Comparison of the Treatment Implications of American Society of Hypertension and International Society of Hypertension 2013 and Eighth Joint National Committee Guidelines: An Analysis of National Health and Nutrition Examination Survey

Venkatesh L. Murthy, Ravi V. Shah, Melvyn Rubenfire, Robert D. Brook

Abstract—Multiple guidelines and statements related to hypertension have recently been published. Much discord has arisen from discrepant treatment and target systolic blood pressure thresholds for individuals aged 60 to 79 years of <150 mm Hg in the guideline published by members assigned to the Eighth Joint National Committee and <140 mm Hg in a statement by the American Society of Hypertension and International Society of Hypertension 2013. We sought to evaluate the public health implications of these differences using data from the 2005 to 2010 National Health and Nutrition Examination Survey (NHANES) cycles. NHANES is an ongoing survey designed to allow characterization of the US population and subpopulations. We found that only ≈2.4% (95% confidence interval, 1.5–3.2%) of adults aged 60 to 79 years had indications for antihypertensive treatment under the more stringent American Society of Hypertension and International Society of Hypertension 2013 guideline but not under Eighth Joint National Committee. About 65.7% (95% confidence interval, 62.4–69.0%) of adults aged 60 to 79 years had indications for treatment under both guidelines. Furthermore, those with indications for treatment under American Society of Hypertension and International Society of Hypertension 2013 but not under Eighth Joint National Committee generally had higher systolic blood pressure and less favorable lipid profiles compared with those with indications for treatment under both guidelines. Importantly, a larger group, comprising 21.0% (95% confidence interval, 18.7–23.2%) of adults aged 60 to 79 years, had either untreated or inadequately treated hypertension and represents an important group for continued efforts. (Hypertension. 2014;64:275-280.) • Online Data Supplement

Key Words: antihypertensive agents ■ blood pressure ■ guideline adherence ■ hypertension ■ prevention & control

With ≈33% of American adults diagnosed with hypertension, hypertension is one of the most important risk factors for myocardial infarction, stroke, and incident heart failure. In 2014, new guidelines from the panel members assigned to the Eighth Joint National Committee (JNC8) and a statement from the American Society of Hypertension and International Society of Hypertension (ASH/ISH) 2013 defined age-specific thresholds for the initiation of antihypertensive therapy in an effort to simplify the management of hypertensive adults. Although several differences exist between these guidelines, the major discord is that the systolic blood pressure (SBP) treatment thresholds and targets for individuals aged 60 to 79 years are discrepant (Table 1). The recommendations of JNC8 call for relaxing blood pressure treatment thresholds and targets in this age range to <150/90 mm Hg, whereas recommendations from ASH/ISH, from a joint European Society of Cardiology/European Society of Hypertension task force, and from a scientific advisory promulgated jointly by the American Heart Association, American College of Cardiology, and the United States Centers for Disease Control and Prevention continue to endorse a target of lower than 140/90 mm Hg. This difference has engendered significant controversy, conflicting publications by factions within writing groups, and even a call for retraction. The resulting controversy has fueled substantial confusion among clinicians, patients, and the general community as to appropriate, life-saving goals for blood pressure. Ultimately, understanding the clinical implications of differing blood pressure treatment thresholds and targets on the number of patients for whom treatment is made is critical for public health and individual clinical care decisions.

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From the Department of Internal Medicine, Division of Cardiovascular Medicine (V.L.M., M.R., R.D.B.), and Department of Radiology, Division of Nuclear Medicine (V.L.M.), University of Michigan, Ann Arbor; and Department of Internal Medicine, Division of Cardiology, Massachusetts General Hospital, Boston (R.V.S.).

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Correspondence to Venkatesh L. Murthy, Departments of Internal Medicine and Radiology, University of Michigan, 1338 Cardiovascular Center, 1500 E Medical Center Dr, SPC 5873, Ann Arbor, MI 48109-5873. E-mail vlmurthy@med.umich.edu

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Table 1. Comparison of JNC8 and ASH/ISH 2013

<table>
<thead>
<tr>
<th>Treatment Threshold and Target Blood Pressure</th>
<th>JNC8</th>
<th>ASH/ISH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic kidney disease</td>
<td>140/90</td>
<td>140/90</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>140/90</td>
<td>140/90</td>
</tr>
<tr>
<td>General population</td>
<td>18–59 y</td>
<td>140/90</td>
</tr>
<tr>
<td></td>
<td>60–79 y</td>
<td>150/90</td>
</tr>
<tr>
<td></td>
<td>≥80 y</td>
<td>150/90</td>
</tr>
</tbody>
</table>

ASH/ISH indicates American Society of Hypertension and International Society of Hypertension; and JNC8, Eighth Joint National Committee.

Methods

The National Health and Nutrition Examination Survey (NHANES) is an ongoing research program conducted by the National Center for Health Statistics aimed at assessing the health and nutritional status of noninstitutionalized, civilian adults and children in the United States using a combination of interviews, physical examinations, and diagnostic testing. The complex survey design of NHANES assigns sample weights to each participant, allowing the estimation of subgroup sizes, proportions, and characteristics among the overall noninstitutionalized US population. The overall study design was approved by the National Center for Health Statistics Institutional Review Board, and informed consent was obtained for all participants.

We combined data from the 2005 to 2006, 2007 to 2008, and 2009 to 2010 data collection cycles to define populations with indications for blood pressure–lowering treatments under JNC8 and ASH/ISH. The primary divergence between these guidelines is the treatment threshold and target SBP in people aged 60 to 79 years, which is the focus of this analysis. Data from participants in morning sessions (n=7457 adults; age ≥18 years) were used. Persons were considered to have diabetes mellitus if their fasting glucose was ≥126 mg/dL, hemoglobin A1c was ≥6.5%, or if reported by history. Subjects were considered to have known cardiovascular disease if they reported being told by a health professional that they had coronary heart disease, angina, heart attack, or stroke. All patients who self-reported being currently being treated with antihypertensive medications were presumed to meet the indications for both JNC8 and ASH/ISH because pretreatment blood pressure measures were not available. Indications for antihypertensive medication and target blood pressure for persons not currently being treated with antihypertensive medications were assigned based on Table 1.

Values are presented as means with 95% confidence intervals (CIs). All statistical tests were performed using SAS 9.4 (SAS Institute Inc, Cary, NC). Type 1 error (α) threshold was set at 0.05. Analytic methods accounted for the complex survey design of NHANES. Domain analysis was used to estimate the parameters for subgroups and to exclude those aged <18 years from final estimates. Variance estimation for survey data was performed using Taylor series. Comparisons were made using linear regression for continuous variables. For categorical and binary variables, comparisons were made using χ2 test. Event rates were compared using a t approximation. Cox proportional hazard regression was used to compare the risks of mortality, cardiovascular mortality, and coronary mortality.

Results

Examining NHANES data between 2005 and 2010, we found that among ≈42.0 (95% CI, 37.1–46.9) million adults aged 60 to 79 years, nearly all individuals who qualified for antihypertensive treatment under ASH/ISH 2013 guidelines also qualified under JNC8 (Table 2; Figure 1). Only 1.0 (95% CI, 0.6–1.4) million people, or 2.4% (95% CI, 1.5–3.2%) of adults aged 60 to 79 years, or 0.4% (95% CI, 0.3–0.5%) of all adults qualified for treatment under ASH/ISH 2013 but not JNC8 (Table S1 in the online-only Data Supplement). These results were similar, regardless of sex (Figure S1) or race (Figure S2).

In addition, individuals not at target blood pressure were likely to be above the target based on both JNC8 and ASH/ISH 2013. Importantly, given the more relaxed targets in JNC8 for older individuals (aged 60–79 years), only a relatively small group of individuals in this age range, 2.8 (95% CI, 2.2–3.4) million or 6.7% (95% CI, 5.4–7.9%) of all adults aged 60 to 79 years, met blood pressure targets of JNC8 but not ASH/ISH 2013 (Figure 2). Of this group, only 1.8 (95% CI, 1.4–2.2) million were currently on treatment. Importantly, much larger numbers of individuals were not at either target (29.2 million; 95% CI, 26.4–32.0 million), corresponding to 21.0% of adults in this age group. Of these, individuals not at target, nearly 1 in 4 or 2.4 (95% CI, 1.9–3.0) million, were completely untreated, whereas the remaining 6.4 (95% CI, 5.1–7.6) million were inadequately treated by either blood pressure guideline. Again, these findings were consistent, regardless of sex (Figure S3) or race (Figure S4).

We found that individuals aged 60 to 79 years who qualify under ASH/ISH alone (versus both ASH/ISH and JNC8) were more likely to be younger (Table 3). Although treatment thresholds and targets are lower under ASH/ISH 2013 than under JNC8 for individuals aged 60 to 79 years, individuals indicated for treatment only under ASH/ISH 2013 and not under JNC8 have a higher average SBP, possibly because all treated individuals were assumed to also qualify under JNC8, and their treated blood pressures were, in many cases, lower than target for both guidelines. Furthermore, this group also had poorer lipid profiles and slightly lower hemoglobin A1c values. Two measures of socioeconomic status, poverty-to-income ratio and education level, were not different between these groups. Finally, the rates of health insurance were similarly high in both groups.

Discussion

We have demonstrated that there is only a relatively modest divergence between recently promulgated blood pressure management guidelines when compared with the numbers of individuals for whom guidelines agree that treatment or more intensive treatment is indicated. There are only relatively small numbers of individuals for whom treatment would be indicated under JNC8 but not under ASH/ISH 2013. A quantitatively much larger group of individuals is currently not meeting targets for either guideline. Ultimately, a renewed focus on initiating aggressive antihypertensive programs in those not at target is a key to the prevention of poor cardiovascular outcomes.
Hypertension affects ≈80 million adult Americans with ≈50% not reaching acceptable blood pressure control. The National Heart, Lung, and Blood Institute commissioned JNC8 to address contemporary thresholds for antihypertensive therapies and their prognostic impact. JNC8 specifies that individuals >60 years of age with hypertension are now recommended for treatment to a goal blood pressure <150/90 mm Hg, as opposed to a lower goal in other consensus statements (<140/90 mm Hg). Indeed, the >150/90 mm Hg criterion for treatment initiation in ASH/ISH guidelines applies to a much older population (aged >80 years). Although the authors of JNC8 suggest that patients tolerating antihypertensive therapy to the older, more stringent target should remain on therapy, the shift in guidelines has produced significant controversy and a request for retraction.

The primary contention between ASH/ISH and JNC8 surrounds the issue of lack of randomized evidence in an elderly population. The authors of ASH/ISH guidelines have cited evidence from several large randomized studies that enrolled patients >60 years of age (eg, Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial, Avoiding Cardiovascular Events in Combination Therapy in Patients Living with Systolic Hypertension) with lack of harm from stricter on-treatment blood pressure criteria (<140/90 mm Hg), with evidence from 1 study that limited more lax criteria to older (aged ≥80 years) individuals. In contrast,
proponents of JNC8 have suggested that the simplification of guideline recommendations may streamline hypertension care without sacrificing cardiovascular prognosis, an ultimate arbiter of successful prevention. A recent meta-analysis suggested that treatment of patients >65 mm Hg to a SBP of <140/80 mm Hg resulted in a 15% reduction in the odds of cardiovascular death, a 37% reduction in the odds of stroke, and a 46% reduction in the odds of heart failure. Although outcome data are not available in NHANES, it remains possible that these risk reductions could have a substantial impact if they are generalizable to the ≈1 million persons who qualify for treatment under ASH/ISH 2013 but not JNC8.

Separate from ongoing debates around the merits of each consensus recommendation, the question of whether the application of each guideline affects the number of individuals at risk (requiring therapy) and their long-term prognosis remains unclear. We demonstrate that, regardless of guideline, undertreatment of existing hypertensive individuals remains the major barrier to effective prevention. It is remarkable that nearly all individuals who qualify under ASH/ISH recommendations qualify as well under JNC8. Only 2.8% of American adults aged 60 to 79 years are at JNC8 target but not ASH/ISH target, whereas 21.0%, ≈8-fold larger group, were not at target at all regardless of guideline. There were no significant, systematic differences in race, sex, or socioeconomic status among those aged 60 to 79 years who qualified only under ASH/ISH 2013 but not JNC8. These findings highlight the real-world implications of differences in these guideline recommendations: the controversy over treatment threshold and target recommendations may overlook a much larger aspect of disease prevention—application of therapies to those individuals with uncontrolled hypertension at highest cardiovascular risk.

The findings of our study need to be viewed in the context of its design. NHANES is a longitudinal survey of American adults with sampling designed to demographically reflect the American population. Although these results strictly should not be extended to non-American populations, it is unlikely that risk factors, distribution, and epidemiology of hypertension are so variable worldwide relative to guideline statements. NHANES data are based on physical examination, laboratory testing, and questionnaires administered during a 1- or 2-day period.

Elements of medical history, such as treatment for hypertension, are based on self-report by participants or a proxy (<5% of subjects) and were not confirmed with medical records. Importantly, we assumed that ≈44% of individuals aged 60 to 79 years who reported taking medications for hypertension had indications for treatment under both JNC8 and ASH/ISH 2013. Off-treatment blood pressure measurements were not available, so it is not possible to be completely certain of the appropriateness of treatment. However, of the 65.7% and 68.1% of individuals in this age range with treatment indications for hypertension under JNC8 and ASH/ISH 2013, respectively, the majority (54.1% and 60.4%, respectively) met the criteria for treatment based on elevated blood pressure despite treatment. Furthermore, 93% of those reporting taking a medication for blood pressure participated in the NHANES medication survey and reported taking ≥1 specific antihypertensive medication. In 81.6% of cases, this was visually confirmed with a pill bottle. Nonetheless, the assumption that all patients currently under treatment qualified under both guidelines could result in a modest underestimation of the differential impact of the 2 guidelines. Specifically, persons aged 60 to 79 years who had been initiated on treatment for SBP between 140 and 150 mm Hg would, in the future, qualify for treatment only under ASH/ISH 2013 and not under JNC8.

In conclusion, applying the 2 new, widely cited consensus documents to a large survey of American adults, we found no significant differences in the proportion of at-risk adults requiring antihypertensive therapy by ASH/ISH versus JNC8 guidelines. Despite the focus on differences in at-risk population for treatment in literature, our results suggest persistent failure to attain target blood pressure regardless of guideline. A shifted focus from differences in guideline documents toward the ultimate goal of disease prevention—focusing on extending life-saving therapies to those at highest risk regardless of cutoffs—is likely to make the greatest favorable impact on long-term prognosis.
Perspectives

Several guidelines have recently been published about the management of hypertension, including statements from panel members of JNC8 and ASH/ISH. Among these, the primary difference is the target systolic blood from individuals aged 60 to 79 years without diabetes mellitus or renal disease. JNC8 recommends a treatment threshold and target SBP of <150 mm Hg, whereas ASH/ISH recommends an SBP of <140 mm Hg. Using data from NHANES, a comprehensive nationwide survey designed to allow characterization of US populations and subpopulations, we demonstrated that the impact of differences between these guidelines is small, with relatively few additional individuals for whom initiation or intensification of treatment would be indicated. By contrast, the population not meeting either guideline is quantitatively substantially larger, indicating that further efforts are needed to address untreated and undertreated hypertension.

Disclosures

V.L. Murthy owns minor stock holdings in Merck and Co, Pfizer, Abbvie, Mylan, Medtronic, and Abbott Laboratories. The other authors report no conflicts.

References

Survey, a nationwide survey of the US population, we found that using data from the National Health and Nutrition Examination Survey (NHANES), we found that 23.2% of adults aged 60 years or older had systolic blood pressure (SBP) of 150 mmHg or higher.


Novelty and Significance

What Is New?

• Recent professional guidelines for the management of hypertension have offered conflicting treatment thresholds and targets for systolic blood pressure in adults aged 60 to 79 years without diabetes mellitus or renal disease (<150 versus ≤140 mm Hg).

• We sought to estimate the incremental numbers of Americans for whom treatment would be indicated for hypertension control under the Eighth Joint National Committee (JNC-8) guidelines compared with the guidelines written by the panel members of the Eighth Joint National Committee.

What Is Relevant?

• Hypertension remains a major contributor to cardiovascular disease in the United States and worldwide. Conflicting treatment recommendations have led to controversy and confusion among physicians, scientists, policy makers, and patients.

Summary

Using data from the National Health and Nutrition Examination Survey, a nationwide survey of the US population, we found that relatively few people meet indications for treatment under American Society of Hypertension and International Society of Hypertension 2013 but not under Eighth Joint National Committee (0.4% of adults >18 years of age). Furthermore, only 2.4% of adults aged 60 to 79 years had blood pressure control considered adequate under Eighth Joint National Committee but not under American Society of Hypertension and International Society of Hypertension 2013. In contrast, 21.0% of adults aged 60 to 79 years, or 8.8 million men and women, were not at either guideline. Approximately one fourth of these individuals (2.4 million) were completely untreated, whereas the remaining three fourths (6.4 million) were inadequately treated by both guidelines. This population of inadequately treated and untreated individuals is ~3-fold larger than the population for whom the guidelines are discrepant (2.8 million) and presents an important group for further public health interventions.
Online Supplement To:
Comparison of the Treatment Implications of the 2013 ASH/ISH and JNC8 Guidelines:
An Analysis of National Health and Nutrition Examination Survey

Venkatesh L. Murthy, M.D., Ph.D. (1, 2); Ravi V. Shah, M.D. (3); Melvyn Rubenfire, M.D. (1) and Robert D. Brook, M.D. (1)
Department of Internal Medicine (Division of Cardiovascular Medicine), University of Michigan, Ann Arbor, MI
Department of Radiology (Divisions of Nuclear Medicine), University of Michigan, Ann Arbor, MI
Department of Internal Medicine (Division of Cardiology), Massachusetts General Hospital, Boston, MA

Correspondence to:
Venkatesh L. Murthy, M.D., Ph.D.
University of Michigan
1338 Cardiovascular Center
1500 E. Medical Center Dr, SPC 5873
Ann Arbor, MI 48109-5873
vlmurthy@med.umich.edu
Tel: (734) 936-5387
Fax: (734) 232-3246
# REFERENCES


### TABLE S1: POPULATION ESTIMATES FOR BLOOD PRESSURE TREATMENT AMONG US ADULTS ≥18 YEARS

<table>
<thead>
<tr>
<th>Category</th>
<th>Number (millions)</th>
<th>Percent of US Adults ≥18 Years (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults Age 18 and Older</td>
<td>222.7 (206.9-238.4)</td>
<td>100</td>
</tr>
<tr>
<td><strong>Indications for Anti-Hypertensive Medication</strong> *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under JNC8</td>
<td>71.3 (64.1-78.5)</td>
<td>28.7 (27.3-30.5)</td>
</tr>
<tr>
<td>Under ASH/ISH 2013</td>
<td>72.3 (65-79.7)</td>
<td>29.1 (27.3-31)</td>
</tr>
<tr>
<td>Under Neither JNC8 nor ASH/ISH 2013</td>
<td>150.3 (139.8-160.9)</td>
<td>60.6 (59-62.2)</td>
</tr>
<tr>
<td>Under JNC8 but not ASH/ISH 2013</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Under ASH/ISH 2013 Only</td>
<td>1 (0.6-1.4)</td>
<td>0.4 (0.3-0.5)</td>
</tr>
<tr>
<td>Under Both JNC8 and ASH/ISH 2013</td>
<td>71.3 (64.1-78.5)</td>
<td>28.7 (27-30.5)</td>
</tr>
<tr>
<td>(all individuals with indications under JNC8 also have indications under ASH/ISH 2013)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Blood Pressure Relative to Target</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Target for Both JNC8 and ASH/ISH 2013</td>
<td>190.6 (177-204.3)</td>
<td>76.8 (75.9-77.7)</td>
</tr>
<tr>
<td>Not Treated and at Target for Both JNC8 and ASH/ISH 2013</td>
<td>151.5 (140.8-162.1)</td>
<td>61 (59.4-62.6)</td>
</tr>
<tr>
<td>Treated and at Target for Both JNC8 and ASH/ISH 2013</td>
<td>39.2 (34.4-43.9)</td>
<td>15.8 (14.5-17.1)</td>
</tr>
<tr>
<td>Not at Either Target</td>
<td>29.2 (26.4-32)</td>
<td>11.8 (11-12.6)</td>
</tr>
<tr>
<td>Untreated and not at either Target</td>
<td>14.4 (12.5-16.2)</td>
<td>5.8 (5.1-6.4)</td>
</tr>
<tr>
<td>Treated but not at Either Target</td>
<td>14.9 (13.1-16.7)</td>
<td>6 (5.4-6.6)</td>
</tr>
<tr>
<td>At JNC8 Target but not ASH/ISH 2013</td>
<td>2.8 (2.2-3.4)</td>
<td>1.1 (0.9-1.3)</td>
</tr>
<tr>
<td>Treated with SBP 140-150 and DBP&lt;90</td>
<td>1.8 (1.4-2.2)</td>
<td>0.7 (0.6-0.9)</td>
</tr>
<tr>
<td>Not Treated with SBP 140-150 and DBP&lt;90</td>
<td>1 (0.6-1.4)</td>
<td>0.4 (0.3-0.5)</td>
</tr>
</tbody>
</table>

JNC8 indicates the guidelines published by panel members assigned to the Eighth Joint National Committee. ASH/ISH 2013 indicates hypertension guidelines published by the American Society of Hypertension and International Society of Hypertension. SBP indicates systolic blood pressure. DBP indicates diastolic blood pressure. *Includes all individuals currently being treated.
treated with antihypertensive persons plus untreated individuals with indications for treatment under the guideline.
Proportion of American men (top) and women (bottom) age 18 and older currently treated with antihypertensive medications or with indications for antihypertensive medications under ASH/ISH 2013 (red), both JNC8 and ASH/ISH 2013 (blue) or neither guideline (white) as a function of age.
FIGURE S2: INDICATIONS FOR ANTI-HYPERTENSIVE TREATMENT BY RACE
Proportion of American whites (top), blacks (middle) and Hispanics (bottom) age 18 and older currently treated with antihypertensive medications or with indications for antihypertensive medications under ASH/ISH 2013 (red), both JNC8 and ASH/ISH 2013 (blue) or neither guideline (white) as a function of age.
Proportion of American men (top) and women (bottom) age 18 and older at target blood pressure as a function of age whose blood pressure is not controlled under both ASH/ISH 2013 and JNC8 guidelines (blue), is controlled under JNC8 but not under ASH/ISH 2013 (green), is controlled with medication under both JNC8 and ASH/ISH 2013 (red), or is at target without...
medication under both JNC8 and ASH/ISH 2013 (white). Tx indicates antihypertensive medication treatment.
FIGURE S4: BLOOD PRESSURE TREATMENT STATUS BY RACE

- **White**
- **Black**
- **Hispanic**

Legend:
- At Both Targets without Tx
- At JNC8 Target but not ASH/ISH 2013
- At Both Targets with Tx
- Not at Either Target
Murthy VL, et al. Comparison of Implications of ASH/ISH 2013 & JNC8

Proportion of American whites (top), blacks (middle) and Hispanics (bottom) age 18 and older at target blood pressure as a function of age whose blood pressure is not controlled under both ASH/ISH 2013 and JNC8 guidelines (blue), is controlled under JNC8 but not under ASH/ISH 2013 (green), is controlled with medication under both JNC8 and ASH/ISH 2013 (red), or is at target without medication under both JNC8 and ASH/ISH 2013 (white). Tx indicates antihypertensive medication treatment.
Proportion of the United States population age 18 and older currently treated with antihypertensive medications or with indications for antihypertensive medications under ASH/ISH 2013 (red), both JNC8 and ASH/ISH 2013 (blue) or neither guideline (white) as a function of age. This figure is identical to that in the main manuscript except for the addition of color.
Proportion of the United States population age 18 and older at target blood pressure as a function of age whose blood pressure is not controlled under both ASH/ISH 2013 and JNC8 guidelines (blue), is controlled under JNC8 but not under ASH/ISH 2013 (green), is controlled with medication under both JNC8 and ASH/ISH 2013 (red), or is at target without medication under both JNC8 and ASH/ISH 2013 (white). Tx indicates antihypertensive medication treatment. This figure is identical to that in the main manuscript except for the addition of color.