Reducing Racial and Ethnic Disparities in Hypertension Prevention and Control: What Will It Take to Translate Research into Practice and Policy?

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INTRODUCTION
Despite available, effective therapies, racial and ethnic disparities in care and outcomes of hypertension persist. Several interventions have been tested to reduce disparities; however, their translation into practice and policy is hampered by knowledge gaps and limited collaboration among stakeholders.

METHODS
We characterized factors influencing disparities in blood pressure (BP) control by levels of an ecological model. We then conducted a literature search using PubMed, Scopus, and CINAHL databases to identify interventions targeted toward reducing disparities in BP control, categorized them by the levels of the model at which they were primarily targeted, and summarized the evidence regarding their effectiveness.

RESULTS
We identified 39 interventions and several state and national policy initiatives targeted toward reducing racial and ethnic disparities in BP control, 5 of which are ongoing. Most had patient populations that were majority African-American. Of completed interventions, 27 demonstrated some improvement in BP control or related process measures, and 7 did not; of the 6 studies examining disparities, 3 reduced, 2 increased, and 1 had no effect on disparities.

CONCLUSIONS
Several effective interventions exist to improve BP in racial and ethnic minorities; however, evidence that they reduce disparities is limited, and many groups are understudied. To strengthen the evidence and translate it into practice and policy, we recommend rigorous evaluation of pragmatic, sustainable, multilevel interventions; institutional support for training implementation researchers and creating broad partnerships among payers, patients, providers, researchers, policymakers, and community-based organizations; and balance and alignment in the priorities and incentives of each stakeholder group.

Keywords: blood pressure; disparities; hypertension; interventions; prevention; policy; racial inequities; research translation.

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DISPARITIES IN HYPERTENSION CONTROL AND PREVENTION

Despite the availability of effective therapy, hypertension remains a significant cause of morbidity and mortality in the United States and a major contributor to cardiovascular disease (CVD), stroke, and chronic kidney disease.[1] Recent estimates from the National Health and Nutrition Examination Survey (NHANES) data suggest that the prevalence of hypertension in African-Americans remains significantly higher than in white or Mexican-American adults.[2,3] Racial disparities in hypertension prevalence have persisted over time.[2,4] Similarly, racial disparities in BP control persist despite longstanding awareness and the development of targeted initiatives to reduce disparities.[2,5–7] Available evidence indicates that, compared with whites, African-Americans receiving adequate treatment should achieve similar declines in overall BP and experience lower rates of hypertension-related morbidity and mortality.[8,9] However, despite improvements in awareness and treatment in the general population, hypertension continues to be poorly diagnosed, treated, and controlled among African-Americans and Hispanics, who suffer disproportionately from hypertension-related morbidity and mortality.[1,2] Furthermore, NHANES data from

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2003 to 2010 suggests that blood pressure (BP) control was achieved in fewer African-Americans (62%) when compared with Mexican-Americans (74%) and Caucasians (75%) even though awareness of hypertension was not significantly different between Caucasians and African-Americans.[2] A study conducted in a Medicaid population in North Carolina from 2005–2006 showed that African-Americans with high BP were more likely to have four or more antihypertensives prescribed and more likely to have received provider responses to hypertension and medication adjustments; however, they were less likely to have attained goal BP.[6] Disparities are also apparent in preventable hospitalizations for hypertension, where the gap in admission rates for hypertension widened between African-American and Caucasian patients from 2004 to 2009.[10]

MULTILEVEL BARRIERS TO REDUCING DISPARITIES IN BLOOD PRESSURE CONTROL

Barriers to reducing disparities in BP control are complex and include factors related to individual patients; family and social support systems; health care providers; organization and practice settings in which health care occurs; the local community environment; and local, state, and national health policy environments. If interventions to reduce disparities are to be successfully designed, targeted, and implemented, it is critical to understand these multifactorial barriers. In this article, we review known barriers to reducing racial disparities in hypertension prevention and control. We present a modified version of the ecological model based on Bronfenbrenner's work[11,12] to describe these barriers, which shows the different levels at which health disparities can be understood (Figure 1). Finally, we highlight innovative interventions to overcome these barriers and present recommendations for translating research findings into practice and policy.

Individual patient level barriers

Factors affecting BP control at the individual level include genetic (e.g., differences in biological responses to treatment), behavioral (e.g., medication adherence and lifestyle factors), cognitive and affective (e.g., knowledge, abilities, and attitudes), and sociodemographic (e.g., socioeconomic status and language proficiency) influences.

Genetic factors. Racial differences in intrinsic biological factors account for only a small amount of observed disparities. Indeed, within racial groups, wide variations in drug-associated changes in BP have been observed, suggesting that many blacks and whites have similar responses to specific drugs.[13]

Behavioral factors. Patient behaviors are believed to contribute significantly to hypertension disparities. Recent studies have demonstrated that adherence is lower in African-American patients than whites,[14–16] and differences in medication adherence are associated with BP control disparities.[15,17] Other behavioral and lifestyle factors (e.g., poor adherence to recommendations about weight management and low-salt diet, heavy drinking and alcoholism, smoking, and use of illicit drugs) may also contribute to disparities in BP control.[18–20]

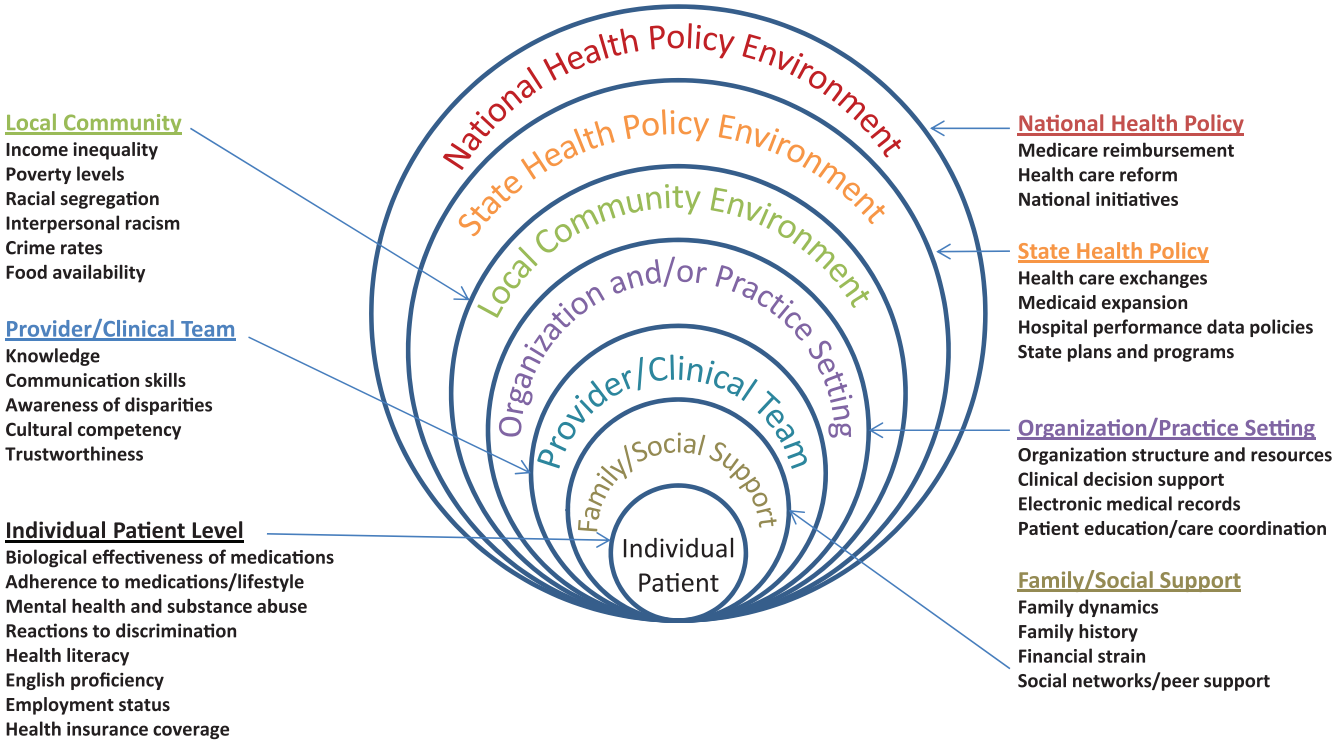

Figure 1 Multilevel influences on disparities in hypertension prevention and control.

Cognitive and affective factors. Patient behaviors and acceptance of medical advice may be influenced by emotional reactions to the environment, cognitive styles and abilities, and beliefs about individual health. A recent study found that being "labeled" as hypertensive was associated with poorer mental health and greater depressive symptoms among African-Americans.[21] Studies of race consciousness show that African-Americans are more likely than whites to think about race, and those who do are more likely to have elevated BP than their white counterparts.[22] Studies of health literacy, another cognitive factor, demonstrate that patients with lower literacy levels are less likely to engage in participatory decision-making with their providers and have worse BP control than those with higher literacy levels.[23]

Sociodemographic factors. Language proficiency may also present a barrier to hypertension control. In 2000, 18% of the total US population reported that they spoke a language other than English at home,[24] and lack of English proficiency has been cited as a barrier to hypertension control in Korean-Americans.[25] Socioeconomic barriers (e.g., unemployment and lack of health insurance) have been shown to be associated with inadequate BP care and control among young African-American men with hypertension.[18] A recent study using national data reported a higher prevalence of no health insurance and poorer access to care among Hispanics and low-income persons with hypertension.[26]

Family/social support level barriers

Family-level factors such as marital status, living arrangements, family dynamics, social support for care, and financial strain impact BP through their influences on stress and adherence to medications.[27] More expensive medications such as calcium channel blockers may result in increased financial strain on families when compared to cheaper, antihypertensives.[28] Additionally, a study reported that many hypertension patients attributed their hypertension to family history and suggested that there was a relationship between this attribution and medication-taking behavior.[29] Findings from the same study also showed that a large percentage of patients rated stress at home as a cause of their hypertension.[29]

Health system and provider level barriers

Racial minorities may also encounter barriers to optimal BP care and control at the health system, provider, and organizational team levels. Barriers include lower quality of care, poorer provider-patient communication, and lower levels of trust in health professionals.[27,30–32]

Lower quality of care. Healthcare settings where many racial minorities receive care have fewer resources and less access to specialists and newer technologies, which may be associated with poorer outcomes.[30] One study of African-Americans with uncontrolled hypertension found that a majority of patients were not receiving diuretics, despite widely publicized recommendations for their use.[33]

Communication barriers. Disparities also exist in the quality of patient–provider communication. Physicians tend to be more verbally dominant and less likely to engage in participatory decision making with African-American patients.[34] African-Americans with uncontrolled BP have shorter visits containing fewer biomedical, psychosocial, and rapport-building statements when compared with whites with controlled BP.[31]

Lower levels of trustworthiness. Studies of hypertensive African-Americans suggest that distrust of health care professionals may pose a significant barrier to medication adherence,[27] and higher levels of perceived discrimination in the health care system have been reported in African-American patients.[32] Increased participatory decision making and rapport building may improve patient trust in physicians, which may mitigate concerns about BP medications and increase uptake of lifestyle changes.[35,36]

Local community environment level barriers

Many community and local environmental factors, such as neighborhood poverty, crime rates, proportion of families living in poverty, availability of healthy foods, residential segregation, and racial isolation contribute to disparities in BP control.[27,37,38] These social determinants of health play a significant role in racial disparities in BP. To illustrate, Kingsbury *et al.*[39] present a conceptual model in which social and environmental factors such as psychosocial stressors, occupational stressors, and environmental stressors may affect sleep quality in a way that would disproportionately affect BP control in African-Americans. Additionally, neighborhood violence has been implicated as a key contextual factor negatively associated with BP medication adherence due to the impact of increased stress on patients.[27] Finally, perceived interpersonal racism has been shown to correlate with increased ambulatory BP measures.[37]

Local, state, and national policy environments level barriers

Pay-for-performance models have been theorized to carry risks of worsening health disparities. Karve *et al.*[40] demonstrated that the percentage of African-American patients served by hospitals is inversely related to performance measures for MI and pneumonia, raising concern that pay-for-performance may place hospitals that serve large minority populations at financial risk. Major pay-for-performance programs in the UK[41] have had no effects on racial disparities in hypertension management. Models of effects of pay-for-performance programs in the United States have not shown increases in disparities.[42] Nevertheless, the risk remains, and experts suggest these programs should consider both overall quality and disparities. Additionally, policy initiatives and wide social programs to improve health may result in worsening of health inequities through a "staircase effect" in which wide-based interventions to improve health may be less likely to be taken up by those with lower socioeconomic status.[43,44] As a result, health inequities may increase by socioeconomic status, and these inequities may

translate to increases in racial disparities. With population-wide initiatives such as Healthy People 2020 in place, the risk remains that disparities in BP control may be paradoxically increased.

INTERVENTIONS TO REDUCE DISPARITIES IN HYPERTENSION CARE AND CONTROL

Interventions developed to improve management of hypertension in racial minorities are numerous. We provide our detailed search strategy for identifying effective interventions in Supplementary Table S1. When possible, we categorized identified interventions by the level of Bronfenbrenner's Ecological Model at which they were primarily targeted. Overall, we identified and reviewed 39 interventions in the literature as well as several state and national policy initiatives targeted toward reducing racial disparities in BP control, 5 of which are ongoing. Most (51.5%) completed and reviewed interventions had patient populations that were majority African-American. Of completed interventions, 27 demonstrated some improvement in BP control or in related process measures, and 7 did not; 23 studies improved BP levels or control rates, 4 improved lifestyle behaviors, 3 improved medication adherence, 2 improved knowledge, and 1 improved participatory decision-making. Of the six studies for which effects on disparities are available, three reduced, two increased, and one had no effect on disparities. We describe these interventions, targeted at multiple levels, and their effects, below and within Tables 1, 2.

Individual patient interventions

Interventions targeting individual patient level barriers (e.g., socioeconomic and lifestyle issues) include patient self-management education, counseling, and motivational strategies (Tables 1, 2).

Patient self-management education strategies. Bosworth *et al.*[45] used home BP monitoring and self-management techniques via telephone, and found that non-white patients had sustained decreases in systolic BP lasting 24 months after the intervention. Glasgow *et al.*[75] demonstrated statistically significant improvements in BP control over 24 months using a self-management intervention developed using an implementation science framework; however, the self-management program was not sustained beyond the study period. Discharge instructions tailored for health literacy level have been demonstrated to be effective in improving postdischarge knowledge about hypertension in emergency room patients who present with hypertension.[51] One self-management program consisting of written educational materials along with BP, exercise, and food consumption logs resulted in improvements in self-reported BP measurements from 96% of patients who returned BP logs.[48] Jackson *et al.*[49] demonstrated that medication and behavioral management interventions delivered through a telephone-based system were effective in reducing systolic and diastolic BP 12 and 18 months after the start of the intervention. Migneault *et al.*[50] found that an automatic, culturally adapted telemedicine system was effective in improving dietary quality, although there were no effects on BP. Balcazar *et al.*[71] demonstrated that a model in which community health workers disseminated NHLBI-produced BP education modules yielded statistically significant dietary behavioral outcomes and perceived benefits of healthy behaviors in Hispanic patients. Zarate-Abbott *et al.*[72] developed a culturally sensitive workplace health education program targeted at low-income Hispanic immigrant housekeepers and demonstrated improvements in systolic and diastolic BP at 17 months. Kim *et al.*[73] tested a self-help multimodal behavioral intervention and showed improvements in BP control, knowledge, self-efficacy, medication adherence, and depression over 12 months in older Korean-Americans.

Counseling strategies. Programs in stress reduction help improve BP control; a transcendental meditation program showed significant reductions in all-cause mortality, MI, stroke, systolic BP, and anger expression in African-American patients with coronary artery disease.[47] The Five Plus Nuts and Beans study is an ongoing randomized trial that looks to compare the effectiveness of general written dietary advice vs. neighborhood-specific counseling regarding food purchasing and dietary behaviors on BP control in African-American patients with medication-controlled hypertension in an urban practice.[79]

Motivational strategies. One study used positive-affect induction and self-affirmation with patient education in African-Americans, demonstrating improvements in medication adherence, but no significant changes in BP control at 12 months.[46]

Family/social support system interventions

Several interventions have also been developed to address barriers to BP control at the level of the family and social support systems (Tables 1, 2).

Targeting family members. Flynn *et al.*[83] conducted focus groups of African-American patients with hypertension and found that patients often cited family members as facilitators in engagement in hypertension self-management. As such, one of the interventions being tested in the Achieving Blood Pressure Control Together (ACT) study will include communication activation for patients and family members.[81]

Targeting peer support. In one intervention, 147 African-Americans with hypertension received a DVD with culturally appropriate stories from peer patients to discuss BP control. The program was noted to improve BP control in these patients up to three months postintervention.[52] Peer-to-peer phone calls from patients with well-controlled hypertension were demonstrated to be effective in reducing systolic BP in African-American patients with uncontrolled

Table 1 Intervention study characteristics

Study	Intervention type	Location	Setting	Sample size	Patient population
Individual patient interventions					
Bosworth *et al.*[45]	Home BP monitoring; Behavioral intervention	North Carolina	Home environment	636	Minority groups: 49% AA
					Mean age: 61 years
					Sex: 66% female
					Income: 19% "inadequate"
Ogedegbe *et al.*[46]	Patient Education; motivational Interviewing	New York City	Clinic	256	Minority groups: 100% AA
					Mean age: 58 years
					Sex: 79% female
					Income: NR
Schneider *et al.*[47]	Stress reduction; behavioral intervention	Milwaukee, WI	Group education	201	Minority groups: 100% AA
					Mean age: 59 years
					Sex: 42% female
					Income: 50% <$10,000/year
Rigsby *et al.*[48]	Patient education; behavioral intervention	Alabama	Church	36	Minority groups: 100% AA
					Age: NR
					Sex: 80.6% female
					Income: NR
Jackson *et al.*[49]	Medication management; behavioral intervention	Durham, NC	Telemedicine	573	Minority groups: 49.5% AA
					Mean age: 63.5 years
					Sex: 8.2% female
					Income: 18.2% "inadequate income"
Migneault *et al.*[50]	Behavioral intervention; patient education	Urban US	Telemedicine	337	Minority groups: 100% AA
					Mean age: 56.3 years
					Sex: 70% female
					Income: median household income $10–20,000/year (range)
Giuse *et al.*[51]	Patient education	Nashville, TN	Emergency room	196	Minority groups: 33.6% nonwhite
					Mean age: 50.5 years (intervention group 1)
					Sex: 55% female
					Income: NR
Family/social support interventions					
Houston *et al.*[52]	Culturally appropriate storytelling intervention	Southern United States	Community	299	Minority groups: 100% AA
					Mean age: 53.7 years
					Sex: 71.4% female
					Income: 61.8% household <$12,000/year

(Continued)

Table 1. Continued

Study	Intervention type	Location	Setting	Sample size	Patient population
Rocha-Goldberg et al.[53]	Group education sessions	Durham, NC	Community	17	Minority groups: 100% Hispanic
					Mean age: 46
					Sex: 59% female
					Income: NR
Rodriguez *et al.*[54]	Group education sessions	Boston, MA	Community	34	Minority groups: 100% AA
					Mean age: 48 years
					Sex: 100% female
					Income: NR
Shaya *et al.*[55]	Group education; social networks	Baltimore, MD	Community	441	Minority groups: 100% AA
					Mean age: 48 years (intervention group)
					Sex: 41.3% female
					Income: NR
Turner *et al.*[56]	Peer support; patient education	Nationwide	Telephone	280	Minority groups: 100% AA
					Mean age: 61.9 years
					Sex: 65% female
					Income: NR
Provider/team interventions					
Thom *et al.*[57]	Physician education; cultural competency training	Northern California	Clinic	429 patients	Minority groups: 23.2% AA, 25.3%
					Hispanic, 13.1% Asian (intervention group)
					Mean age: 54.9 years (intervention group)
					Sex: 49% female (intervention group)
					Income: NR
Organization/practice interventions					
Hicks *et al.*[58]	Electronic medical records (EMRs)	Urban population	Clinic (EMR)	2,027	Minority groups: 33% AA
					Median age: 64 years (intervention group 1)
					Sex: 66.1% female
					Income: NR
Hebert *et al.*[59]	Clinical support model	Southern United States	Clinic	898	Minority groups: 36.3% AA, 21.6% Hispanic
					Mean age: 57 years
					Sex: 35.6% female
					Income: NR
Samal *et al.*[60]	EMRs	Nationwide	Clinic (EMR)	17,016	Minority groups: 14% AA, 15% Hispanics
					Mean age: 51 years
					Sex: 67% female
					Income: NR
Song *et al.*[61]	New clinic model	Boston, MA	Mobile clinic (delivery design)	5,900	Minority groups: 68.3% AA, 13.9% Hispanic (returners)

(Continued)

Table 1. Continued

Study	Intervention type	Location	Setting	Sample size	Patient population
					Mean age: 56.8 years (returners)
					Sex: 51% female (returners)
					Income: NR
Local community environment interventions					
Ravenell *et al.*[62]	Increased screening; Motivational Interviewing; Patient Navigation	New York City	Community (barbershops)	Ongoing 480 planned	Minority groups: 100% AA
					Age: Ongoing
					Sex: 100% male
					Income: Ongoing
Zoellner *et al.*[63]	Community-based participatory research (CBPR), Multicomponent Lifestyle Intervention	Southern Mississippi	Community	269	Minority groups: 94% AA
					Mean age: 44.3 years
					Sex: 85% female
					Income: 28.3% household income< $20,000/year
Troyer *et al.*[64]	Home delivered Dietary Approaches to Stop Hypertension (DASH) diet meals	Not reported	Community	210	Minority groups: 39% nonwhite
					Age: 100% >60 years
					Sex: 82.9% female
					Income: 43% < 165% of poverty line
National health policy interventions					
Hicks *et al.*[65]	Organizational change; quality improvement	Nationwide	Nationwide database review (community health centers)	10,153	Minority groups: 13% AA
					Mean Age: 56
					Sex: 56% female
					Income: NR
Landon *et al.*[66]	Organizational change; quality improvement	Nationwide	Nationwide database review (community health centers)	9,658 (3,362 with HTN)	Minority groups: 13.2% AA, 23% Hispanic (HTN intervention)
					Mean age: 56.1 years (HTN intervention)
					Sex: 56.2% female (HTN intervention)
					Income: NR
Multilevel: individual patient and provider/team setting interventions					
Johnson *et al.*[67]	Patient education; provider education	Baltimore, MD	Clinic	552	Minority groups: 91.3% AA
					Mean age: 55 years (intervention group 1)
					Sex: 65.3% female
					Income: NR
Pezzin *et al.*[68]	Telemedicine; home BP monitoring; patient education	Urban US area	Telemedicine	845	Minority groups: 100% AA
					Mean age: 64.3 years

(Continued)

Table 1. Continued

Study	Intervention type	Location	Setting	Sample size	Patient population
					Sex: 66% female
					Income: NR
Bove *et al.*[69]	Nurse management system; telemedicine	Urban and rural sites	Telemedicine/clinic	388	Minority groups: 1% AA (rural); 76.5% AA (urban)
					Mean age: 62.5 years (rural); 57.9 years (urban)
					Sex: 44.4% female (rural), 47.5% (urban)
					Income: 43% < $25,000/year
Han *et al.*[25]	Nurse management system; telemedicine	Baltimore, MD	Telemedicine	360	Minority groups: 100% Asian (Korean-American)
					Mean age: 51.9 years
					Sex: 53% female
					Income: NR
Multilevel: individual patient and local community environment interventions					
Cene *et al.*[70]	Community-based nurse practitioner/ community health worker team care; enhanced clinical care	Baltimore, MD	Community/clinic	363	Minority groups: 100% AA
					Mean age: 47.8 years
					Sex: 63% female
					Income: NR
Balcazar *et al.*[71]	Family-centered and CBPR/community feasibility program; patient education	El Paso, TX	Community	98	Minority groups: 100% Hispanic (Mexican-Americans)
					Mean age: 54.9 years (intervention group)
					Sex: 78.5% female
					Income: 79% household income< $15,000/year
Zarate-Abbott *et al.*[72]	Health education; workplace intervention	South Texas	Workplace	21	Minority groups: 100% Hispanic (Mexican-American)
					Mean age: 50
					Sex: 100% female
					Income: NR
Kim *et al.*[73]	Multimodal self-help program; patient education	Baltimore-Washington metro area	Community	440	Minority groups: 100% Asian (Korean-American)
					Mean age: 70.9 years
					Sex: 72.4% female
					Income: NR
Multilevel: family/social support and local community environment interventions					
Victor *et al.*[74]	Community involvement; patient education; peer-based health messaging	Dallas, TX	Community (barbershops)	1,297	Minority groups: 100% AA
					Mean age: 49.5 years (intervention group)
					Sex: 100% male
					Income: 14.3% < 100% of poverty level

(Continued)

Table 1. Continued

Study	Intervention type	Location	Setting	Sample size	Patient population
Multilevel: individual patient and organization/practice setting interventions					
Glasgow *et al.*[75]	Patient HTN self-management education; weight loss intervention	Boston, MA	Community Health Center	365	Minority groups: 71.2% AA, 13.1% Hispanic
					Mean age: 54.6 years
					Sex: 71% female
					Income: 54.5% <$25,000/year
Multilevel: provider/team and organization/practice setting interventions					
Cooper *et al.*[76]	Physician communication skills training; patient activation	Baltimore, MD	Clinic	279	Minority groups: 62% AA
					Mean age: 59.7 years (intervention group 1)
					Sex: 65.9% female
					Income: 68% < $35,000/year
Kim *et al.*[77]	Home BP monitoring; telemedicine	Baltimore, MD	Telemedicine	359	Minority groups: 100% Korean-American
					Age: 52
					Sex: 53% female
					Income: NR
Ogedegbe *et al.*[78]	Patient education; motivational interviewing; Home BP monitoring; lifestyle counseling; physician feedback; monthly hypertension case rounds	New York City	Community Health Center	1,059	Minority groups: 100% AA
					Mean age: 56.5 years
					Sex: 71.6% female
					Income: 72.4% household income< $20,000/year
Cooper *et al.*[79]	Improved BP measurement; organizational change (care management staff added); audit/feedback and communication skills training for physicians	Baltimore, MD	Clinic/system	~45,000 (~16,000 with HTN)	Minority groups: 42% AA, 2% Hispanic, 2% Asian, 3% multiracial
					Mean age: 48 years
					Sex: 62% female
Multilevel: organization/practice setting and local community environment interventions					
Halladay *et al.*[80]	Community health coach; home BP monitoring; patient education; phone coaching; practice-level HTN care quality improvement	North Carolina	Clinic/community	Ongoing	Ongoing
Multilevel: individual, family/social support, and local community environment interventions					

(Continued)

Table 1. Continued

Study	Intervention type	Location	Setting	Sample size	Patient population
Ephraim *et al.*[81]	Community health workers; patient self-management and communication skills training; home BP monitoring	Baltimore, MD	Clinic/community	Ongoing	Ongoing
Cooper (Miller) *et al.*[82]	Dietary advice; facilitated access to healthy foods	Baltimore, MD	Clinic/community	Ongoing	Ongoing

Abbreviations: AA, African-American; BP, blood pressure; HTN, hypertension; NR, not reported.

hypertension.[56] Rodriguez *et al.*[54] demonstrated that a group education course, which contained information on dietary and lifestyle changes, was effective in reducing systolic BP at 6 and 12 weeks postintervention. In addition, a hypertension education program targeted to African-Americans with CVD focused around peer groups and social networks was more effective in decreasing systolic and diastolic BP when compared with usual care.[55] One 6-week culturally tailored group behavioral intervention for Hispanic/Latino adults resulted in improvements in systolic BP, weight, body mass index, and physical activity as compared with preintervention baseline measures.[53]

Targeting extended social networks. The ACT study[56] is currently ongoing and involves community health workers to leverage individual patient factors along with family and social support factors to improve patient participation in hypertension self-management. Victor *et al.*[74] demonstrated that an intervention targeting African-American owned barbershops where barbers were enabled to work as health educators and provide BP checks improved BP control and marginally decreased systolic BP in clients with hypertension.

Provider/team interventions

Several interventions have addressed patient–provider communication as a major means of improving BP control (Tables 1, 2). One intervention did not demonstrate any statistically significant differences in BP among patients whose primary physicians were randomized to a cultural competence curriculum.[57] However, Cooper *et al.* tested physician communication skills training and patient activation by community health workers and showed improvements in participatory decision making and systolic BP.[76] The latter interventions reduced racial disparities in participatory decision-making and patient positive affect (personal communication with author), but widened disparities in patient question-asking between patients with low and adequate health literacy.[23] Johnson *et al.*[67] demonstrated that a combined approach of physician education by hypertension specialists as well as patient counseling on BP management resulted in statistically significant improvements in BP control over 6 months in a primarily African-American patient population. A nurse-driven program to facilitate CVD self-management behaviors was effective in decreasing systolic and diastolic BP; these changes were not enhanced by a concomitant telephone-based intervention.[69] Bilingual nurse counseling in Korean-Americans has shown to be effective in improving medication adherence, alcohol consumption, and exercise, with frequency of counseling related to intervention effect.[25] Finally, Pezzin *et al.*[68] demonstrated that a home-based nurse and health educator counseling intervention improved BP control among recently discharged African-American patients with stage 2 hypertension.

ORGANIZATION/PRACTICE SETTING INTERVENTIONS

Several interventions examined the effectiveness of changes in organizational setting or practices in helping to control BP (Tables 1, 2). Song *et al.*[61] demonstrated significant decreases in BP among patients who followed-up at mobile health clinics for BP care. The role of electronic medical records (EMRs) was examined in two studies; both showed that clinics without EMR systems had greater racial disparities in BP control.[58,60] Use of clinical decision support technology in EMR systems has been shown to improve BP control across all ethnicities.[58] In addition, Kim *et al.*[77] demonstrated that a 6-week behavioral education program followed by BP telemonitoring and bilingual nurse telephone counseling was effective in markedly improving BP control in a Korean-American immigrant population. Furthermore, use of intensive outpatient health services, such as heart failure management clinics, was also demonstrated to reduce racial disparities in BP control.[59] Ogedegbe *et al.*[78] randomized community health centers in NC to a practice-based multicomponent educational intervention or usual care, and did not observe significant changes in patients' BP control. Project ReD CHiP is an ongoing, multilevel health system quality improvement intervention that includes training in accurate BP measurement by staff; provider education (including audit and feedback of panel data stratified by race/ethnicity and communication skills focused on enhancing medication adherence); and access to improved wraparound care management services for patients in a large urban primary care network.[82] Project ReD CHiP incorporates multiple individual level and provider or health system-level components, which have been guided by significant stakeholder engagement throughout development and implementation in order to ensure sustainability. The Heart Healthy Lenoir project combines practice-level quality improvement interventions to improve BP control with patient-directed interventions, using a health coach to improve BP control.[80]

Table 2. Intervention study results

Study	Design	Primary outcomes	Improvement in blood pressure control or related outcomes?
Individual patient interventions			
Bosworth *et al.*[45]	Randomized controlled trial	Systolic blood pressure	Yes: Significant decreases in BP in nonwhite patients at 24 months after receiving a combined self-management/home BP monitoring intervention
Ogedegbe *et al.*[46]	Randomized controlled trial	Medication adherence	Yes: Positive-affect induction leads to significantly improved medication adherence at 12 months in AA patients with HTN
Schneider *et al.*[47]	Randomized controlled trial	Time to first event: mortality, MI, or stroke	Yes: Significant decrease of 4.9 mm Hg in systolic blood pressure in patients randomized to receive transcendental meditation
Rigsby *et al.*[48]	Prepost study	Increased knowledge of hypertension, risk factors	Yes: 96% of participants who submitted daily BP logs reductions in blood pressure
Jackson *et al.*[49]	Randomized controlled trial	Mean systolic, diastolic blood pressure	Yes: Decreased systolic blood pressure at 18 months postintervention after receiving a combined medication management/behavioral intervention
			Reduced disparities: Decreased systolic and diastolic blood pressure in African-Americans compared to whites
Migneault *et al.*[50]	Randomized controlled trial	Changes in physical activity, diet index score	No: No statistically significant reduction in systolic or diastolic BP among patients who received culturally tailored behavior intervention (vs. education-only controls)
Giuse *et al.*[51]	Sequential randomized trial	Improvements in hypertension knowledge	Yes: Significant increases in hypertension knowledge after receiving emergency room discharge instructions tailored to health literacy
Family/social support interventions			
Houston *et al.*[52]	Randomized controlled trial	Change in blood pressure	Yes: A storytelling intervention produced improved blood pressure control at 3 months in a population of AA patients with HTN
Rocha-Goldberg *et al.*[53]	Prepost study	Systolic BP, dietary changes, BMI	Yes: A culturally adapted group behavioral intervention resulted in significant improvements in systolic blood pressure in Hispanic/Latino adults
Rodriguez *et al.*[54]	Prepost study	Blood pressure, body weight, BMI, waist circumference	Yes: A 12-week nutrition and physical activity intervention produced a 38% relative reduction in hypertension prevalence in AA women
Shaya *et al.*[55]	Nonrandomized study	Blood pressure	Yes: A hypertension education program focused on clustering in social networks resulted in improved systolic and diastolic BPs at 18 months
Turner *et al.*[56]	Randomized controlled trial	Coronary heart disease risk; systolic BP	Yes: A peer patient behavioral support system resulted in significant reductions in systolic blood pressure
Provider/team interventions			
Thom *et al.*[57]	Nonrandomized study	Patient reported physician cultural competency	No: No statistically significant changes in systolic BP in patients after physicians were randomized to a cultural competence curriculum
Organization/practice interventions			
Hicks *et al.*[58]	Randomized study	Blood pressure	Yes: Clinical decision support improves HTN outcomes across all ethnicities
Hebert *et al.*[59]	Pre-post study	Blood pressure	Yes: Patients enrolled in heart failure disease management programs had reductions in BP
			Reduced disparities: Reduction of racial disparities in control
Samal *et al.*[60]	Observational study	Blood pressure control	No: Increased disparities in BP control in African-Americans in clinics that did not use EMRs
Song *et al.*[61]	Longitudinal prepost study	Blood pressure control	Yes: Average reduction of 10.7 mm Hg in SBP, 6.2 mm Hg in DBP in patients returning to a mobile health clinic
Local community environment interventions			
Ravenell *et al.*[62]	Randomized controlled trial	Blood pressure control; medication adherence	Ongoing

(Continued)

Table 2. Continued

Study	Design	Primary outcomes	Improvement in blood pressure control or related outcomes?
Zoellner *et al.*[63]	Pre-post study	Blood pressure	Yes: Statistically significant decreases in systolic and diastolic BP at 6 months; sugar intake after enrolling patients in a community-based blood pressure management program
Troyer *et al.*[64]	Randomized controlled trial	Dietary adherence to Dietary Approaches to Stop Hypertension (DASH) guidelines	Yes: Elderly patients receiving DASH-adherent meals were more likely to become DASH adherent in their overall diets
			Impact on disparities: Improvements in DASH adherence were marginally larger in whites and patients with higher income
National health policy interventions			
Hicks *et al.*[65]	Observational study	Disparity scores on quality of care indicators	Impact on disparities: Health disparities collaboratives at community health centers do not reduce disparities in hypertension care or outcomes
Landon *et al.*[66]	Nonrandomized control study	Improvements in quality of care indicators and outcomes	No: No improvement in processes of care or clinical outcomes for hypertension in community health centers participating in quality improvement collaboratives
Multilevel: individual patient and provider/team setting interventions			
Johnson *et al.*[67]	Randomized controlled trial	Blood pressure control	Yes: Statistically significantly better improvements in BP control over 6 months for patients in the intervention group (patient and provider education) vs. usual care group
Pezzin *et al.*[68]	Randomized controlled trial	Blood pressure control	Yes: A combination of home monitoring and a nurse-led medication management intervention improved BP control in AA patients with stage 2 hypertension
Bove *et al.*[69]	Randomized controlled trial	Weight, BP, physical activity	Yes: A nurse management system resulted in improvements in BP control in urban and rural populations. Telemedicine did not improve outcomes.
Han *et al.*[25]	Randomized controlled trial	Medication adherence; smoking cessation; alcohol consumption; exercise	Yes: A bilingual nurse telephone counseling program in Korean-Americans resulted in improvements in medication adherence, alcohol consumption, and exercise, with frequency of counseling related to intervention effect
Multilevel: individual patient and local community environment interventions			
Cene *et al.*[70]	Randomized controlled trial	Low density lipoprotein levels, smoking cessation, blood pressure	No: No significant differences in BP control between high-risk AA patients who received a community-based intervention vs. those who received enhanced clinical care
Balcazar *et al.*[71]	Randomized controlled trial	BP, waist circumference, BMI, attitudes toward BP, BP self-management behaviors	Yes: A family and community intervention using NHLBI educational modules resulted in improvements in dietary behavioral outcomes and perceived benefits of healthy behaviors in Hispanic/Latino patients
Zarate-Abbott *et al.*[72]	Prepost study	Blood pressure control, BP self-management behavioral change	Yes: A workplace educational intervention among Hispanic housekeepers yielded significant improvements in systolic and diastolic BPs 17 months post-intervention
Kim *et al.*[73]	Randomized controlled trial	Blood pressure control	Yes: Significant changes in blood pressure control over 12 months; attenuated at 18 months
Multilevel: family/social support and local community environment interventions			
Victor *et al.*[74]	Randomized controlled trial	Blood pressure control rates	Yes: AA barbershops in which barbers were enabled to act as health educators/BP screeners had higher blood pressure control rates in hypertensive patients
Multilevel: individual patient and organization/practice setting interventions			
Glasgow *et al.*[75]	Randomized controlled trial	Weight, blood pressure	Yes: Statistically significant improvements in BP control over 24 months for patients enrolled in a blood pressure self-management intervention using the RE-AIM framework
Multilevel: individual patient, provider/team and organization/practice setting interventions			
Cooper *et al.*[76]	Randomized controlled trial	Blood pressure control; patient and physician participatory decision making (PDM); physician communication skill changes	Yes: Significant changes in patient involvement in care/ participatory decision-making; significant reductions in BP among patients with uncontrolled BP

(Continued)

Table 2. Continued

Study	Design	Primary outcomes	Improvement in blood pressure control or related outcomes?
			Impact on disparities: Improvements in patient communication and PDM larger in blacks than whites but smaller in persons with low vs. adequate health literacy (personal communication)
Kim *et al.*[77]	Randomized controlled trial	Blood pressure control	Yes: A 6-week behavioral education program followed by blood pressure telemonitoring and bilingual nurse telephone counseling was effective in improving BP control in a Korean-American immigrant population
Ogedegbe *et al.*[78]	Cluster-randomized clinical trial	Blood pressure control	No: No statistically significant difference in BP control for patients randomized to a practice-based multicomponent educational intervention (vs. usual care)
Multilevel: organization/practice setting and local community environment interventions			
Halladay *et al.*[80]	Nonrandomized observational trial	Blood pressure change	Ongoing
Cooper *et al.*[79]	Nonrandomized pragmatic trial	Disparity in blood pressure change	Ongoing
Multilevel: individual, family/social support, and local community environment interventions			
Ephraim *et al.*[81]	Randomized controlled trial	Blood pressure control	Ongoing
Cooper (Miller) *et al.*[82]	Randomized controlled trial	Blood pressure control	Ongoing

Abbreviations: BP, blood pressure; BMI, body mass index; HTN, hypertension; LDL, low density lipoprotein.

The latter two projects, funded by the National Institutes of Health (NIH) Centers for Population Health and Health Disparities, are using principles of community-based participatory research (CBPR) and implementation science throughout intervention planning and development and adapting the interventions to local context to enhance sustainability.

Local community environment interventions

Several interventions have sought to improve BP control on the community level (Tables 1, 2). An ongoing community screening intervention for BP control targeting African-American males in barbershops seeks to identify patients from local communities with high BP and randomize them to subsequent motivational interviewing and patient navigator interventions.[62] Zoellner *et al.*[63] used a CBPR approach to enroll patients from a Mississippi town into a BP management program including group education sessions, weekly pedometer log compliance, and motivational enhancement sessions. This study demonstrated statistically significant decreases in systolic and diastolic BP and sugar intake in participants, who were primarily African-American. Cene *et al.*[70] evaluated a community-based self-management program provided by community health workers and a nurse practitioner for African-Americans patients with high CVD risk; this intervention did not produce significant changes in systolic or diastolic BP. A Dietary Approaches to Stop Hypertension (DASH) meal delivery program to older adults with CVD was effective in making recipient diets Dietary Approaches to Stop Hypertension (DASH)-adherent; however, this program was more effective in white and higher income patients.[64]

State/national policy environment interventions

Several interventions have been developed to address disparities in BP management and control at state and national levels (Tables 1, 2). Many of these policy initiatives are relatively new and evidence of long-term effectiveness and best practices for sustaining and disseminating these interventions are not yet clear. For example, the Health Services and Research Administration (HRSA) has sponsored health disparities collaboratives in community health centers. Of the centers that had health disparities collaboratives, there was no significant improvement in intermediate outcomes or composite quality measures for hypertension,[66] although they were successful in improving process of care measures for asthma and diabetes. To date, large-scale analyses of health disparities collaboratives have shown no effect on composite quality outcomes or disparities for hypertension.[65,66] The reasons for this may be multifactorial. For instance, it is unclear how effective interventions are being disseminated from practice to practice. Initiatives such as the Million Hearts Project will be helpful in elucidating this information; the project is convening broad groups of stakeholders from provider professional organizations, health care system leaders, community-based organizations, advocacy groups, retail pharmacy and medical technology vendors, pharmaceutical and biotech companies, policy makers, funders, and the public health sector to encourage sharing of best practices, technical support, tools, and collaborations on demonstrations that can be scaled up and spread (MillionHearts.org). Specific to hypertension control, the Million Hearts Project seeks to prevent one million heart attacks and strokes by 2017 through quality improvement initiatives; increasing awareness; and improving access to care.[84]

Similarly, the Department of Health and Human Services and the CDC have sponsored multiple initiatives to reduce racial disparities in BP control, both directly and indirectly. The Affordable Care Act has also provided multiple provisions to reduce health disparities, including the expansion of Medicaid coverage to improve access; requiring that all federally funded programs collect data on race, ethnicity, primary language, disability status, and gender; expanding funding for the National Health Service Corps and creating Health Professional Training Grants for underserved areas; and by providing $11 billion for community health center programs to expand coverage through FQHCs. In addition, the HHS has made data collection to track disparities a priority through the Healthy People 2020 project, and the CDC has implemented multiple initiatives to reduce health disparities through its Office of Minority Health and Health Equity, by providing support to the Community Preventive Services Task Force and the National Prevention Council, and by providing funding for further community initiatives through Community Transformation Grants.[85]

Several state initiatives also focus on reductions in health disparities. In 2009, the Institute of Medicine held a roundtable on health disparities, from which a four-pronged summary of recommendations was released.[86] This broad-based set of recommendations included suggestions on capacity-building and enhancement of access to quality resources at the community level; within health care services; and at the level of the health care system; as well as overarching recommendations on how to support local efforts at local, state, and national policy levels.[86] Minnesota launched an Eliminating Health Disparities Initiative (EHDI) in 2001 to focus on reducing disparities in eight key areas, one of which is CVD.[87] Concomitantly, CVD death rate decreased significantly in African-Americans over the 1999–2004 time period when compared to 1995–1999.[87] Massachusetts has spearheaded several initiatives to reduce disparities, including a Health Disparities Council to track the progress of statewide health care reform programs in reducing disparities, revision of Mass Health Medicaid financial incentives to reduce disparities, and stratification of healthcare effectiveness quality measures by race and ethnicity.[86] In Maryland, the 2012 Health Improvement and Disparities Reduction Act provided $4 million to fund the development of Health Enterprise Zones (HEZs) to improve health outcomes and reduce health disparities, as well as provisions for additional tax credits and loan repayment assistance within the HEZs.[88] The law also encourages reporting and analysis of health disparities data, as well as continued cultural competency training for health care providers.[88] To our knowledge, the initiatives in Massachusetts and Maryland have not yet reported their results.

RECOMMENDATIONS FOR TRANSLATING EFFECTIVE INTERVENTIONS INTO PRACTICE AND POLICY

Several effective interventions exist to improve BP in racial and ethnic minorities; however, evidence that they will reduce disparities is limited. To strengthen the evidence and translate it into practice and policy, we recommend implementation and rigorous evaluation of pragmatic, multilevel interventions; institutional support for broad stakeholder partnerships that include payers, patients, researchers, policymakers, and community-based organizations; and balance and alignment in the priorities and incentives of each stakeholder group. Table 3 enumerates these recommendations.

Successful strengthening of the evidence base for implementation research and subsequent translation into practice in real world settings for the reduction of disparities calls for the training of a new cadre of individuals with relevant expertise and skill sets.[89] In particular, the ability to integrate data from a wide variety of sources and embrace the analytic rigor required for solving complex, multilevel challenges typical in the health disparities arena will be essential. Training for this work must not only be transdisciplinary but must explicitly go beyond the traditional biomedical construct of health to include the social, psychological, cultural, behavioral, and ecological domains. It will be crucial to link this training with the appropriate communities where racial and ethnic disparities are most profound.[89]

Because barriers to reducing disparities in BP control are encountered at multiple levels of influence (Figure 1), interventions targeting barriers at several levels of the ecological model may be more effective at addressing disparities than those targeting barriers at only one or two levels.[90,91] For researchers, we recommend designing and testing pragmatic interventions in real-world settings using implementation research methods to describe contextual influences and examine multilevel effects; and incorporating process measures, cost and economic analyses, and outcomes important to patients and communities. This may inform key stakeholders actively working to translate research findings into policy and practice. This work may also mobilize policy makers, providers, and organizations to implement and support these interventions on a broad scale, leading to sustainability of existing initiatives.

Assessing and increasing capacity at individual, organizational, and community levels is critical to intervention success.[92] Collaborative efforts with full transparency with respect to aligning incentives and setting common priorities, values, and goals from all involved stakeholders will be important in producing sustained reductions in racial disparities in hypertension. From the payer perspective, measuring and tracking quality of care stratified by race, ethnicity and primary language and being cognizant of the potential for disparities with pay-for-performance models are important, as is the development of new Current Procedural Terminology (CPT®) codes to allow for adequate reimbursement for new and innovative models of care.

Similarly, continued active monitoring of progress across racial, ethnic, and sociodemographic groups at local, state, and national levels will be helpful in ensuring equity effectiveness and in preventing the development of further disparities. Our work has confirmed the observation made by others that certain populations that suffer disproportionate morbidity and mortality are relatively underrepresented in disparities-focused health services research.[91] In the National Institutes of Health-funded study of 1,268 disparities-focused health services research initiatives conducted between 2007 and 2011, fewer research projects were designed to detect,

Table 3 Recommendations

Funders
Continue to promote research with broad stakeholder engagement and with plans for sustainability through all agencies, including National Institutes of Health, Agency for Healthcare Research and Quality, and PCORI and private foundations
Provide mechanisms to implement and test dissemination of effective interventions not just to researchers and healthcare delivery organizations, but to patients and community-based organizations
Communicate with patients and community-based organizations to align their priorities, values, and goals with those of researchers and payers
Policymakers
Develop and expand Current Procedural Terminology (CPT®) billing codes for wraparound and preventive services including patient education, telemedicine, mid-level provider driven, and team-based interventions
Encourage reporting of data to identify and address disparities
Provide funding and other incentives for multilevel community-based initiatives
Payers
Provide clear provisions for reimbursement for wraparound and preventive services including patient education, telemedicine, mid-level provider driven and team-based interventions
Design pay-for-performance and other reimbursement models that incentivize both quality and disparities reduction
Partner with researchers and healthcare providers to align incentives and reimbursement policies to support evidence-based effective interventions
Researchers
Continue development and innovation of multilevel interventions to reduce racial disparities
Assess community capacities as part of sustainability assessments in developing interventions
Maintain effective dialogue with patients and community-based organizations not just to disseminate best practices, but also to establish common sets of priorities, values, and goals
Communicate with payers about effective evidence-based practices and other evidence needed to inform changes to reimbursement
Provide training to the next generation of health disparities and implementation science researchers
Patients
Provide feedback to researchers and community-based organizations about effectiveness of interventions
Provide input to providers and community-based organizations about priorities, values, and goals
Community-based organizations
Communicate with researchers, payers, and patients about community priorities, values, and goals, and provide feedback on research, health system, and public health interventions
Work with researchers to build capacity to study, measure and disseminate effective interventions
Providers and healthcare organizations
Enroll in programs that reimburse for delivering covered services to low-income patients
Become familiar with community-based resources that enhance patient access to medications, specialty services, health promotion programs, and other social services
Incorporate sliding scale and/or flexible payment plans when possible
Include equity in healthcare delivery as a pillar of your quality improvement strategy and measure quality of care in all domains, stratified by groups/ethnicity
Explore and improve climate, policies, and training related to diversity within your practice or organization
Use culturally and linguistically appropriate signage, language services, and printed patient information for your patient population, and provide cultural and linguistic competence training for all providers and staff
Provide training for providers and clinical staff in patient-centered communication skills
Share best practices with colleagues, researchers, payers, community-based organizations, and policymakers

understand, or eliminate disparities affecting American Indians/Native Americans (3%) and Pacific Islanders/Native Hawaiians (<1%) than in Blacks/African-Americans (24%) or in Hispanics/Latinos (18%).[93]

Finally, patients and community-based organizations should continue to communicate their priorities and work with researchers, healthcare provider organizations, and policy-makers to build their own capacities, mobilize resources, and advocate for change.

SUPPLEMENTARY MATERIAL

Supplementary materials are available at *American Journal of Hypertension* (http://ajh.oxfordjournals.org).

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DISCLOSURE

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