From background to solutions: Eliminating sex gaps in clinical electrophysiology practice

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Sex, a biological construct, and gender, a sociocultural construct, both influence the epidemiology and outcomes of various cardiac arrhythmias, leading to disparities that have been observed in clinical practice. Addressing disparities is crucial to improve the quality of clinical care. We recognize gender equality as the ultimate goal to ensuring equitable health care and propose the following strategies to achieve the goal: sex- and gender-stratified research, quality improvement initiatives, implicit bias training, promotion of women into leadership positions in cardiology, peer support, and shared decision-making to help mitigate disparities. However, further research on how to improve the widespread adoption and implementation of such strategies in the clinical setting is required.

KEYWORDS Cardiac arrhythmias; Gender; Sex; Sex differences; Sex gaps

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Introduction

Sex, a biological construct defined by genetic characteristics, and gender, a sociocultural construct of behaviors and expressions, both influence the epidemiology and outcomes of various cardiac arrhythmias. In addition, discrimination or exclusion based on gender or gender identity may give rise to health care disparities and prevent achievement of health equity.[1] Although sex and gender have distinct meanings and varying impacts on the observed disparities, there are no studies that account for them separately. Subsequently, when we use the terms sex differences or sex gaps, we acknowledge that they may be due to sex or gender.

Sex differences in the epidemiology of various cardiac arrhythmias are well recognized. Women have a higher incidence of atrioventricular nodal reentrant tachycardia, dysautonomia syndromes, and congenital long QT syndrome. Men have a higher incidence of atrioventricular reentrant tachycardia, atrial fibrillation (AF), sudden cardiac death, Brugada syndrome, and arrhythmogenic right ventricular cardiomyopathy.[2] Sex gaps also exist in clinical electrophysiology practice. Women are more likely to experience diagnostic delays, have lower utilization rates of device therapy, and are less likely to be referred for catheter ablation compared with men.[2–5] These differences in epidemiology and clinical care apply only to high-income countries, with insufficient data to draw definite conclusions in low- and middle-income countries.

In this article, we propose strategies to address sex disparities, review the evidence supporting our strategies, and identify areas that require further investigation.

Gender equality for equitable health care

Gender equality refers to the equal rights, responsibilities, and opportunities for women and men, girls and boys, as well as transgender and nonbinary individuals with responsibilities and opportunities that will not depend on whether they are born male or female.[6] Gender inequality has a significant negative impact on health, with gender norms affecting vulnerability to risk, health-seeking behavior, accessibility to health services, and the response of health systems. Gender also interacts with other social determinants of health, including economic status, neighborhood of residence, education, ethnicity, and sexual orientation, accentuating health disparities.[7] Hence, gender equality has the potential to improve health outcomes for all. In recognition of the collaborative partnership among various stakeholders needed to achieve gender equality, the United Nations adopted the 2030 Agenda for Sustainable Development.[6] The Sustainable Development Goals 3 (“Ensure healthy lives and promote well-being for all at all ages”) and 5 (“Achieve gender equality and empower all women and girls”) provide the framework for improving gender equality while improving the health of all. There is a need for a revitalized global partnership involving governments, civil society, and the private sector as envisioned by the United Nations, to implement and achieve the Sustainable Development agenda to further the

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KEY FINDINGS

- Biologically defined sex and socioculturally determined gender both influence cardiac arrhythmias, leading to the observed differences in clinical care.
- Ensuring gender equality has the potential to improve health outcomes for both males and females, thereby resulting in equitable health care.
- Accounting for sex and gender in research is crucial to improve female underrepresentation in cardiovascular clinical trials.
- Acknowledging sex-specific differences in guideline documents and adoption of guideline-based quality improvement programs to address them may help to improve outcomes.
- Expanding access to peer support groups, advocating for women leadership in cardiology, countering gender stereotypes with implicit bias training, and acknowledging female choices during the shared decision-making process are additional strategies to mitigate the observed sex differences.

cause of gender equality as a means to ensure equitable health care.

Accounting for sex and gender in clinical research

Medical research often does not account for the effects of sex and gender, with a lack of stratified analyses[8] and continued underrepresentation of females in clinical research.[9] Sex and gender analysis may improve the accuracy of data interpretation, lead to the development of safer and more targeted therapeutics, and combat stereotypes, all of which lead to more rigorous and responsible science.[10] Table 1 lists the efforts of major research funding agencies to address adequate representation of females in biomedical research. Adoption of such research mandates by funding agencies across the world is needed because it will help characterize geographic variations in sex disparities, particularly in data-sparse low-income countries. Tannenbaum et al[10] provide a generic roadmap for analyzing sex and gender (Figure 1) while calling for interdisciplinary and discipline-specific work to sharpen and standardize the approaches. We believe that a similar approach tailored to the clinical context of cardiac arrhythmias can be helpful in addressing disparities. That being said, we acknowledge the methodological challenges of sex- and gender-based analyses, including their complex interaction with each other and with other biological and social variables, and also the multidimensional and nonbinary nature of gender. The complex interaction between sex and gender is represented well by the experience and perception of pain. It involves biological differences in the physiology of pain signaling and sociocultural components in how pain is reported across genders and how it is perceived by physicians.[10] Also, acknowledging the nonbinary nature of gender, "gender diverse" is an emerging terminology to describe identities outside the traditional male and female dichotomy.[11] Little is known about how gender identity affects cardiac arrhythmias, although there is a suggestion that there may be an increased incidence of cardiovascular disease among transgender individuals.[12] Further complicating this subject is the sheer number of gender identities that exist, ranging from 6 recognized by the Centers for Disease Control and Prevention (including an additional gender category)[13] to the 58 listed options on Facebook,[14] making systematic study a formidable task.

Table 1 Policies of government-based international funding agencies to integrate sex and gender into biomedical research

Region	Policy	Key features
United States	National Institutes of Health Policy on Sex as a Biological Variable (2016)[62]	- Design studies that take sex into account - Tabulate, analyze, report, and publish sex-based data
Canada	Government of Canada's Health Portfolio Sex and Gender-Based Analysis (2009)[63]	- Sex- and gender-based analyses to develop, implement, and evaluate health activities to address the different needs of women and men
European Union	European Commission's Gender Equality Strategy through Horizon 2020 and Horizon Europe (2014)[64]	- Integration of gender dimension into research and innovation - Having a gender quality plan and increasing gender balance

Clinical practice guidelines

Clinical practice guidelines are defined by the National Academy of Medicine (formerly the Institute of Medicine) as "statements that include recommendations, intended to optimize patient care, that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options."[15] They are utilized by health care providers, professional medical societies, funders, and regulatory authorities, and thus they have an enormous impact on clinical decision-making. In this section, we will outline strategies to enhance the role of clinical practice guidelines to address sex disparities.

Stakeholder engagement

A stakeholder is any "individual or group who is responsible for or affected by health- and health care–related decisions that can be informed by research evidence."[16] Several international organizations have incorporated stakeholder engagement in the development of guidelines to ensure acceptability and usability to the end users and also to

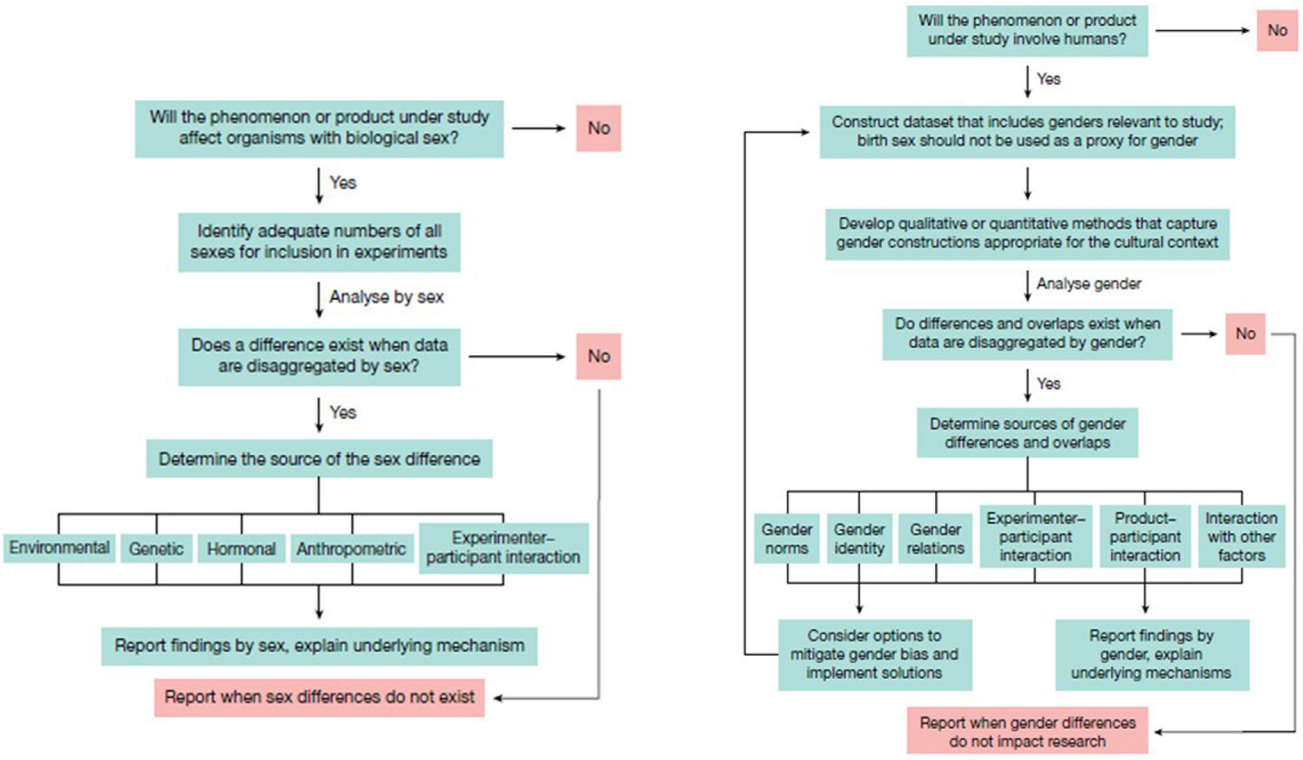

Figure 1 Decision tree for analyzing and reporting sex and gender. (From Tannenbaum C, Ellis RP, Eyssel F, Zou J, Schiebinger L. Sex and gender analysis improves science and engineering. Nature 2019;575:137–146. With permission.)

improve the relevance and usefulness of the guidelines. Although engagement of multiple stakeholders has been shown to help reduce health care disparities,[17] there is a lack of consensus and guidance on how to meaningfully engage multiple stakeholders in guideline committees. Research is underway to tackle this question and to subsequently improve health outcomes and reduce disparities.[18] Guideline committees in the meantime can ensure equitable female participation in multiple roles, including, but not limited to, researchers, clinicians, and patients in an effort to address sex disparities.

Acknowledging sex-specific differences in guideline documents

Acknowledging existing sex and gender differences in the manifestations of cardiac arrhythmias and in the cardiovascular care of patients with arrhythmias is an important first step in addressing disparities. This recognition affords the opportunity to understand the mechanisms behind these differences and to intervene appropriately by making sex-specific recommendations when applicable. Table 2 highlights sex-specific differences covered by the guidelines and identifies those not addressed by current guideline documents.

Guideline documents, at the very least, should advocate for similar approaches to diagnosis and treatment for both sexes when supported by evidence. For instance, there are no specific recommendations for equal treatment based on sex in the guidelines for cardiac implantable device therapy, despite evidence of an equal or a higher magnitude of benefit (or no evidence of lower benefit) and lower implantation rates in women compared to men. A good example is cardiac resynchronization therapy (CRT), as women derive a larger benefit than men and at shorter QRS durations, with the current QRS cutoffs specified in the guidelines being more relevant to male than female patients.[19] Therefore, this observation warrants consideration of sex-specific recommendations for CRT. Only the 2020 European Society of Cardiology guideline on AF recommends that both men and women be offered diagnostic assessment and therapies equally to prevent AF-related complications (class I).[20] Guideline documents should continue to make recommendations for management in sex-specific clinical situations such as pregnancy and the peripartum period.

Quality improvement programs

Get With The Guidelines (GWTG) is an evidence-based quality improvement initiative based on the American College of Cardiology/American Heart Association guidelines to improve the care of patients with cardiac diseases and stroke.[21] The program is an ongoing voluntary data collection and continuous hospital-based quality improvement initiative. It provides clinical decision support tools, webinars, conferences, and expert field staff to assist in providing sophisticated quality improvement programs. GWTG uses a Web-based patient management tool to collect clinical data, provide decision support, and provide real-time online reporting features with access to benchmarked performance data. The program uses a collaborative model to bring

Table 2 Sex-specific differences in the management of cardiac arrhythmias covered by guideline documents and select clinical issues not addressed by the documents

Clinical practice guideline document	Sex-specific differences highlighted	Sex-specific recommendations	Differences not covered by guidelines
2018 ACC/AHA/HRS guideline on bradycardia and conduction delay[65]	None	No recommendations	• Sex differences in indications for pacemaker therapy • Higher PPM implant-related complications in women
2021 ESC guideline on cardiac pacing and cardiac resynchronization therapy[66]	Pacing indications and complication rates	No recommendations	• The guideline addresses all sex-specific disparities for which data are available
2015 ACC/AHA/HRS guideline on supraventricular tachycardia[67]	Greater frequency of AVNRT in women	Recommendations for acute and ongoing management of SVT in pregnancy	• Women experience worse symptoms, are referred for ablation later, and are less likely to be treated with ablation • Sex-differences in the electrophysiology of accessory pathways with Wolff-Parkinson-White syndrome and AVRT
2020 ESC guideline on atrial fibrillation[68]	Differences in epidemiology and cardiovascular care of AF are addressed in detail	Men and women with AF should be offered diagnostic assessment and therapies equally to prevent stroke and other AF-related complications (Class 1, Level A) Women with symptomatic pAF or persAF should be offered timely access to rhythm control therapies, including AF catheter ablation, when appropriate for medical reasons (Class IIa, Level B)	• Emerging data on differences with direct acting anticoagulants and left atrial appendage occlusion
2019 ACC/AHA/HRS focused update on atrial fibrillation[69]	Differences in stroke risk from AF are addressed	No recommendations	• Differences in epidemiology (except stroke risk) and cardiovascular care are not addressed
2017 ACC/AHA/HRS guideline on ventricular arrhythmias and sudden cardiac death[70]	Differences in the risk of SCD and VAs	Recommendations for management during pregnancy	• Additional data are available on differences in etiology and outcomes from SCD, especially in relation to nonischemic causes in women
2022 AHA/ACC/HFSA guideline on heart failure[71] (device and interventional therapy)	None	No recommendations	• Differences in utilization, adverse effects, and efficacy with device therapy in heart failure
2021 ESC guideline on heart failure[72] (cardiac rhythm management for heart failure)	None	No recommendations	• Differences in utilization, adverse effects, and efficacy with device therapy in heart failure
2021 ESC guideline on cardiac pacing and cardiac resynchronization therapy[66]	Greater magnitude of benefit with CRT in women	No recommendations	• Differences in utilization and adverse effects with CRT
2013 HRS/EHRA expert consensus statement on inherited primary arrhythmia syndromes[73]	Differences in epidemiology of BrS is addressed	No recommendations	• Differences in epidemiology of LQTS and SQTS • Arrhythmic risk and management during pregnancy
2017 ACC/AHA/HRS guideline on ventricular arrhythmias and sudden cardiac death[70] (channelopathies)	Differences in epidemiology of LQTS and BrS are addressed	Pregnancy-specific recommendations for management of arrhythmic risk in LQTS	• Differences in the epidemiology of SQTS • Arrhythmic risk and management during pregnancy
2015 International Task Force consensus document on arrhythmogenic right ventricular cardiomyopathy[74]	None	No recommendations	• Men are more likely to be affected and have a higher risk for SCD • Arrhythmic risk and management during pregnancy

Table 2 (*Continued*)

Clinical practice guideline document	Sex-specific differences highlighted	Sex-specific recommendations	Differences not covered by guidelines
2017 ACC/AHA/HRS guideline on ventricular arrhythmias and sudden cardiac death[70]	None	No recommendations	

ACC = American College of Cardiology; AF = atrial fibrillation; AHA = American Heart Association; AVNRT = atrioventricular nodal reentrant tachycardia; AVRT = atrioventricular reentrant tachycardia; BrS = Brugada syndrome; CRT = cardiac resynchronization therapy; EHRA = European Heart Rhythm Association; ESC = European Society of Cardiology; HFSA = Heart Failure Society of America; HRS = Heart Rhythm Society; LQTS = long QT syndrome; PAF = paroxysmal atrial fibrillation; persAF = persistent atrial fibrillation; PPM = permanent pacemaker; SCD = sudden cardiac death; SQTS = short QT syndrome; SVT = supraventricular tachycardia; VA = ventricular arrhythmia.

Modified from Amuthan R, Curtis AB. Sex-specific considerations in drug and device therapy of cardiac arrhythmias.[2] With permission.

together teams from many hospitals in a region to work together to address barriers to care. Hospital teams learn to clearly state their goals for each performance measure and select a pilot population and location to begin the process. They also learn to use plan-do-study-act cycles to test their ideas for change.[22] Figure 2 shows the framework of the GWTG program. The program publicly recognizes hospitals with Performance Achievement Awards for meeting specific achievement measures.

The GWTG heart failure (HF) module was launched in 2005. Analysis of the GWTG HF registry of implantable cardioverter-defibrillator (ICD) use in eligible patients admitted with HF and left ventricular ejection fraction $\leq$30% at participating institutions from January 2005 to June 2007 demonstrated sex and racial differences. Females were approximately 40% less likely to receive an ICD compared to males.[23] With ongoing quality improvement measures, analysis of the registry in 2009 demonstrated a significant increase in ICD use over time in all sex and race groups, with resolution of the racial differences but with persistent sex differences.[24] The program also suggested that systemic bias was responsible for the observed sex differences, with females less likely than males to receive counseling for ICD therapy despite no differences in ICD use among those who were counseled.[25]

The GWTG AF module was launched in 2014 to increase adherence to evidence-based guidelines for AF. The program demonstrated that high-level adherence to guideline-recommended stroke prevention measures was achievable with increased prescription of oral anticoagulants in both sexes over time[26] and near-universal prescription of oral anticoagulants in patients with AF and HF.[27] The registry also showed that females with nonparoxysmal AF were more likely to receive adjunctive ablation lesion sets compared with males, suggesting that patient sex may guide ablation approach, a strategy that is not strongly supported by evidence.[28]

The utility of performance improvement initiatives to produce equitable improvements in guideline-recommended therapies regardless of sex was shown in the IMPROVE HF (Registry to Improve the Use of Evidence-Based Heart Failure Therapies in the Outpatient Setting) study.[29] IMPROVE HF was a prospective study of a practice-based performance improvement intervention in patients with systolic HF or postmyocardial infarction left ventricular dysfunction. At baseline, females were less likely than males to be treated with anticoagulation and implantable defibrillators (with and without CRT). Significant improvements in most of the quality measures were evident at 24 months for both sexes. The absolute magnitude of improvement was significantly better in females compared with males for CRT and ICD therapy as well as for composite HF care.

Quality improvement programs also have the potential to improve clinical outcomes, with a study showing that hospitals receiving a GWTG Performance Achievement Award as having a lower risk-adjusted mortality for HF compared to other hospitals participating in the program.[30] The lower mortality was explained in part by a better process of care with quality improvement. Thus, guideline-based performance improvement initiatives are useful to surveil for sex differences, understand whether these differences result from disparities in care, and improve adherence to guidelines in an effort to improve outcomes.

Peer support and advocacy

Patients can offer shared experiences, knowledge, and language that may significantly benefit those in need of support.[31] In recognition of the obstacles to care faced by women with heart disease, a support network called "WomenHeart: The National Coalition for Women with Heart Disease" was founded by 3 women in 1999.[32] WomenHeart's stated mission is to "improve the lives of women with or at risk for heart disease, while fighting for equity in heart health." Trained patient volunteers provide women with peer-to-peer support, information, and encouragement through local support networks across the United States. WomenHeart is also involved in hospital and corporate partnerships to achieve its mission. A systematic review of peer-supported interventions for health promotion and disease prevention from randomized controlled trials demonstrated the benefits of both group-based and dyadic peer support.[33] Group-based interventions that used peers as educators improved knowledge, attitudes, beliefs, and perceptions,

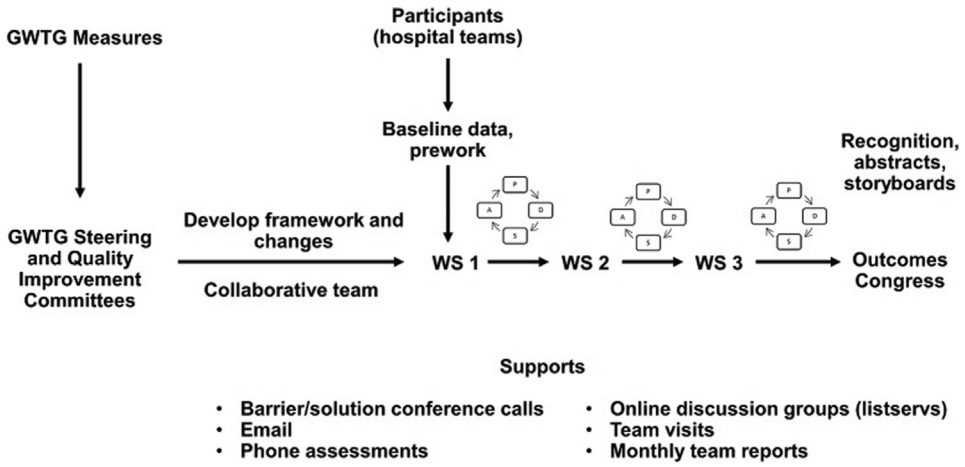

Figure 2 Framework of the Get With The Guidelines (GWTG) quality improvement initiative. WS = workshop. (From Ormseth CH, Sheth KN, Saver JL, Fonarow GC, Schwamm LH. The American Heart Association's Get With the Guidelines (GWTG)—Stroke development and impact on stroke care. Stroke Vasc Neurol 2017;2:94–105. With permission.)[77]

and dyadic peer support influenced behavior change. However, the effect of peer support on sex disparities has not been systematically studied.

In 2004, the American Heart Association created the Go Red for Women initiative, designed to raise awareness about heart disease in women to empower them to take action to lower their risk.[34] This initiative has had a measurable impact on women's cardiovascular health, with a significant increase in heart disease awareness among women. It has also brought about behavioral change in the form of increased physical activity in well-informed women. The initiative supports online risk assessment tools designed specifically for women and collaborates with the Institute for Precision Medicine to build a women's health registry and research marketplace. Go Red for Women was also instrumental in bringing about health care reform, supporting provisions prohibiting insurance companies from charging women higher premiums than their male counterparts and also requiring Medicare and most private health plans to cover preventive services for women.[35]

Programs such as these, with the tools and resources that they provide, can be leveraged by health care providers to better deliver care to women with cardiovascular diseases. It remains to be seen whether these programs will alleviate some of the sex disparities that have been observed.

Implicit bias training

Bias is the negative evaluation of one group and its members relative to another, and when it occurs in an unintentional and unconscious manner, it is termed implicit bias.[36] Implicit bias may involve age, gender, sexual orientation, ethnicity, nationality, or socioeconomic status. A systematic review of published peer-reviewed literature on implicit bias concluded that health care professionals exhibit the same level of bias as that of the wider population.[37] The review also noted that biases are likely to influence diagnosis and treatment decisions in certain circumstances, thereby affecting the quality of clinical care, leading to health care disparities. The effect of implicit gender bias on clinical decision-making was demonstrated in a cohort of practicing cardiologists in the United States, with identical hypothetical male and female patients evaluated differently for suspected coronary artery disease.[38]

Implicit bias training incorporates educational interventions to increase awareness of bias and to instruct on strategies to reduce and manage bias. Several strategies to reduce bias have been described and empirically verified in the social psychology literature (Table 3), but there is only limited research testing the validity of such strategies in the clinical setting.[39] To address the knowledge gaps that limit the effectiveness of implicit bias training in the clinical context, Hagiwara et al[40] highlighted crucial translational gaps in the current versions of training utilized by health care organizations. Table 4 lists the ideal characteristics of implicit bias training as proposed by Hagiwara et al.[40] Although additional research is needed to improve and standardize our current versions of implicit bias training, there are enough data to recommend incorporation of such training in medical schools and health care organizations in an effort to reduce health care disparities in general, including sex disparities.

Shared decision-making

Shared decision-making (SDM) is defined as a process in which clinicians and patients work together to make decisions and select tests, treatments, and care plans based on clinical evidence that balances risks and expected outcomes with patient preferences and values. SDM is viewed as a key component of patient-centered health care.[41] Studies evaluating the effectiveness of SDM interventions have demonstrated improved affective-cognitive outcomes involving knowledge and attitudinal effects[42] and also better outcomes in disadvantaged patients, with the potential to reduce health care disparities.[43] Poor SDM use has been

Table 3 Evidence-based strategies to reduce implicit bias as described by basic social psychology research

Pursuing egalitarian goals	Association of egalitarian goals with everyday tasks to undermine and inhibit the implicit nature of stereotype activation
Identifying common identity	Recategorization of the patient based on shared social identities/hobbies/interests to inhibit activation of stereotypes
Counter-stereotyping	Collecting information on counter-stereotypical attributes and behaviors to mitigate activation of stereotypes
Perspective taking	Taking the perspective of a stigmatized patient to be able to empathize with a difficult situation in order to adopt a favorable impression
Stereotype replacement	Replacing stereotypical responses for nonstereotypical responses with reflection on why the response occurred
Individuation	Obtaining specific information about group members to evaluate them based on personal attributes as opposed to stereotypes associated with the group
Increasing contact	Interactions with out-group members to reduce implicit bias

Table 4 Characteristics of an ideal implicit bias training

Bias awareness training with techniques to increase internal motivation and clear evidence-based strategies to reduce bias
Training methods based on evidence of effectiveness in improving patient outcomes
Training methods that balance the reality of a revenue-based, health care system against the time needed by health care providers to engage in evidence-based strategies to reduce bias
Training methods that focus on negative nonverbal and paraverbal behaviors to improve provider communication

Adapted from Hagiwara N, Kron FW, Scerbo MW, Watson GS. A call for grounding implicit bias training in clinical and translational frameworks. Lancet 2020;395:1457–1460. With permission.

associated with worse patient-reported outcomes and higher health care utilization.[44]

Although no studies have evaluated the effect of SDM on sex disparities, a participant-level meta-analysis showed that the SDM outcomes of decisional conflict, patient satisfaction, and patient engagement had no significant interaction with the gender of the clinician or the patient.[45] This suggests that gender may not be a barrier to implementation of SDM measures during clinical encounters. Hence, SDM can be a powerful tool in accounting for female choices and advocating for a female-centric health care model. However, recognizing the difficulty with SDM implementation in practice, we highlight the recommendations of Beach and Sugarman[46] to aid with the realization of SDM in real-world scenarios (Table 5). One clinical scenario in which this might be particularly useful would be patients undergoing cardiac device implantation. A review of studies in patients undergoing device implantation suggested that female patients had greater concerns with body image with a potential impact on quality of life.[47] Acknowledging body image concerns as part of the SDM process around the time of implantation might help with compliance and address any negative psychosocial outcomes. Future studies are needed to test whether such interventions would improve the observed sex disparities with cardiac device therapy.

Within the SDM model, it is important to recognize the impact of patient preference on observed sex differences. In a prospective cohort study of patients admitted with suspected acute coronary syndrome, women were less likely than men to accept their physician's recommendation for invasive cardiac catheterization, potentially accounting for some of the disparities observed with cardiovascular testing.[48] It is not known whether patient preferences impact the sex gaps in clinical electrophysiology and whether such preferences are modulated by race and ethnicity.

Female leadership in cardiology

Women in the workforce

Women are underrepresented in cardiology as trainees and as part of the workforce across many developed nations.[49] In the United States, among all cardiology trainees from 2017–2018, 21% were women, with only 10%–12% in the procedural subspecialities of interventional cardiology and electrophysiology.[50] Similarly, women made up only 15% of the cardiology workforce in the United States in 2019.[51] Diversity is important because it encourages consideration of alternate views and helps to reduce bias.[52] A systematic review concluded that diversity in health care across multiple domains of race, age, and sex can help improve patient care quality and financial results.[53] The Cardiovascular Disease Section of the American College of Cardiology conducted a systematic review of studies examining patient–physician gender concordance.[54] They concluded that patient–physician gender concordance may influence patient outcomes, with most studies showing a positive association between gender concordance and outcomes, suggesting that females received better care from female physicians. Moreover, there are data suggesting that female physicians have better outcomes compared with their male counterparts,[55,56] and that they exhibit more patient-centered communication techniques that are preferred by patients.[57] Thus, attracting and retaining women in cardiology is a key initiative to improve outcomes and help address sex disparities. In order to have a meaningful impact on improving representation of women in cardiology, a collaborative effort from institutions, professional societies, research organizations, and peer cardiologists is required.

Women in academic medicine

Women are underrepresented in cardiovascular clinical trial leadership and authorship, and among journal editorial

Table 5 Suggestions for enhancing SDM in clinical practice

Professional guidelines that advocate for SDM to include specificity of the task
Use of decision aids to meaningfully engage in SDM
Prioritize SDM on clinical decisions that have substantial consequences for the patient and are likely to be preference sensitive
Creation of an interpersonal environment that facilitates engagement
Prudent clinical recommendations

SDM = shared decision-making.

Adapted from Beach MC, Sugarman J. Realizing shared decision-making in practice. JAMA 2019;322:811–812. With permission.

boards.[58,59] Studies have demonstrated a higher enrollment of women in clinical trials and a greater likelihood of sex- and gender-based analyses as the number of female authors and trial investigators increased.[60] Female leadership in publishing also provides role models for future generations and decreases publication bias against women. Hence, promoting women in leadership roles may have the dual advantage of addressing disparities in academic medicine while lessening the impact of observed sex disparities in clinical practice. Major factors contributing to the dearth of women in leadership roles include gender stereotyping, with male gender associated with leadership; implicit bias, which adversely affects professional advancement of women; and institutional culture.[61] Some suggestions for fair practices to improve women leadership are highlighted in Table 6.

Future directions

Although we list several strategies to address sex disparities, further research is needed to better understand how to implement such strategies in order to mitigate the disparities. Implementation research is a field of health research that can help with turning these potential strategies into effective solutions. It is defined as the "scientific inquiry into questions concerning implementation—the act of carrying an intention into effect, which in health research can be policies, programs, or individual practices (collectively called interventions)."[61] It seeks to understand and work in real-world settings by paying attention to the context in which the implementation occurs and the factors that influence them. Several qualitative and quantitative methods can be utilized, and relevant outcomes that can be measured include acceptability, adoption, appropriateness, feasibility, fidelity, implementation cost, coverage, and sustainability. Thus, implementation research can be a valuable tool to effectively address sex disparities.

Table 6 Suggestions to improve women leadership in academic cardiology

Resolving the barriers faced by women in cardiology identified by the American College of Cardiology workforce survey—family concerns, occupational radiation, discrimination, disparity in compensation, and lack of career advancement[75]
Adoption of the American College of Cardiology Women in Cardiology Leadership Council recommendations to enhance recruitment, retention, and career advancement of women cardiologists[76]
Adoption of policies to counter gender stereotyping and bias, including behavioral strategies, nondiscretionary and transparent decision-making in hiring, compensation, and promotion[61]

Conclusion

The observed sex disparities in clinical cardiac electrophysiology are the result of a complex interplay of biological and sociocultural factors. Hence, solutions to the disparities require a multifaceted approach, with meaningful engagement of all the involved stakeholders. We recognize gender equality as the ultimate goal to ensuring equitable health care. While working toward such an egalitarian goal, strategies such as promoting sex- and gender-based analyses in research, expanding the use of quality improvement programs, advocating for women leadership in cardiology, countering gender stereotypes with implicit bias training, and acknowledging female choices during the SDM process may help eliminate sex gaps in clinical practice. Although the evidence base describing sex disparities has developed rapidly, the literature on implementation science to test the effectiveness of strategies to reduce disparities has not kept pace. For such strategies to emerge as effective solutions, we recommend implementation research to understand how these interventions work in real-world settings and to test approaches to improve them.

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