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Review article

Highlights of the Society for Cardiovascular Magnetic Resonance 2025 conference: Leading the way to accessible, efficient, and sustainable cardiovascular magnetic resonance

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ABSTRACT

The 28th Annual Scientific Sessions of the Society for Cardiovascular Magnetic Resonance (SCMR) took place from January 29 to February 1, 2025, in Washington, D.C. SCMR 2025 brought together a diverse group of 1714 cardiologists, radiologists, scientists, and technologists from more than 80 countries to discuss emerging trends and the latest developments in cardiovascular magnetic resonance (CMR). The conference centered on the theme "Leading the Way to Accessible, Sustainable, and Efficient CMR," highlighting innovations aimed at making CMR more clinically efficient, widely accessible, and environmentally sustainable.

The program featured 728 abstracts and case presentations with an acceptance rate of 86% (728/849), including early career award abstracts, oral abstracts, oral cases and rapid-fire sessions, covering a broad range of

Abbreviations: 3DMWT, 3D maximal left ventricular wall thickness; AAO, Ascending aortic output; AHA, American Heart Association; AI, Artificial Intelligence; ARVC, Arrhythmogenic right ventricular cardiomyopathy; ASL, Arterial spin labeling; AVVR, Atrioventricular Valve Regurgitation; bSSFP, balanced Steady State Free Precession; CCT, Cardiac computed tomography; CE, Contrast-enhanced; CEST, Chemical Exchange Saturation Transfer; CT, Computed tomography; CMR, Cardiac Magnetic Resonance; CHD, Congenital Heart Disease; DENSE, Displacement Encoding with Stimulated Echoes; DIR, Double inversion recovery; DSP, Desmoplakin; DTI, Diffusion tensor imaging; EAT, Epicardial adipose tissue; EATVi, Epicardial adipose tissue volume index; ECG, Electrocardiogram; ECV, Extracellular volume; EDV, End diastolic volume; ESV, End systolic volume; Ex-CMR, Exercise CMR; FA, Fractional anisotropy; FAC, Fatty acid composition; FDR, First-degree relatives; FLNC, Filamin C; GCS, Global circumferential strain; HCM, Hypertrophic cardiomyopathy; HF, Heart failure; HFpEF, Heart failure with preserved ejection fraction; HLHS, Hypoplastic left heart syndrome; ICD, Implantable Cardioverter Defibrillator; iCMR, Interventional CMR; iRSS, Intramyocardial regional strain score; LGE, Late Gadolinium Enhancement; LMNA, Lamin A/C; LV, Left Ventricle; LVCI, Left ventricular cardiac index; LVEF, Left ventricular ejection fraction; NC, Non-cardiac; NICM, Non-ischemic cardiomyopathy; Non-CE, Non-Contrast Enhanced; NYHA, New York Heart Association classification; MACE, Major adverse cardiovascular events; MI, Myocardial Infarction; MOLLI, Modified Look-Locker inversion recovery imaging; MPR, Myocardial perfusion reserve; MRI, Magnetic Resonance Imaging; PCWP, Pulmonary capillary wedge pressure; P/CHD, Pediatric and congenital heart disease; P/LP, Pathogenic or likely pathogenic; PVR, Pulmonary vascular resistance; RHC, Right Heart Catheterization; RV, Right ventricle; RVEF, Right ventricular ejection fraction; RVESVi, Right ventricular end-systolic volume index; SCD, Sudden cardiac death; SCMR, Society for Cardiovascular Magnetic Resonance; SEMA, Semaglutide; SFA, Saturated fatty acid; SNR, Signal to Noise Ratio; SPECT, Single-photon emission computed tomography; SVR, Systemic vascular resistance; TAVR, Transcatheter Aortic Valve Replacement; TV, Tricuspid valve

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CMR topics. It also offered engaging invited lectures across eight main parallel tracks and included four plenary sessions, two gold medalists, and one keynote speaker, with a total of 826 faculty participating. Focused sessions on accessibility, efficiency, and sustainability provided a platform for discussing current challenges and exploring future directions, while the newly introduced CMR Innovations Track showcased innovative session formats and fostered greater collaboration between researchers, clinicians, and industry. For the first time, SCMR 2025 also offered the opportunity for attendees to obtain CMR Level 1 Training Verification, integrated into the program. Additionally, expert case reading sessions and hands-on interactive workshops allowed participants to engage with real-world clinical scenarios and deepen their understanding through practical experience.

Key highlights included plenary sessions on a variety of important topics, such as expanding boundaries, health equity, women's cardiovascular disease and a patient-clinician testimonial that emphasized the profound value of patient-centered research and collaboration. The scientific sessions covered a wide range of topics, from clinical applications in cardiomyopathies, congenital heart disease, and vascular imaging to women's heart health and environmental sustainability. Technical topics included novel reconstruction, motion correction, quantitative CMR, contrast agents, novel field strengths, and artificial intelligence applications, among many others.

This paper summarizes the key themes and discussions from SCMR 2025, highlighting the collaborative efforts that are driving the future of CMR and underscoring the Society's unwavering commitment to research, education, and clinical excellence.

1. Introduction

The 28th Annual Scientific Sessions of the Society for Cardiovascular Magnetic Resonance (SCMR) took place from January 29 to February 1, 2025, in Washington, DC, bringing together a diverse community of professionals dedicated to advancing the field of cardiovascular magnetic resonance (CMR). As the main global CMR conference, SCMR 2025 provided a unique platform for cardiologists, radiologists, scientists, and technologists to discuss clinical applications, emerging trends and the latest developments in CMR.

This year's conference, themed "Leading the Way to Accessible, Sustainable, and Efficient CMR," highlighted innovations aimed at making CMR more clinically efficient, widely accessible and environmentally sustainable. The theme was reflected throughout the scientific program including educational and scientific sessions, debates, as well as joint educational-industry sessions on these topics. Furthermore, new keynote-style focused sessions on accessibility, efficiency, and sustainability provided a platform for discussing current challenges and exploring future directions. The conference emphasized the role of efficient magnetic resonance imaging (MRI) through developments in rapid imaging, artificial intelligence (AI) based acquisition, reconstruction and analysis, and optimized workflows. Global accessibility was also a central focus, with sessions on expanding CMR programs worldwide and strategies for overcoming barriers to implementation in low-resource settings. Environmental sustainability in CMR was highlighted with dedicated discussions on minimizing the carbon footprint of imaging practices and optimizing resource utilization, especially in the era of AI.

SCMR 2025 welcomed 1714 attendees (39% female) from more than 80 countries across six continents, demonstrating the society's expanding global reach and influence (Figs. 1 and 2). Notably, 527 individuals attended for the first time, while 530 were trainees, and 186 participated in the newly introduced Level 1 Training program. A total of 360 attendees joined the conference remotely. The United States had the largest representation with 955 delegates, followed by the United Kingdom with 148 and Germany and Canada with 52. Regarding professional backgrounds, 47% of attendees were cardiologists, 16% radiologists, 10% pediatric and congenital heart disease (CHD) experts, 13% non-physician scientists, 7% technologists, and 7% from other fields. While these percentages align closely with previous meetings, SCMR 2025 saw a significant increase in the participation of scientists, rising from 7% in CMR 2024 to 13% this year.

The program featured 728 abstracts and case presentations with an acceptance rate of 86%, including 144 Early Career Award and oral abstracts, 34 oral cases, 372 rapid-fire abstracts and 144 quick-fire cases, covering a broad range of CMR topics and offering an opportunity for researchers to present their latest findings and engage in scientific exchange. The program also offered engaging invited lectures across eight main (11 in total) parallel tracks and included 4 plenary sessions, 2 gold medalists, and 1 keynote speaker. The faculty comprised 826 experts (44% female) from 55 countries, including 367 speakers, 70 panelists, and 389 moderators, ensuring a comprehensive, diverse and dynamic program.

Key highlights of the program were the inspiring and thought-provoking opening, keynote and closing plenary talks. During the opening plenary session, Dr. Roderic I. Pettigrew from Texas A&M University delivered a lecture on the future of CMR and its expanding role in medicine, whilst Dr. Clyde W. Yancy from Northwestern University addressed the imperative of inclusive excellence and health equity in

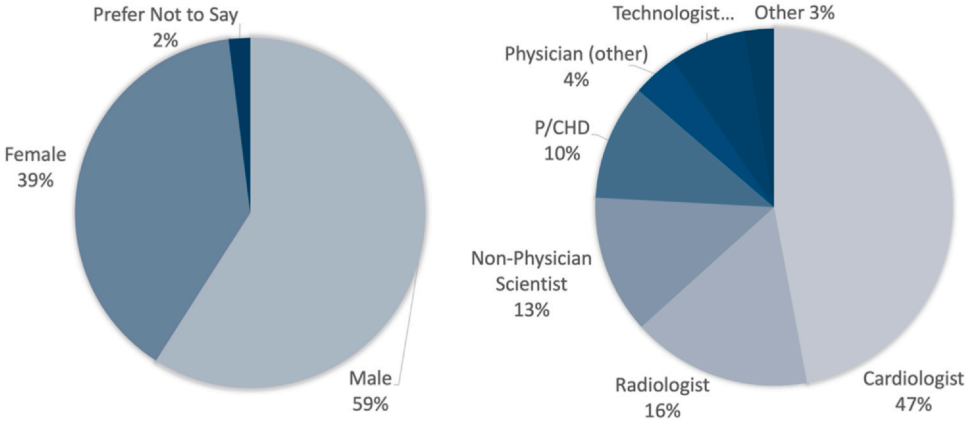


Fig. 1. Overview of registration to SCMR 2025. SCMR 2025 welcomed 1714 attendees (39% female) from more than 80 countries across six continents. *SCMR* Society for Cardiovascular Magnetic Resonance

Top 10 countries registration

Countries	Attendees
United States	955
United Kingdom	148
Germany	52
Canada	52
India	43
Switzerland	41
Sweden	41
Netherlands	38
Brazil	25
France	22

Fig. 2. Overview of registration to SCMR 2025. SCMR 2025 welcomed 1714 attendees from more than 80 countries across six continents. The table show the top 10 countries registration. *SCMR* Society for Cardiovascular Magnetic Resonance

cardiovascular care. The keynote lecture by Dr Stefan Neubauer focused on the next challenges and potential game-changers for CMR and cardiac computed tomography (CCT). The closing plenary session included an inspiring patient testimonial given by Jason Conway, who together with Dr. Kanae Mukai emphasized the profound value of patient-centered research and collaboration. Dr. Martha Gulati from Cedars Sinai Medical Center, discussed critical steps toward achieving equity in women's heart health.

The program included a preconference day with four parallel tracks: the Physicians Pre-Conference, Pediatric & CHD Pre-Conference, Interventional CMR (iCMR) Pre-Conference, and the SCMR-International Society for Magnetic Resonance in Medicine (ISMRM) co-provided workshop on "Cutting Edge Imaging of Cardiac Microstructure, Motion, and Strain." These pre-conferences provided specialized, in-depth learning opportunities tailored to distinct subfields within the CMR community, ensuring that attendees could engage in highly relevant and targeted educational experiences. In particular, the purpose of the SCMR-ISMRM co-provided workshop was to bring together clinicians and scientists to discuss the latest technological advances in the field of cardiac microstructure and motion mapping, and to identify clinical pathways for their application for the benefit of patients. This workshop offered cutting-edge scientific presentations, complemented by hands-on demonstrations of software packages by industry partners, and a panel discussion focusing on future directions of the field. For the first time this year, the SCMR-ISMRM co-provided workshop fees were included in SCMR 2025 registration.

The main conference program included eight parallel tracks including clinical and translation, science, pediatric/CHD, technologist, early career, hot topics and focus sessions, read with experts and hands-on session and the CMR innovations track. The scientific sessions featured a wide array of topics, including clinical applications from heart failure, inherited and inflammatory cardiomyopathies, ischemic cardiomyopathy, pediatric and CHD, and valves and vascular imaging to women's heart disease and environmental sustainability. Technical topics featured in SCMR 2025 included novel reconstruction and motion correction, quantitative and multiparametric CMR, novel contrasts, novel field strengths and AI applications along the entire medical imaging pipeline. The conference also underscored the importance of standardization, reproducibility, and value-based imaging in ensuring the widespread adoption of CMR across diverse healthcare settings.

A notable highlight of SCMR 2025 was the introduction of the CMR innovations track, which brought together scientific, educational, and industry perspectives to drive forward the next generation of CMR technology and applications. This track included three new session formats: Science Slam, Unmet clinical needs, and Open-source software. It also included a collaborative show-off session with industry partners and three sessions with industry in efficient, accessible and sustainable CMR. Additionally, the CMR Innovations Track featured the first-ever SCMR-MICCAI joint workshop, further strengthening ties between the cardiovascular imaging and computational imaging communities. The joint SCMR-MICCAI sessions at SCMR 2025 offered technical and clinical expert views regarding unsolved issues in CMR imaging and AI. It also offered the opportunity for participants of the MICCAI CMRxRecon2024 challenge to present their findings to clinical and technical CMR experts. The workshop also marked the official launch of the CMRxRecon2025 challenge, which focuses on the development of foundation models for cardiac MRI reconstruction to meet real-world challenges spanning multiple centers, vendors, and disease conditions.

Collaboration with sister societies played a crucial role in SCMR 2025, with eight joint sessions and one pre-conference workshop co-organized with eleven international societies: European Society of Cardiovascular Radiology (ESCR), European Association of Cardiovascular Imaging (EACVI), North American Society for Cardiovascular Imaging (NASCI), American Society of Nuclear Cardiology (ASNC), Society of Cardiovascular Computed Tomography (SCCT), American Society of Echocardiography (ASE), International Society of Magnetic Resonance in Medicine (ISMRM), Society of Magnetic Resonance Angiography (SMRA), Medical Image Computing and Computer Assisted Intervention Society (MICCAI), Asian Society of Cardiovascular Imaging (ASCI) and Sociedade Brasileira de Cardiologia (DIC). These sessions fostered interdisciplinary dialogue and provided a holistic perspective on CMR's role in medical imaging.

This year, for the first time, SCMR also introduced a dedicated track for CMR Level 1 Training Verification. This initiative allowed attendees to obtain 17.5 h of structured training as part of their meeting registration, fulfilling the requirements for CMR Level 1 verification. Participants were required to attend at least 13 out of the 16 designated "Level 1 course" sessions, making this a significant milestone in SCMR's commitment to education and professional development.

Recognizing the importance of networking and early career development, SCMR 2025 offered a rich array of opportunities for early career professionals. Special sessions were designed to foster mentorship, provide insights into career pathways, and facilitate collaborations between junior and senior investigators. Highlights included dedicated networking events, panel discussions and dedicated sessions on grant writing and research funding, and a special session on patient engagement and advocacy. These initiatives underscored SCMR's dedication to nurturing the next generation of leaders in cardiovascular imaging.

In summary, SCMR 2025 exemplified a commitment to advancing CMR through innovation, collaboration, and education. As the global CMR community looks to the future, the insights and discussions generated at SCMR 2025 will undoubtedly shape the next breakthroughs in cardiovascular MR, driving progress toward more accessible, efficient, sustainable and impactful CMR applications worldwide. This paper summarizes the key themes and discussions from SCMR 2025, highlighting the collaborative efforts that are driving the future of CMR and underscoring the Society's unwavering commitment to research, education, and clinical excellence.

2. Focus sessions

The SCMR 2025 conference emphasized three core themes—efficient, accessible, and sustainable CMR—including dedicated 1-hour focus sessions for each domain.

The focus session on efficient CMR provided important insights on strategies to enhance CMR workflow, optimize patient outcomes, and streamline reporting and referral processes. Dr. Deborah Kwon emphasized the importance of optimizing referral pathways and reporting structures to improve efficiency. Dr. Subha Raman discussed strategies to enhance CMR protocols and exam workflows, ensuring improved throughput and patient care. The panel discussion, featuring Dr. Yuchi Han and Dr. Matthias Stuber, further explored practical implementation strategies. The session underscored the necessity of refining operational

workflows and utilizing emerging technologies such as highly accelerated imaging or AI supported reporting to maximize the impact of CMR in clinical settings.

For accessible CMR, the focus session addressed the critical need to make CMR more available globally, particularly in low- and middle-income countries. Dr. Katia Menacho Medina highlighted the development of rapid CMR techniques that could be deployed in resource-limited settings, reducing scan times while maintaining diagnostic accuracy. Dr. Juliet Varghese explored innovations in CMR equipment, focusing on lower-field imaging and reduced helium usage to make the technology more affordable and sustainable. Panelists Dr. Amedeo Chiribiri and Dr. James C. Carr engaged in a discussion on overcoming financial and infrastructural barriers to broader CMR adoption. The session emphasized the importance of cost-effective innovations and strategic implementation to expand CMR accessibility worldwide.

The focus session covering the topic of sustainable CMR examined how the CMR environmental footprint can be minimized while maintaining high diagnostic performance. Dr. Kate Hanneman provided insights into sustainable imaging practices, advocating for energy-efficient CMR scan protocols and eco-conscious operational strategies. Dr. Thomas Küstner discussed the environmental impact of AI in CMR, presenting a balanced view of its advantages and challenges. Panelists Dr. Tessa S. Cook and Dr. Peng Hu further deliberated on actionable steps to enhance sustainability in CMR. The session highlighted the imperative for the medical imaging community to integrate green technologies and responsible AI usage to reduce CMR's environmental impact while maintaining clinical excellence.

The SCMR 2025 focus sessions underscored the essential roles of efficiency, accessibility, and sustainability in advancing CMR. By optimizing workflows, expanding access to underserved regions, and integrating sustainable practices, the field continues to evolve toward more impactful and responsible utilization of CMR technology.

3. Clinical highlights

At this year's SCMR conference, several educational and abstract sessions highlighted cutting-edge advancements in CMR across a range of clinical applications, from heart failure and inherited cardiomyopathies to ischemic heart disease and congenital heart disease (Fig. 3). The following sections briefly summarize some of these clinical highlights, emphasizing how CMR is shaping the future of cardiovascular care.

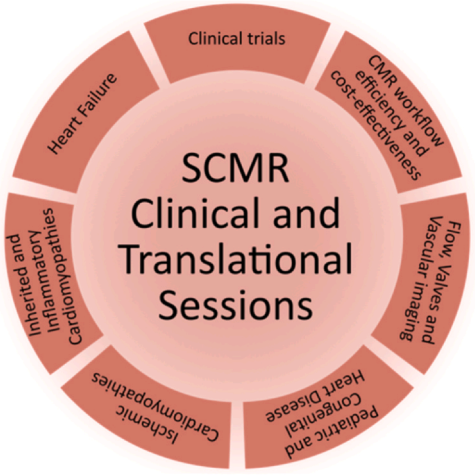


Fig. 3. Clinical and translational scientific sessions at the SCMR. The clinical and translational scientific sessions comprised 12 educational sessions, 5 oral abstract sessions and multiple rapid- and quick-fire sessions in a wide range of topics including (but not limited to) heart failure, inherited and inflammatory cardiomyopathies, ischemic cardiomyopathy, pediatric and congenital heart disease, flow, valves and vascular imaging, CMR workflow efficiency and cost-effectiveness and clinical trials. *CMR* cardiovascular magnetic resonance, *SCMR*Society for Cardiovascular Magnetic Resonance

3.1. Heart failure

CMR continues to be an invaluable tool in the assessment of heart failure, providing unmatched accuracy in evaluating both right and left ventricular size and function [1]. Beyond volumetric analysis, CMR is becoming indispensable for determining the etiology of heart failure through late gadolinium enhancement (LGE) and other tissue characterization techniques, which help identify patterns of myocardial injury. Additionally, CMR offers critical prognostic information, enhancing risk stratification and guiding management decisions in patients with heart failure.

This year's SCMR conference featured numerous sessions highlighting the evolving role of CMR in the assessment of patients with suspected heart failure with preserved ejection fraction (HFpEF) [2]. Several presentations underscored the potential of CMR to unravel the complex pathophysiology of HFpEF, which involves a multifaceted interplay between abnormal diastolic function, systemic inflammation, and coronary microvascular dysfunction. This interplay contributes to increased interstitial myocardial fibrosis and myocardial stiffness [3]. A particularly intriguing topic was the emerging role of epicardial adipose tissue (EAT) as a potential contributor to the pathophysiology of HFpEF.

One notable abstract by Bresticker et al. demonstrated that treatment with empagliflozin in a mouse model of early-stage cardiometabolic HFpEF led to a significant reduction in EAT quantity and proinflammatory characteristics, as well as improvements in myocardial perfusion reserve (MPR) and diastolic and systolic function [4]. These findings suggest that the cardioprotective effects of empagliflozin may be mediated through its favorable impacts on EAT quality and microvascular function.

Another significant contribution came from Echols et al, who presented data showing that elevated saturated fatty acid (SFA) content in EAT is strongly associated with key features of HFpEF, including higher H2FPEF scores and more severe diastolic dysfunction [5]. Their results indicate that EAT fatty acid composition (FAC) might be a more sensitive biomarker for assessing HFpEF than EAT volume index (EATVi), highlighting the potential for FAC as a diagnostic and prognostic tool.

In the Early Career Award session for translation, two abstracts presented compelling findings on the use of CMR for HFpEF characterization. The study by Skacel et al. revealed that semaglutide (SEMA) significantly reversed impairments in MPR, systolic strain, and diastolic strain rate in a mouse model of cardiometabolic HFpEF induced by a high-fat, high-sucrose diet [6]. These results suggest that the cardioprotective effects of SEMA in HFpEF may involve improvements in coronary microvascular function and cardiac strain. Meanwhile, the abstract by Xavier et al, which won the early career award in the translation category, showed that exercise CMR combined with proteomic profiling could distinguish HFpEF patients with left ventricle (LV) ejection fraction above and below 60% [7]. Their findings identified altered lipid metabolism as a potential therapeutic target, and demonstrated that oral ketone administration improved cardiac output and stress diastolic function in HFpEF patients. These insights point to metabolic modulation as a promising therapeutic strategy for managing HFpEF.

Lastly, the abstract that won the Early Career Award in the clinical category by Ghanbari et al introduced a non-invasive work-volume (W-V) loop derived from exercise CMR (Ex-CMR) [8]. This technique was shown to effectively differentiate exercise-induced HFpEF from non-cardiac (NC) dyspnea by capturing distinct differences in volumetric dynamics and workload. The study reported significant variations in loop angles and areas between HFpEF and NC-dyspnea cohorts, suggesting that the W-V loop may serve as a reproducible tool for phenotyping patients with unexplained dyspnea.

3.2. Inherited and inflammatory cardiomyopathies

CMR plays a crucial role in the assessment of inherited and inflammatory cardiomyopathies by offering detailed information on cardiac morphology, function, and tissue characterization [1,9,10]. Its capability to detect myocardial fibrosis LGE and assess myocardial inflammation and edema using T1 and T2 mapping establishes CMR as an indispensable tool for accurate diagnosis, risk stratification, and management of these conditions. Additionally, CMR can differentiate between various forms of cardiomyopathies, such as hypertrophic, arrhythmogenic, and dilated cardiomyopathies, and identify distinct patterns of myocarditis and other inflammatory processes, thereby enabling personalized treatment strategies and enhancing patient outcomes.

This year's SCMR conference featured several high-level sessions focusing on the expanding role of CMR in assessing patients with inherited and inflammatory cardiomyopathies [11,12]. Notably, discussions centered around how CMR can characterize specific genetic cardiomyopathy phenotypes [13,14]. For example, CMR studies revealed that desmosomal gene variants are frequently associated with arrhythmogenic cardiomyopathies, while cytoskeletal gene variants are more commonly linked to dilated cardiomyopathies [13]. Moreover, the PKP2 gene mutation was often associated with a classic Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC) phenotype, whereas the Desmoplakin (DSP) gene mutation was linked to a left-dominant arrhythmogenic phenotype. Interestingly, both DSP and Filamin C (FLNC) gene mutations were associated with a ring-like LGE pattern. The scientific sessions also highlighted the potential overlap between genetic cardiomyopathies and myocarditis, emphasizing how certain genetic cardiomyopathies may present with recurrent bouts of myocarditis ("hot phase bursts"), leading to progressive myocardial injury and fibrosis.

An insightful abstract by Zareba et al demonstrated that first-degree relatives (FDRs) of DCM probands exhibit significant CMR differences based on genetic risk, with older FDRs carrying pathogenic or likely pathogenic (P/LP) variants showed larger LV volumes, lower ejection fraction, and worse myocardial strain compared to genetically negative FDRs [15]. The presence of abnormal myocardial strain across all genetic risk groups suggests potential unmeasured genetic risks in FDRs classified as negative.

Another notable abstract by Topriceanu et al. highlighted that Lamin A/C (LMNA) mutation carriers with preserved LV function have longer T2 times, higher serum troponin levels, increased extracellular volume (ECV), and impaired myocardial strain, indicating subclinical myocardial inflammation and remodeling [16]. The study further showed that CMR-derived focal fibrosis and strain biomarkers possess prognostic value for major adverse cardiovascular events (MACE), suggesting their potential utility in enhancing current risk prediction tools for LMNA cardiomyopathy.

In addition, several sessions emphasized the growing role of CMR in assessing hypertrophic and infiltrative cardiomyopathies. For instance, an abstract by Marianchuk et al revealed that 3D maximal left ventricular wall thickness (3DMWT), derived from automated deep learning-based 3D-shape phenomics, is only weakly associated with replacement fibrosis but strongly and independently linked to adverse outcomes in hypertrophic cardiomyopathy (HCM). This suggests that 3DMWT could serve as an independent risk marker in HCM risk models [17].

Furthermore, an abstract by Laghzali et al. demonstrated that fractional anisotropy (FA) derived from diffusion tensor imaging (DTI) can detect early myocardial microstructural changes in HCM even in the absence of functional abnormalities, suggesting that FA could serve as a sensitive biomarker for early HCM detection and risk stratification [18].

Lastly, Aspinall et al presented a multivariable risk score using CMR-derived metrics to predict adverse outcomes in asymptomatic (NYHA-I) HCM patients, achieving a concordance-index of 0.75 and effectively stratifying patients into low- and high-risk subgroups [19]. This risk score shows promise for identifying asymptomatic HCM patients who might benefit from targeted surveillance or early therapeutic intervention.

3.3. Ischemic cardiomyopathy

Evaluation of myocardial ischemia, infarction, and associated downstream events and outcomes continues to be a core focus of CMR research and clinical implementation. As a community, we are seeing increasing demand for quantitative stress perfusion CMR and numerous tools and techniques are now available to help integrate this into clinical practice [20,21]. This increased demand was evidenced by two Rapid Fire Abstract sessions focused on quantitative perfusion. Abstracts in these sessions explored topics ranging from effect of wall thickness and mass on stress perfusion quantification [22] to the evaluation of perfusion in patients with rheumatoid arthritis [23]. Dr. Ana Almeida also provided an overview of the clinical utilization of quantitative stress perfusion during the Ischemic Cardiomyopathy "Read with the Experts" session.

The clinical & translational session on quantitative CMR biomarkers in clinical practice demonstrated numerous new and evolving techniques for better assessing risk after myocardial infarction (MI). In this session, Schulz et al demonstrated the CMR-derived epicardial adipose tissue can be used as an independent marker of MACE after MI [24]. In the same session, Lange et al showed how using CMR to model pulmonary capillary wedge pressure (PCWP) after acute MI is independently associated with MACE, particularly in patients with overall less myocardial damage [25].

Finally, in the late breaking clinical trial session, Kwong et al reinforced the important role of stress CMR by providing a post hoc analysis of the ISCHEMIA trial comparing CMR and single-photon emission computed tomography (SPECT)/stress echo. In their study, the authors found that stress CMR severity was associated with all trial-specific outcomes, and there was no significant association with SPECT/stress echo [26].

3.4. Pediatric and congenital heart disease

The pediatric and congenital heart disease (P/CHD) program at SCMR 2025 consisted of a whole day P/CHD preconference, 6 P/CHD main track sessions, an oral abstract session, an oral case session, 10 rapid-fire abstract sessions, and 6 rapid-fire case sessions. Selected scientific highlights are briefly presented.

Criteria and risk scores for the management of repaired tetralogy of Fallot are continually being refined and increasingly rely on CMR data. In a recent American Heart Association (AHA) scientific statement, an algorithm was proposed to consider pulmonary valve replacement in repaired tetralogy of Fallot that incorporates multiple CMR criteria, including right ventricular ejection fraction (RVEF) $\leq$46%, left ventricular ejection fraction (LVEF) $\leq$50%, and an INDICATOR risk score $\geq$3, which includes use of the biventricular global function index (a calculation using end-diastolic volume (EDV), end-systolic volume (ESV), and ventricular mass from MRI) [27]. Ghonim S et al. published a surveillance risk score that incorporates the extent of biventricular LGE and biventricular ejection fraction, among other variables, to predict all-cause mortality [28]. In fact, a recent machine learning derived risk model found that amongst a gamut of potential clinical, hemodynamic, and imaging input variables, right ventricular end-systolic volume index (RVESVi) and RVEF by CMR were the two strongest predictors for major adverse cardiovascular events [29].

Advanced CMR imaging offers independent anatomic and functional data to help guide decision making in borderline ventricles. In borderline LV, an LVEDVi $\geq$25 mL/m^2 and ascending aortic output (AAO) flow or left ventricular cardiac index (LVCI) $\geq$1.8–2.0 L/min/m^2 are reasonable criteria to consider biventricular repair in the neonate or in

patients after hybrid LV recruitment [30]. CMR criteria for biventricular conversion in older 2–4 year-olds could include LVEDVi ≥ 40 mL/m^2, LVSVi ≥ 30 mL/m^2, and LEVDP < 13–15 mmHg [31]. For right ventricular (RV) hypoplasia, biventricular conversion could perhaps be considered with RVEDV $\geq$ 30 ml/m^2, RVEF $\geq$ 55% and RV/LV SV $\geq$ 0.4 in left-dominant unbalanced AVSD or RV mass $\geq$ 10 g/m^2 in pulmonary atresia with intact ventricular septum [32].

New data from Wibf et al., at a surgical center at moderate-altitude, interestingly found that pre-Fontan systemic vascular resistance (SVR) was associated with death/transplant while pulmonary vascular resistance (PVR) was not [33].

For post-Fontan management, powerful information is emerging from large multicenter registries, including new CMR biomarkers that provide insights into Fontan hemodynamics and physiology. Data from the Australia/New Zealand registry found that Fontan patients with RV dominant ventricles and $\geq$ moderate atrioventricular valve regurgitation (AVVR) by echocardiography were at increased risk of death/transplant [34]. Subsequently, the Fontan Outcomes Registry using CMR Examination (FORCE) data also showed that $\geq$ moderate AVVR by CMR was a strong negative predictor for exercise performance and death/transplant [35]. CMR generated hemodynamic force profiles of the RV in Hypoplastic left heart syndrome (HLHS) patients were associated with catheterization hemodynamics [36], specific shape variants derived from statistical shape modeling of the RV in HLHS patients were associated with tricuspid valve (TV) function and regurgitation along with composite adverse outcomes [37], and single ventricle EDP and EDV are co-correlated and both associated with adverse outcomes on multivariable analysis [38].

CMR measures of increased RV mass and decreased RV function are considered high-risk outcome predictors in pediatric pulmonary hypertension [39–41], and for the first time CMR criteria of RVEF < 44% and RVMi > 80 g/m^2 are now included in the risk stratification tool proposed by the pediatric task force of the 7th World Symposium on Pulmonary Hypertension [42].

The first multicenter data incorporating LGE quantification in pediatric HCM has recently been published, which showed that pediatric HCM patients with LGE $\geq$10% are at increased risk of sudden cardiac death, and moreover, that the addition of LGE quantification improved the performance of existing pediatric HCM risk scores [43]. Similarly, LGE radiomics in pediatric HCM are associated with an increased risk of HCM-related sudden cardiac death [44].

Overall, the P/CHD program at SCMR 2025 was a dynamic and enriching educational experience filled with exciting science that fostered insightful discussions and facilitated meaningful connections within a thriving P/CHD CMR community.

3.5. Flow, valves and vascular imaging

The last decade has seen tremendous advances in flow imaging, which now allow for improved assessment of valve disease with CMR, as well as numerous new and improved acquisition and analysis techniques [45,46]. While unlikely to ever supplant echocardiography as the first-line assessment of valvular disease, the ability to provide comprehensive hemodynamic and structural characterization of multiple valves and the vasculature has led to increasing CMR utilization in many valve-disease patients.

This year's SCMR conference featured several sessions in flow, valves and vascular imaging. In the session "Flow and Vascular Imaging," Dr. Jose F.R. Palomares provided critical insight in to how to incorporate flow imaging into clinical practice while Dr. Jadranka Stojanovska described her perspectives on how to perform valvular assessment in the pulmonic, tricuspid and mitral valves. Numerous valve-related case reports were presented throughout the meeting and "Read with the Experts" sessions focused on mitral valve disease and aortic valve disease were led by Dr. Kana Fujikura and Dr. Geraldine Villasana, respectively.

In vascular imaging, te Kiefte et al. presented a very interesting study evaluating the age-related changes in aortic wall thickness with 4D flow MRI assessed hemodynamics. This study demonstrated that aorta wall thickness and pulse wave velocity increased with age and aortic wall thickness was independently associated with wall shear stress angle. These findings add evidence to a biomechanical link between hemodynamics and vessel wall changes [47]. In the clinical Early Career Award session, Berhane et al. demonstrated how deep learning can be utilized to quantify time-resolved 3D hemodynamics direct from contrast-enhanced MRA [48]. By not requiring 4D flow MRI acquisition, this technique could help improve access to hemodynamic analyses.

3.6. CMR workflow efficiency and cost-effectiveness

An important part of the theme of this year's conference was CMR efficiency. Workflow efficiency can include all aspects of the imaging chain including placing orders, protocoling exams, image acquisition, analysis, and interpretation [49,50]. Indeed, efficiency is foundational to the other major themes of the conference ("accessible" and "sustainable" CMR). Generally, when thinking about efficiency, imagers and imaging scientists tend to think about acceleration techniques and increasingly AI reconstruction approaches that result in high-quality images with significantly shorter acquisition times. An entire session in the CMR Innovations track focused on this issue and how researchers and industry are working to solve these issues. However, what was particularly compelling in this year's meeting was the number of topics focused on other parts of workflow. For example, Delso et al. presented a deep learning model being used to automate aortic valve plane placement to aid technologist during scanning [51], while Vegunta et al. showed that a commercially available deep learning reconstruction algorithm can reduce bSSFP cine imaging scan times by 25–40% while preserving image quality [52].

An increased focus of this years' meeting was related to efficiency in other parts of the imaging chain. A vigorous Debate session highlighted the pros and cons of a tailored CMR approach (presented by Dr. James Moon) vs. comprehensive CMR imaging (presented by Dr. Tefvik Ismail). More than anything, the speakers and panelist in this session found that the answer is probably somewhere in the middle between these two extremes, but a thoughtful approach to protocol design is key to a successful CMR program. During the focus session on efficient CMR, Dr. Deborah Kwon described her system's efforts to optimize referrals through smart order sets, clear reporting, and effective communications with referring physicians. In this same session, Dr. Subha Raman led an important discussion on how rapid CMR can improve throughput and ease integration into imaging practices, while still positively impact patient outcomes.

3.7. Clinical trials

CMR has emerged as an invaluable tool in clinical trials due to its unparalleled accuracy in assessing cardiac structure, function, and tissue characteristics non-invasively. Its ability to detect subtle changes using techniques such as LGE and T1/T2 mapping enables precise evaluation of therapeutic effects. The high sensitivity and reproducibility of CMR can significantly reduce the number of patients required to achieve statistical power, enhancing trial efficiency. Additionally, its lack of ionizing radiation supports longitudinal studies, enhancing the reliability and validity of trial outcomes.

This year's SCMR conference featured several groundbreaking clinical trials leveraging the strengths of CMR. A notable study by Chan et al. introduced the first multi-metric risk score integrating quantitative LGE and CMR metrics to predict sudden cardiac death (SCD) risk in HCM patients [53]. The model, which included LGE burden, maximal wall thickness, left atrial diameter, family history of SCD, and LV end-systolic volume, demonstrated superior predictive performance with a

c-statistic of 0.78 compared to the traditional ESC risk score of 0.67.

In the STOP-CA trial, Juhasz et al. demonstrated that atorvastatin significantly reduced the risk of a substantial decline in left ventricular global circumferential strain among lymphoma patients undergoing anthracycline-based chemotherapy, suggesting a cardioprotective effect [54]. Similarly, Garimella et al. showed in the MESA study that changes in intramyocardial regional strain score (iRSS) over 10 years were a robust predictor of incident heart failure (HF) and stroke, while global strain changes were not, highlighting iRSS as a more sensitive marker for adverse outcomes [55].

As mentioned in the ischemic cardiomyopathy session, in a post hoc analysis of the ISCHEMIA trial, Kwong et al. demonstrated that stress CMR was more strongly associated with cardiovascular outcomes—including cardiovascular death, non-fatal MI, and hospitalizations—compared to SPECT/echo, emphasizing the superior prognostic utility of CMR [26]. Meanwhile, Lechner et al. reported that CMR-guided transcatheter aortic valve replacement (TAVR) resulted in similar implantation success rates as CT-guided TAVR across different age groups, supporting CMR as a viable alternative for TAVR planning [56].

Scadi et al. showcased the long-term efficacy and safety of iCMR-guided ablation for isthmus-dependent atrial flutter, achieving an 85% success rate with no recurrences in 82% of patients over a median follow-up of 27 months [57]. Additionally, Flett et al. presented promising data from the BRITISH trial, which investigates the potential of CMR-identified myocardial scar to guide ICD (implantable cardioverter defibrillator) implantation and reduce all-cause mortality in non-ischemic cardiomyopathy (NICM) patients [58]. With 264 patients enrolled and ongoing recruitment, the trial aims to provide definitive evidence by 2030 to inform international guidelines.

Collectively, these studies underscore the growing role of CMR in enhancing risk stratification, guiding therapeutic decisions, and improving outcomes in various cardiac conditions, further solidifying its position as a cornerstone in cardiovascular clinical trials.

4. Technical highlights

This year's SCMR conference showcased cutting-edge technical advancements in cardiac MRI, with dedicated workshops and scientific sessions. The SCMR-ISMRM workshop explored the latest developments in cardiac diffusion imaging and motion, highlighting new acquisition techniques, open-source tools, and AI-driven approaches for improving robustness and clinical feasibility. The inaugural SCMR-MICCAI workshop strengthened the collaboration between CMR and computational imaging communities, focusing on AI-driven reconstruction challenges. Finally, the scientific sessions presented a broad range of technological breakthroughs, including innovations in low-field MRI, metabolic and oxygen-sensitive imaging, and machine learning applications for CMR analysis. Selected scientific highlights are briefly presented.

4.1. SCMR-ISMRM workshop

Cardiac diffusion imaging [59] and motion mapping [60] provide some of the most detailed characterizations of myocardial structure and function to date; however, obtaining these data within clinically acceptable scan times while ensuring adequate robustness remains challenging. The SCMR/ISMRM co-provided workshop featured a range of recent innovations to address these pressing challenges (Fig. 4).

Scott et al. investigated the use of ultrahigh performance gradients with up to 200 mT/m strength and 200 T/m/s slew-rate and reported whole-ventricular coverage in an efficient diffusion imaging protocol in under 25 min [61]. Novel open-source tools were presented to lower the entry hurdle for the use of advanced cardiac diffusion MRI. Hannum et al. presented open-source DTI acquisitions [62] using the PulseSeq framework [63], while Cork et al. reported on an cardiac diffusion post-processing toolbox in python [64]. In motion encoding, Hussein et al.

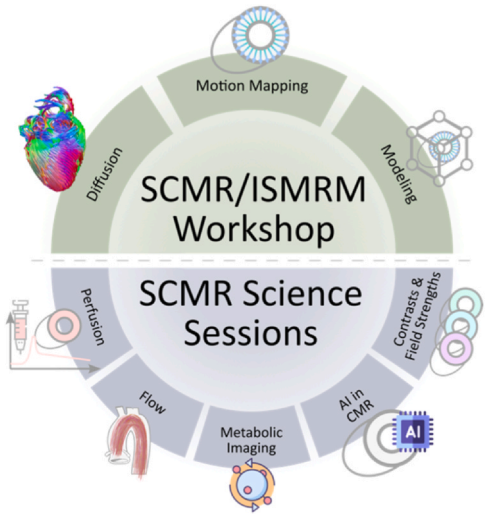


Fig. 4. Scientific technological innovations at the SCMR/ISMRM co-provided workshop and the SCMR scientific sessions. The workshop comprised three topics in microstructural and motion CMR, while the scientific sessions comprised five oral abstract sessions and multiple rapid- and quick-fire sessions in a wide range of topics including (but not limited to) perfusion, flow, metabolic imaging, AI in CMR and novel contrasts and field strengths. *SCMR* Society for Cardiovascular agnetic resonance, *ISMRM* International Society of Magnetic Resonance in Medicine, *CMR* cardiovascular magnetic resonance, *AI* artificial intelligence

used a displacement encoding with stimulated echoes (DENSE) based approach to provide detailed insights into microstructural motion characterization [65]. Six parameters were proposed for characterization along the myocardial material directions providing promising candidates for intuitive characterization of pathological changes. Finally, to enable the use of data driven evaluation of DENSE images, Barbaroux et al. proposed an approach to generate realistic synthetic data, as a means to minimize bias in the training data [66].

These works highlight microstructural and motion imaging, fueled by new hardware and data driven processing, as a vibrant area of research, inching closer to routine clinical use.

4.2. SCMR-MICCAI workshop

SCMR 2025 introduced the first-ever SCMR-MICCAI joint workshop, strengthening the connection between the CMR and computational imaging communities. MICCAI Society is "dedicated to the promotion, preservation and facilitation of research, education and practice in the field of medical image computing and computer assisted medical interventions including biomedical imaging and medical robotics". This workshop consisted of two sessions. The first session provided clinical and technical experts views on opportunities and challenges of AI as well as on the demands of AI for CMR imaging techniques in clinical scenarios. By bringing together leading technical and clinical experts, the workshop facilitated discussion on the practical implementation of AI-driven solutions in CMR. A particular focus was given to the growing role of AI in overcoming technical barriers such as slow exams, motion artifacts, inefficient workflows, and the limited availability of high-quality, standardized datasets for algorithm development. This session also introduced the CMRxRecon MICCAI challenges. For three consecutive years, CMRxRecon has hosted the CMRx series challenges, covering topics such as CMR image quality control, rapid imaging, and multi-contrast reconstruction. The session also launched the CMRxRecon2025 challenge, which will focus on developing foundation models for cardiac MRI reconstruction. This new challenge aims to address real-world constraints by ensuring robustness across multiple centers, vendors, and disease conditions. Further details of the

CMRxRecon2025challenge can be found here: https://cmrxrecon.github.io/2025/Home.html.

The second session of the workshop provided an opportunity for participants in the MICCAI CMRxRecon2024 challenge to present their findings to an audience of clinical and technical experts in CMR. The CMRxRecon2024 challenge included the following two independent reconstruction tasks: (1) multicontrast CMR reconstruction and (2) random sampling CMR reconstruction. The first task focused on developing a contrast-universal model that can provide good image quality reconstruction for highly accelerated uniform undersampling being able to process multiple contrast reconstructions with different sequences, views, and scanning protocols using a single universal model. The second task focused on developing a sampling-universal model that can robustly reconstruct CMR images from different k-space trajectories at different acceleration factors. A common strategy across the best performance algorithms was the incorporation of data consistency and domain-specific priors. Further details of the CMRxRecon2024 challenge can be found in their website (https://cmrxrecon.github.io/2024/Home.html) and data publication [67].

By fostering collaboration between SCMR and MICCAI, the joint workshop exemplified a growing convergence between computational imaging, MR physics and clinical practice, paving the way for future innovations in CMR that enhance both efficiency and accessibility.

4.3. Science sessions

During the scientific sessions technical innovations were presented across 4 oral sessions and multiple rapid- and quick-fire sessions (Fig. 4).

Low-field (< 1T) techniques have received keen interest at the meeting. At 0.55T free-breathing techniques have shown promising image quality. For late gadolinium enhancement image navigation was used in a large animal model to achieve whole heart coverage with 1.8 mm isotropic resolution [68]. For Ferumoxytol-enhanced cine imaging, a free-running, motion binning approach enabled 2 mm isotropic resolution in 5 min scan time [69].

The field of metabolic and oxygen-sensitive cardiac MR has also seen novel developments. Cheema et al. presented a free-breathing, steady-state technique for chemical exchange saturation transfer (CEST) imaging at 3T [70]. Based on the multi-tasking framework [71] quantitative creatine assessment showed visually high map quality, with good homogeneity throughout the myocardium, and reduced creatine levels in infarcted areas in a large animal model. Advances in cardiac oxygenation imaging have been reported exploiting the oxygenation contrast between the left and right ventricular blood pools. Moukarzel et al. used cine imaging in combination with breathing maneuvers and reported sex differences in the relationship between stress and the blood pool oxygenation ratio [72]. Zhang et al. reported on their use of quantitative susceptibility mapping and demonstrated the ability to predict invasively derived cardiac indices in 66 patients undergoing right heart catheterization (RHC) [73].

The abstract by Bozic-Iven et al., which won the Early Career Award in the Basic category, focuses on mitigating the impact of heart rate variability in myocardial arterial spin labeling (ASL) using a Double Inversion Recovery (DIR) labeling approach. Their results demonstrate that DIR-labeling significantly reduces physiological noise and improves SNR, enhancing the robustness and precision of myocardial ASL perfusion quantification, potentially facilitating its clinical translation [74].

Finally, machine learning based approaches have demonstrated the ability to elevated cardiac MR image analysis. Machine learning based clustering of 3D-shape models from 405 HCM patients has yielded two distinct phenotype clusters [75]. Cluster membership has been shown to be independently associated with adverse clinical outcomes, providing promise for risk stratification.

4.4. Artificial intelligence in cardiovascular MRI

AI continues to advance CMR across all stages of the imaging pipeline, driving both technical developments and clinical applications. SCMR 2025 featured 96 (of 728; 13%) AI-focused abstracts, reflecting a vibrant and maturing field where new algorithm development coexisted with the real-world evaluation of existing solutions.

Approximately half of these studies focused on developing new models, while the other half aimed to evaluate existing solutions in independent and often more clinically representative datasets. Development studies typically included a median of 250 subjects (interquartile range, 134–533), while evaluation studies involved 40 subjects (interquartile range, 16–91). This increasing emphasis on external testing reflects a commendable shift towards assessing AI performance beyond initial cohorts. In two of the largest studies, Masci et al. leveraged CMR-derived phenotypes from standard clinical imaging in a cohort of 31,784 UK Biobank subjects to estimate cardiovascular biological age and its association with clinical outcomes [76], while Li et al. evaluated 3039 routine-care patients to show how an AI-assisted CMR scanning workflow improved efficiency and image quality without compromising outcomes [77].

Dataset characteristics further reflected the current landscape and emerging opportunities for AI in CMR. Most studies remained single-center, but nearly one in five already incorporated multicenter datasets—an essential step for improving generalizability. Similarly, while proprietary data predominated, a growing number of studies leveraged established repositories such as ACDC [78], CIROC [79], DETERMINE [80], FORCE [81], or the SCMR Registry [82]. Inline integration of AI methods directly within imaging workflows was reported in about a fifth of studies, reflecting progress toward clinical translation. Notably, Daibes et al. used multicenter data from over 700 subjects across five institutions within the SCMR Registry to demonstrate synthetic hematocrit prediction for ECV quantification without blood sampling [83], highlighting the growing potential of collaborative efforts and shared resources.

Compared to the literature in previous years [50], this year's abstracts revealed a clear use-case shift beyond segmentation, with image reconstruction becoming the most represented area (Fig. 5). This reflects the growing interest in improving scan efficiency, accelerating acquisitions, and enabling novel sequences, such as free-breathing [84] or low-field imaging [85]. Among these, Lanza et al. presented a vendor-integrated solution that achieved up to 84% scan time reduction in cine imaging while maintaining excellent quality and accuracy [86]. Segmentation remained highly active, reflecting its increasing maturity with widespread use of models like nnUNet [87] and foundation models, while fine-tuning for specific domains, such as scar quantification [88], continues to drive innovation. Classification maintained a strong presence, with approaches for contrast-free tissue characterization from cine images [89]. Registration, localization, and synthesis methods showed modest increases, with applications including co-registration for non-contrast parametric mapping [90], to automated plane prescription [91] and the generation of cost-efficient cine images using diffusion models [92]. Quality control, although less frequently explored, remains essential, with contributions such as uncertainty quantification providing pixel-wise confidence maps during automated scar segmentation [93]. These trends were mirrored in the underlying architectures, with convolutional neural networks remaining predominant, while transformer-based models continued to emerge as a promising alternative for both image and text-related applications.

Similarly, AI applications across CMR sequences demonstrated both consolidation and expansion. Cine imaging remained the most explored sequence, particularly for function assessment and motion analysis [86]. Increasing attention was directed towards LGE imaging, such as free-breathing single-shot LGE enhanced by AI super-resolution [94], and mapping techniques, including synthetic hematocrit estimation for ECV mapping without blood sampling [83]. AI solutions also expanded

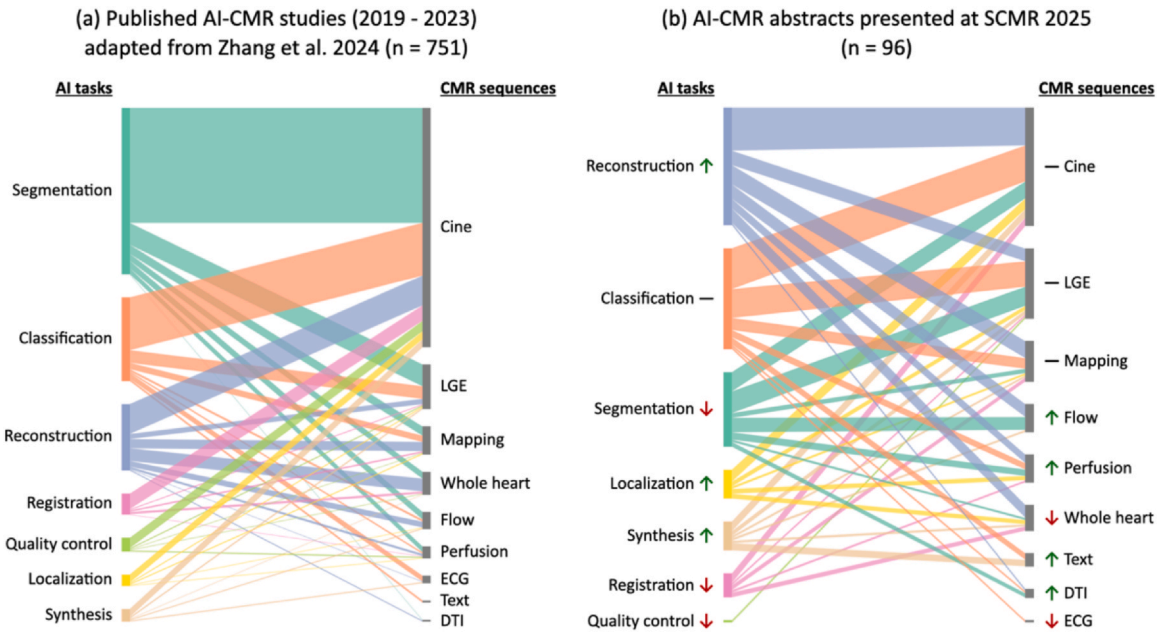


Fig. 5. Comparison of AI applications across CMR tasks and sequences, illustrating (a) previous trends in the literature and (b) emerging directions based on SCMR 2025 abstracts. Panel (a) is adapted from a recent review [50], summarizing 751 AI–CMR studies from 2019 to 2023. Panel (b) reflects the same systematic analysis applied to 96 AI-focused abstracts presented at SCMR 2025. Arrows in panel (b) indicate changes in relative prevalence compared to prior literature (↑ increase, ↓ decrease, — stable). Reconstruction has become the most represented task, surpassing segmentation, while increased attention is evident in localization, synthesis, and advanced sequences such as flow, perfusion, DTI, and text-based methods. *AI* artificial intelligence, *CMR* cardiovascular magnetic resonance, *SCMR* Society forCardiovascular Magnetic Resonance, *DTI* diffusion tensor imaging

into more complex sequences, including flow [95], whole-heart imaging [96], perfusion [97], and DTI [98]. Emerging text-based applications, including automated reporting and vision-language models, further illustrated early steps towards integrating AI for report generation and clinical communication [99]. Overall, AI in CMR is maturing, with a shift beyond segmentation towards image reconstruction, workflow integration, risk prediction and real-world evaluation across the imaging pipeline.

5. Technologists highlights

Technologists undertake a critical role in the acquisition of CMR. Therefore, it is fundamental for the advancement of this growing field that technologists are provided with the opportunity to attend specialized conferences. SCMR 2025 is one such conference where a dedicated track is targeted specifically for Technologists, but crucially for anyone new to CMR.

The technologist track of SCMR2025 was composed of six sessions, four educational and two abstract/case study sessions and attended both in person and virtually. A total of 118 technologists attended, representing 16 countries. Twenty-one were a key part of the faculty, with many moderating or giving a presentation for the first time.

The four educational sessions were structured to provide practical and pathological education on all the key areas of CMR. Presentations were delivered by a broad range of experienced technologists, scientists and cardiologists/radiologists on acquiring high-quality images in subjects such as: Tips and tricks on imaging devices, sequence planning, 4D flow and CHD imaging, while intertwining the theme of accessible, efficient and sustainable CMR, with presentations on Sustainability, 30-min fast track CMR, Low field scanning and advancement in AI. There was also a session on career development, which highlighted the opportunities that are opening to technologists in reporting and how to run a successful clinical and research department simultaneously.

This year the abstract session was headlined by Dr Katharine Thomas who gave a practical how-to guide on Abstracts, providing Techs with step-by-step instructions, to increase the quantity and quality of abstracts submitted next years. Dr. Ashwin Venkateshvaran provided a similar guide for case studies using AI-assisted technology to highlight the advantages and pitfalls of this new tool.

Amanda Potersnak won the best abstract award for presenting her work on “Dynamic Contrast MR Lymphangiography with percutaneous lymphatic intervention of pulmonary lymphatic leak in the setting of VSD and partial anomalous pulmonary venous return [100].”

Another highlight of the CMR2024 technologist track, was the sustainability talk presented by Dr. Hibba Kurdi who gave clear statistics on the environmental impact MRI departments have globally and then provided eco-design and operational strategies to reduce the carbon footprint of MRI for energy costs savings.

SCMR 2025 was a wonderful opportunity for new and experienced technologists to network and forge relationships with departments from around the world and share new ideas and techniques to grow and improve the quality, efficiency, and sustainability of CMR worldwide.

6. CMR innovations highlights

This year’s conference introduced the CMR Innovations track, a dedicated space for nontraditional session formats, special topics, and industry participation. The track featured software demonstrations, science communication and clinical needs sessions, and discussions on sustainability, efficiency, and accessibility—aligning with the overall theme of the 2025 meeting.

Two sessions highlighted open-source tools designed to enhance CMR research and clinical workflows. The first session included a device-agnostic MRI simulation framework, allowing researchers to optimize imaging protocols across different hardware platforms, an open-source T1 mapping sequence, enabling reproducible quantification for myocardial tissue characterization, and a TensorFlow-based CMR library, integrating AI-powered image reconstruction and segmentation. The second session introduced a 4D flow MRI toolbox, providing advanced hemodynamic analysis and visualization, and two DTI processing tools offering insights into myocardial microstructure and fiber architecture. Each session concluded with developer Q&A session,

where attendees engaged directly with software creators. These projects underscored the growing role of community-driven development in expanding access to advanced CMR techniques while reducing dependence on proprietary software.

The Unmet Clinical Needs session aimed to bridge communication gaps between clinicians and technical experts, ensuring imaging advancements address real-world patient care challenges. A guiding principle was that a method is only as valuable as the problem it solves. Three finalists identified needs for automated volumetric segmentation for images of simple and complex congenital heart disease, methods for imaging fine mitral valve structure and using results to stratify risk for major adverse cardiac events, and multiparametric imaging for heart transplant monitoring, emphasizing reliable detection and grading of cardiac allograft vasculopathy severity. The session served as a call to action for the CMR research community, setting priorities for future technical developments based on clinical needs.

The Science Slam was a five-minute pitch competition designed to make research accessible to a general audience. The goal was to improve public understanding of CMR science, build trust in research, and inspire the next generation of scientists. This year's winners presented fast pediatric imaging with ultrashort echo time methods and heart failure detection based on myocardial stiffness measurements. These presentations highlighted the power of effective science communication in bridging research and clinical application, making complex ideas relatable to both professionals and the public.

Dedicated sessions addressed challenges in making CMR more sustainable, efficient, and accessible, focusing on both technical and logistical barriers. The sustainability session addressed ways to reduce CMR's environmental impact, including scanner energy consumption and greenhouse gas emissions. Presentations included helium-free MRI technology and contrast-agent-free imaging as ways to reduce reliance on nonrenewable resources. The efficiency session explored innovations aimed at optimizing workflows, reducing scan times, and automating key processes. AI-powered tools for automating scan prescriptions [101], all-in-one imaging [102], and real-time imaging [103] were presented as ways to enhance patient throughput without sacrificing diagnostic precision. The accessibility session addressed barriers to CMR adoption in low-resource settings and innovative strategies for expanding availability. Presenters showcased mobile and telemedically supervised CMR systems, which enable remote imaging for underserved populations.

Finally, the show-off session provided a space to highlight newly available commercial technologies. Presentations covered next-generation post-processing algorithms, integrated imaging platforms, and novel approaches to imaging. Attendees received a high-level overview of these developments, with discussions allowing for direct engagement with industry experts. This format encouraged meaningful dialogue about the present and future of CMR and current available offerings for clinical practice.

6.1. Early career sessions

The Early Career sessions at SCMR 2025 provided mentorship, career development, and networking opportunities, equipping trainees and early-stage professionals with tools to succeed in cardiovascular magnetic resonance. "Launch Your CMR Career: Funding and Research" offered strategies for securing grants, managing projects, and building research teams, with insights on funding landscapes across US and Europe. "Broadening Horizons: Navigating Professional Growth and Personal Balance" explored career progression, professional branding, entrepreneurship, and work-life balance, including challenges faced by clinician-scientists. "Collaborating with Patient Organizations to Build Your Career" emphasized advocacy-driven research, highlighting opportunities to engage with patient groups to enhance clinical impact. A panel discussion provided actionable strategies for integrating patient-centered principles into academic and industry careers. "Navigating Future Landscapes: Building Teams, Career, and Integrating Innovations" explored team leadership, career transitions, and AI in CMR. A panel discussion focused on AI's expanding role in cardiac imaging and its implications for clinical practice and research.

The Early Career Award Sessions recognized groundbreaking research. The Basic Science Award Winner was Masa Bozic-Iven for "Double Inversion Recovery for Mitigating the Impact of Heart Rate Variability in Myocardial Arterial Spin Labeling". The Clinical Award Winner was Fahime Ghanbari, MD, for "Exercise CMR-Derived Work-Volume Loop in Exercise-Induced HFpEF". The Translational Award Winner was Roshan Xavier, MD, MA, for "Exercise CMR and Proteomic Characterization of HFpEF Across the Spectrum of LV Ejection Fraction."

The Speed Mentoring Session was a highlight, connecting early-career attendees with leaders in academia, industry, and clinical practice. Through rapid-fire mentorship, participants gained insights into research, industry pathways, and leadership development. SCMR 2025's Early Career program was a launchpad for the future of CMR, providing essential mentorship and professional growth opportunities. Through structured sessions and award-winning research, this year's program reinforced the society's commitment to nurturing the next generation of cardiovascular imaging leaders.

6.2. Vision for the future: shaping the future of CMR

The SCMR 2025 conference emphasized three core themes: Efficient, accessible, and sustainable CMR. As CMR continues to evolve, these themes highlight the need for streamlined workflows, broader accessibility, and environmentally responsible practices. Efficient CMR focuses on optimizing protocols and workflows to enhance patient outcomes and operational effectiveness. Accessible CMR addresses the global disparities in CMR availability, advocating for cost-effective and scalable solutions. Sustainable CMR underscores the importance of reducing the environmental impact of imaging technologies while maintaining diagnostic accuracy.

Future innovations will refine these areas, ensuring that CMR remains a leading tool in cardiovascular imaging while addressing global healthcare challenges. Emerging trends include the integration of AI for automated analysis, enhanced workflow automation, and real-time data processing to reduce scan and reporting times. Additionally, further refinement of standardized 20–30-minute CMR protocols will facilitate widespread adoption in clinical practice. Accessible CMR will benefit from ongoing efforts to develop cost-effective imaging solutions and increased global collaboration to train healthcare professionals in low-resource settings. The use of low-field MRI coupled with efficient CMR protocols and low-dose, or non-contrast techniques offers high potential to make CMR a viable option for a broader patient population worldwide. Sustainable CMR will require continuous innovation in energy-efficient MRI technologies and the responsible application of AI to minimize computational demands and lead the way towards sort and easy-to-perform CMR protocols for a wide range of application across the pediatric and adult patient populations. The development of low-dose contrast agent strategies coupled with eco-friendly scanner designs (low field, helium free, etc.) can contribute to reducing the overall environmental footprint of CMR. Furthermore, industry partnerships and regulatory support will be crucial in ensuring sustainability remains a priority in medical imaging.

By optimizing workflows, expanding access to underserved regions, and integrating sustainable practices, the field of CMR continues to rapidly evolve toward more global and impactful utilization of CMR. SCMR plays a critical role in continuing to expand CMR worldwide by building on our well-established multi-disciplinary approach (Fig. 6) towards improving global cardiovascular health through innovation, education, advocacy, networking, research, and clinical excellence.

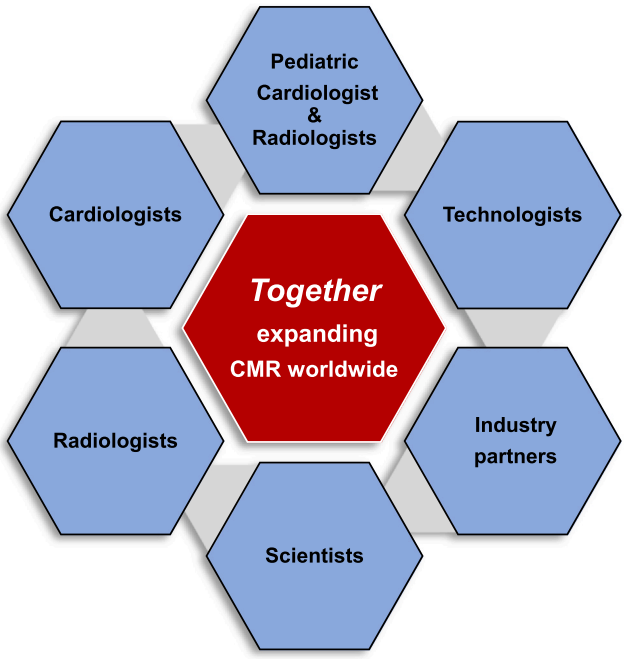


Fig. 6. SCMR builds on a multi-disciplinary and collaborative approach to advance CMR worldwide, including all CMR professionals (cardiologist, radiologist, pediatric specialists, scientists, engineers, technologists, nurses, administrators, and trainees) as well as industry parents and those involved with CMR sequence development, basic and clinical research, procedural planning, image acquisition and analysis, interpretation, and the delivery of a clinical service. *CMR* cardiovascular magnetic resonance, *SCMR* Society for Cardiovascular Magnetic Resonance

7. What to expect at SCMR 2026

The SCMR 29th Annual Scientific sessions will be held for first time in South America in Rio de Janeiro from 4, February 2026 to 7, February 2026. The conference theme "CMR worldwide: A global commitment to Cardiovascular Care" reflects SCMR's dedication to advancing CMR on a truly global scale. Set against the vibrant backdrop of Rio de Janeiro, the conference will not only highlight scientific excellence but also foster regional collaboration and celebrate the power of international collaboration in improving cardiovascular care for all.

Author contributions

Claudia Prieto: Conceptualization, Writing – original draft, Writing – review & editing. **Bradley D. Allen:** Writing – original draft, Writing – review & editing. **Clerio F. Azevedo:** Writing – original draft, Writing – review & editing. **Bruno Bezerra:** Lima Writing – original draft, Writing – review & editing. **Christopher Z. Lam:** Writing – original draft, Writing – review & editing. **Rebecca Mills:** Writing – original draft, Writing – review & editing. **Merel Huisman:** Writing – original draft, Writing – review & editing. **Ricardo A. Gonzales:** Writing – original draft, Writing – review & editing. **Sebastian Weingärtner:** Writing – original draft, Writing – review & editing. **Anthony G. Christodoulou:** Writing – original draft, Writing – review & editing. **Carlos Rochitte:** Writing – original draft, Writing – review & editing. **Michael Markl:** Writing – original draft, Writing – review & editing.

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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