantitative assessment of ventricular volumes and myocardial injury. In this context, artificial intelligence–based approaches have been developed to automate image analysis while preserving clinical validity. [Alabed et al., 2022]

Large multicenter studies demonstrate that AI-derived measurements of LV end-diastolic volume, end-systolic volume, and LVEF show strong agreement with expert manual CMR analysis and correlate with invasive hemodynamic indices obtained during cardiac catheterization. Importantly, AI-derived LVEF retains prognostic significance, with reduced values independently associated with increased risk of cardiovascular and all-cause mortality. These observations support the role of AI-based CMR analysis as a scalable tool for functional assessment and potenial long-term risk stratification rather than a purely technical innovation. [Alabed et al., 2022]

Not limited to global ventricular function, DL pipelines have demonstrated robust performance in the automated quantification of myocardial infarction using late gadolinium enhancement (LGE) imaging. High agreement between AI-generated and manually delineated infarct size has been reported, with performance comparable to interobserver variability among experienced readers. Automated infarct segmentation may therefore support standardized assessment of myocardial scar burden in both clinical practice and research, particularly in longitudinal follow-up and multicenter studies. [Schwab et al., 2025]

AI-based CMR analysis has also shown high diagnostic accuracy in the detection of inflammatory myocardial disease. DL and transformer-based models enable automated diagnosis of myocarditis with excellent performance metrics and spatial localization consistent with inflammatory patterns observed on CMR. Although these results highlight the diagnostic potential of AI in myocardial tissue characterization, most available evidence is derived from retrospective datasets and requires validation in prospective, multicenter clinical cohorts before routine implementation. [Jafari et al., 2022]

While AI-driven CMR reconstruction and super-resolution techniques have demonstrated marked improvements in image quality and acquisition efficiency, their incremental clinical value beyond established CMR protocols remains insufficiently supported by outcome-based evidence. At present, these technically advanced methods are primarily confined to specialized centers and were not the primary focus of this review. [Malagi, Li, Tao & Yang, 2025]

In conclusion, AI applications in CMR demonstrate the greatest clinical relevance in automated assessment of ventricular function, myocardial infarction, and inflammatory disease. Although technical advances in image reconstruction are promising, current evidence supports prioritizing AI tools that directly inform diagnosis, prognosis, and clinical decision-making. Further prospective validation is required to define the role of AI-assisted CMR within routine cardiovascular care pathways. [Alabed et al., 2022; Schwab, Pamminger, Kremser, Haltmeier & Mayr, 2025]

5. Artificial Intelligence in Intravascular Optical Coherence Tomography

AI–assisted analysis of intravascular OCT has emerged as a promising approach for automated identification of high-risk atherosclerotic plaque phenotypes and outcome-oriented risk stratification. While thin-cap fibroatheroma (TCFA) detected by expert core laboratories has long been associated with increased coronary event risk, manual OCT analysis is time-consuming and subject to interobserver variability, limiting its scalability in clinical practice.

Recent evidence suggests that AI-based OCT analysis may provide prognostic information comparable to, and in selected contexts exceeding, conventional expert assessment. In a prospective cohort derived from the PECTUS-obs study, Volleberg et al. demonstrated that AI-identified TCFA was significantly associated with adverse clinical outcomes, including myocardial infarction, death, and unplanned revascularization. Notably, vessel-level AI-TCFA assessment showed stronger prognostic discrimination than lesion-level analysis, likely reflecting the advantages of standardized, fully automated evaluation of the entire imaged coronary segment. This finding highlights the potential of AI to move OCT interpretation beyond focal lesion characterization toward comprehensive vessel-level risk assessment. [Volleberg et al., 2025a; Volleberg et al., 2025b]

Complementary evidence from large retrospective cohorts further supports the prognostic relevance of AI-driven OCT plaque characterization. Niioka et al. demonstrated that DL–based classification of plaque phenotypes accurately differentiated normal, stable, and vulnerable plaques and independently predicted future lesion-related and composite cardiovascular events, with performance comparable to expert OCT interpretation. [Niioka et al., 2022] Similarly, validation studies of automated whole-vessel OCT analysis systems, such as AutoOCT, indicate that AI can reliably quantify clinically relevant plaque features and replicate treatment-related changes in plaque composition observed in core laboratory analyses. [Jessney et al., 2025]

Collectively, available evidence indicates that AI-based OCT analysis enables standardized, reproducible, and prognostically meaningful assessment of coronary plaque vulnerability. By reducing reliance on manual interpretation and enabling vessel-level evaluation, AI has the potential to enhance intracoronary imaging–guided risk stratification and support more personalized interventional and pharmacological strategies.

Limitations and Challenges of Clinical Implementation of Artificial Intelligence

Notwithstanding consistently high diagnostic performance across modalities, the absence of prospective evidence demonstrating improved patient outcomes remains the principal barrier to widespread clinical adoption of AI-based tools in cardiology.

Despite the rapidly growing body of evidence supporting the diagnostic and prognostic potential of AI in cardiology, several important limitations continue to restrict its widespread clinical adoption. A central challenge relates to data quality, representativeness, and generalizability. Most AI models have been developed using retrospective datasets derived from single centers or highly curated multicenter cohorts, which may not adequately reflect the heterogeneity of real-world clinical populations. Differences in patient demographics, disease prevalence, comorbidity burden, and imaging acquisition protocols can lead to significant degradation of algorithmic performance when models are deployed outside their training environment. [Khera et al., 2024]

Closely related to generalizability is the issue of bias and fairness. AI models trained on imbalanced datasets may perform unevenly across age groups, sexes, ethnic backgrounds, or clinical subpopulations. In cardiology, where disease presentation and risk profiles vary substantially between populations, such biases may exacerbate existing health disparities. Although bias mitigation strategies and subgroup analyses are increasingly reported, standardized frameworks for evaluating fairness and equity of AI systems in clinical cardiology remain lacking. [Khera et al., 2024; Barański, 2024]

Another major limitation is the limited interpretability of many DL–based systems. Black-box models often provide accurate predictions without transparent reasoning, making it difficult for clinicians to understand, verify, or contest AI-generated outputs. This lack of explainability may undermine clinician trust and poses challenges for shared decision-making with patients. While explainable artificial intelligence techniques such as saliency maps and feature attribution methods are under active development, their clinical validity and reliability have not yet been uniformly established. [Khera et al., 2024]

Regulatory and legal considerations further complicate clinical implementation. Current regulatory frameworks are primarily designed for static medical devices and may not adequately address adaptive or continuously learning AI systems. Uncertainty regarding liability in cases of AI-assisted diagnostic errors remains unresolved, particularly when clinical decisions are influenced by opaque algorithms. Moreover, the evidentiary standards required for regulatory approval often focus on technical performance metrics rather than demonstrable improvements in patient-centered outcomes. [Khera et al., 2024; Barański, 2024]

Practical barriers related to workflow integration and infrastructure also play a critical role. Successful deployment of AI tools requires seamless integration with existing electronic health record systems, imaging platforms, and clinical workflows. Many healthcare institutions lack the technical infrastructure, interoperability standards, or trained personnel necessary to implement and maintain AI solutions at scale. In addition, the introduction of AI may alter clinical workflows in ways that increase cognitive load or disrupt established practices if not carefully designed with end users in mind. [Khera et al., 2024]

Data privacy and cybersecurity represent additional concerns. AI systems rely on large volumes of sensitive patient data, often aggregated across institutions. Ensuring compliance with data protection regulations and safeguarding against data breaches or model inversion attacks is essential for maintaining patient trust. Federated learning and privacy-preserving analytics offer potential solutions, but their adoption remains limited in routine clinical practice. [Barański, 2024]

Finally, there is a notable lack of prospective, outcome-driven clinical trials evaluating the real-world impact of AI-assisted decision-making in cardiology. While many studies report impressive diagnostic accuracy, relatively few demonstrate that AI implementation leads to improved clinical outcomes, reduced costs, or better allocation of healthcare resources. Without such evidence, the role of AI is likely to remain confined to decision support rather than becoming an integral component of guideline-directed cardiovascular care. [Khera et al., 2024]

In aggregate, these limitations highlight that AI should currently be viewed as an adjunct to clinical expertise rather than a replacement for it. Addressing challenges related to generalizability, interpretability, regulation, and workflow integration will be essential for the responsible and equitable adoption of AI technologies in contemporary cardiology. [Khera et al., 2024; Barański, 2024]

Future Perspectives of Artificial Intelligence in Cardiology

Future progress in the clinical application of AI in cardiology will depend less on further improvements in isolated performance metrics and more on rigorous validation, integration, and demonstration of clinical impact. While current AI-based models frequently achieve diagnostic accuracy comparable to expert interpretation across electrocardiography and cardiovascular imaging modalities, their widespread adoption will require evidence that AI-assisted workflows improve patient outcomes, efficiency, or resource utilization in real-world settings. [Khera et al., 2024]

A key future direction involves prospective, outcome-driven clinical studies. Most existing evidence is derived from retrospective analyses using curated datasets, which limits generalizability. Large, multicenter trials evaluating AI-assisted decision-making against standard-of-care workflows are essential to establish whether improved diagnostic performance translates into reductions in adverse cardiovascular events, unnecessary testing, or healthcare costs. Such studies will be particularly important in AF screening, functional coronary assessment, and plaque-based risk stratification, where clinical decision thresholds remain nuanced. [Raghunath et al., 2021; Li et al., 2024]

Another critical area of development is model robustness and external validation across diverse populations, imaging platforms, and healthcare systems. Future AI tools must demonstrate consistent performance across varying acquisition protocols, disease prevalence, and demographic characteristics. Standardized reporting frameworks and benchmarking strategies will be required to enable meaningful comparison between algorithms and to facilitate regulatory approval and clinical translation. [Khera et al., 2024]

Interpretability and clinician trust will also play a central role in future implementation. Advances in explainable artificial intelligence may help bridge the gap between complex model outputs and clinical reasoning, allowing clinicians to understand, verify, and appropriately contextualize AI-generated results. Rather than replacing expert judgment, future AI systems are likely to function as transparent decision-support tools that augment clinician expertise. [Barański, 2024]

Finally, integration into routine clinical workflows represents a decisive challenge. AI solutions that seamlessly interface with existing imaging platforms and electronic health records, reduce reporting burden, and align with established clinical pathways are more likely to achieve adoption. Incremental implementation focused on workflow optimization, standardized quantification, and risk stratification may prove more effective than attempts at fully autonomous clinical decision-making. [Ihdayhid et al., 2024; Khera et al., 2024]

Taken as a whole, the future of AI in cardiology lies in responsible, evidence-based integration. By prioritizing prospective validation, transparency, and clinical relevance, AI has the potential to evolve from a promising analytical tool into a reliable component of contemporary cardiovascular care. [Khera et al., 2024; Barański, 2024]

Discussion

This narrative review synthesizes current clinical evidence on AI applications across key domains of contemporary cardiology, including AF detection and multiple cardiovascular imaging modalities. Across these diverse applications, AI-based approaches consistently demonstrate diagnostic performance comparable to expert interpretation, accompanied by meaningful reductions in analysis time and interobserver variability. Collectively, these findings support the role of AI as a clinically relevant decision-support technology rather than a purely experimental or technical innovation.

A key observation emerging from this cross-modality analysis is that many of the earliest clinically relevant benefits of AI relate to workflow optimization and standardized quantification, rather than to substantial gains in diagnostic accuracy. In AF detection, AI enables identification of latent arrhythmic risk from sinus rhythm ECGs and supports more targeted screening strategies. In cardiovascular imaging, AI facilitates automated segmentation, functional assessment, and plaque characterization, reducing operator dependence while preserving prognostic information. These applications illustrate how AI may enhance efficiency and consistency within established diagnostic pathways.

Despite consistently high technical performance, several shared limitations constrain widespread clinical adoption. Most studies remain retrospective and rely on curated datasets acquired under controlled conditions, raising concerns regarding generalizability to routine clinical practice. External validation across diverse populations and healthcare systems is limited, and prospective trials demonstrating improved patient outcomes attributable to AI-guided decision-making are largely lacking. Importantly, these challenges are observed consistently across electrophysiology and imaging applications, underscoring their systemic rather than modality-specific nature.

Another important consideration is model interpretability. While DL algorithms excel at pattern recognition, their limited transparency may hinder clinician trust, regulatory acceptance, and clinical accountability. Ongoing efforts to improve explainability and to integrate AI outputs into existing clinical workflows will be critical for successful implementation. Current evidence supports a complementary role for AI, in which algorithmic outputs augment rather than replace expert clinical judgment.

Across the diverse applications reviewed, several cross-cutting translational patterns emerge that help contextualize the current clinical role of AI in cardiology. First, the most consistent near-term impact of AI lies in workflow optimization and standardized quantification rather than in large gains in diagnostic accuracy. Second, AI-derived assessments that integrate information at the patient or vessel level tend to demonstrate greater prognostic relevance than isolated, lesion-level analyses, as illustrated across imaging modalities. Finally, predictive and risk-enrichment applications—such as AF prediction from sinus rhythm ECGs—appear to offer greatest clinical value when used to guide targeted monitoring strategies rather than as standalone diagnostic tools. Together, these patterns suggest that the clinical impact of AI is most likely to be realized when embedded within existing care pathways as a decision-support layer, rather than deployed as an autonomous diagnostic system.

Viewed collectively, the integrated perspective presented in this review clarifies both the clinical promise and the practical constraints of AI in cardiology. By identifying shared translational challenges across electrophysiology and cardiovascular imaging, this synthesis underscores the need for prospective, outcome-driven studies and suggests that the near-term clinical impact of AI is most likely to be achieved through improved efficiency, reproducibility, and decision support within established clinical pathways.

Conclusions

Artificial intelligence demonstrates substantial diagnostic and prognostic value across key domains of contemporary cardiology, including electrocardiography, non-invasive cardiovascular imaging, and intracoronary assessment. *By integrating evidence across these modalities, this review emphasizes shared translational challenges and identifies clinical settings in which AI is most likely to deliver early benefit.* Across these modalities, AI-based systems consistently improve efficiency, reproducibility, and risk stratification, often achieving performance comparable to expert interpretation across multiple applications. Importantly, the clinical relevance of these approaches extends beyond technical feasibility, as multiple studies demonstrate meaningful associations between AI-derived metrics and long-term cardiovascular outcomes.

In AF, AI-enabled analysis of electrocardiographic data facilitates earlier detection, improved rhythm monitoring, and more targeted screening strategies, with potential implications for stroke prevention. In cardiovascular imaging, automated interpretation of echocardiography, coronary computed tomography angiography, cardiac magnetic resonance imaging, and intravascular optical coherence tomography reduces operator dependency and interobserver variability while preserving diagnostic and prognostic accuracy in controlled and retrospective imaging studies. Collectively, these advances suggest that AI may help address key limitations of data-intensive cardiovascular diagnostics, particularly in high-volume clinical settings.

Nevertheless, despite rapid technological progress and encouraging performance metrics, several barriers continue to limit widespread clinical implementation. Most AI models have been developed using retrospective datasets with limited external validation, raising concerns regarding generalizability across diverse patient populations and healthcare systems. In addition, heterogeneity in model architectures, a lack of standardized reporting frameworks, and the limited interpretability of DL algorithms pose challenges for clinician trust, regulatory approval, and integration into routine workflows. Crucially, high diagnostic accuracy alone is insufficient to justify clinical adoption in the absence of prospective evidence demonstrating improved patient outcomes.

Taken together, current evidence supports the role of AI as a complementary decision-support tool rather than a replacement for expert clinical judgment. Future progress will depend on rigorous external validation, transparent and interpretable model design, and well-designed prospective studies evaluating the impact of AI-assisted decision-making on clinical outcomes and healthcare efficiency. With continued methodological refinement and responsible integration into clinical practice, AI has the potential to become an integral component of contemporary cardiovascular care.

Disclosures

Author’s Contributions
Conceptualization: Radosław Gryko
Methodology: Radosław Gryko, Julia Mieszkowska
Software: Norbert Grabias, Radosław Gryko
Check: Anna Tejchma, Radosław Gryko
Validation / Check: Maria Rajkowska, Radosław Gryko
Formal Analysis: Paulina Jarząbek, Radosław Gryko
Investigation: Radosław Gryko, Aleksandra Włodarczyk
Resources: Jędrzej Piotrowski, Radosław Gryko
Data curation: Łukasz Woźniak, Radosław Gryko
Writing – rough preparation: Bernard Myszewski, Radosław Gryko
Writing – Review and Editing: Julia Mieszkowska, Radosław Gryko
Supervision / Project Administration: Radosław Gryko, Norbert Grabias

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REFERENCES

1. Alabed, S., Alandejani, F., Dwivedi, K., Karunasaagarar, K., Sharkey, M., Garg, P., de Koning, P. J. H., Tóth, A., Shahin, Y., Johns, C., Mamalakis, M., Stott, S., Capener, D., Wood, S., Metherall, P., Rothman, A. M. K., Condliffe, R., Hamilton, N., Wild, J. M., O'Regan, D. P., Lu, H., Kiely, D. G., van der Geest, R. J., & Swift, A. J. (2022). *Validation of artificial intelligence cardiac MRI measurements: Relationship to heart catheterization and mortality prediction*. *Radiology, 305*(1), 68–79 https://doi.org/10.1148/radiol.212929
2. Attia, Z. I., Noseworthy, P. A., Lopez-Jimenez, F., Asirvatham, S. J., Deshmukh, A. J., Gersh, B. J., Carter, R. E., Yao, X., Rabinstein, A. A., Erickson, B. J., Kapa, S., Friedman, P. A., & Carter, R. E. (2019). An artificial intelligence–enabled ECG algorithm for the identification of patients with atrial fibrillation during sinus rhythm: A retrospective analysis of outcome prediction. *The Lancet, 394*(10201), 861–867. https://doi.org/10.1016/S0140-6736(19)31721-0
3. Barański, J. (2024). Inteligentna rewolucja w medycynie – zastosowanie sztucznej inteligencji (AI) w medycynie: Przegląd, korzyści i wyzwania. *Przegląd Epidemiologiczny, 78*(3), 287–302. https://doi.org/10.32394/pe/194484
4. Du, M., Hu, X., Zhou, Y., & Li, J. (2025). Artificial intelligence in CT angiography for the detection of coronary artery stenosis and calcified plaque: A systematic review and meta-analysis. *Academic Radiology, 32*(7), 3776–3787. https://doi.org/10.1016/j.acra.2025.03.054
5. Freedman, B., Hindricks, G., Banerjee, A., Baranchuk, A., Ching, C. K., Du, X., Fitzsimons, D., Healey, J. S., Ikeda, T., Lobban, T. C. A., Mbakwem, A., Narasimhan, C., Neubeck, L., Noseworthy, P. A., Philbin, D. M., Pinto, F. J., Rwebembera, J., Schnabel, R. B., & Svendsen, J. H. (2021). World Heart Federation roadmap on atrial fibrillation – A 2020 update. *Global Heart, 16*(1), 41. https://doi.org/10.5334/gh.1023
6. Ihdayhid, A. R., Sehly, A., He, A., Joyner, J., Flack, J., Konstantopoulos, J., Newby, D. E., Williams, M. C., Ko, B. S., Chow, B. J. W., & Dwivedi, G. (2024). *Coronary artery stenosis and high-risk plaque assessed with an unsupervised fully automated deep learning technique*. *JACC: Advances, 3*(9), Article 100861. https://doi.org/10.1016/j.jacadv.2024.100861
7. Jafari, M., Shoeibi, A., Ghassemi, N., Heras, J., Khosravi, A., Ling, S., Alizadehsani, R., Beheshti, A., Zhang, Y., Wang, S., Górriz, J.M., Acharya, U.R., & Alinejad-Rokny, H. (2022). Automatic Diagnosis of Myocarditis Disease in Cardiac MRI Modality using Deep Transformers and Explainable Artificial Intelligence. *ArXiv, abs/2210.14611*. https://doi.org/10.48550/arXiv.2210.14611
8. Jessney, B., Chen, X., Gu, S., Huang, Y., Goddard, M., Brown, A., Obaid, D., Mahmoudi, M., Garcia Garcia, H. M., Hoole, S. P., Räber, L., Prati, F., Schönlieb, C.-B., Roberts, M., & Bennett, M. (2025). Artificial intelligence-led whole coronary artery OCT analysis: Validation and identification of drug efficacy and higher-risk plaques. *Circulation: Cardiovascular Imaging, 18*(11), e018133. https://doi.org/10.1161/CIRCIMAGING.125.018133
9. Khera, R., Oikonomou, E. K., Nadkarni, G. N., et al. (2024). Transforming cardiovascular care with artificial intelligence: From discovery to practice: JACC state-of-the-art review. *Journal of the American College of Cardiology, 84*(1), 97–114. https://doi.org/10.1016/j.jacc.2024.05.003
10. Kusunose, K., Abe, T., Haga, A., Fukuda, D., Yamada, H., Harada, M., & Sata, M. (2020). A deep learning approach for assessment of regional wall motion abnormality from echocardiographic images. *JACC: Cardiovascular Imaging, 13*(2), 374–381. https://doi.org/10.1016/j.jcmg.2019.02.024
11. Lau, E. S., Di Achille, P., Kopparapu, K., Andrews, C. T., Singh, P., Reeder, C., Al-Alusi, M., Khurshid, S., Haimovich, J. S., Ellinor, P. T., Picard, M. H., Batra, P., Lubitz, S. A., & Ho, J. E. (2023). *Deep learning–enabled assessment of left heart structure and function predicts cardiovascular outcomes*. *Journal of the American College of Cardiology, 82*(20), 1936–1948. https://doi.org/10.1016/j.jacc.2023.09.800

12. Li, M., Zhang, L., Wang, Y., & Xu, X. (2024). Exploration of fractional flow reservation score based on artificial intelligence post-processing for coronary artery lesions in patients with diabetes and coronary heart disease. *SLAS Technology, 29*(6), Article 100196. https://doi.org/10.1016/j.slast.2024.100196
13. Malagi, A. V., Li, X., Tao, Q., & Yang, H.-J. (2025). *Advanced cardiac MRI: Integrating AI and machine learning for post imaging reconstruction*. *Current Treatment Options in Cardiovascular Medicine, 27*, Article 67. https://doi.org/10.1007/s11936-025-01116-z
14. Melzi, P., Tolosana, R., Cecconi, A., Sanz-García, A., Ortega, G. J., Jimenez-Borreguero, L. J., & Vera-Rodriguez, R. (2021). Analyzing artificial intelligence systems for the prediction of atrial fibrillation from sinus-rhythm ECGs including demographics and feature visualization. *Scientific Reports, 11*, Article 22786. https://doi.org/10.1038/s41598-021-02179-1
15. Mittal, S., Oliveros, S., Li, J., Barroyer, T., Henry, C., & Gardella, C. (2021). *AI filter improves positive predictive value of atrial fibrillation detection by an implantable loop recorder*. *JACC: Clinical Electrophysiology, 7*(8), 965–975. https://doi.org/10.1016/j.jacep.2020.12.006
16. Niioka, H., Kume, T., Kubo, T., Soeda, T., Watanabe, M., Yamada, R., Sakata, Y., Miyamoto, Y., Wang, B., Nagahara, H., Miyake, J., Akasaka, T., Saito, Y., & Uemura, S. (2022). Automated diagnosis of optical coherence tomography imaging on plaque vulnerability and its relation to clinical outcomes in coronary artery disease. *Scientific Reports, 12*, Article 14067. https://doi.org/10.1038/s41598-022-18473-5
17. Noseworthy, P. A., Attia, Z. I., Behnken, E. M., Giblon, R. E., Bews, K. A., Liu, S., … & Carter, R. E. (2022). Artificial intelligence-guided screening for atrial fibrillation using electrocardiogram during sinus rhythm: A prospective non-randomised interventional trial. *The Lancet, 400*(10359), 1206–1212. https://doi.org/10.1016/S0140-6736(22)01637-3
18. Raghunath, S., Pfeifer, J. M., Ulloa-Cerna, A. E., Nemani, A., Carbonati, T., Jing, L., vanMaanen, D. P., Hartzel, D. N., Ruhl, J. A., Lagerman, B. F., Rocha, D. B., Stoudt, N. J., Schneider, G., Johnson, K. W., Zimmerman, N., Leader, J. B., Kirchner, H. L., Griessenauer, C. J., & Fornwalt, B. K. (2021). Deep neural networks can predict new-onset atrial fibrillation from the 12-lead ECG and help identify those at risk of atrial fibrillation-related stroke. *Circulation, 143*(13), 1287–1298. https://doi.org/10.1161/CIRCULATIONAHA.120.047829
19. Schwab, M., Pamminger, M., Kremser, C., Haltmeier, M. & Agnes Mayr, A. (2025). Deep learning pipeline for fully automated myocardial infarct segmentation from clinical cardiac MR scans. *Radiology Advances, 2*(4), 1-11.https://doi.org/10.1093/radadv/umaf023
20. Tromp, J., Seekings, P. J., Hung, C.-L., Iversen, M. B., Frost, M. J., Ouwerkerk, W., Jiang, Z., Eisenhaber, F., Goh, R. S. M., Zhao, H., Huang, W., Ling, L.-H., Sim, D., Cozzone, P., Richards, A. M., Lee, H. K., Solomon, S. D., Lam, C. S. P., & Ezekowitz, J. A. (2022). Automated interpretation of systolic and diastolic function on the echocardiogram: A multicohort study. *The Lancet Digital Health, 4*(1), e46–e54. https://doi.org/10.1016/S2589-7500(21)00235-1
21. Tu, L., Deng, Y., Chen, Y., & Luo, Y. (2024). Accuracy of deep learning in the differential diagnosis of coronary artery stenosis: A systematic review and meta-analysis. *BMC Medical Imaging, 24*, Article 243. https://doi.org/10.1186/s12880-024-01403-4
22. Volleberg, R. H. J. A., van der Waerden, R. G. A., Luttikholt, T. J., van der Zande, J. L., Cancian, P., Gu, X., Mol, J.-Q., Quax, S., Prokop, M., Sánchez, C. I., van Ginneken, B., Išgum, I., Thannhauser, J., Saitta, S., Nishimiya, K., Roleder, T., & van Royen, N. (2025a). Artificial intelligence-based identification of thin-cap fibroatheromas and clinical outcomes: The PECTUS-AI study. *European Heart Journal, 46*(46), 5032–5041. https://doi.org/10.1093/eurheartj/ehaf595
23. Volleberg, R. H. J. A., van der Waerden, R. G. A., Luttikholt, T. J., van der Zande, J. L., Cancian, P., Gu, X., Mol, J.-Q., Quax, S., Prokop, M., Sánchez, C. I., van Ginneken, B., Išgum, I., Thannhauser, J., Saitta, S., Nishimiya, K., Roleder, T., & van Royen, N. (2025b). Comprehensive full-vessel segmentation and volumetric plaque quantification for intracoronary optical coherence tomography using deep learning. *European Heart Journal – Digital Health, 6*(3), 404–416. https://doi.org/10.1093/ehjdh/ztaf021
24. Yang, Y., Zhou, Z., Zhang, N., Wang, R., Gao, Y., Ran, X., Sun, Z., Zhang, H., Yang, G., Song, X., & Xu, L. (2024). Performance of artificial intelligence in detecting the chronic total occlusive lesions of coronary artery based on coronary computed tomographic angiography. *Cardiovascular Diagnosis and Therapy, 14*(4). https://doi.org/10.21037/cdt-23-407