Cardio Expert Column

Patient-centered cardiovascular imaging

How referring physicians, imaging readers, technologists, and imaging equipment companies can engender trust and foster intentional partnerships with patients to improve their longevity

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> ***"Strive to integrate the understandings of the humanist and artist with those of the scientist, engineer, manager, architect, planner, and social scientist."***
>
> *- President Charles M. Vest's Charge to the MIT Graduates, June 5, 1998*

Integrating Equity, Technology, and Patient Experience in Cardiovascular Imaging

The goal of patient care is to support the patient through all stages of their healthcare, from initial referral to diagnosis and corrective treatment, to improve their outcome and survival. In many cases, care extends beyond the individual patient; for example, in pediatric care, patients comprise the parent–child unit. The patient experience is also influenced by interactions between patients and the healthcare team, including with reception, technologists, and specialists. In fields such as cardiology, patients frequently encounter various imaging modalities. Given this environment of interconnected care between medical staff and technology, equipment vendors can also contribute to patient health by designing systems that reduce patient anxiety, improve comfort, shorten scan time, facilitate post-processing, and improve diagnostic accuracy.

In a seminal 2001 report, the Institute of Medicine addressed inefficiencies in the United States healthcare system, proposing six core aims: safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity. Focusing on patient-centered care, this objective focuses on nurturing a partnership between health care providers and the patient to improve outcomes, satisfaction, and quality of care. This partnership is essential for improving representation of marginalized patient groups that are traditionally underrepresented in clinical trials. The Institute of Medicine defines equity as high-quality care that removes barriers that prevent marginalized patients from accessing healthcare as well as ensures their inclusion in data collection. Building on this framework, as of 2024, Medicare requires hospitals in the United States to screen adult inpatients for five social drivers of health: food insecurity, housing instability, transportation needs, utility difficulties, and interpersonal safety. Equally important is improving patients' emotional well-being and reducing diagnosis and prognosis anxiety through timely and accurate reporting.

Regarding cardiovascular imaging, there has been a shift in focus from image quality alone toward patient partnership, including shared decision-making, safety, and overall patient experience. A holistic approach to patient care requires an understanding of all cardiovascular imaging modalities, including magnetic resonance imaging (MRI), computed tomography (CT), echocardiography, and nuclear imaging. This integrated perspective can reduce unnecessary tests, minimize radiation exposure, and improve outcomes through better use of clinical data and collaborative care teams.

To further support this patient-centered approach, clinicians can leverage a variety of innovative tools. Artificial intelligence (AI) is a key advancement that has emerged over the past decade. Table 1 describes how each staff member in an imaging center can support patient well-being and how AI can further enhance that support.

Table 1

Patient experience at the imaging center:
staff interactions and AI-enabled improvements

	Front Desk	Technologist	Imaging Specialist
Patient Interactions	• Scheduling process • Instructions on how to prepare for the scan • Safety screening	• Instructions (e.g., breath-holding and positioning)	• Protocol adjustments • Reporting
Improvements with AI	• Efficient check in/out process • Shorter patient stays	• Less artifacts Better images • Shorter scan time	• Comprehensive and accurate interpretation • Faster report turn around time
Patient Experience	**Overall Benefit = Reduced patient anxiety**		

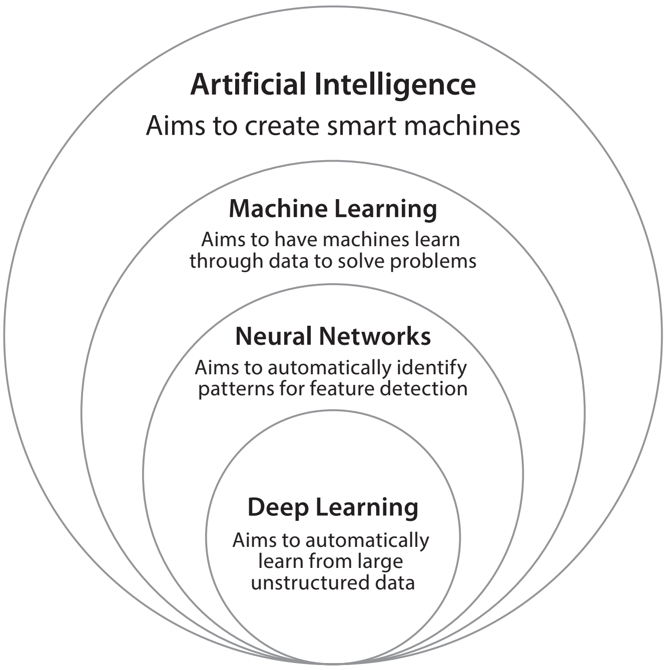
AI and partnerships between imaging specialists, equipment vendors, and patients

AI-related terminology

Artificial intelligence has become a prominent topic in cardiovascular imaging, through the application of methods such as machine learning (ML), neural networks, and deep learning. Figure 1 outlines the differences between these methods. AI is a broad field focused on performing tasks that simulate human intelligence and problem-solving. Machine learning is a subset of AI that is used to discover patterns in data to improve performance without explicit programming. A neural network is a type of machine learning model designed to loosely mimic the human brain. It learns by passing data through multiple interconnected layers, where the weight of each connection is used to help the model produce increasingly accurate results. Deep learning is a more advanced form of machine learning that uses neural networks with multiple layers, potentially hundreds in some cases, to analyze complex datasets. It can also process unlabeled data to detect hidden patterns.

Figure 1

AI terminology



The American Medical Association Current Procedural Terminology Editorial Panel describes three classes of AI applications for medical services and procedures: assistive, augmentative, and autonomous (Table 2). Assistive AI detects relevant clinical data without performing additional analysis. Augmentative AI analyzes and/or quantifies data to generate a clinically meaningful output; however, physician input is required to check, interpret, and complete the work accurately. These two categories account for most of the approved AI/ML devices that are in use today. In contrast, Autonomous AI generates clinically meaningful conclusions without physician input; retinal imaging platforms provide one example.

Table 2

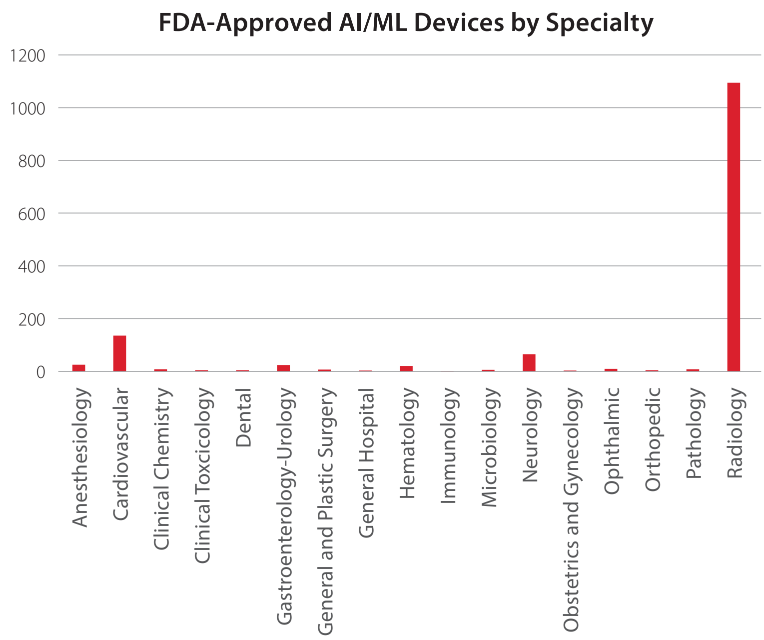
AI applications for medical services and procedures, as described by the Current Procedural Terminology Editorial Panel

	Assistive	Augmentative	Autonomous
Mechanism	Detects clinically relevant data	Analyzes and/or quantifies data to generate clinically meaningful output	Interprets data and independently generates clinically meaningful conclusions
Provides independent diagnosis and/or management decision is provided	**No**	**No**	**Yes**
Performs analysis	**No**	**Yes**	**Yes**
Physician interpretation is required	**Yes**	**Yes**	**No**

As of March 6, 2026, 1,430 AI/ML-enabled medical devices have been approved by the U.S. Food and Drug Administration. Radiology applications (including cardiovascular imaging) account for 76.5% of these devices (Figure 2), and the number of newly approved devices continues to increase. In 2025, 295 AI/ML medical devices received 510(k) clearances, including 19 ultrasound, 16 MRI, and 11 CT systems.

Figure 2

FDA-Approved AI/ML Devices by Specialty as of 3/6/26



Among the cardiovascular imaging modalities (MRI, CT, nuclear imaging, and echocardiography), several assistive and augmentative AI/ML tools can be leveraged to improve patient experience (Table 3). Assistive AI/ML streamlines scan workflow, patient positioning, and image centering. Augmentative AI/ML supports noise reduction, image optimization, and automated quantification. Examples include volumetric measurements (MRI, CT, and echocardiography), strain analysis (MRI and echocardiography), plaque assessment and coronary fractional flow reserve (CT), and myocardial perfusion and blood flow (nuclear SPECT/PET) in routine clinical practice. This information is based on the American Medical Association Category I Current Procedural Terminology codes in use at the time of this writing.

Key benefits include improved image quality due to noise reduction, shorter scan time, enhanced workflow efficiency, and improved reproducibility in serial and longitudinal examinations used in disease surveillance. These benefits enhance patient experience by reducing claustrophobia through shorter scan and breath-hold times, particularly in cardiac MRI; minimizing contrast and radiation exposure; enabling diagnostic imaging in patients with challenging anatomy; and increasing diagnostic confidence, allowing physicians to complete reports promptly and maintain a positive relationship with the referring provider.

Table 3

AI applications in cardiovascular imaging in standard clinical practice

	MRI	CT	Nuclear	Echo
Assistive	• Patient centering • Dose reduction			• Scan workflow
Augmentative	• Image de-noising • Volumetrics • Strain	• Image de-noising • Volumetrics • Coronary flow • Coronary plaque	• Image de-noising • Cardiac function and perfusion quantitation • Myocardial blood flow	• Image de-noising • Volumetrics • Strain
Benefits	• Improve image quality (less noise) • Shorter scan time • Improved clinician workflow (faster reporting) • Increased reproducibility for serial scans			

Future opportunities and considerations for imaging specialists

Although several assistive and augmentative AI/ML devices are currently available across cardiovascular imaging modalities, opportunities remain to improve the data quality and diversity in order to harness their full potential. As AI/ML devices increasingly evolve into sophisticated and automated features, data quality and diversity must be ensured. To ensure high-quality image acquisition, training data must be robust and incorporate images from a diverse group of patients regarding age, sex, ethnicity, race, and location from both academic and community settings. Without the representation of marginalized patients, AI/ML models risk amplifying biases within datasets. Standardizing image acquisition and data quality is important for future research.

Human interaction remains a crucial component of patient healing, as patients engage with physicians, advanced practice providers, front desk staff, and technologists. Existing AI/ML devices can be implemented alongside patient-centered care to support patient wellness. The partnership between AI/ML and physicians, technologists, and equipment vendors will be essential to advancing the field. Recognizing the interconnectedness of image quality, scan efficiency, clinical outcomes, and human elements in cardiovascular imaging will strengthen patient advocacy.

> ***"The best interest of the patient is the only interest to be considered, and so that the sick may have the benefit of advancing knowledge, union of forces is necessary."***
>
> \- ***Doctor William J. Mayo***

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