Racial and ethnic differences in implantable cardioverter-defibrillator patient selection, management, and outcomes

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Racial and ethnic differences in treatment—cardiovascular and otherwise—have been documented in many aspects of the American health care system and can be seen in implantable cardioverter-defibrillator (ICD) patient selection, counseling, and management. ICDs have been demonstrated to be a powerful tool in the prevention of sudden cardiac death, yet uptake across all eligible patients has been modest. Although patients who do not identify as White are disproportionately eligible for ICDs in the United States, they are less likely to see specialists, be counseled on ICDs, and ultimately have an ICD implanted. This review explores racial and ethnic differences demonstrated in ICD patient selection, outcomes including shock effectiveness, and postimplantation monitoring for both primary and secondary prevention devices. It also highlights barriers for uptake at the health system, physician, and patient levels and suggests areas of further research needed to clarify the differences, illuminate the driving forces of these differences, and investigate strategies to address them.

KEYWORDS ICD; Disparities; Race; Ethnicity; Outcomes

Introduction

Cardiovascular disease is the leading cause of death for all Americans, and sudden cardiac death (SCD) accounts for a large proportion of cardiovascular deaths, totaling 230,000–350,000 deaths per year.[1] The implantable cardioverter-defibrillator (ICD) has been demonstrated to be a powerful tool in the prevention of SCD based on landmark clinical trials in the 1990s and 2000s that evaluated the safety and efficacy of the ICD for the prevention of SCD in those at high risk without prior history of SCD (primary prevention) and those with a prior SCD event (secondary prevention).[2–6]

Despite compelling findings from these clinical trials, ICD uptake has been modest, with an estimated 20%–40% of eligible patients ultimately receiving an ICD.[7,8] Although there was an uptrend in ICD implantation in the early 2000s following the landmark primary prevention trials in particular, the rate of ICD implantation subsequently waned. Furthermore, ICD uptake has not been consistent across demographic subgroups. For example, a cross-sectional analysis from 2006 to 2011 noted patients who ultimately received an ICD were more likely to be White (58.8%) and more likely to be male (72.9%), and ≥65 years of age (62.4%).[9] This analysis also showed that while the majority of all American ICD recipients during this time were White, the rate of ICD implantation as a function of population declined among Whites after 2006 during a period of simultaneous increase among Black Americans (Figure 1). Trends in implantation by race after 2011 are unknown.

Racial and ethnic differences

Racial and ethnic differences in treatment—cardiovascular and otherwise—have been documented in many aspects of the American health care system.[10–12] Reasons for these differences are incompletely understood and reflect a combination of patient, physician, and health care system factors and cannot readily be explained exclusively by differences in disease processes. In some cases, these differences may reflect fundamental injustices in which case the differences reflect true disparities.

This review aims to summarize some of the current literature evaluating racial and ethnic differences that exist in ICD patient selection, counseling, implantation, management, and outcomes. It also highlights current barriers to addressing

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KEY FINDINGS

- The burden of sudden cardiac death disproportionately affects patients who do not identify as White. Implantable cardioverter-defibrillators (ICDs) are powerful tools in both primary and secondary prevention of sudden cardiac death. However, eligible patients who do not identify as White are less likely to see specialists, be counseled on ICDs, and ultimately have an ICD implanted.

- Racial and ethnic differences in ICD outcomes include shock effectiveness, postimplantation monitoring, and management for both primary and secondary prevention devices.

- Barriers for uptake of ICDs exist at the health system, physician, and patient levels. Further study and work is needed to clarify the differences, illuminate the driving forces of these differences, and investigate strategies to address them.

these differences that exist on the patient, hospital, and system levels and provides suggestions for possible next steps and further areas of study. It is explicitly acknowledged that the literature summarized herein mostly categorizes patients into racial and ethnic groups based on patient self-identification or that assigned by clinical trial staff or other administrators. Thus, in the contemporary literature, race mostly reflects a social construct that may or may not have any rooting in biology or physiology and is often a surrogate for a host of confounding factors such as insurance status,[9,13] social determinants of health,[14] and comorbidity, to name a few.[15] Importantly, most of the historical literature examining race subgroups often focuses solely on Black and White patients (rather than those who identify with other races) and categorizes race as "White" and "non-White" or "other," significantly limiting the interpretation of findings among subgroups of Black, Asian, and Hispanic patients as well as patients who identify with other racial and ethnic subgroups.

This review does not include discussion of the ICD combined with cardiac resynchronization therapy (CRT) or of CRT alone and related differences, although these are known to exist.[16–18] The research reported in this article adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.

Eligibility demographics

Black, Hispanic, and Asian patients and those who identify with other or multiple races account for a disproportionate burden of SCD events, and among these groups, Black patients make up the largest proportion.[19–22] However, population-level SCD risk is an imperfect proxy for ICD eligibility, as some proportion may be due to reversible causes such as ischemia, thus precluding eligibility. That said, analyses from the ARIC (Atherosclerosis Risk in Communities) study from the 1980s show that Black males carry

the largest lifetime risk of SCD and, compared with other groups at the time of SCD, are younger; have higher prevalence of current tobacco use, diabetes, hypertension, and left ventricular hypertrophy; and are less likely to have coronary artery disease.[23] This latter finding has been replicated in an autopsy study of SCD victims in San Francisco.[24] In a more contemporary study in 2015, Reinier and colleagues[22] analyzed nearly 2144 cases of SCD in Oregon and demonstrated that Black men and women had a higher rate of SCD than their White counterparts. Similar to findings from the ARIC study, Black patients in this cohort were more likely to be younger and have diabetes or hypertension.[22] Overall additional studies are needed for further refine the clinical characteristics of those patients eligible for primary and secondary prevention ICD. Early works suggested that Black patients, Hispanic patients, and patients who identify with other races who are ICD eligible were less likely to receive counseling in ICD benefits[25] and, ultimately, to receive an ICD.[8,26–28] This was despite meta-analytic evidence demonstrating no differences in mortality by race across all ICD indications.[29] More recent observational data suggest that these trends may have improved.[9]
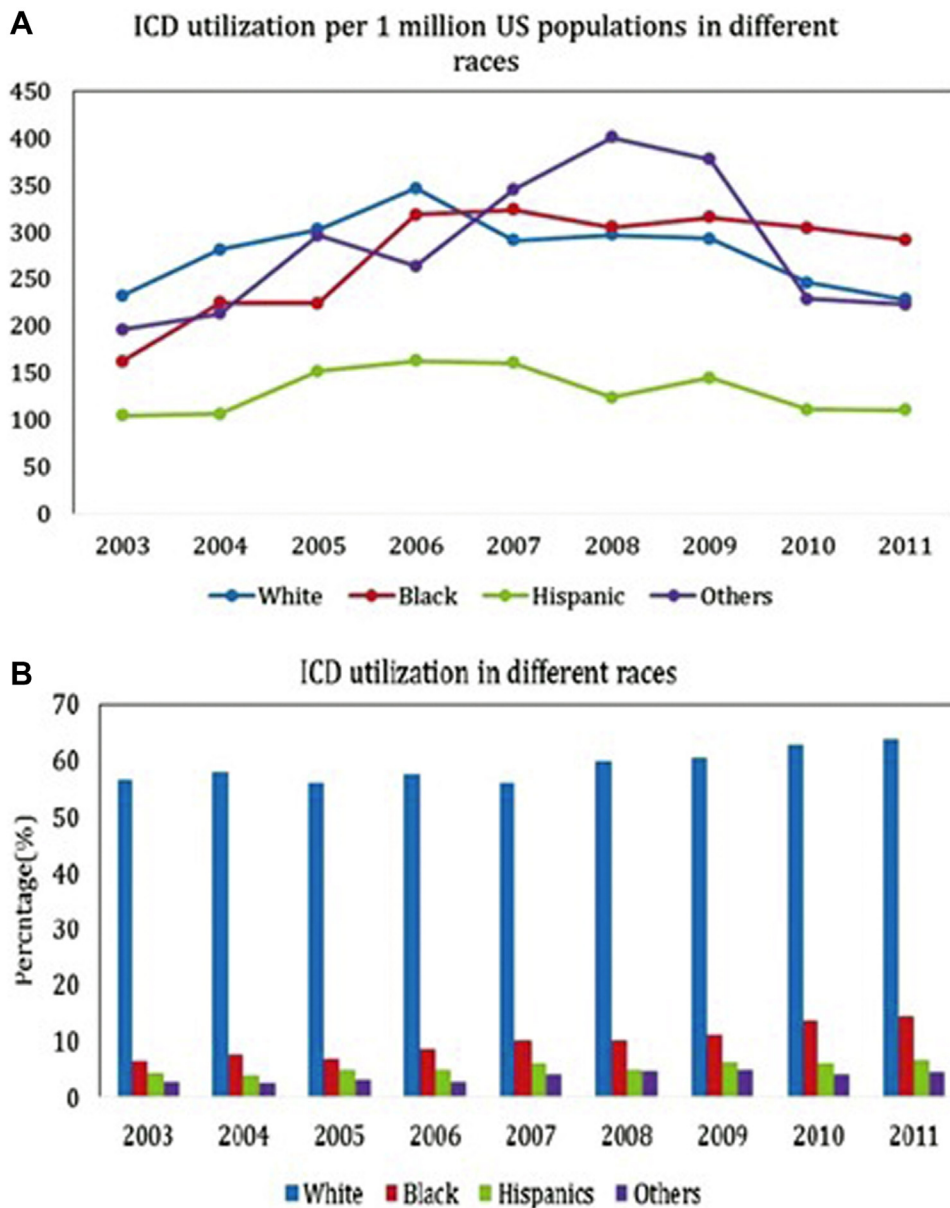
Primary prevention

A primary prevention ICD is recommended for patients without prior history of SCD but at high risk for SCD. The largest proportion of patients meeting these broad criteria are those with heart failure with reduced ejection fraction (HFrEF) despite optimal medical therapy. In addition, those with a familial history or genetic conditions with high risk of SCD are also eligible.[1–6] The population of patients eligible for a primary prevention ICD expanded dramatically following the landmark clinical trials of the 1990s and 2000s that demonstrated benefit of the primary prevention ICD in various populations with HFrEF including patients with ischemic and nonischemic cardiomyopathy. For example, among others, the combination of the MADIT (Multicenter Automatic Defibrillator Implantation Trials) I and II and the MUSTT (Multicenter UnSustained Tachycardia Trial) trials established the benefit of a primary prevention ICD in patients with ischemic cardiomyopathy.[2–4,6] In 2005, the SCD-HeFT (Sudden Cardiac Death in Heart Failure Trial) trial demonstrated benefit of a primary prevention ICD in patients with both ischemic and nonischemic cardiomyopathy as compared with amiodarone or placebo.[5]

In the wake of these trials, primary prevention ICDs were incorporated into practice guidelines[1,30] and remain a mainstay in the effort to prevent SCD in patients with heart failure. However, uncertainties exist regarding the impact of race and ethnicity on the application as well as safety and effectiveness of the primary prevention ICD in racial and ethnic subgroups.

Patient selection

While some regional variation exists, it is estimated that only 20%–40% of all eligible patients ultimately have an

Figure 1   Implantable cardioverter-defibrillator (ICD) utilization by racial subgroup.[9] **A:** ICD utilization initially increased in the early 2000s following landmark primary prevention trials; however, the rate of ICD implantation subsequently waned. **B:** ICD uptake was not consistent across all races: while the rate of ICD implantation as a function of population declined among White Americans after 2006, the rate among Black Americans increased.

ICD implanted,[7,25,28] and this varies widely by race (Figure 1). Black patients and those belonging to other racial and ethnic subgroups are significantly less likely to receive a primary prevention ICD compared with White patients, even when accounting for relevant clinical and nonclinical factors (eg, location, insurance, clinical status).[8,26–28] For example, an analysis of the National Registry to Advance Heart Health found that among eligible patients, Black patients were significantly less likely than White patients to receive an ICD (30% vs 40%, $P < .001$), and this difference persisted even when controlling for demographics, clinical characteristics, and socioeconomic differences (odds ratio [OR], 0.62; 95% confidence interval [CI], 0.5–0.75, $P < .001$).[8] Another cohort analysis

of over 26,000 patients noted that non-White race was an independent negative predictor of ICD implantation (OR, 0.88; 95% CI, 0.817–0.964).[26]

Comparative outcomes among racial subgroups

Data are inconsistently available for racial subgroup analyses of the landmark primary prevention ICD trials. Neither the MADIT-I nor the DINAMIT (Defibrillator in Acute Myocardial Infarction Trial) trial reported race as a demographic characteristic. In other studies, the enrolled population was predominantly White resulting in insufficient power for racial subgroup analyses. For example, the percentage of enrolled patients who were White was 88% in the MUSTT, 87% in MADIT-II, and 77% in SCD-HeFT trials (Table 1).[5,31]

Table 1 Composition of landmark clinical trials by race

Trial	Year	Total patients	White	Non-White	Non-White patients with an ICD
Primary prevention					
MADIT-I[3]	1996	196	Racial demographics not reported		
MUSTT[6]	1999	704	618 (88)	84 (12)	316
MADIT-II[2]	2002	1175	1073 (91)	102 (9)	65
DINAMIT[4]	2004	674	Racial demographics not reported		
SCD-HeFT[5]	2005	1676	1087 (65)	589 (35)	189
Secondary prevention					
CASH[46]	2000	288	Racial demographics not reported		
CIDS[44]	2000	659	Racial demographics not reported		
AVID[45]	2009	800	Racial demographics not reported		

Values are n or n (%).

AVID = Antiarrhythmic vs Implantable Defibrillators; CASH = Cardiac Arrest Study Hamburg; CIDS = Canadian Implantable Defibrillator Study; DINAMIT = Defibrillator in Acute Myocardial Infarction Trial; ICD = implantable cardioverter-defibrillator; MADIT = Multicenter Automatic Defibrillator Implantation Trials; MUSTT = Multicenter UnSustained Tachycardia Trial; SCD-HeFT = Sudden Cardiac Death in Heart Failure Trial.

Thus, in addition to underpowering for subgroup analysis, this reflects under-representation in these primarily American trials, given the higher background risk of SCD among Black Americans.

Furthermore, the data from subgroup analyses that do exist are mixed as to whether the mortality benefits of a primary prevention ICD apply to all racial and ethnic subgroups equally (Table 2).[31–33] The PROSE-ICD (Prospective Observational Study of Implantable Cardioverter-Defibrillators) study identified an increased risk of dying without receiving an appropriate ICD shock among Black recipients of a primary prevention ICD compared with non-Black patients within the first 2 years after implantation.[15] This is consistent with findings from the SCD-HeFT trial demonstrating that mortality risk was greater among Black recipients of an ICD compared with non-Black patients but without a significant difference in the rate of ICD shocks.[34] Furthermore, while long term follow-up of patients enrolled in MADIT-II trial demonstrated benefit of a primary prevention ICD,[35] this finding was not seen among the 102 enrolled Black patients.[31] As stated previously, however, there was insufficient power to draw conclusions based on these analyses.

Whether systemic differences exist with respect to ICD programming (specifically tachycardia detection zones) is not known.

The most unequivocal evidence supporting the use of the primary prevention ICD applies to patients with ischemic cardiomyopathy. Data supporting ICD use in nonischemic cardiomyopathy are less abundant. Indeed, the role of the primary prevention ICD in nonischemic cardiomyopathy has been the focus of subsequent rigorous investigation in the context of a dramatic evolution in medical therapy and the growth of cardiac resynchronization therapy.[36,37] This is relevant in the discussion of effectiveness of primary prevention ICDs given that Black patients are more likely to have nonischemic HFrEF.[38,39]

The landmark clinical trials of the 1990s and 2000s were conducted prior to the current generation of goal directed medical therapy which has resulted in an ongoing decline in SCD risk.[40] A Swedish registry analysis in 2019 attempted to address this discrepancy between outcomes in the randomized trials and realities of contemporary practice. This analysis demonstrated persistent short- and long-term mortality reduction following contemporary ICD implantation.[41] However, these findings are not easily generalized to the U.S. population, given the substantial differences in baseline demographic characteristics. Al-Khatib and colleagues[42] sought to answer this question by using contemporary registry data to mirror the study populations of the MADIT-II and SCD-HeFT trials in the National Cardiovascular Data Registry (NCDR). This analysis suggested no statistically significant difference in mortality reduction in real-world contemporary practice as compared with the study populations.[42] Subgroup analysis by race was not available for this large registry comparison and remains an area for future study. In the absence of randomized data, observational data have been assessed to explore the difference, if any, in the survival benefits of an ICD by race. For example, analysis of survival data among ICD-eligible patients enrolled in the Get With the Guidelines Heart Failure Registry compared with ICD recipients in the NCDR-ICD registry demonstrated that an ICD was association with reduced mortality in all groups with no meaningful difference when mortality was compared between the group of White patients and all other patients.[43] Despite these areas of uncertainty, the ICD remains a mainstay of treatment for the prevention of SCD in eligible patients of all races and ethnicities with heart failure and reduced left ventricular ejection fraction.

Secondary prevention

Secondary prevention of SCD with ICD implantation is unequivocally recommended for survivors of unstable or sustained ventricular tachycardia or ventricular fibrillation due to an irreversible cause and with reasonable life expectancy (>1 year).[1] This recommendation is based on results of rigorous clinical trials comparing ICDs with antiarrhythmic drug therapy.[1,44–46] In these patients, ICDs have been associated with a significant mortality benefit embodied by a 23%–27% reduction of all-cause mortality.[45,46]

The body of literature supporting the use of an ICD for secondary prevention of SCD is more limited than that supporting primary prevention likely reflecting lack of equipoise for the former. Furthermore, data examining ICDs for secondary prevention in racial subgroups are limited: none of the CASH (Cardiac Arrest Study Hamburg), CIDS (Canadian Implantable Defibrillator Study), or AVID (Antiarrhythmic vs Implantable Defibrillators) trials reported racial demographics (Table 1).[44–46]

Despite significant benefits of an ICD for the reduction in mortality for survivors of cardiac arrest, the post–cardiac

Table 2 Outcomes from studies of the primary prevention ICD by race subgroup

Trial	Outcomes by race		
	ICD therapies	All-cause mortality and sudden cardiac death	All-cause mortality without appropriate ICD shock
MUSTT (not powered for subgroup analysis)[32]	Not reported	All-cause mortality in Black patients (1 of 7) vs White patients (34 of 158), P = NS	Not reported
MADIT-II (not powered for subgroup analysis)[31]	Not reported	ICD-related reduction in all-cause mortality for Black patients (P = .96) vs White patients (P < .02) Mortality due to sudden cardiac death in patients with an ICD vs without: Black patients (HR, 1.71; 95% CI, 0.33–8.84; P = .62) vs White patients (HR, 0.29; 95% CI, 0.17–0.49; P < .01)	Not reported
PROSE-ICD[15]	Black patients vs White patients (HR, 0.78; 95% CI, 0.51–1.19)	All-cause mortality in Black vs White patients with an ICD (HR, 1.24; 95% CI, 0.96–1.59)	Black patients vs White patients (HR, 1.33; 95% CI, 1.02–1.74)
SCD-HeFT[34]	Black patients vs White patients (HR, 1.10; 95% CI, 0.80–1.51; P = .56)	All-cause mortality of Black patients vs White patients with or without an ICD (HR, 1.27; 95% CI, 1.01–1.58; P = .038) All-cause mortality with vs without ICD similar in Black patients (HR, 0.65; 95% CI, 0.43–0.99) vs White patients (HR, 0.73; 95% CI, 0.58–0.90)	Not reported

CI = confidence interval; HR = hazard ratio; ICD = implantable cardioverter-defibrillator; MADIT-II = Multicenter Automatic Defibrillator Implantation Trials II; MUSTT = Multicenter UnSustained Tachycardia Trial; PROSE-ICD = Prospective Observational Study of Implantable Cardioverter-Defibrillators; SCD-HeFT = Sudden Cardiac Death in Heart Failure Trial.

arrest ICD implantation rate in eligible patients is lower than expected across all patients. In a study of 1238 adult survivors of out-of-hospital cardiac arrest deemed ICD eligible, only 57% ultimately had an ICD implanted.[47]

While the rate of secondary prevention ICD implantation among eligible patients is low, that burden is carried inconsistently across demographic subgroups. For example, women are less likely to receive an ICD as compared with men, and age is also a negative predictor of ICD implantation.[48,49] Race is similarly associated with the rate of ICD implantation. Despite similar hospitalization rates between Black and White patients with a primary diagnosis of ventricular tachycardia and ventricular fibrillation, Black patients have the highest in-hospital mortality, and significantly lower utilization of ICDs.[48,50] Groeneveld and colleagues[50] performed a 10-year cohort study of 5948 survivors of cardiac arrest and found that Black patients 66–74 years of age were less likely than their White counterparts to receive an ICD by 90 days (OR, 0.58; 95% CI, 0.36–0.946). These investigators found that differences in ICD implantation and other cardiovascular interventions accounted for a 7% increase in mortality for Black patients.

Reasons for this difference can be attributed to a number of factors discussed subsequently.

Postimplantation monitoring

Once implanted, racial differences in the management and effectiveness of ICDs persist. For example, White patients are more likely to be enrolled in remote monitoring than other groups of patients. An analysis of Boston Scientific devices linked to the NCDR-ICD registry showed that when race was not identified as White, there was an associated lower rate of both remote monitoring enrollment and activation.[51] This is critically important because remote monitoring has been associated with a broad range of clinical, economic, and quality-of-life benefits[52] and is recommended for all eligible patients.[53]

Shock effectiveness

Several studies have investigated whether there may be an etiologic model to explain the discrepancy in mortality benefits from an ICD in racial subgroups described previously. One consideration is that Black patients are more likely to have a nonischemic etiology of cardiomyopathy,[38,39] which as a group makes them less prone to ventricular arrhythmias and less likely to benefit from an ICD. Supporting evidence for this hypothesis includes a study of 1189 patients with left ventricular ejection fraction <30% in which Black
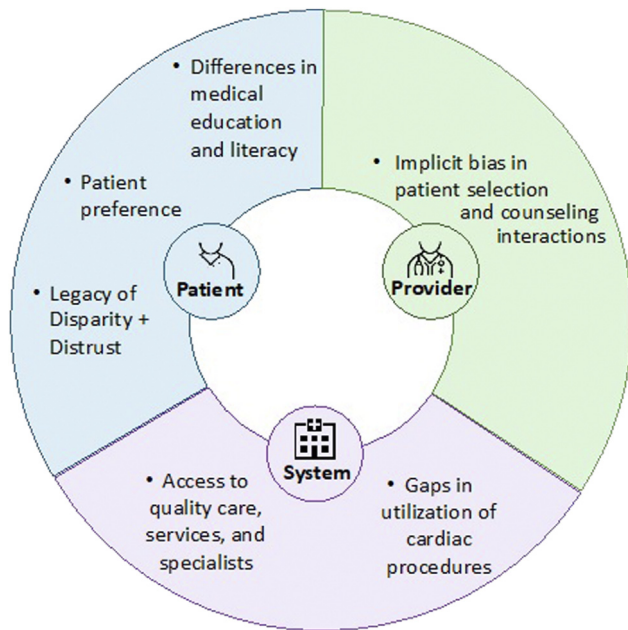
Figure 2 Barriers to equitable uptake of ICD utilization. Barriers to the uptake in implantable cardioverter-defibrillators have been identified at the system, provider, and patient levels. Further exploration is needed to elucidate the role that these barriers play and viable strategies to address them.

patients were more likely to die without receiving an appropriate shock than their White counterparts.[15]

Conversely, among Black patients with ischemic cardiomyopathy, some evidence suggests propensity for proarrhythmic substrate. In a subgroup analysis of the MUSTT trial, anatomic differences between White and Black patients with ischemic cardiomyopathy were noted: Black patients were more likely to have left ventricular hypertrophy (52% Black vs 36% White patients; P = .019); however, White patients were more likely to have undergone prior coronary artery bypass grafting (57% White vs 33% Black patients; P = .001) or prior percutaneous revascularization (68% White vs 43% Black patients; P = .001). In a subgroup analysis of clinical outcomes, it was noted that while White patients experienced a 38% reduction in cardiac arrest or fatal arrhythmia when treated with electrophysiologically guided therapy, a 3-fold increase in cardiac arrest and fatal arrhythmias after the addition of antiarrhythmics was observed among the 231 Black patients enrolled, though this was not statistically significant (adjusted hazard ratio, 2.82; 95% CI, 0.87–9.14). Furthermore, Black patients randomized to electrophysiologically guided therapy who did not receive an ICD had lower survival than their White counterparts (27% vs 66%; P = .012). Although some of the overall survival difference can be accounted for by a lower ICD rate and a lower rate of revascularization in Black patients, this subgroup analysis suggests there may be differences in ischemic substrate and associated benefits from an ICD between racial subgroups.[32]

Implantation of an ICD is only one part of SCD prevention; ICD programming has been demonstrated to be

increasingly important in reducing mortality through better detection and more effective treatment of ventricular arrhythmias as well as through reduction in inappropriate shocks.[54] Thus, it is important to recognize that in the Multicenter Automatic Defibrillator Implantation Trial–Reduce Inappropriate Therapy (MADIT-RIT) study, high rate and delayed detection programming was associated with similar reductions in inappropriate therapy regardless of race. However, Black patients were found to also have a greater reduction in appropriate therapies as compared with White patients with these changes, suggesting a higher rate of self-terminating ventricular arrhythmias.[55]

Barriers to uptake
As noted previously, the lower rate of ICD implantation among non-White groups has been well documented; however, the underlying mechanisms for this difference are incompletely understood. Contributing factors affecting the clinical encounter have been proposed at the health system, physician, and patient levels (Figure 2).

Systems
Care for patients who are not identified as White tends to be clustered into specific hospitals.[56,57] For example, a retrospective study of over 2 million patients found that Black patients were more likely to receive care at hospitals that cared for a disproportionately large cohort of Black patients: 18%–20% of Black patients were admitted to hospitals with 9%–20% of Black inpatients and 29%–34% of Black patients were admitted to hospitals with >20% Black inpatients, compared with only 12%–13% and 6% of White patients admitted to each, respectively.[57] These hospitals which care for the largest percentage of Black patients have less access to subspecialty care—a necessary but insufficient factor for accessing ICD care.[56]

This difference in care setting has a significant impact on patient outcomes[58–60] and may at least partly be due to differences in available services and specialists. This was illustrated by Groeneveld and colleagues,[57] who found a lower rate of cardiovascular procedural utilization in hospitals caring for a higher percentage of Black patients. Compared with Black patients admitted to hospitals with <9% Black inpatients, those admitted to hospitals with >20% Black patients had significantly lower rates of various cardiovascular procedures including bioprosthetic aortic valve replacements (OR, 0.44; 95% CI, 0.30–0.63), coronary artery bypass grafting (OR, 0.78; 95% CI, 0.69–0.87), and dual-chamber pacemaker placement (OR, 0.70; 95% CI, 0.63–0.78).[57] This suggests that underuse of ICDs among Black patients may reflect broader differences in cardiovascular care at the level of health care systems, or in some cases, overuse in non-Black patients.[61]

However, this is not the whole story. Even at hospitals disproportionately caring for Black patients, White patients were more likely to undergo advanced cardiovascular procedures than their Black counterparts.[57] A study of Veterans'

Affairs Medical Centers demonstrated that Veterans' Affairs Medical Centers caring for a higher percentage of Black patients had a larger racial gap in utilization of cardiac procedures than those caring for primarily White patients.[59] Interestingly, this gap was smaller for ICD implantation than for other procedures (OR: 65% White vs 54% Black patients for ICD implantations, compared with 81% White vs 45% Black patients for aortic valve replacement, 86% White vs 69% Black patients for percutaneous coronary intervention, and 85% White vs 54% Black patients for dual-chamber pacemaker placement). Other differences in cardiovascular care may also impact the utilization of ICDs for eligible patients. For example, Black and Latinx patients admitted to a single, urban, tertiary care center for heart failure exacerbations were less likely to be admitted to the Cardiology Service than their White counterparts, and this difference was associated with a higher 30-day readmission and mortality rate.[62]

Differences in access to specialists extends beyond the inpatient setting. A retrospective chart review of 9761 patients with coronary artery disease or heart failure noted that Black and Hispanic patients with heart failure had 13% fewer specialist cardiology consultations as compared with White patients ($P = .01$ and $P = .04$, respectively).[63] Overall, this barrier to receiving subspecialist and procedural care likely contributes to the lower rate of ICD implantation.

Physician

Data suggest that implicit biases among physicians may impact both patient selection and counseling interactions that lead to device implantation.

A paper survey administered to roughly 10,000 physicians demonstrated no statistical difference in the rate of ICD referral based on patient race.[64] However, this study was conducted via paper survey rather than using real-life clinical data, which could meaningfully impact results. To that point, other studies have attempted to quantify bias in real world practice. Blair and colleagues[65] surveyed 2900 patients regarding their experience with 134 primary care clinicians in terms of communication, trust, and interpersonal interactions with the clinician to create a single patient-centered care composite score. These scores were compared with the clinicians' tests measuring explicit and implicit biases. Although there was not significant explicit bias noted by clinicians, there was variability in implicit biases measured. Furthermore, the clinicians with a higher rate of implicit biases were rated lower by Black patients as compared with White patients ($P = .04$) regarding patient-centered care. Latinx patients rated their clinicians lower overall as compared with patients of other races ($P = .001$); however, the ratings did not correlate with the clinicians' implicit bias scores.[65] Although not specific to cardiology, biases within the patient–physician relationship like these may impact physician referral patterns and patients' decisions. In addition to implicit biases, other physician factors may affect the physician–patient interaction, resulting in differences in care for racial and ethnic subgroups including cultural dissonance, burnout, and language barriers and challenges if interpreters are needed and associated time pressures. Further study is needed to identify best practices to limit the impact of bias on the delivery of evidence-based care for patients at risk for SCD.

The ICD preimplantation counseling process has been highlighted as an area in which implicit biases may propagate the racial uptake difference. The majority of patients who receive ICD preimplantation counseling choose to have a device implanted; however, Black, Hispanic, and other racial and ethnic minority patients are less likely to receive that counseling as compared with White patients.[25] Furthermore, when surveyed, a majority of electrophysiologists reported using shared decision making when counseling around ICD risks and benefits (which is a requirement for coverage for some Medicare beneficiaries); however, 62% were unaware of race-based differences in patient perception of ICDs.[66]

As with patient–physician interactions throughout health care, individual interactions between the patient and physician have a large impact on ICD referral and acceptance, and these interactions are vulnerable to implicit biases from both the patient and the physician. How the medical community can best mitigate this is an area of ongoing study, however, diversification of the cardiovascular team workforce is likely to help. One study demonstrated that when video counseling is racially concordant, it may help close the gap on racial differences in patient preferences around ICD.[67]

Patient

Finally, patient preferences play a big role in acceptance of ICD implantation. This is particularly true in the setting of primary prevention ICDs in which the assessment of risks and benefits is nuanced, and decision making relies more heavily on patient preferences, rather than exclusively on explicit measures of risk. As such, the shameful historical mistreatment of Black patients by the medical community may contribute significantly to the decision-making process. While reasons for declining an ICD were not systematically collected in the MUSTT trial, when ICD was recommended, 7% of White patients refused, as compared with 20% of Black patients ($P = .001$).[32] This is seen similarly with other cardiovascular procedures, including percutaneous coronary intervention and coronary artery bypass grafting,[68–70] and is consistent with other studies showing that Black patients were less likely to trust in specialist recommendations as compared with White patients.[71] Data show that preferences and procedural refusal are multifactorial and are confounded by differences in medical literacy, financial barriers, and other systemic factors. For example, Black patients have a similar baseline interest in innovative technology[72] compared with White patients and that it is differences in knowledge of specific procedures that may explain apparent differences in preferences.[73]

Overcoming a legacy of differences in ICD care will require consistent, intentional efforts including, but not

Table 3 Knowledge gaps and proposals for action

Category	Knowledge gap	Strategy to address gap
Patient identification	Current market sizing for overall ICD-eligible patients in the United States, broken down by relevant race and ethnic identities including more than just White and Black, indication (primary vs secondary), and clinical characteristics of eligible patients	Analysis of real-world evidence sources including registries, claims, and/or electronic health records
Counseling	Updated rates of ICD referrals/counseling of eligible patients	Multicentered review of referral patterns using electronic health record data or real-world data sources like claims data to assess differences in micro- and macrogeography and practice setting
Uptake	Current ICD implantation rates by patient demographics (including race), location of implantation, and indication	Analysis of real-world evidence sources including registries, claims, and/or electronic health records
	Reasons behind differences in ICDs among racial minorities	Patient- and clinician-facing surveys
Mortality	Effectiveness of primary and secondary prevention ICDs in ischemic and nonischemic cardiomyopathy within racial and ethnic subgroups	Assessment in existing large data sets like the National Cardiovascular Data Registry ICD Registry or clinical trials with adequate power for subgroup analyses in the setting of contemporary medical and device based therapy
	Presence vs absence of physiological differences in SCD risk between racial/ethnic subgroups that may impact safety and effectiveness of an ICD	Cohort and adequately powered subgroup analyses
Management	Reasons for lower utilization of remote monitoring of ICDs in racial and ethnic subgroups	Patient- and clinician-facing surveys
Preimplantation counseling	Effect and practicality of automated referral notifications	Clinical and implementation trials
	Effect of implicit biases on ICD implantation decision	Patient- and clinician-facing surveys; implementation trial
	Effect of physician education on race-based preferences ICDs	Patient- and clinician-facing surveys; implementation trial
Postimplantation management	Strategies to increase remote monitoring enrollment and activation	Clinical and implementation trials

ICD = implantable cardioverter-defibrillator.

limited to, developing decision support tools and education for culturally competent communication, promotion of a diverse medical workforce, and thoughtful clinical trial design to allow for adequately powered subgroup analysis when there is physiological reason to suspect differences in subgroups.

Limitations

There are several limitations to the available data (see Future Directions) and, consequently, to this review article. It is worth noting that many of the studies investigating racial differences within ICD patient selection, implantation, and management primarily compare Black patients with their White counterparts and do not include additional racial and ethnic minority groups (eg, Hispanic, Asian American). Understanding the full scope of differences will be important as the medical field continues to work toward closing gaps in care. Additionally, several of the studies in this area, including the landmark trials, predate the current generation of guideline directed medical therapy. The overall improvement in heart failure mortality over the last several decades undoubtedly changes the risk-benefit calculations of an ICD especially those for primary prevention.

Future directions

There is immense need for further understanding along all aspects of ICD patient eligibility, selection, and uptake as well as postimplantation management and mortality effects (Table 3). Most fundamental is an ongoing need for further study using adequately powered subgroup analyses to understand the safety and effectiveness of both emerging and standard-of-care interventions in important racial and ethnic subgroups, the underlying reasons for noted differences, and strategies to improve them. Additional future directions include research aimed at barriers to ICD utilization from the patient, clinician, and health system perspectives and interventions to mitigate them including automated algorithms identifying at-risk individuals, standardized referral algorithms, multidisciplinary counseling conversations (including Primary Care Physicians), and validated video counseling programs.

Conclusion

Racial differences exist within cardiovascular care and extend to ICD patient selection, counseling, utilization, and clinical outcomes. Factors contributing to these differences are multifactorial and exist on the level of health systems, clinicians, patients, and the intersection of these

entities during the clinical encounter. There is tremendous need for further study to clarify the role of the ICD in the current era of guideline directed medical therapy in general and in important and historically underserved racial and ethnic subgroups.

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