Digital Health to Improve GL-based Management

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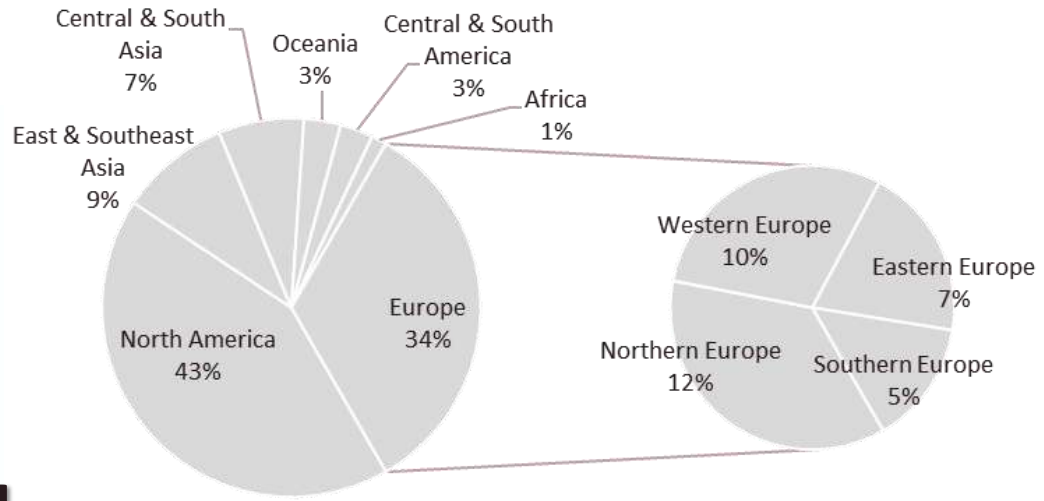

How can we optimize the use of the Guidelines?!

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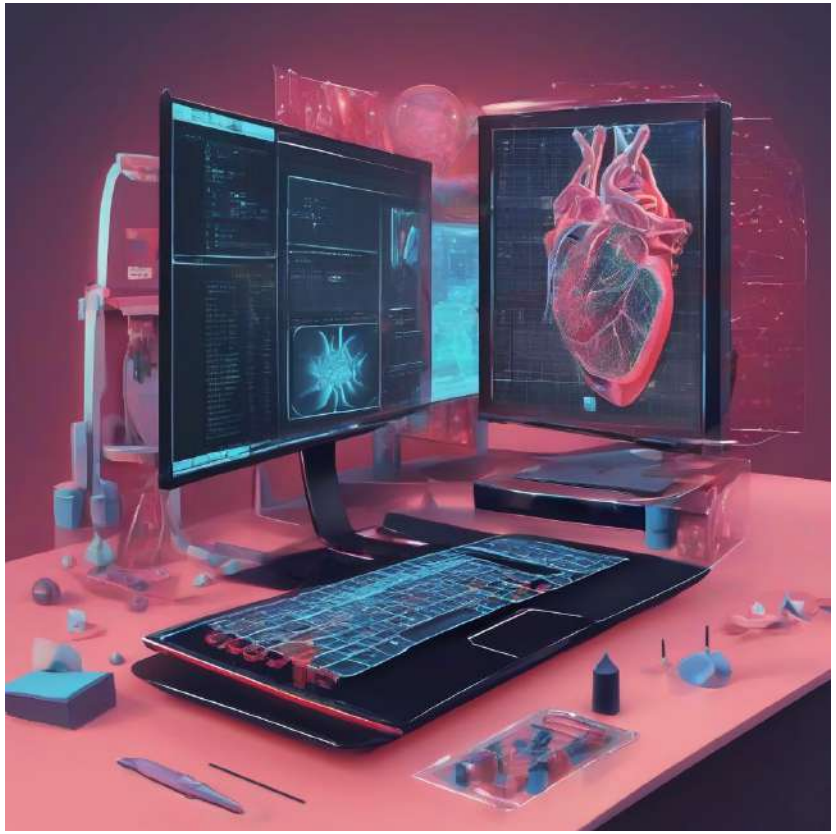

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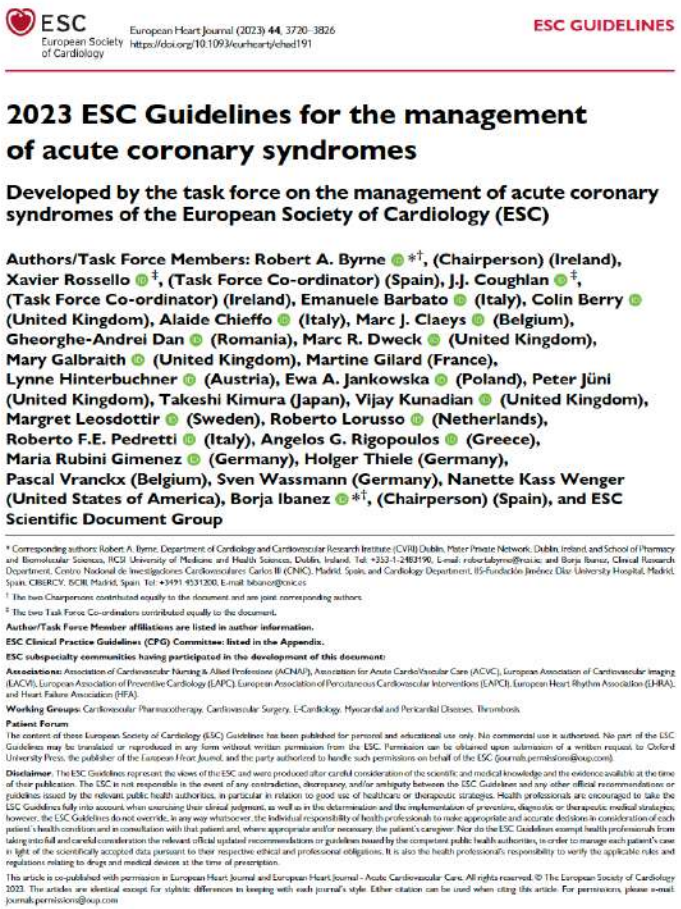
Example Guideline



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ESC GUIDELINES

2023 ESC Guidelines for the management of acute coronary syndromes

Developed by the task force on the management of acute coronary syndromes of the European Society of Cardiology (ESC)

Authors/Task Force Members: Robert A. Byrne [*†], (Chairperson) (Ireland), Xavier Rossello [‡], (Task Force Co-ordinator) (Spain), J.J. Coughlan [‡], (Task Force Co-ordinator) (Ireland), Emanuele Barbato (Italy), Colin Berry (United Kingdom), Alaide Chieffo (Italy), Marc J. Claeys (Belgium), Gheorghe-Andrei Dan (Romania), Marc R. Dweck (United Kingdom), Mary Galbraith (United Kingdom), Martine Gilard (France), Lynne Hinterbuchner (Austria), Ewa A. Jankowska (Poland), Peter Jüni (United Kingdom), Takeshi Kimura (Japan), Vijay Kunadian (United Kingdom), Margret Leosdottir (Sweden), Roberto Lorusso (Netherlands), Roberto F.E. Pedretti (Italy), Angelos G. Rigopoulos (Greece), Maria Rubini Gimenez (Germany), Holger Thiele (Germany), Pascal Vranckx (Belgium), Sven Wassmann (Germany), Nanette Kass Wenger (United States of America), Borja Ibanez [*†], (Chairperson) (Spain), and ESC Scientific Document Group

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† The two Chairpersons contributed equally to the document and are joint corresponding authors.

‡ The two Task Force Co-ordinators contributed equally to the document.

Author/Task Force Member affiliations are listed in author information.

ESC Clinical Practice Guidelines (CPG) Committee: listed in the Appendix.

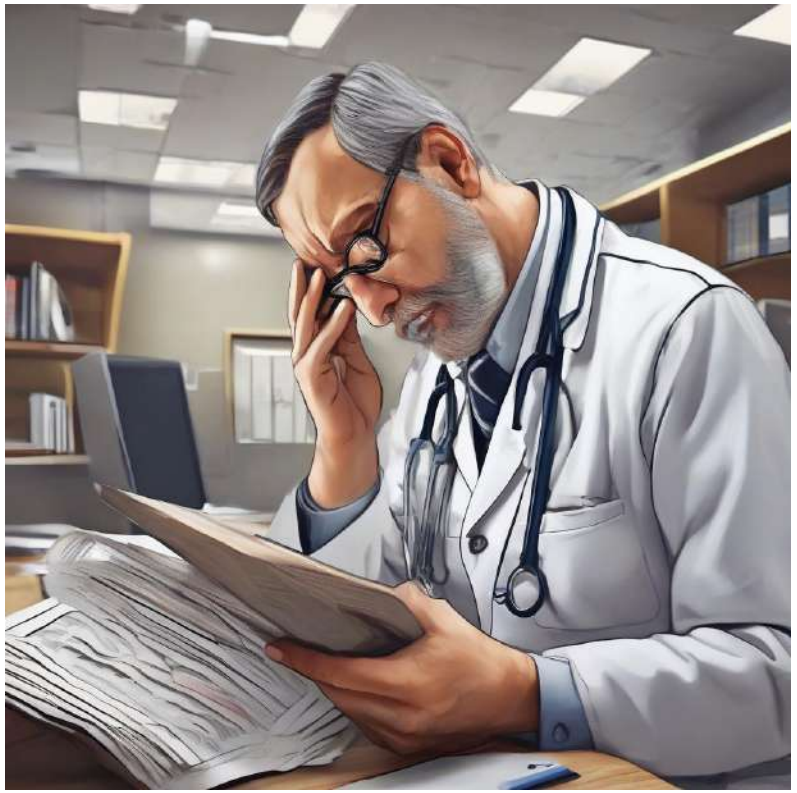
ESC subspecialty communities having participated in the development of this document:

Associations: Association of Cardiovascular Nursing & Allied Professions (ACNAP), Association for Acute CardioVascular Care (ACVC), European Association of Cardiovascular Imaging (EACVI), European Association of Preventive Cardiology (EAPC), European Association of Percutaneous Cardiovascular Interventions (EAPCI), European Heart Rhythm Association (EHRA), and Heart Failure Association (HFA).

Working Groups: Cardiovascular Pharmacotherapy, Cardiovascular Surgery, E-Cardiology, Myocardial and Pericardial Diseases, Thrombosis.

Patient Forum

126 Pages
900 References



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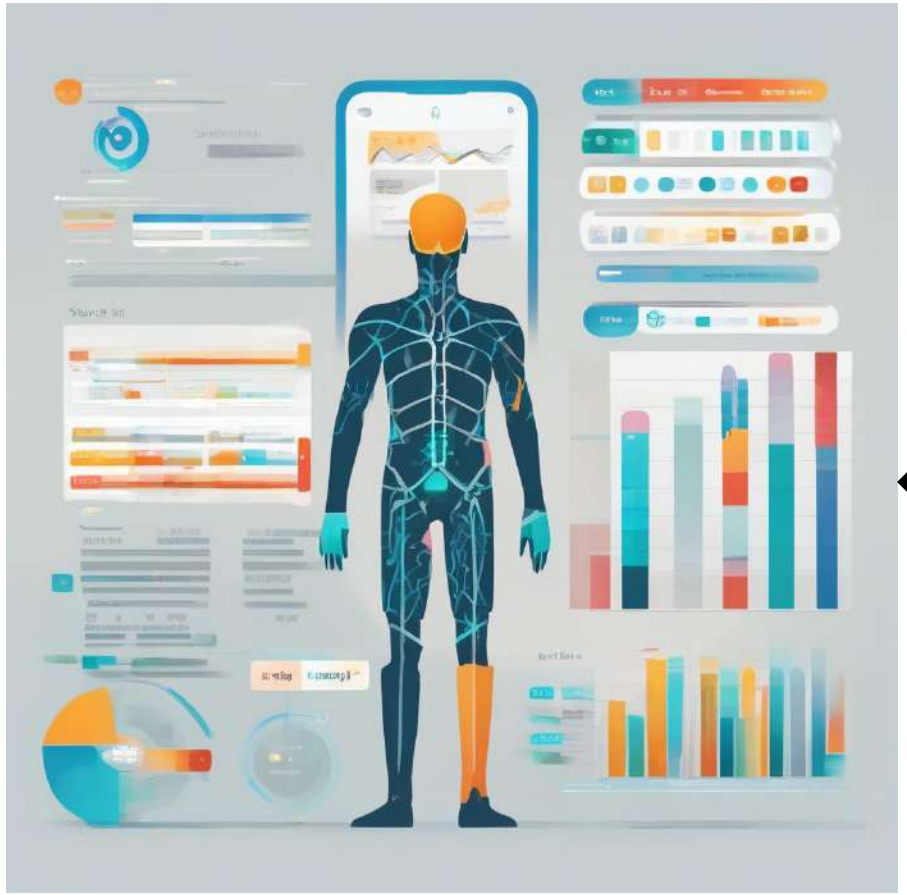
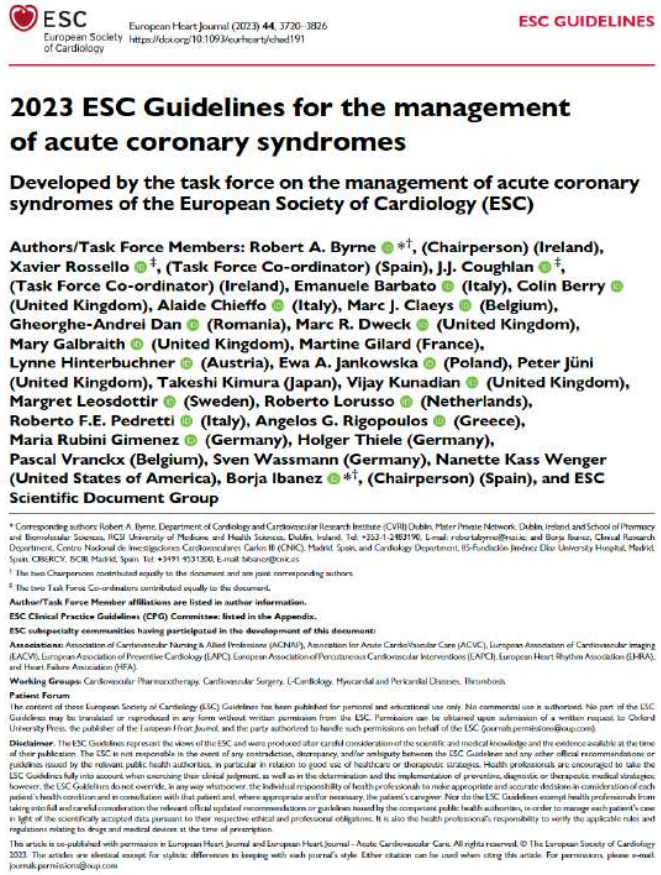
Integrate the Guidelines into Electronic Health Record Systems



Electronic Health Record



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Patient Forum

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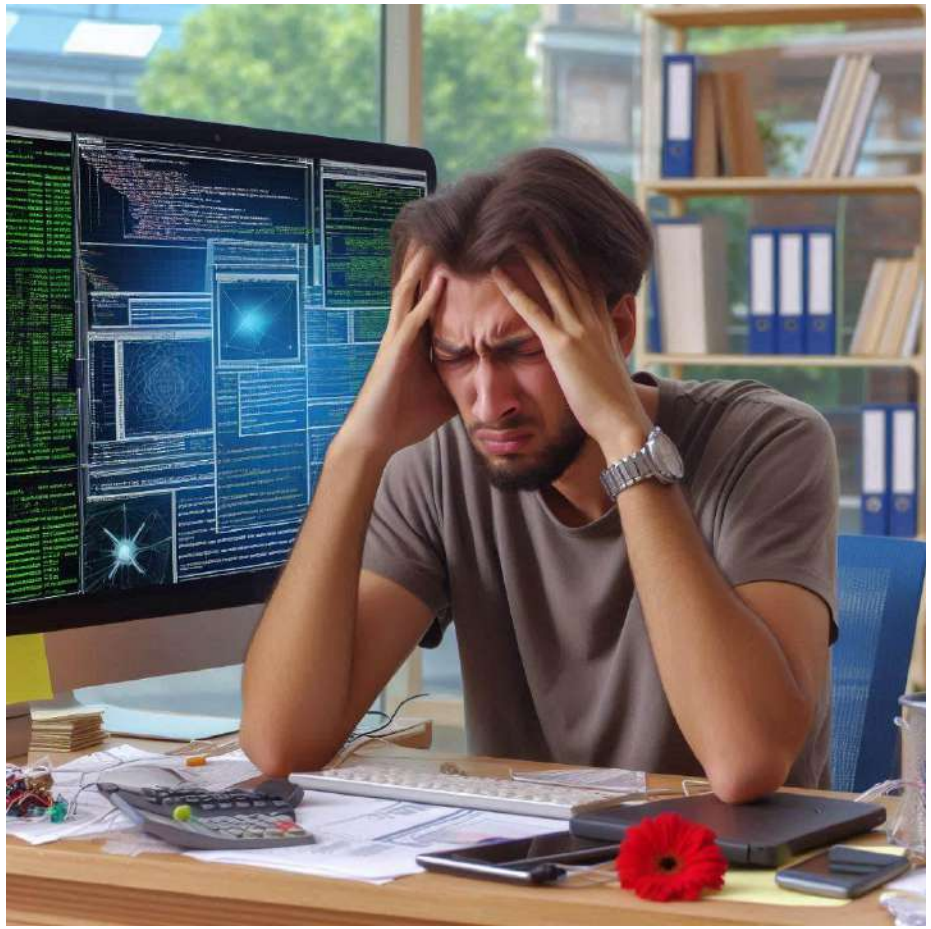
Easier said than done



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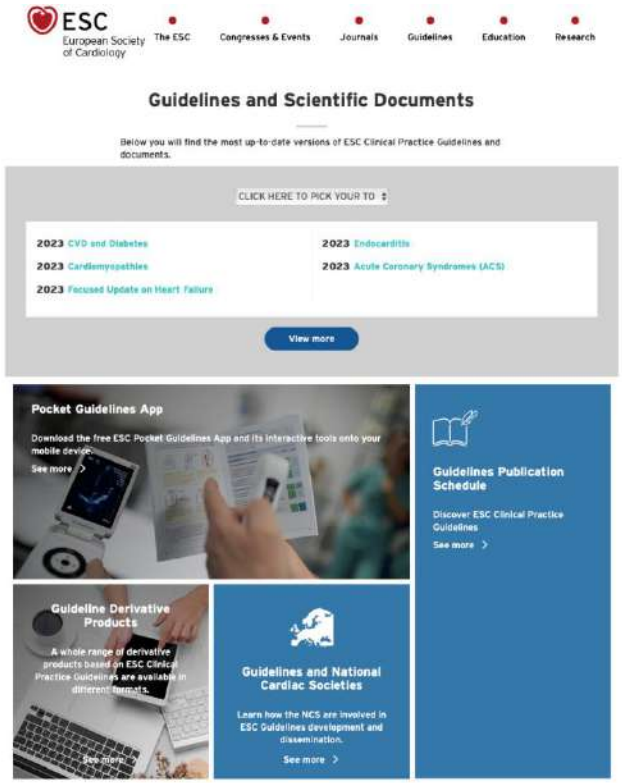
Why are CV Guidelines not implemented in EHR's?

- How to deal with large pieces of text using traditional programming tools
- Translate it to many different languages
- Complex texts and frequent updates
- EHR systems may not have the capability to effectively integrate the guidelines in their workflows
- Limited interoperability between different EHR systems and healthcare providers

The ESC Guidelines “Digital”



27 Titles

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The World after ChatGPT

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Large Language Models (LLM's)

European Heart Journal – Digital Health

Erasmus MC University Medical Center Rotterdam

AI Goes Mainstream: The Democratization of Artificial Intelligence

Bill Gates: AI is most important tech advance in decades

14 hours ago

By Tom Gerken
Technology reporter

Microsoft co-founder Bill Gates says the development of artificial intelligence (AI) is the most important technological advance in decades.

In a blog post on Tuesday, he called it as fundamental as the creation of the microprocessor, the personal computer, the Internet, and the mobile phone.

"It will change the way people work, learn, travel, get health care, and communicate with each other," he said.

He was writing about the technology used by tools such as chatbot ChatGPT.

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What is Solved and can be

- How to deal with large pieces of text using traditional programming tools (LLM's)
- Translate it to all the different languages within Europe (LLM's)
- Complex texts and frequent updates (LLM's)
- EHR systems may not have the capability to effectively integrate the guidelines in their workflows (AI facilitating Clinical Decision Support)
- Limited interoperability between different EHR systems and healthcare providers (becomes mandatory)

Can Digital tools enhance Patients' Adherence to their Treatment Regimens?

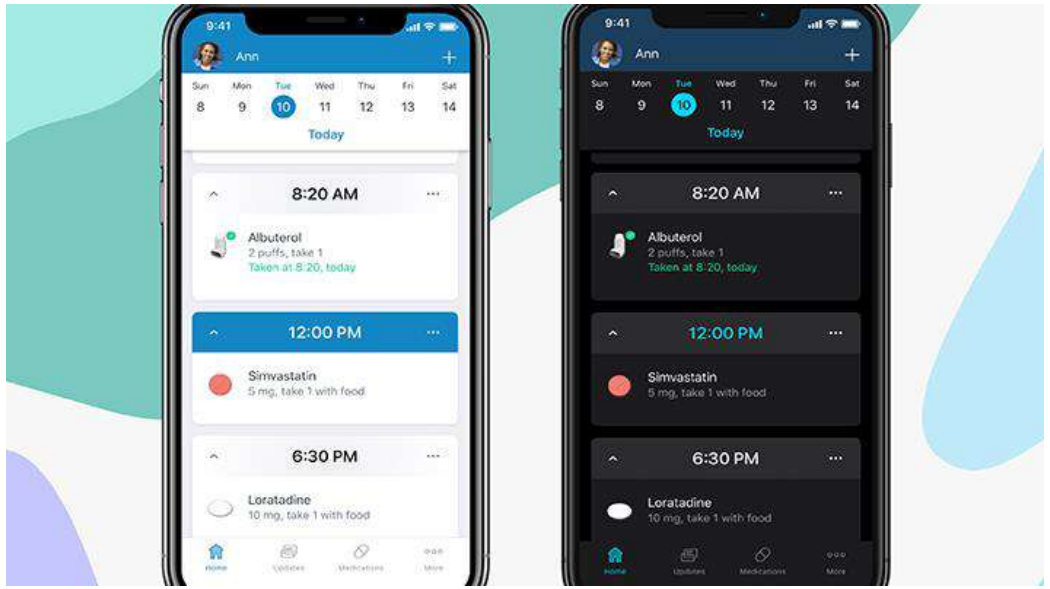
Digital Tools to Improve Medication Adherence

- **Medication reminder apps:** smartphone apps for medication reminders, track doses taken, etc.
- **Smart pill dispensers:** These devices are equipped with alarms or notifications to remind patients to take their medication
- **Medication management platforms:** Online platforms and apps that help patients organize their medications and also provide educational resources and track adherence over time.
- **Telemedicine services:** Virtual consultations with healthcare providers offering medication management support.

Digital Tools to Improve Medication Adherence

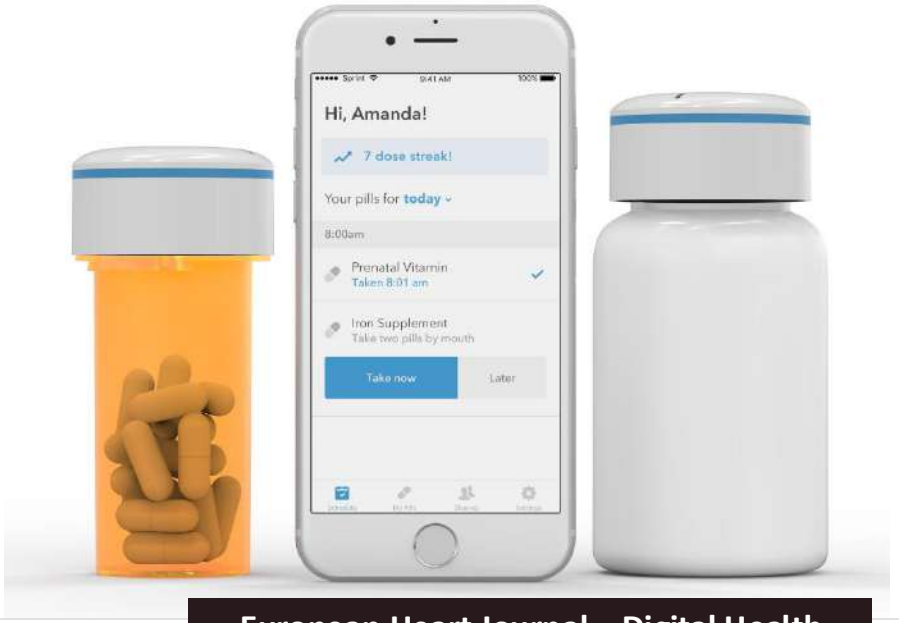
- **Wearable devices:** To send medication reminders and track adherence, while also monitoring vital signs and tracking physical activity to track overall health management.
- **Personal health record apps:** Apps that allow users to store their medication information, dosage instructions, and schedules in one place.
- **Gamification:** Apps using gamification techniques can make treatment adherence more engaging and rewarding for patients.

Medication Adherence



Smartphone app

Smart pill dispensers



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Besides the Purely Clinical Guidelines

Could it be beneficial to have Guidelines focused on the application of Digital Cardiovascular tools?

Future AI guidelines for Echocardiography

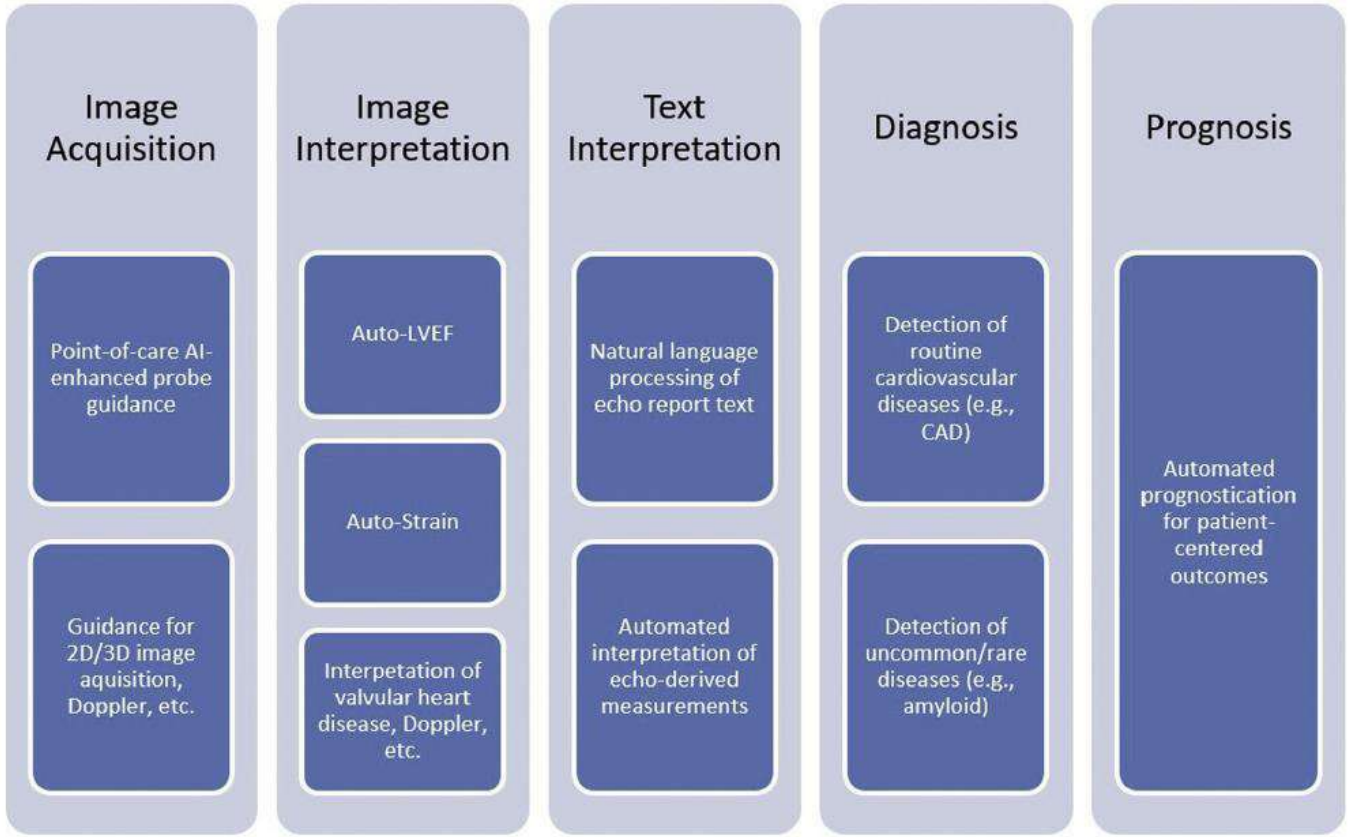

Figure 1 Current and potential applications of AI in echocardiography. The applications of AI in echocardiography span multiple domains, including image acquisition, image interpretation, text interpretation, diagnosis, and prognosis.

ARTIFICIAL INTELLIGENCE AND ECHOCARDIOGRAPHY

Editorial Comment

Future Guidelines for Artificial Intelligence in Echocardiography

Andrew S. Tseng, MD, MPH, Francisco Lopez-Jimenez, MD, MBA, and Patricia A. Pellikka, MD, *Rochester, Minnesota*

The application of artificial intelligence (AI) in echocardiography has shown tremendous growth in the past decade, with the exciting potential for standardization, reducing variability, automating measurements, and recognizing uncommon diseases.[1] With the advent of advanced techniques in machine learning, such as neural networks and the accessibility of large digital data sets from electronic health records, the breadth and pace with which these advancements are occurring are accelerating. This abundance of new studies varies in scope, aim, and generalizability. Standardized methods, such as the Consolidated Standards of Reporting Trials–Artificial Intelligence (CONSORT-AI) and Proposed Recommendations for Cardiovascular Imaging-Related Machine Learning Evaluation (PRIME) checklist, have been developed to evaluate AI studies in a systematic fashion.[2,3] Undoubtedly, as the field of AI matures within the practice of echocardiography, these new technologies will be incorporated into echocardiography guidelines. The potential application of AI in echocardiography is constantly expanding (Figure 1). In this editorial, we provide a fundamental conceptual framework to approach clinical guideline development in this growing field (Figure 2).

CHALLENGES OF AI IN ECHOCARDIOGRAPHY

The application of AI in echocardiography poses unique challenges when it comes to model development and performance evaluation. The two main sources of echocardiographic data are interpreted reports, including measurements and raw images or moving image clips. The use of AI in natural language processing and cluster analysis of echocardiography measurements and reports requires appropriate identification and handling of structured data (clearly coded data; e.g., body mass index, E/A ratio), semistructured data, and unstructured data (free-text data; e.g., qualitative assessments of valvular regurgitation). Therefore, the steps required for natural language processing may include (1) preprocessing of text, (2) document selection containing variables of interest using AI or a preset rule-based engine, (3) sentence segmentation to identify sentences containing data elements, (4) relationship extraction of the sentence and data element, (5) filtering of inconsistencies, and (6) postprocessing to present usable data.[4] Challenges include interpretation of unstructured data, portability, and reliability of existing algorithms at different institutions and varying electronic medical records.[5] Cluster analysis is an analytic method that groups data according to similarities and differences; analysis may be supervised (using predetermined differences) or unsupervised (allowing the computer to detect similarities and differences among groups).[6]

Likewise, AI in echocardiographic image interpretation requires a multistep approach: (1) cohort selection, (2) view labeling (e.g., apical four-chamber), (3) segmentation of cardiac chambers and other cardiac structures, (4) echocardiographic measurements, (5) disease detection, and finally (6) reporting.[7,8] The inherent variability of image acquisition and processing in echocardiography can make standardization difficult. Images are obtained using different vendors, different settings, and sometimes off-axis views. Images include two- and three-dimensional images, Doppler, color flow, and both still and moving formats. Image quality is also variable depending on patient anatomy and the technical skill of the sonographer. All of these factors distinguish echocardiography from other imaging modalities such as computed tomography, which rely primarily on still images with fewer technical variables. Such variation inevitably requires AI methods and sufficient data to overcome these limitations. Notably, advancements in image processing methods, particularly with convolutional neural networks, coupled with advancements in graphics unit processing power, have led to impressive results within medical image classification and segmentation tasks.[9] These methods are currently applied not only to automate image interpretation (e.g., Ultromics EchoGo and EchoGo Pro for AI-enhanced automated strain analysis, left ventricular ejection fraction, and detection of coronary artery disease; HeartLab Pulse EchoLab for automated left ventricular strain and ejection fraction; DiA LVivo EF for automatic view selection and left ventricular ejection fraction; TomTec Arena for measurement automation), to guide image acquisition (e.g., Caption Health Caption AI for real-time guidance of ultrasound probe for point-of-care devices), and even to combine electrocardiography, cardiac auscultation, and point-of-care ultrasound to measure stroke volume, ejection fraction, and cardiac output (e.g., EchoNous Kosmos).

Evaluating the test performance of AI in echocardiography can also present important obstacles. One example is overfitting in which the algorithm models the training data too closely such that noise and random variations in training data are learned as concepts for the model. This results in high reported performance for similar data sets or sets coming from the same institution or health care system but poorer performance when tested in other settings. This not only limits generalizability but challenges the validity of the tool. Now, there are emerging programing techniques to address this source of bias and error. Another AI-specific concern, particularly in convolutional neural networks, is the so-called black box, where programmers and researchers cannot evaluate the underlying AI logic. This becomes particularly salient when there is a possibility of AI to incorporate nonclinical, unrelated data in its decision-making. Heatmaps (i.e.,

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Dr. Pellikka has received research funding from the American Society of Echocardiography Foundation and Ultromics, with money paid to her institution. Dr. Lopez-Jimenez is a coinventor of the low ejection fraction algorithm, with patents with Eko Health and Anumana (Dr. Lopez-Jimenez and Mayo Clinic may benefit from its commercialization); is a member of the Anumana advisory board; and has received honoraria from Menarini for a talk on artificial intelligence in cardiology.

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For the latest Digital Cardiovascular Developments as AI en Remote Medicine

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In Summary

With significant progress in AI technology conquering various challenges, such as processing complex texts like guidelines, the previous limitations to successfully integrate them into health IT environments such as electronic health record systems could be resolved.

Regarding patient adherence to their treatment, a variety of digital tools could be available. It is crucial to involve patients in the development process and evaluation of what works and what does not

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