

# Treatment Intensification for Hypertension in US Ambulatory Medical Care

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**Background**—Hypertension is widely prevalent yet remains uncontrolled in nearly half of US hypertensive adults. Treatment intensification for hypertension reduces rates of major cardiovascular events and all-cause mortality, but clinical inertia remains a notable impediment to further improving hypertension control. This study examines the likelihood and determinants of treatment intensification with new medication in US ambulatory medical care.

**Methods and Results**—Using the nationally representative National Ambulatory Medical Care Survey (2005–2012) and National Hospital Ambulatory Medical Care Survey (2005–2011), we identified adult primary care visits with diagnosed hypertension and documented blood pressure exceeding goal targets and assessed the weighted prevalence and odds ratios of treatment intensification by initiation or addition of new medication. Approximately 41.7 million yearly primary care visits (crude N: 14 064, 2005–2012) occurred among US hypertensive adults with documented blood pressure  $\geq 140/90$  mm Hg, where treatment intensification may be beneficial. However, only 7.0 million of these visits (95% confidence interval 6.2–7.8 million) received treatment intensification with new medication, a weighted prevalence of 16.8% (15.8% to 17.9%). This proportion was consistently low and decreased over time. This decline was largely driven by decreasing medication initiation levels among patients on no previous hypertension medications from 31.8% (26.0% to 38.4%) in 2007 to 17.4% (14.0% to 21.4%) in 2012, while medication addition levels remained more stable over time.

**Conclusions**—US hypertensive adults received treatment intensification with new medication in only 1 out of 6 primary care visits, a fraction that is declining over time. A profound increase in intensification remains a vast opportunity to maximally reduce hypertension-related morbidity and mortality nationwide. (*J Am Heart Assoc.* 2016;5:e004188 doi: 10.1161/JAHA.116.004188)

**Key Words:** blood pressure • hypertension medication • medication addition • medication initiation

Hypertension is widely prevalent and largely manageable yet remains uncontrolled in nearly half of US hypertensive adults.<sup>1–3</sup> Although effective pharmaceutical treatments are readily available and reduce the risk for major cardiovascular diseases,<sup>4</sup> inadequate adherence among patients to hypertension medication and the inertia of physicians to intensify treatment contribute to substantial morbidity, mortality, hospitalization, and health care costs.<sup>5–7</sup> Recent studies suggest that treatment intensification improves hypertension management even with suboptimal adherence and reduces

risks of cardiovascular events and deaths.<sup>8–11</sup> Specifically, the addition of new medications and dose escalation of existing medications are both considered reasonable approaches for achieving goal blood pressure.<sup>4</sup>

In defining goal blood pressure, the Seventh and Eighth Joint National Committees<sup>4,12</sup> and the European Society of Hypertension and the European Society of Cardiology guidelines<sup>13</sup> have recommended a systolic/diastolic blood pressure (SBP/DBP) target of less than 140/90 mm Hg for the general adult population including those with chronic kidney disease or diabetes mellitus, although the SBP/DBP target for the elderly is less consistent. A recent systematic review and meta-analysis of 19 trials suggested that intensive blood pressure lowering, including targeting SBP/DBP lower than current recommendations, has further protective effects against major cardiovascular events.<sup>14</sup> The recent Systolic Blood Pressure Intervention Trial (SPRINT) showed that with treatment targeting an SBP of less than 120 mm Hg compared with 140 mm Hg, nondiabetic adults aged 50 and above at high risk for cardiovascular events had lower rates of all-cause mortality and major cardiovascular events<sup>15</sup>; in

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prespecified subgroup analysis, this benefit was similarly observed among those aged 75 years or older.<sup>16</sup> However, the Heart Outcomes Prevention Evaluation (HOPE)-3 trial found that the addition of candesartan and hydrochlorothiazide did not lower rates of major cardiovascular events in an intermediate-risk population with high-normal SBP but no cardiovascular disease.<sup>17</sup> These results have generated extensive scientific discussion and popular media attention while potentially resetting goal blood pressure in clinical practice and guidelines on hypertension management.

The lowering of blood pressure targets will inevitably require population-wide treatment intensification, but the magnitude of this potential change in practice is unknown. In this study we describe the current prevalence and patterns of hypertension treatment intensification with new medication by means of either medication initiation or medication addition at conventional and proposed blood pressure targets. In assessing conventional targets at the SBP/DBP of 140/90 mm Hg, we aim to examine physicians' current practice in hypertension management; in assessing alternative targets including 120/80 mm Hg, we aim to study the magnitude of potential practice change should lower blood pressure goals be adopted.

## Methods

### Study Design

We obtained public-use data from the National Ambulatory Medical Care Survey (NAMCS) between 2005 and 2012 and from the National Hospital Ambulatory Medical Care Survey (NHAMCS) between 2005 and 2011. These 2 US nationally representative multistage stratified probability sample surveys were administered by the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention and collected data on patient visits to non-federally employed office-based physicians in direct patient care and to outpatient departments of nonfederal and noninstitutional general and short-stay hospitals. In the survey design, physicians or hospitals were chosen among 112 primary sampling units used in the National Health Interview Survey; then in NAMCS, individual physicians were surveyed for a systematic random sample of visits in a 1-week period, and in NHAMCS, outpatient clinics were surveyed for visits in a 4-week period. This design enables national-level estimates using survey weights provided by the NCHS.

Available survey data included patient characteristics, reason for visit, continuity of care, vital signs, and medications. In NAMCS the unweighted physician response rates were 61.5%, 58.9%, 61.6%, 59.1%, 62.1%, 58.3%, 54.1%, and 39.3% from 2005 to 2012. In NHAMCS the unweighted outpatient department response rates were 85.4%, 85.6%, 80.2%, 83.3%, 85.3%, and 83.6% from 2005 to 2010 (2011

rate unavailable). Both studies were authorized by Section 306 of the Public Health Service Act and approved by the NCHS Research Ethics Review Board with waivers of patient informed consent. Analyses in this paper were approved with exemption at Beth Israel Deaconess Medical Center. Detailed survey methods are available online.<sup>18</sup>

Because hypertension guidelines generally recommend confirmation of hypertension diagnosis before treatment, and because hypertension management may not be routinely expected of specialty providers, we primarily focused our analyses on visits from established patients with hypertension diagnoses to primary care physicians, requiring affirmative responses to 3 survey questions: (1) "Are you the patient's primary care physician/provider?" (2) "Has the patient been seen in your practice before?" and (3) "Regardless of the diagnoses written previously, does patient now have hypertension?" In addition, we included only visits that recorded blood pressure readings and the status ("new" or "continued") of hypertension medication use if any. Last, we excluded pre-/postsurgery visits and visits related to injury including poisoning and adverse effects of medical treatment, based on survey questions on injury, reason for visit, and diagnosis items, because hypertension medication adjustment may be inappropriate in these scenarios. In this subpopulation of ambulatory medical care visits, we studied the prevalence and odds ratios of hypertension treatment intensification with new medication at various blood pressure levels across a wide range of clinical and demographic groups. For comparison, we also examined visits to cardiovascular specialists and compared treatment intensification to general/family practice and internal medicine physicians in NAMCS, which provides physician specialty information.

### Key Variables

We defined treatment intensification with new medication as prescribing a new hypertension medication when blood pressure was elevated above target. An SBP/DBP of 140/90 mm Hg was used as the target level for our main analyses. Hypertension medications were identified using the National Drug Code directory drug classes and the Multum classification of therapeutic classes and included antihypertensives,  $\alpha$ -agonists/ $\alpha$ -blockers, agents for hypertensive emergencies, angiotensin-converting enzyme inhibitors, antiadrenergic agents,  $\beta$ -adrenergic blocking agents, calcium channel blocking agents, diuretics, peripheral vasodilators, vasodilators, antihypertensive combinations, angiotensin II inhibitors, and renin inhibitors. Of note, information on medication dose adjustment was not collected in NAMCS or NHAMCS, so this study of treatment intensification examined medication additions or substitutions only.

Other characteristics assessed include sex, age, race/ethnicity (white, non-Hispanic; black, non-Hispanic; Hispanic; other), chronic disease diagnoses (cerebrovascular disease, chronic renal failure, diabetes mellitus, and hyperlipidemia), major reason for visit (new problem, <3 month onset; chronic problem, routine; chronic problem, flare-up; preventive care), total number of existing medications (0, 1, 2, 3,  $\geq 4$ ), total number of visits within the past year (0, 1-2, 3-5,  $\geq 6$ ), insurance type (private insurance, Medicare, Medicaid or Children's Health Insurance Program [CHIP], self-pay, other), and geographic region (Northeast, Midwest, South, West).

## Statistical Analysis

NAMCS and NHAMCS data were combined and analyzed using Stata version 14 (StataCorp, College Station, TX), accounting for the multistage probability design and visit weights as reported by NCHS to approximate the demographic distributions of the full US population. We report visit characteristics with 95% confidence intervals (CIs) and the prevalence of treatment intensification with new medication in various clinical and demographic groups and by the status of existing hypertension medication use (yes vs no). In addition, we assessed the crude and adjusted odds ratios of intensification using logistic regression. In multivariable models we accounted for sex, age, race/ethnicity, systolic blood pressure, presence of each chronic condition, major reason for the visit, total number of existing medications, current hypertension medication use, total number of visits within the past year, insurance type, geographic region, and survey year and type. We primarily examined the conventional target SBP/DBP of 140/90 mm Hg but also tested an SBP target of 120 mm Hg and other levels for comparison.

In sensitivity analyses we assessed treatment intensification in the subset of otherwise eligible visits where neither nutrition nor exercise counseling was provided (or ordered) because health education for behavioral risk factor modifications may be attempted before pharmacologic intervention. Last, we examined the rate of treatment intensification in similar visits to cardiovascular specialists and compared it to those seen by general/family practitioners and internists.

The authors had full access to the public data in the study and take responsibility for the data analysis and its integrity.

## Results

A total of 287 288 visits were surveyed in NAMCS from 2005 to 2012 and 233 963 in NHAMCS from 2005 to 2011, for a grand total of 521 251 visits. From these, we identified 14 064 visits among hypertensive adults with a documented SBP/DBP  $\geq 140/90$  mm Hg and known medication status in a noninjury or –surgery-related primary care visit; this

corresponded to 41.7 million yearly visits. Table 1 lists the characteristics of these visits and by existing hypertension medication use. Women outnumbered men, and about two-thirds of visits concerned patients aged 50 to 79 and documented systolic blood pressure between 140 and 159 mm Hg. In addition, among people with existing hypertension medication use compared to those without, more had cerebrovascular disease, diabetes mellitus, or hyperlipidemia, were being seen for routine check-ups of chronic problems (compared to new problems), and were on Medicare (compared to private insurance). We observed no marked differences in age or systolic blood pressure distribution with respect to existing hypertension medication use.

## Prevalence of Treatment Intensification With New Medication in the United States

Among these nearly 42 million visits, treatment intensification, including medication initiation and medication addition, occurred in only 7.0 million (95% CI 6.2–7.8 million), a weighted prevalence of 16.8% (15.8% to 17.9%). This proportion decreased from 19.3% (16.0% to 23.1%) in 2007 to a nadir of 12.3% (10.4% to 14.5%) in 2012, largely driven by a drop of hypertension medication initiation from 31.8% (26.0% to 38.4%) in 2007 to 17.4% (14.0% to 21.4%) in 2012 (Figure 1,  $P=0.014$  for trend over time). The overall weighted prevalence of treatment intensification in the group without existing hypertension medication use (medication initiation) was 26.4% (24.4% to 28.5%), compared with 11.2% (10.1% to 12.4%) in the group already on hypertension medication (medication addition).

Even among visits in which providers offered neither nutrition nor exercise counseling, the weighted prevalence of medication initiation was only 25.8% (23.6% to 28.1%), and that of medication addition was only 11.4% (10.1% to 12.7%). Of the 5.1 million annual visits seen by cardiologists (crude N 2319, 2005–2012), medication initiation occurred in 27.2% (22.1% to 33.0%) of these visits, and medication addition in 14.1% (12.1% to 16.3%), which was 1.51 (1.21–1.89; adjusted odds ratio 1.68 [1.32–2.13]) times more likely than that in those seen by general/family practice physicians; there was no significant difference seen in intensification between cardiologists and internists.

## Patterns of Treatment Intensification in Clinical and Demographic Subgroups

Table 2 provides weighted prevalence and odds ratios of treatment intensification with new medication by visit characteristics. Table 3 provides similar data by existing hypertension medication use. Among the clinical and demographic characteristics that were assessed, existing hypertension

**Table 1.** Characteristics of NAMCS and NHAMCS Visits 2005–2012\*

| Characteristics                             | All Visits       | Existing Hypertension Medication Use? |                  |
|---|------------------|---------------------------------------|------------------|
|   |                  | Yes                                   | No               |
| Crude N                                     | 14 064           | 8871                                  | 5193             |
| Weighted N                                  | 41 702 385       | 26 305 818                            | 15 396 567       |
| <b>Sex</b>                                  |                  |                                       |                  |
| Female                                      | 58.1 (56.8-59.4) | 58.1 (56.4-59.7)                      | 58.1 (55.9-60.3) |
| Male  | 41.9 (40.6-43.2) | 41.9 (40.3-43.6)                      | 41.9 (39.7-44.1) |
| <b>Age</b>                                  |                  |                                       |                  |
| 18 to 49 y                                  | 18.4 (17.2-19.8) | 15.9 (14.5-17.3)                      | 22.9 (20.6-25.3) |
| 50 to 64 y                                  | 34.5 (33.2-35.8) | 34.1 (32.4-35.8)                      | 35.2 (33.2-37.2) |
| 65 to 79 y                                  | 31.1 (29.8-32.5) | 32.2 (30.6-33.8)                      | 29.3 (27.4-31.2) |
| ≥80 y                                       | 15.9 (14.8-17.1) | 17.8 (16.3-19.5)                      | 12.7 (11.2-14.3) |
| <b>Race/Ethnicity</b>                       |                  |                                       |                  |
| White, non-Hispanic                         | 68.8 (65.7-71.7) | 69.3 (65.8-72.5)                      | 68.0 (64.4-71.3) |
| Black, non-Hispanic                         | 17.5 (14.8-20.7) | 17.7 (14.6-21.3)                      | 17.3 (14.5-20.5) |
| Hispanic                                    | 9.0 (7.3-11.0)   | 8.6 (7.0-10.6)                        | 9.6 (7.3-12.4)   |
| Other                                       | 4.7 (3.7-6.1)    | 4.4 (3.2-6.1)                         | 5.2 (3.8-7.1)    |
| <b>Blood pressure, mm Hg (mean)</b>         |                  |                                       |                  |
| Systolic                                    | 150 (149-150)    | 150 (150-151)                         | 149 (148-150)    |
| Diastolic                                   | 85 (84-85)       | 84 (84-85)                            | 86 (86-87)       |
| <b>Systolic blood pressure</b>              |                  |                                       |                  |
| 120 to 129 mm Hg                            | 2.7 (2.3-3.2)    | 2.0 (1.6-2.4)                         | 3.9 (3.1-4.9)    |
| 130 to 139 mm Hg                            | 6.9 (6.2-7.7)    | 6.6 (5.7-7.5)                         | 7.5 (6.4-8.8)    |
| 140 to 149 mm Hg                            | 44.7 (43.2-46.1) | 44.3 (42.5-46.1)                      | 45.4 (43.1-47.6) |
| 150 to 159 mm Hg                            | 21.9 (20.9-22.9) | 22.5 (21.0-24.0)                      | 20.9 (19.2-22.6) |
| 160 to 169 mm Hg                            | 13.0 (12.1-14.0) | 13.8 (12.6-15.2)                      | 11.5 (10.3-12.9) |
| 170 to 179 mm Hg                            | 5.2 (4.7-5.8)    | 5.1 (4.5-5.9)                         | 5.4 (4.4-6.5)    |
| ≥180 mm Hg                                  | 5.1 (4.5-5.8)    | 5.3 (4.5-6.2)                         | 4.8 (4.0-5.8)    |
| <b>Chronic condition</b>                    |                  |                                       |                  |
| Cerebrovascular disease                     | 4.1 (3.6-4.7)    | 4.8 (4.1-5.6)                         | 3.0 (2.4-3.8)    |
| Chronic renal failure                       | 3.6 (3.1-4.3)    | 4.0 (3.4-4.8)                         | 2.9 (2.1-4.0)    |
| Diabetes mellitus                           | 28.7 (27.1-30.3) | 30.9 (29.0-32.9)                      | 24.9 (23.1-26.9) |
| Hyperlipidemia                              | 42.5 (40.3-44.9) | 47.0 (44.4-49.6)                      | 35.0 (32.3-37.7) |
| <b>Major reason for the visit</b>           |                  |                                       |                  |
| New problem (<3 months)                     | 26.1 (24.6-27.6) | 22.1 (20.4-23.9)                      | 32.8 (30.7-35.0) |
| Chronic problem, routine                    | 47.6 (45.4-49.8) | 52.5 (50.1-54.9)                      | 39.2 (36.0-42.6) |
| Chronic problem, flare-up                   | 9.6 (8.4-10.8)   | 8.6 (7.5-9.9)                         | 11.1 (9.2-13.3)  |
| Preventive care                             | 15.4 (14.1-16.9) | 15.6 (14.1-17.2)                      | 15.2 (13.4-17.2) |
| <b>Total number of existing medications</b> |                  |                                       |                  |
| 0   | 20.8 (19.1-22.7) | —                                     | 56.4 (53.4-59.2) |
| 1   | 12.2 (11.1-13.3) | 10.6 (9.2-12.2)                       | 14.9 (13.4-16.4) |
| 2   | 11.5 (10.6-12.5) | 12.3 (11.1-13.6)                      | 10.2 (8.8-11.8)  |
| 3   | 11.1 (10.2-12.1) | 14.0 (12.8-15.2)                      | 6.2 (5.2-7.4)    |
| ≥4  | 44.4 (42.1-46.7) | 63.1 (60.9-65.3)                      | 12.4 (10.8-14.2) |

Continued

**Table 1.** Continued

| Characteristics                                    | All Visits       | Existing Hypertension Medication Use? |                  |
|--|------------------|---------------------------------------|------------------|
|  |                  | Yes                                   | No               |
| <b>Total number of visits within the past year</b> |                  |                                       |                  |
| 0  | 3.6 (3.2-4.2)    | 3.1 (2.5-3.7)                         | 4.6 (3.8-5.6)    |
| 1 to 2   | 26.7 (25.4-28.0) | 25.7 (24.1-27.3)                      | 28.5 (26.6-30.5) |
| 3 to 5   | 38.9 (37.4-40.5) | 39.7 (37.9-41.4)                      | 37.7 (35.3-40.2) |
| ≥6   | 30.7 (28.9-32.5) | 31.6 (29.6-33.6)                      | 29.2 (26.8-31.7) |
| <b>Expected source of payment</b>                  |                  |                                       |                  |
| Private insurance                                  | 39.9 (38.1-41.8) | 37.4 (35.2-39.7)                      | 44.2 (41.6-46.9) |
| Medicare   | 42.3 (40.5-44.2) | 45.0 (42.9-47.2)                      | 37.7 (34.9-40.6) |
| Medicaid or CHIP                                   | 8.3 (7.3-9.5)    | 8.4 (7.3-9.7)                         | 8.2 (6.6-10.2)   |
| Self-pay   | 3.7 (3.2-4.3)    | 3.4 (2.9-4.0)                         | 4.2 (3.4-5.3)    |
| Other  | 5.7 (4.8-6.7)    | 5.7 (4.7-7.0)                         | 5.6 (4.6-6.8)    |
| <b>US census region</b>                            |                  |                                       |                  |
| Northeast  | 16.2 (13.2-19.8) | 16.6 (13.3-20.5)                      | 15.5 (12.5-19.1) |
| Midwest  | 25.8 (21.9-30.1) | 26.5 (22.4-31.1)                      | 24.6 (20.2-29.7) |
| South  | 40.9 (36.7-45.3) | 40.4 (35.9-45.1)                      | 41.7 (36.8-46.8) |
| West   | 17.1 (14.3-20.3) | 16.5 (13.6-19.9)                      | 18.1 (14.9-22.0) |

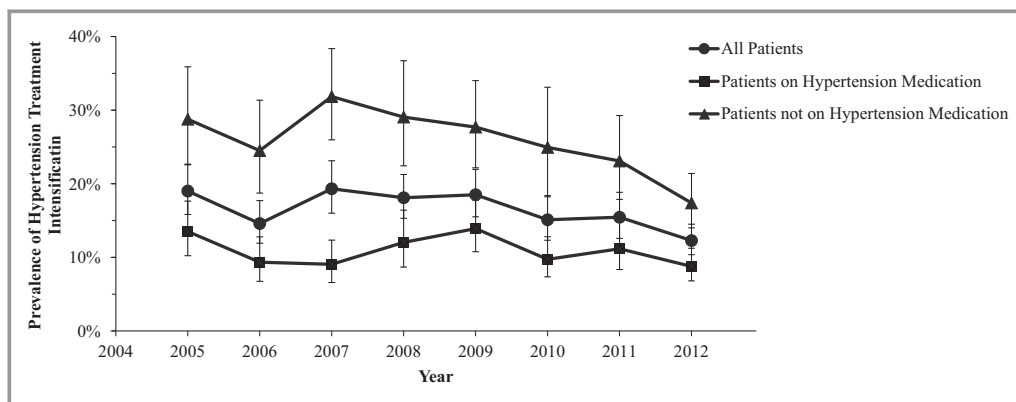
CHIP indicates Children’s Health Insurance Program; NAMCS, National Ambulatory Medical Care Survey; NHAMCS, National Hospital Ambulatory Medical Care Survey. \*Data are weighted % prevalence (or weighted means for blood pressure) with 95% confidence interval in parentheses among adult primary care visits with diagnosed hypertension and measured blood pressure at or above 140/90 mm Hg.

medication use predicted the lowest odds for treatment intensification with new medication.

Among all visits, female sex, older age, lower systolic blood pressure (yet higher than 140 mm Hg), and diabetes mellitus diagnosis were significantly associated with lower likelihood of treatment intensification, although no difference was found in race/ethnicity, diagnosis of cerebrovascular disease or chronic renal failure, or geographic regions (Table 2). On

adjustment, visits for new problems and preventive care became significant for lower likelihood of intensification, compared with routine check-ups of chronic problems (Table 2).

These patterns were generally observed in both people with existing hypertension medication use and those without. There were, however, some apparent differences. Among adults with existing hypertension medication use, non-



**Figure 1.** Prevalence of hypertension treatment intensification in the United States 2005–2012.

**Table 2.** Hypertension Treatment Intensification by Patient Characteristics in NAMCS and NHAMCS Visits 2005–2012\*

| Characteristics                                    | Prevalence       | Crude OR                                | Adjusted OR <sup>†</sup>                |
|--|------------------|---|---|
| <b>Sex</b>   |                  |   |   |
| Female   | 15.4 (14.1-16.8) | 0.79 (0.69-0.90)                        | 0.81 (0.70-0.95)                        |
| Male   | 18.7 (17.3-20.2) | Referent                                | Referent                                |
| <b>Age</b>   |                  |   |   |
| 18 to 49 y   | 21.6 (19.3-24.2) | 0.87 (0.83-0.92) per a 10-year increase | 0.91 (0.86-0.96) per a 10-year increase |
| ≥50 y  | 15.7 (14.6-16.8) |   |   |
| <b>Race/Ethnicity</b>                              |                  |   |   |
| White, non-Hispanic                                | 16.1 (14.9-17.4) | Referent                                | Referent                                |
| Black, non-Hispanic                                | 18.9 (16.3-21.9) | 1.22 (0.99-1.50)                        | 1.20 (0.95-1.50)                        |
| Hispanic   | 16.8 (13.8-20.2) | 1.05 (0.82-1.35)                        | 1.01 (0.77-1.33)                        |
| Other  | 19.4 (13.8-26.5) | 1.26 (0.83-1.91)                        | 1.24 (0.81-1.91)                        |
| <b>Systolic blood pressure</b>                     |                  |   |   |
| 120 to 129 mm Hg                                   | 11.8 (6.7-20.1)  | 0.90 (0.47-1.69)                        | 0.60 (0.30-1.21)                        |
| 130 to 139 mm Hg                                   | 14.1 (10.9-18.0) | 1.10 (0.82-1.47)                        | 0.91 (0.67-1.22)                        |
| 140 to 149 mm Hg                                   | 13.0 (11.8-14.4) | Referent                                | Referent                                |
| 150 to 159 mm Hg                                   | 17.2 (15.2-19.4) | 1.39 (1.15-1.68)                        | 1.48 (1.21-1.79)                        |
| 160 to 169 mm Hg                                   | 21.7 (18.9-24.8) | 1.85 (1.52-2.26)                        | 2.07 (1.68-2.55)                        |
| 170 to 179 mm Hg                                   | 27.3 (22.1-33.3) | 2.51 (1.84-3.44)                        | 2.67 (1.85-3.85)                        |
| ≥180 mm Hg   | 32.1 (26.2-38.6) | 3.16 (2.33-4.29)                        | 3.61 (2.62-4.98)                        |
| <b>Chronic condition</b>                           |                  |   |   |
| Cerebrovascular disease                            | 16.1 (11.3-22.4) | 0.95 (0.63-1.43)                        | 1.23 (0.78-1.92)                        |
| Chronic renal failure                              | 18.1 (12.9-24.6) | 1.09 (0.74-1.62)                        | 1.34 (0.89-2.02)                        |
| Diabetes mellitus                                  | 13.6 (12.0-15.4) | 0.71 (0.61-0.84)                        | 0.77 (0.64-0.93)                        |
| Hyperlipidemia                                     | 14.9 (13.4-16.4) | 0.78 (0.67-0.91)                        | 1.01 (0.86-1.18)                        |
| <b>Major reason for the visit</b>                  |                  |   |   |
| New problem (<3 months)                            | 17.1 (15.1-19.3) | 1.01 (0.84-1.20)                        | 0.75 (0.62-0.92)                        |
| Chronic problem, routine                           | 17.0 (15.5-18.6) | Referent                                | Referent                                |
| Chronic problem, flare-up                          | 15.9 (12.9-19.4) | 0.92 (0.72-1.17)                        | 0.77 (0.57-1.03)                        |
| Preventive care                                    | 15.6 (13.1-18.5) | 0.90 (0.72-1.14)                        | 0.76 (0.60-0.97)                        |
| <b>Total number of existing medications</b>        |                  |   |   |
| 0  | 27.9 (24.8-31.1) | 1.57 (1.22-2.03)                        | 1.09 (0.82-1.44)                        |
| 1  | 19.7 (16.8-23.0) | Referent                                | Referent                                |
| 2  | 17.0 (13.7-20.8) | 0.83 (0.59-1.17)                        | 0.98 (0.69-1.39)                        |
| 3  | 14.7 (12.0-17.9) | 0.70 (0.52-0.94)                        | 0.97 (0.70-1.33)                        |
| ≥4   | 11.3 (9.9-12.8)  | 0.52 (0.40-0.66)                        | 0.89 (0.68-1.18)                        |
| Existing hypertension medication use               | 11.2 (10.1-12.4) | 0.35 (0.30-0.41)                        | 0.37 (0.30-0.46)                        |
| <b>Total number of visits within the past year</b> |                  |   |   |
| 0  | 23.3 (17.8-29.9) | Referent                                | Referent                                |
| 1 to 2   | 21.4 (19.3-23.7) | 0.90 (0.62-1.30)                        | 1.04 (0.69-1.54)                        |
| 3 to 5   | 15.6 (14.0-17.3) | 0.61 (0.43-0.86)                        | 0.74 (0.51-1.08)                        |
| ≥6   | 13.5 (11.6-15.8) | 0.51 (0.35-0.76)                        | 0.66 (0.43-1.01)                        |

Continued

Table 2. Continued

| Characteristics            | Prevalence       | Crude OR         | Adjusted OR <sup>†</sup> |
|----------------------------|------------------|------------------|--------------------------|
| Expected source of payment |                  |                  |                          |
| Private insurance          | 19.3 (17.5-21.2) | Referent         | Referent                 |
| Medicare                   | 14.1 (12.4-16.0) | 0.69 (0.56-0.84) | 0.88 (0.68-1.13)         |
| Medicaid or CHIP           | 13.4 (9.9-17.8)  | 0.65 (0.45-0.93) | 0.69 (0.47-1.01)         |
| Self-pay                   | 21.9 (17.2-27.4) | 1.17 (0.83-1.64) | 0.99 (0.69-1.44)         |
| Other                      | 21.1 (17.0-25.9) | 1.12 (0.82-1.51) | 1.13 (0.82-1.55)         |
| US census region           |                  |                  |                          |
| Northeast                  | 14.6 (12.1-17.4) | Referent         | Referent                 |
| Midwest                    | 17.2 (15.1-19.6) | 1.22 (0.94-1.59) | 1.18 (0.91-1.54)         |
| South                      | 17.0 (15.4-18.8) | 1.20 (0.95-1.53) | 1.09 (0.86-1.38)         |
| West                       | 17.7 (15.5-20.1) | 1.26 (0.97-1.63) | 1.16 (0.88-1.55)         |

CHIP indicates Children's Health Insurance Program; NAMCS, National Ambulatory Medical Care Survey; NHAMCS, National Hospital Ambulatory Medical Care Survey; OR, odds ratio. \*Data are weighted % prevalence or OR with 95% confidence interval in parentheses among adult primary care visits with diagnosed hypertension and measured blood pressure at or above 140/90 mm Hg.

<sup>†</sup>The adjusted model accounted for all listed characteristics in this table, in addition to survey year and type.

Hispanic blacks were more likely to receive medication addition, whereas individuals on 4 or more existing medications were less likely to receive medication addition (Table 3). In contrast, among those without existing hypertension medication use, individuals on 4 or more existing medications were more likely to receive medication initiation (Table 3). In addition, in those already taking hypertension medication, medication addition occurred in 11.5% (9.1% to 14.6%) of those aged 80 and above, compared to 10.6% (8.9% to 12.6%) in those aged 50 to 64. In contrast, medication initiation occurred in 17.4% (12.1% to 24.5%) of those aged 80 and above, compared to 27.9% (24.7% to 31.2%) in those aged 50 to 64.

### Prevalence and Patterns of Treatment Intensification at Different Blood Pressure Levels

We assessed treatment intensification with new medication at several different SBP levels by clinical and demographic characteristics (Figure 2). Overall, among 88.4 million yearly visits from hypertensive adults with a documented SBP  $\geq 120$  mm Hg, only 9.7 million received treatment intensification. This corresponds to a weighted prevalence of 11.0% (10.4% to 11.7%), which was particularly low among people aged 50 and above (10.1%; 9.5% to 10.8%), compared with younger adults (15.2%; 13.6% to 16.9%). As expected, intensification was more likely with higher levels of measured blood pressures, although prevalence only reached 25.2% (22.8% to 27.9%) even among visits with an SBP  $\geq 160$  mm Hg, corresponding to merely 2.5 out of 9.7 million visits annually where treatment intensification could have occurred.

### Discussion

In this study of US ambulatory medical care visits, hypertension treatment intensification with new medication occurred in only 1 out of 6 visits to a primary care physician. This low prevalence of intensification was observed across a wide variety of clinical and demographic groups and, perhaps most disturbingly, decreased over time, particularly for hypertension medication initiation. The driving force of this decline is unclear, but it may partly result from the competing demand on primary care physicians to address multiple chronic conditions and more medication needs per patient in addition to a growing number of professional society guideline recommendations, despite little change in per-visit time with patients.<sup>19,20</sup> In addition, the variation in the trends of medication initiation and addition remains to be explained. Nonetheless, our results suggest that a physician treatment decision, specifically intensification with new medication, remains an important opportunity at the clinical visit level to further blood pressure control.

To our knowledge, this study is the first to examine national trends in clinical inertia for hypertension treatment. Our results cast a somewhat different light on the national problem of hypertension than previous studies. The National Health and Nutrition Examination Surveys<sup>3,21,22</sup> have reported population-wide improvement in hypertension control for a similar time period. However, this improvement may reflect poorly understood underlying population trends in blood pressure more than better control due to medication per se.<sup>23,24</sup> Put differently, our results at the visit level provide insight into the substantial and apparently growing clinical challenge of therapeutic inertia, whereas other approaches

**Table 3.** Hypertension Treatment Intensification by Patient Characteristics and Existing Medication Status in NAMCS and NHAMCS Visits 2005–2012\*

| Characteristics                                    | With Existing Hypertension Medication Use |   | Without Existing Hypertension Medication Use |   |
|--|---|---|--|---|
|  | Prevalence                                | Adjusted OR <sup>†</sup>                | Prevalence                                   | Adjusted OR <sup>†</sup>                |
| <b>Sex</b>   |   |   |  |   |
| Female   | 10.3 (8.9-12.0)                           | 0.78 (0.61-0.99)                        | 24.1 (21.4-26.9)                             | 0.82 (0.66-1.03)                        |
| Male   | 12.4 (10.8-14.1)                          | Referent                                | 29.6 (26.9-32.4)                             | Referent                                |
| <b>Age</b>   |   |   |  |   |
| 18 to 49 y   | 11.7 (9.1-14.8)                           | 0.98 (0.89-1.09) per a 10-year increase | 33.5 (29.8-37.3)                             | 0.88 (0.81-0.95) per a 10-year increase |
| ≥50 y  | 11.1 (10.0-12.3)                          |   | 24.3 (22.0-26.6)                             |   |
| <b>Race/Ethnicity</b>                              |   |   |  |   |
| White, non-Hispanic                                | 10.5 (9.3-11.8)                           | Referent                                | 25.9 (23.4-28.5)                             | Referent                                |
| Black, non-Hispanic                                | 13.8 (10.7-17.6)                          | 1.47 (1.10-1.96)                        | 27.9 (23.6-32.8)                             | 1.06 (0.76-1.48)                        |
| Hispanic   | 10.3 (7.2-14.5)                           | 0.97 (0.62-1.52)                        | 26.7 (20.5-34.0)                             | 1.03 (0.70-1.51)                        |
| Other  | 13.9 (8.5-22.0)                           | 1.26 (0.78-2.04)                        | 27.4 (18.0-39.3)                             | 1.11 (0.59-2.09)                        |
| <b>Systolic blood pressure</b>                     |   |   |  |   |
| 120 to 129 mm Hg                                   | 7.2 (2.1-21.3)                            | 0.77 (0.21-2.86)                        | 15.9 (8.6-27.4)                              | 0.51 (0.23-1.13)                        |
| 130 to 139 mm Hg                                   | 6.8 (4.3-10.7)                            | 0.75 (0.45-1.27)                        | 24.9 (18.5-32.8)                             | 1.00 (0.66-1.52)                        |
| 140 to 149 mm Hg                                   | 8.3 (6.9-9.9)                             | Referent                                | 20.9 (18.4-23.7)                             | Referent                                |
| 150 to 159 mm Hg                                   | 11.1 (8.9-13.7)                           | 1.38 (1.00-1.91)                        | 28.5 (24.3-33.0)                             | 1.63 (1.24-2.16)                        |
| 160 to 169 mm Hg                                   | 15.4 (12.7-18.5)                          | 2.00 (1.49-2.68)                        | 34.6 (28.7-41.1)                             | 2.25 (1.64-3.09)                        |
| 170 to 179 mm Hg                                   | 23.4 (17.6-30.5)                          | 3.27 (2.14-4.99)                        | 33.7 (24.7-44.0)                             | 1.99 (1.18-3.36)                        |
| ≥180 mm Hg   | 21.2 (15.1-28.8)                          | 2.94 (1.78-4.86)                        | 52.7 (42.7-62.5)                             | 4.67 (3.04-7.19)                        |
| <b>Chronic condition</b>                           |   |   |  |   |
| Cerebrovascular disease                            | 15.7 (10.4-22.9)                          | 1.54 (0.95-2.50)                        | 17.3 (10.1-27.9)                             | 0.70 (0.35-1.41)                        |
| Chronic renal failure                              | 15.3 (10.2-22.3)                          | 1.43 (0.86-2.37)                        | 24.5 (13.3-40.8)                             | 1.32 (0.60-2.92)                        |
| Diabetes mellitus                                  | 9.9 (8.2-11.8)                            | 0.86 (0.69-1.08)                        | 21.5 (18.1-25.2)                             | 0.75 (0.57-1.00)                        |
| Hyperlipidemia                                     | 11.1 (9.5-12.8)                           | 1.13 (0.90-1.42)                        | 23.5 (20.6-26.7)                             | 0.91 (0.73-1.14)                        |
| <b>Major reason for the visit</b>                  |   |   |  |   |
| New problem (<3 months)                            | 10.8 (8.7-13.4)                           | 0.93 (0.70-1.24)                        | 24.3 (21.1-27.9)                             | 0.62 (0.46-0.82)                        |
| Chronic problem, routine                           | 11.4 (10.0-13.1)                          | Referent                                | 29.7 (26.2-33.6)                             | Referent                                |
| Chronic problem, flare-up                          | 14.7 (11.2-19.1)                          | 1.29 (0.87-1.91)                        | 17.4 (12.4-23.9)                             | 0.45 (0.29-0.70)                        |
| Preventive care                                    | 8.6 (6.4-11.6)                            | 0.71 (0.49-1.01)                        | 27.9 (22.9-33.6)                             | 0.76 (0.55-1.06)                        |
| <b>Total number of existing medications</b>        |   |   |  |   |
| 0  | —   | —                                       | 27.9 (24.8-31.1)                             | 1.33 (0.97-1.83)                        |
| 1  | 16.7 (13.2-20.8)                          | Referent                                | 23.5 (18.9-28.7)                             | Referent                                |
| 2  | 12.8 (9.8-16.5)                           | 0.74 (0.49-1.12)                        | 25.7 (18.5-34.4)                             | 1.22 (0.73-2.04)                        |
| 3  | 13.4 (10.5-17.0)                          | 0.76 (0.50-1.14)                        | 19.9 (14.5-26.7)                             | 1.03 (0.64-1.66)                        |
| ≥4   | 9.5 (8.1-11.1)                            | 0.50 (0.34-0.73)                        | 26.9 (22.3-32.0)                             | 1.57 (1.04-2.39)                        |
| <b>Total number of visits within the past year</b> |   |   |  |   |
| 0  | 12.2 (6.7-21.1)                           | Referent                                | 36.1 (27.4-45.8)                             | Referent                                |
| 1 to 2   | 12.1 (9.6-15.0)                           | 1.07 (0.51-2.25)                        | 35.8 (32.0-39.8)                             | 1.03 (0.61-1.74)                        |
| 3 to 5   | 11.1 (9.5-12.8)                           | 0.96 (0.49-1.89)                        | 23.7 (20.7-27.0)                             | 0.63 (0.38-1.03)                        |
| ≥6   | 10.6 (8.5-13.1)                           | 0.96 (0.47-1.98)                        | 19.0 (15.5-23.2)                             | 0.48 (0.28-0.83)                        |

Continued



Table 3. Continued

| Characteristics            | With Existing Hypertension Medication Use |                          | Without Existing Hypertension Medication Use |                          |
|----------------------------|---|--------------------------|--|--------------------------|
|                            | Prevalence                                | Adjusted OR <sup>†</sup> | Prevalence                                   | Adjusted OR <sup>†</sup> |
| Expected source of payment |   |                          |  |                          |
| Private insurance          | 10.9 (9.2-12.9)                           | Referent                 | 31.5 (28.5-34.7)                             | Referent                 |
| Medicare                   | 11.6 (9.9-13.6)                           | 1.11 (0.78-1.59)         | 19.2 (15.9-22.8)                             | 0.69 (0.50-0.95)         |
| Medicaid or CHIP           | 8.8 (4.9-15.5)                            | 0.77 (0.41-1.47)         | 21.4 (16.8-26.8)                             | 0.68 (0.46-0.99)         |
| Self-pay                   | 10.9 (7.2-16.1)                           | 0.87 (0.52-1.46)         | 37.0 (28.5-46.5)                             | 1.13 (0.69-1.85)         |
| Other                      | 13.7 (9.7-19.0)                           | 1.25 (0.77-2.03)         | 33.8 (26.0-42.5)                             | 1.07 (0.72-1.59)         |
| US census region           |   |                          |  |                          |
| Northeast                  | 8.8 (6.4-12.1)                            | Referent                 | 25.1 (20.1-30.9)                             | Referent                 |
| Midwest                    | 12.4 (10.2-15.0)                          | 1.40 (0.92-2.12)         | 26.2 (21.5-31.6)                             | 1.08 (0.73-1.59)         |
| South                      | 10.9 (9.1-12.8)                           | 1.17 (0.80-1.71)         | 27.2 (24.5-30.2)                             | 1.09 (0.79-1.50)         |
| West                       | 12.5 (10.2-15.3)                          | 1.45 (0.95-2.22)         | 25.7 (21.6-30.3)                             | 0.99 (0.66-1.50)         |

CHIP indicates Children’s Health Insurance Program; NAMCS, National Ambulatory Medical Care Survey; NHAMCS, National Hospital Ambulatory Medical Care Survey; OR, odds ratio. \*Data are weighted % prevalence or OR with 95% confidence interval in parentheses among adult primary care visits with diagnosed hypertension and measured blood pressure at or above 140/90 mm Hg.

<sup>†</sup>The adjusted model accounted for all listed characteristics in this table, in addition to survey year and type.

better address the dietary, environmental, and clinical contributions to blood pressure nationwide. Nonetheless, further research is needed to reconcile the apparent discrepancy between sustained treatment inertia and improved control of hypertension nationally.

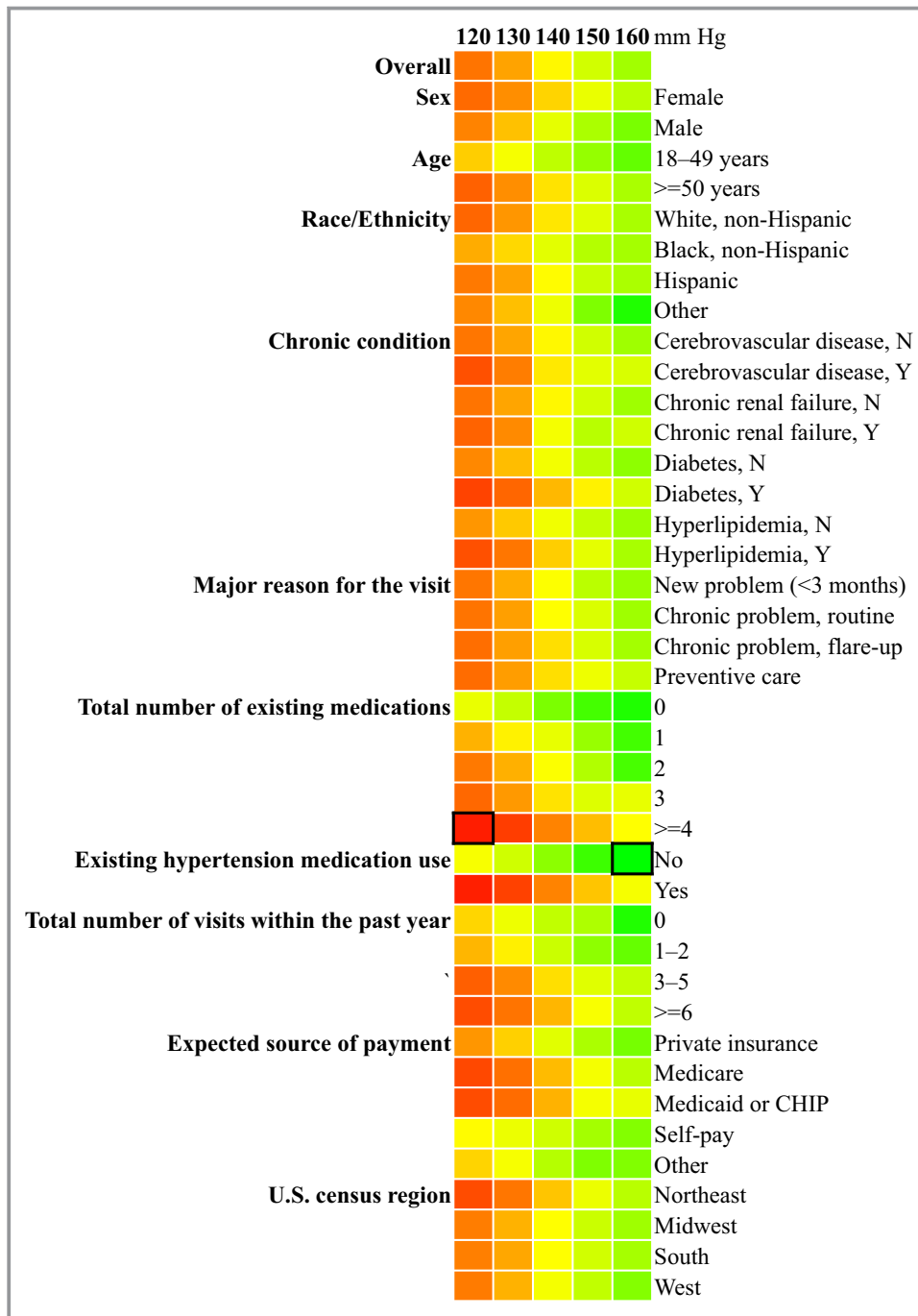
In assessment of clinical and demographic subgroups, we did not find significant racial disparities in treatment intensification, except for higher adjusted odds for intensification among non-Hispanic blacks than whites, consistent with some<sup>25,26</sup> but not all<sup>27</sup> reports in the literature. We observed lower prevalence and odds of treatment intensification in older adults; this may result from a relative lack of evidence supporting a goal SBP less than 150 mm Hg in the elderly<sup>28,29</sup> until the recent SPRINT results.<sup>15,16</sup> In contrast, for people with diabetes mellitus, a goal SBP/DBP of 130/80 mm Hg was recommended in 2003,<sup>12</sup> and yet treatment intensification from 2005 to 2012 among diabetic adults remained low even compared to those without diabetes mellitus. This appears concerning because diabetic patients commonly require at least 2 or 3 hypertension medications to achieve the recommended blood pressure,<sup>30–32</sup> even though the specific level of goal blood pressure in this population remains a focus of discussion.<sup>4,15,33,34</sup>

To achieve lower goal blood pressure, a dramatic increase in treatment intensification appears to be necessary. Of note, although the HOPE-3 trial did not seem to support treatment intensification among intermediate-risk patients without cardiovascular disease, the study was not designed to test lower blood pressure targets and cannot exclude the possibility of greater effectiveness with further reduction in blood pressure,

as acknowledged by its authors.<sup>17</sup> Given the low prevalence of intensification currently, it remains important to understand the reasons of clinical inertia, a topic that has been widely reviewed.<sup>35–37</sup> Efforts to improve treatment inertia are apt to require multidimensional approaches, including cultural shifts led by medical opinion leaders, automated reminders at the visit level, and more widespread integration of pharmacists into primary care and hypertension management.<sup>36,38,39</sup> Regardless of the methods used, a substantial effort will be needed to mobilize the forces necessary to overcome clinical inertia, given that opportunities for intensification are so often missed.

Last, it should be noted that clinical inaction may reflect appropriate care in certain circumstances<sup>40</sup>; these include prior visits with satisfactory blood pressure readings, side effects from previously prescribed hypertensive drugs that preclude new options, patients’ informed preference against intensified treatment, and the initiation of lifestyle interventions such as diet and exercise, particularly given low adherence to guidelines.<sup>41</sup> Interestingly, our results showed that even among visits where lifestyle interventions were not attempted, the prevalence of treatment intensification was not appreciably different from that among all visits. Nonetheless, lifestyle modifications and patient engagement, as with organizational interventions and health system improvement, are crucial for improving and maintaining hypertension control<sup>35–37,42</sup> in addition to timely and appropriate treatment intensification with new medication.

Our study has important strengths but also limitations. The lack of data on medication dose contributes to underestimation of true treatment intensification, which would include dose



**Figure 2.** Weighted prevalence of hypertension treatment intensification at different systolic blood pressure levels by patient characteristics in NAMCS and NHAMCS visits 2005–2012. Data are color-coded based on weighted prevalence from the lowest (red) to the highest (green). The minimum (6.9%) and the maximum (38.4%) are indicated with dark squares. Numbers are calculated among adult primary care visits with diagnosed hypertension and measured blood pressure at or above listed systolic blood pressure levels. CHIP indicates Children’s Health Insurance Program; NAMCS, National Ambulatory Medical Care Survey; NHAMCS, National Hospital Ambulatory Medical Care Survey.

escalation, but this does not affect estimates of medication initiation, which have been consistently low and declining over time. Furthermore, medication addition may have benefits over

dose escalation including higher efficacy and fewer side effects,<sup>43,44</sup> and, in one cohort study of patients with diabetes mellitus, addition was ~3 times more common than dose

escalation.<sup>45</sup> Indeed, an average of 1 additional medication is needed to achieve an SBP target of 120 mm Hg,<sup>15</sup> and multiple additions are typically necessary for people with common chronic conditions like diabetes mellitus<sup>30-32</sup> and chronic kidney disease.<sup>46,47</sup>

NAMCS and NHAMCS collected single blood pressure measurements; repeated blood pressure measures at multiple visits would have allowed us to estimate clinical inertia across groups of visits rather than single visits, where clinical uncertainty may be greater.<sup>48,49</sup> Nonetheless, the very low rates of intensification observed here suggest that 5 or more visits with elevated blood pressure occur before 1 results in intensification. Furthermore, limited information on clinical history and cardiovascular risk profile precluded us from extensive considerations of the clinical context in each visit, but we deliberately only included patients with diagnosed hypertension, who would likely warrant treatment, and not those with an isolated blood pressure elevation. Because we did not include subjects with undiagnosed hypertension, the true burden of undertreated hypertension is undoubtedly much larger than estimated here. Last, our results may be influenced by a change in the 2012 NAMCS that emphasized automated data collection by trained Census personnel, although formal evaluation by the NCHS suggests that this introduced little or no bias into its estimates.<sup>50</sup>

In summary, this study shows that among hypertensive adults in the United States with blood pressure over goal targets, treatment intensification with new medication occurs in only 17% of primary care visits. Given recent evidence supporting a lower goal blood pressure target, as many as 88 million yearly visits from hypertensive adults may potentially benefit from treatment intensification, but only 9.7 million currently receive new hypertension medication. Timely and appropriate intensification may markedly improve hypertension-related morbidity and mortality nationwide, but this will require a profound increase in the likelihood of treatment intensification in physician practice while overcoming widespread and often persistent clinical inertia.

## Disclosures

None.

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