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RESEARCH ARTICLE

Management of Hypertension in Primary Care Safety-Net Clinics in the United States: A Comparison of Community Health Centers and Private Physicians' Offices

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Objective. To examine adherence to guideline-concordant hypertension treatment practices at community health centers (CHCs) compared with private physicians' offices.

Data Sources/Study Setting. National Ambulatory Medical Care Survey from 2006 to 2010.

Study Design. We examined four guideline-concordant treatment practices: initiation of a new medication for uncontrolled hypertension, use of fixed-dose combination drugs for patients on multiple antihypertensive medications, use of thiazide diuretics among patients with uncontrolled hypertension on ≥3 antihypertensive medications, and use of aldosterone antagonist for resistant hypertension, comparing use at CHC with private physicians' offices overall and by payer group.

Data Collection/Extraction Methods. We identified visits of nonpregnant adults with hypertension at CHCs and private physicians' offices.

Principal Findings. Medicaid patients at CHCs were as likely as privately insured individuals to receive a new medication for uncontrolled hypertension (AOR 1.0, 95 percent CI: 0.6–1.9), whereas Medicaid patients at private physicians' offices were less likely to receive a new medication (AOR 0.3, 95 percent CI: 0.1–0.6). Use of fixed-dose combination drugs was lower at CHCs (AOR 0.6, 95 percent CI: 0.4–0.9). Thiazide use for patients was similar in both settings (AOR 0.8, 95 percent CI: 0.4–1.7). Use of aldosterone antagonists was too rare (2.1 percent at CHCs and 1.5 percent at private clinics) to allow for statistically reliable comparisons.

Conclusions. Increasing physician use of fixed-dose combination drugs may be particularly helpful in improving hypertension control at CHCs where there are higher rates of uncontrolled hypertension.

Key Words. Hypertension, community health centers, clinical inertia, treatment intensification, fixed-dose combination, single-pill combination

Hypertension (HTN) is the most common, modifiable risk factor for all-cause and cardiovascular-related deaths in the United States (Farley et al. 2010), but it remains uncontrolled in nearly half of affected individuals despite national initiatives targeting improved blood pressure (BP) control (Nwankwo et al. 2013). Uncontrolled HTN is even more prevalent in high-risk populations (i.e., low-income patients, African Americans) who tend to receive care at community health centers (CHCs; Shi et al. 2010). Hence, practice-based interventions tailored to target improved BP control at CHCs would enhance national initiatives for population control of HTN. Current efforts to improve BP control have focused on improving treatment intensification rates among physicians (Khanna et al. 2012), as well as using widely available fixed-dose combination drugs for patients requiring multiple medications, thiazide diuretics for patients with difficult-to-control HTN (i.e., uncontrolled on ≥3 BP medications), and aldosterone antagonist for resistant HTN (Chobanian et al. 2003; Shaya et al. 2008; Basile and Neutel 2010; Pimenta and Calhoun 2012; James et al. 2014). Each of these four treatment practices is guideline concordant and associated with higher rates of HTN control (Wald et al. 2009; Fontil et al. 2015; Williams et al. 2015). However, implementation of these recommendations and other evidence-based practices has been uneven (Fontil et al. 2014).

Although prior studies suggest that CHCs demonstrate comparable performance in preventive and primary care processes (Goldman et al. 2012), patterns of antihypertensive treatment practices at CHCs have not been explored, and it is unknown the extent to which CHCs provide guideline-concordant care. To address this gap in the literature, we sought to examine HTN treatment patterns at CHCs during visits to primary care physicians. The gold standard for treatment intensification rate, use of thiazide diuretics, use of fixed-dose combination drugs, and use of aldosterone antagonists is not

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known and would be difficult to determine. Therefore, we compared these treatment practices at CHCs to those observed at private physicians' offices where the majority of primary care visits in the United States occur (Hong et al. 2010; Goldman et al. 2012). We used a multiyear, nationally representative survey of office-based visits to physician practices in the United States to compare four guideline-concordant HTN management practices at CHCs and private physicians' offices. A better understanding of current practice is important to informing future practice-based interventions to improve HTN treatment in vulnerable populations that receive care at CHCs.

METHODS

Data and Study Design

The National Ambulatory Medical Care Survey (NAMCS) is a nationally representative cross-sectional survey of ambulatory office visits to physicians in the United States that uses a multi-stage probability sampling design to represent all visits to non–federally employed office-based physicians engaged in direct patient care. The design involves sampling of defined geographic areas, physician practices within those areas, and patient visits within each practice (Chobanian et al. 2003). Individuals are not followed longitudinally, and the sampling scheme makes it unlikely that one individual would contribute multiple visits across different survey years. NAMCS collects information on type of clinic setting, including CHCs and private practice (solo or group). Starting in 2006, NAMCS oversampled visits from 104 CHCs to obtain reliable national estimates. A more detailed description of NAMCS methodology is available from the National Center for Health Statistics (NCHS).

Study Sample

We used NAMCS survey data from 2006 to 2010 and included all patient visits in which the patient was at least 18 years old, was seen by a physician in general/family practice or internal medicine, had a diagnosis of HTN (described below), and had a recorded BP for the visit. We limited the analysis to visits to CHCs and private physicians' offices. Visits at other clinic settings such as free standing/urgicenter, mental health center, nonfederal government, and family-planning clinics were excluded. We also excluded visits in which the patient was specified as pregnant or had a positive pregnancy test; treatment guidelines for pregnant women differ from the general population.

To avoid visits where elevated BP may be transient or physicians might reasonably not be expected to address BP elevation, we excluded visits for pre- and post-operative evaluation and visits intended for administering specific therapies or therapeutic procedures, such as joint injection, physical therapy, or minor surgeries such as joint manipulation or wart removal. We also excluded end-stage renal disease (ESRD) because dialysis-related fluctuations in BP and electrolyte disturbances associated with ESRD may impact therapeutic decisions for BP management.

Patient and Visit Characteristics

Patient information and visit characteristics were abstracted from the medical record by the physician, physician staff, or Census Bureau staff. Age, race, gender, insurance coverage, reason for visit, and geographic region, as well as the number of medications added or continued by the physician at the visit, were recorded. Office BP was ascertained by routine measurements, and NAMCS did not specify timing of measurements, type of sphygmomanometer, BP cuff size, or number of repeated measurements. We also identified comorbid conditions such as ischemic heart disease (IHD) and diabetes. Practice setting characteristics were also recorded, including type of practice (private physicians' office, CHC) and geographic region. Factors that may be related to visit intensity included total number of chronic diseases and number of screening/diagnostic/nonmedical treatment or services provided during the visit (Katerndahl, Wood, and Jaen 2010). Neighborhood poverty was defined as the percentage of the population in the patient's zip code with income below the poverty level. We divided the poverty levels into tertiles: (1) less than 10 percent below the poverty level; (2) 10–19.99 percent below the poverty level; and (3) greater than 19.99 percent below the poverty level.

We identified visits of patients with HTN by any ICD-9_CM coded for HTN (401-405) or a "yes" answer to the survey question: "Regardless of diagnosis for this visit, does the patient now have HTN?," or BP ≥140/90 mmHg while taking ≥ 2 antihypertensive medications. To identify antihypertensive medications, we reviewed the Multum Lexicon database used by NAMCS for coding medications. We identified antihypertensive drug classes and then reviewed individual medication names to ensure that they were medications likely used for the purpose of BP management. See Appendix 1 online for the list, by class, of medications we defined as antihypertensive medications. Each component of a fixed-dose combination drug is counted as one BP

medication. We defined resistant HTN as visits reporting ≥4 distinct classes of continued BP medications or an elevated BP (≥140/90 mmHg) despite ≥3 continued medications with at least one first-line medication (thiazide, ACE inhibitor, angiotensin receptor blocker, or calcium channel blocker) included in the medication list.

National Ambulatory Medical Care Survey reported medications as either continued or newly prescribed during the visit. Medications reported as continued were considered to be the patient's medication regimen at presentation. Since our study period predates recent HTN guidelines that raised the BP target goal for elderly patients without diabetes or kidney disease (James et al. 2014), we defined uncontrolled HTN as BP ≥140/90 mmHg.

Type of Clinic Setting

National Ambulatory Medical Care Survey identifies CHCs based on information from the Health Resources Administration's Bureau of Primary Health Care Uniform Data System and Indian Health Service. CHCs, as defined in NAMCS, include federally qualified health centers (FQHCs), Urban Indian Health Program that received FQHC designation, and FQHC look-alikes. These look-alikes are organizations that meet the eligibility requirement of FQHCs and cost-based reimbursement but do not receive funding under section 330 of the Public Health Services Act. Private physicians' offices, including solo and group practice, account for more than 70 percent of primary care visits in the United States (Goldman et al. 2012).

Statistical Analysis

We used chi-square analysis to describe differences in patient and visit characteristics between CHCs and private offices. To evaluate potential differences in physicians' treatment of HTN at CHCs and private offices, we analyzed four guideline-concordant treatment practices: (1) prescribing a new medication in visits with uncontrolled BP; (2) use of fixed-dose combination in patients with two or more antihypertensive medications; (3) use of thiazide diuretics in patients with uncontrolled BP on three or more antihypertensive agents; and (4) use of aldosterone antagonists in patients with resistant HTN (Gonzaga and Calhoun 2008; James et al. 2014). We first used chi-square analysis to describe these treatment practices at CHCs compared with private clinics. We used multivariable logistic regression to assess for differences in prescribing of a new medication for uncontrolled HTN, use of fixed-dose

combination, and use of thiazide diuretics between CHCs and private clinics. Prevalent use of aldosterone antagonist was too low to test for potentially differential use by clinic setting. Finally, we tested for interactions between clinic setting and type of insurance (Private, Medicare, Medicaid, or other—self-pay/workman's compensation/uninsured/unknown) in predicting use of fixed-dose combination drugs and prescribing of new medication for uncontrolled BP. We tested for this interaction because insurance coverage influences what medications are available, and FQHCs are able to purchase drugs at reduced prices through the 340B program. All multivariable models included race, gender, age, and geographic region for face validity in addition to IHD, heart failure, total number of chronic conditions, and type of insurance. The model for provision of new medication for uncontrolled HTN included additional predictors such as whether HTN was identified by the patient as a reason for the visit, the patient's current office BP, number of BP medications currently taking, number of visits in the previous 12 months, and number of nonmedication treatment or services provided during the visit chosen based on previous literature and clinical judgment (Shaya et al. 2008; Khanna et al. 2012; Fontil et al. 2014). Neighborhood poverty was also included as a potential surrogate for patient socioeconomic status and factors in the "built environment" (Khanna et al. 2012) that may be associated with disparities in HTN prevalence and treatment (Kershaw et al. 2011).

Results

We included 12,880 visits of nonpregnant adult patients with HTN for analysis. Among these visits, 3,858 were made to CHCs, and 9,022 were made to private practice clinics representing 25.4 million and 496 million visits, respectively. Compared with private offices, CHCs had a higher prevalence of visits with patients taking ≥2 BP medications (45.5 percent vs. 40.1 percent, $p = .03$ and a higher prevalence of resistant HTN (21.0 percent vs. 17.4 percent, $p = .02$). Patients at CHCs were younger (mean age = 57.7 vs. 64.0, $p = .01$) and more likely to be nonwhite (37.4 percent vs. 17.5 percent, $p < .01$). CHC visits had a higher prevalence of diabetes and tobacco use while private physicians' offices had a higher prevalence of arthritis and cancer among these patients. The unadjusted rate of BP control was lower at CHCs than private physicians' offices (55.4 percent vs. 60.1 percent, $p = .03$; Table 1).

Table 1: Visits of Established Adult Patients with Hypertension at Community Health Centers and Private Clinics: NAMCS 2006–2010

	Community Health Center (N = 3,858)		Private Practice (N = 9,022)		
Patient Characteristics	Observed Visits	Percent (SE)	Observed Visits	Percent (SE)	p-Value
Demographics					
Age (mean, SD)		57.7 (30.3)		64.0 (11.1)	<.01
18–34	208	5.0% (0.7)	247	2.7% (0.2)	
35–64	2,594	64.3% (2.4)	4,363	47.8% (1.0)	
65–79	830	24.5% (1.9)	2,953	33.0% (0.6)	
80+	226	6.2% (1.1)	1,459	16.6% (0.6)	
Female	2,284	59.6% (1.1)	4,987	55.6% (0.7)	<.01
Race					
White	2,051	62.6% (4.4)	7,597	82.5% (1.4)	<.01
Black	1,343	29.0% (4.6)	1,070	13.4% (1.3)	
Other	464	8.4% (1.7)	355	4.1% (0.5)	
Socioeconomic factors					
Region					
Northeast	891	24.3% (6.2)	1,432	15.3% (2.1)	<.01
Midwest	770	11.2% (3.3)	2,855	28.3% (2.4)	
South	1,190	33.3% (7.3)	3,317	41.3% (2.8)	
West	1,007	31.2 (8.8)	1,418	15.1% (2.1)	
Type of insurance					
Private	658	15.2% (3.1)	5,661	63.2% (1.3)	<.01
Medicare*	935	31.6% (3.8)	2,406	26.9% (1.2)	
Medicaid only	955	25.2% (3.1)	379	4.1% (0.4)	
Other	1,310	28.0% (2.5)	576	5.9% (0.5)	
Percent poverty in patient's zip code					
<10%	784	14.5% (2.2)	4,687	50.0% (2.3)	
10–19.99%	1,376	33.5% (3.6)	2,666	30.8% (1.9)	
>19.99%	1,477	45.8% (4.9)	1,186	13.7% (1.2)	
Unknown	221	6.2% (1.4)	483	5.4% (0.6)	
Medical history†					
Ischemic heart disease	222	6.8% (1.0)	800	8.5% (0.5)	.15
Diabetes	1,377	37.8% (2.5)	2,623	29.2% (0.8)	<.01
Congestive heart failure					
Chronic kidney disease	97	2.9% (0.5)	296	3.3% (0.4)	.57
Obesity	794	16.4% (2.0)	1,439	15.7 (0.8)	.73
Depression	604	14.5% (2.6)	1,200	12.6% (0.5)	.44
Cerebrovascular disease	101	3.4% (0.7)	360	3.8% (0.3)	.57
Tobacco use	834	29.7% (2.4)	1,103	16.6% (0.7)	<.01
Arthritis	632	17.3% (1.9)	1,969	22.5% (1.0)	.02
Asthma	327	7.4% (0.9)	574	6.3% (0.4)	.24
Cancer	122	2.5% (0.5)	514	5.7% (0.4)	<.01

Continued

Table 1: *Continued*

Patient Characteristics	Community Health Center (N = 3,858) Observed Visits	Community Health Center (N = 3,858) Percent (SE)	Private Practice (N = 9,022) Observed Visits	Private Practice (N = 9,022) Percent (SE)	p-Value
Total no. of chronic diseases					
0–1	806	18.7% (1.8)	1,651	18.1% (0.7)	.57
2	1,196	34.5% (2.9)	2,684	30.2% (0.8)	
3+	1,853	48.8% (3.1)	4,676	51.7% (1.2)	
Total no. of medications at presentation					
0	233	4.4% (0.9)	678	7.5% (0.7)	.06
1	372	8.4% (1.6)	891	10.0% (0.6)	
2	422	8.6% (1.5)	997	10.% (0.5)	
3+	2,831	78.7% (3.7)	6,456	71.5% (1.4)	
No. of visits in the past 12 months					
0	86	2.2% (0.4)	334	3.8% (0.3)	.06
1–2	928	22.6% (3.1)	2,409	27.2% (0.9)	
3+	2,844	75.3% (3.0)	6,279	69.1% (1.0)	
Selected factors associated with blood pressure					
HTN is reason for the visit	788	20.9% (1.4)	1,798	19.9% (1.0)	.54
Mean systolic BP (SD)		136.3 (20.7)		133.6 (17.9)	
Mean diastolic BP (SD)		80.7 (13.0)		78.1 (11.5)	
HTN stage					
Stage I: 140–159/90–99	1,117	63.2% (3.0)	2,598	71.2% (1.0)	<.01
Stage 2: 160–179/100–109	470	27.3% (2.2)	798	22.0 (1.0)	
Severe HTN: ≥180/≥110	202	9.5% (1.2)	237	6.8% (0.5)	
No. of antihypertensive medications at presentation (mean, SD)					
0	985	25.1% (1.4)	2,646	29.6% (1.4)	.15
1	1,144	27.1% (1.9)	2,505	27.4% (0.6)	
2	927	25.7% (2.2)	2,118	23.2% (0.6)	
3+	802	22.0% (1.5)	1,753	19.7% (0.8)	
Uncontrolled hypertension[‡]	1,789	44.6% (2.2)	3,633	39.9% (0.8)	.03
Resistant hypertension[§]	764	21.0% (1.3)	1,561	17.4% (0.7)	.02
On ≥4 BP medications					
Uncontrolled HTN on ≥3 BP medications					
Factors related to visit intensity					
Total no. of nonmedication treatment or services provided					
0–2	51	4.9% (2.9)	1,340	13.1% (1.0)	.06
3	149	10.3% (4.0)	1,729	18.8% (0.9)	
4	439	20.9% (3.4)	2,063	21.4% (0.7)	
5+	934	63.9% (9.0)	4,264	46.8% (1.4)	

Notes. Percentages are reported as survey-weighted column %.
p-values using chi-square and t-test analyses comparing CHC versus private practice.
*Medicare patients also covered by Medicaid, but excluded those who also have private insurance.
[†]Identified by the survey question, "Does this patient now have [this disorder]?"
[‡]Uncontrolled hypertension: BP ≥140/90 mmHg.
[§]Resistant hypertension: patient on ≥4 BP medications or has uncontrolled hypertension with ≥3 BP medications at presentation.

Prescribing a New Antihypertensive Medication at Visits with Uncontrolled Office BP

The overall rate of new BP medication provision in patient visits with uncontrolled HTN was 16.3 percent (SE 0.8). Patients at CHCs had higher odds of receiving a new medication for uncontrolled HTN as compared with private physicians' offices (AOR 1.6, 95 percent CI: 1.1–2.4; Table 2). Among patients at CHCs, individuals with Medicaid were as likely as privately insured individuals to receive a new medication for uncontrolled HTN (AOR 1.0, 95 percent CI: 0.5–1.8). However, among patients at private physicians' offices, those with Medicaid were less likely to receive a new medication compared with those with private insurance (AOR 0.3, 95 percent CI: 0.1–0.6). Patients at CHCs were less likely to be on fixed-dose combination drugs compared with those at private offices (AOR 0.6, 95 percent CI: 0.4–0.9; Table 2).

Table 2: Treatment Practice Patterns in Hypertension Treatment at Community Health Centers Compared with Private Practice

	Community Health Center Weighted %(SE)	*Private Practice Weighted % (SE)*	*Unadjusted OR (95% CI)*	*Adjusted OR (95% CI)*
New antihypertensive medication prescribed during visits with uncontrolled HTN[†]	18.3% (1.9)	16.2% (0.8)	1.2 (0.9–1.5)	1.6 (1.1–2.4)
Prevalent use of fixed-dose combination drugs in patients taking ≥2 BP medications[‡]	17.1% (2.2)	24.6% (0.9)	0.6 (0.4–0.9)	0.6 (0.4–0.9)*
Prevalent use of thiazide in patients with uncontrolled BP on ≥3 BP medications[‡]	60.6% (7.2)	64.5% (1.8)	0.8 (0.4–1.6)	0.7 (0.4–1.5)
Prevalent use of aldosterone antagonists for resistant hypertension	2.1% (0.8)	1.5% (0.4)	1.4 (0.6–3.2)	N/A

Notes. **p*-value <.05.
[†]Adjusted for age, gender, race, geographic region, type of insurance, history of diabetes, history of ischemic heart disease, history of congestive heart failure, number of comorbid conditions, hypertension listed as a reason for the visit, systolic and diastolic BP, number of BP medications currently taking, number of comorbid conditions, number of visits in the previous 12 months, and number of nonmedication treatment or services provided, and percent poverty in patient's zip code.
[‡]Adjusted for age, gender, race, geographic region, type of insurance, history of diabetes, history of ischemic heart disease, history of congestive heart failure, and number of comorbid conditions.
OR compares the likelihood of use at CHC with private practice as the reference group.
Prevalent use = medication listed as either continued or newly prescribed; each component of a fixed-dose combination drug is counted as one BP medication.
BP, blood pressure.

New medication prescription was similar in both clinic settings for patients covered by private insurance or Medicare (Table 3).

Medication Use

Among visits of patients on ≥2 BP medications, use of fixed-dose combination was reported in 17.1 percent (SE 2.2) at CHCs and 24.6 percent (SE 0.9) at private clinics (AOR 0.6, 95 percent CI: 0.4–0.9). Thiazide use for patients with uncontrolled BP on ≥3 BP medications was similar in both settings (AOR 0.8, 95 percent CI: 0.4–1.7). Use of spironolactone for resistant HTN was too rare (2.1 percent at CHCs and 1.5 percent at private clinics) to allow for statistically reliable comparisons (Table 2).

DISCUSSION

We used yearly nationally representative surveys of office-based visits to U.S. physicians to examine guideline-concordant treatment of HTN at CHCs from 2006 to 2010. We found that the use of fixed-dose combination antihypertensive drugs was lower at CHCs than in private physicians' offices. Compared with private physicians' offices, primary care physicians at CHCs were more likely to prescribe a new medication for uncontrolled HTN among Medicaid patients. There was no difference in thiazide diuretic use, and the use of aldosterone antagonists for resistant HTN was extremely uncommon in both settings.

Our study suggests that CHCs are more likely to initiate new medications for Medicaid patients whose HTN is uncontrolled compared with private clinics. Previous studies have suggested that physician bias may play a role in explaining lower rates of treatment intensification observed in Medicaid patients (Harle, Harman, and Yang 2013). Theories about physician decision making suggest that when a physician faces uncertainty, the physician will resort to intuitive reasoning that relies on cognitive disposition to respond, or biases, where the physician will use patient characteristics to aid with clinical decision making (Croskerry 2002). This type of reasoning can lead to disparities in treatment intensification if physicians assume Medicaid patients have lower access to medications and/or lower medication adherence. CHCs have greater awareness and links to community resources or other mechanisms to provide medications at discounted prices. CHCs also frequently employ culturally concordant staff to support patient self-management and

Table 3: Provision of New Antihypertensive Medication for Adult Patients Who Presented with Blood Pressure ≥140/90 mmHg by Sociodemographic Factors and Hypertension Stage

	Community Health Centers (N = 789)			Private Practice (N = 3,633)		
	Total Visits with BP ≥140/90 mmHg	New Medication Prescribed (%, SE)	Adjusted OR (95% CI)	Total Visits with BP ≥140/90 mmHg	New Medication Prescribed (%, SE)	Adjusted OR‡ (95% CI)
Type of insurance						
Private	304	17.4% (3.6)	Ref	2,263	17.3% (1.0)	Ref
Medicare†	407	10.9% (3.4)	0.6 (0.2–1.4)	934	14.2% (1.5)	1.0 (0.7–1.3)
Medicaid only	456	20.8% (4.6)	1.0 (0.5–1.8)	167	9.0% (2.4)	0.3 (0.1–0.6)*
Other	622	24.3% (3.0)	1.1 (0.6–2.0)	269	18.8% (3.1)	0.8 (0.5–1.3)
Demographics						
Age (per 10 years)			1.0 (0.8–1.3)			0.9 (0.8–1.0)
Female	1,060	16.3% (2.5)	0.7 (0.4–1.1)	2,032	15.1% (1.0)	0.9 (0.7–1.1)
Male	729	21.4% (3.5)	Ref	1,601	17.6% (1.1)	Ref
Race						
White	857	19.1% (2.3)	Ref	2,964	15.6% (0.9)	Ref
Black	723	23.9% (3.7)	1.8 (1.0–3.1)	522	18.2% (1.9)	1.2 (0.8–1.7)
Other	209	9.8% (3.3)	0.7 (0.3–1.1)	147	19.4% (5.1)	1.3 (0.6–2.8)
Region						
Northeast	383	19.2% (3.5)	Ref	510	14.0 (2.2)	Ref
Midwest	368	27.2% (6.7)	1.5 (0.6–3.5)	1,142	15.4% (1.6)	1.2 (0.8–1.9)
South	595	15.1% (2.5)	0.7 (0.4–1.2)	1,414	17.3% (1.2)	1.4 (0.9–2.2)
West	443	17.5% (2.6)	0.8 (0.4–1.5)	567	16.2% (1.7)	1.1 (0.7–1.9)
Blood pressure						
Systolic (per 10 mmHg)			1.3 (1.2–1.7)	2,598	12.5% (0.8)	Ref
Diastolic (per 5 mmHg)			1.1 (1.0–2.9)	1,035	25.3% (2.0)	2.4 (1.0–1.1)

Notes. * p-value <.05.
†Includes Medicare patients also covered by Medicaid, but excludes those who also have private insurance.
‡Adjusted for type of insurance, age, gender, race, geographic region, percent poverty in patient's zip code, hypertension listed as a reason for the visit, hypertension stage, number of BP medications currently taking, number of comorbid conditions, history of diabetes, history of ischemic heart disease, history of congestive heart failure, number of comorbid conditions, number of visits in the previous 12 months, number of nonmedication treatment or services provided, and percent poverty in patient's zip code.

language assistance (Ku et al. 2011). These resources and services offered at CHCs may work together to strengthen the physician–patient relationship, facilitate trust, reduce negative bias, and contribute to reducing clinical inertia (Heisler et al. 2008; Schoenthaler et al. 2014). These and other potential explanations for differential patterns of clinical inertia in Medicaid patients based on clinic setting offer interesting areas for future inquiry.

We found that physician use of fixed-dose combination drugs for HTN is low across the United States, and lower at CHCs, even adjusting for patient sociodemographic factors, comorbidity burden, and pill burden (i.e., number of current BP medications). European (Mancia et al. 2013) and the 2014 U.S. guidelines for HTN treatment(James et al. 2014) support the use of fixed-dose combinations based on evidence from clinical trials, observational studies, and practice-based interventions (Chatzizisis et al. 2009; Byrd et al. 2011). The rationale for their use is that fixed-dose combination medications provide better efficacy and greater medication adherence than free combination of two single-ingredient medications. Over 75 percent of hypertensive patients will require two or more medications to achieve BP control. The BP reduction from combining drugs from two different classes is approximately five times greater than doubling the dose of one drug.

Concerns about higher cost and reduced flexibility in titrating medication dosing could be the main barriers to use of fixed-dose combination drugs (Shaya et al. 2008). However, recent developments have made these drug formulations more accessible, affordable, and easy to use. Whereas generic formulations were previously unavailable, several generic formulations have been widely covered by Medicaid plans since 2005 (Shaya et al. 2008; "Convenient Prescription Refills from $4"). Several fixed-dose combination drugs are covered as preferred drugs in Medicaid formularies in California, Texas, Florida, and New York. Medicaid plans in Maryland and South Carolina also provide coverage for fixed-dose combinations (Dickson and Plauschinat 2008; Shaya et al. 2008). Many fixed-dose combination drugs are now listed in discount plans at major U.S. pharmacies such as Walgreens and Walmart. Last, out-of-pocket cost for fixed-dose combination drugs may in some instances be lower because patients may only have to pay one payment for a fixed-dose combination drug prescription, whereas they have to pay twice for two single-agent drugs prescribed separately (Rabbani and Alexander 2008). Uptake may have lagged as providers may not have been aware of formulary changes, and there may be plans or geographic areas that don't provide coverage for fixed-dose combination drugs. Regarding reduced flexibility in medication dosing, one analysis of Medicaid patients found that "complex"

patients such as older men with more comorbidities were less likely to receive prescription for fixed-dose combination drugs (Shaya et al. 2008). Similarly, physicians at CHCs may perceive their patients as more complex and requiring greater flexibility in titrating medication dosing and intake regimen. While titration of fixed-dose combination drugs may be more cumbersome than titration of two separate pills, the availability of multiple dose formulation (e.g., benazepril/hydrochlorothiazide 10/12.5 mg, 20/12.5 mg, and 20/25 mg) should make dose titration more facile. One additional barrier could be physicians' concerned about a potential for higher risk of medication adverse effects in "complex" patients. However, fixed-dose combination drugs potentially reduce the risk of adverse effects in part because low-dose combination therapy has less toxicity than using a higher dose of a single drug (Kuschnir et al. 1996; Wald et al. 2009). Taken together, we believe that current utilization rates of fixed-dose combination drugs may reflect a low awareness of recent developments that should make increasing their use (as recommended by guidelines) more feasible and practical in private practice and CHCs (Shaya et al. 2008). Therefore, quality improvement efforts in improving HTN management in CHCs should emphasize the increased use of fixed-dose combination drugs and aldosterone antagonists as strategies to improve BP control.

As with prior studies, we found that physician use of aldosterone antagonists in resistant HTN was low across the country despite substantial evidence of their efficacy in treating resistant HTN (Ouzan et al. 2002; Epstein and Calhoun 2011; Vaclavik et al. 2011; Clark, Ahmed, and Calhoun 2012; Fontil et al. 2014). Behavioral norms, entrenched practice patterns, and low awareness on the part of physicians may be major barriers to increased utilization of aldosterone antagonists. Nevertheless, there is a body of evidence that suggests aldosterone antagonist as the most effective add-on drug to achieve HTN control in patients with resistant HTN (Calhoun et al. 2008; Clark, Ahmed, and Calhoun 2012; Jaques 2013; Williams et al. 2015). As recent HTN treatment guidelines have recommended their increased use, quality improvement efforts should develop appropriate and targeted interventions to address these potential barriers (Gonzaga and Calhoun 2008; Mancia et al. 2013; James et al. 2014). BP control (i.e., BP <140/90 mmHg) observed at CHCs was lower than the control rate at private clinics. In addition to the physician treatment practices we examined in this study, other health care processes such as physician–patient encounter frequency, lifestyle counseling, and patient-specific factors, such as medication adherence, diet, and alcohol use that influence BP control, were not considered in this

BP control estimate. Comparison of intermediate health outcomes, such as BP control, across different health care settings requires appropriate adjustment for patient case mix and relevant systemic factors (Hong et al. 2010). This study was not designed to compare health outcomes. Rather, it focused on examination of guideline-concordant antihypertensive treatment practices with known efficacy in lowering BP and increasing BP control across two disparate clinical settings.

Some limitations should be considered in interpreting these results. First, the cross-sectional nature of the data precludes us from knowing whether a medication had been discontinued in the past because of patient preference or intolerance. Since NAMCS does not record medication dose, our study speaks only to new medication prescription, not overall intensification. Treatment intensification in practice often involves dose escalation prior to adding a new medication, thereby raising the concern for misclassification of treatment intensification. This misclassification would only lead to ascertainment bias if it occurred differentially between CHCs and private physicians' offices. However, differential misclassification is not likely because preference for dose escalation over adding new medications should not differ by clinic setting, especially after adjusting for the number of antihypertensive medications that patients are currently taking. NAMCS does not provide any information on medication adherence, previous response to therapy, or treatment intensification at subsequent visits. Potential differential practice patterns in terms of delaying treatment intensification at CHCs and private clinics could also have led to ascertainment bias. This potential bias is less likely since we adjusted for visit frequency. Although we were unable to assess medication adherence, it seems unlikely that potential differences in medication adherence would account for the observed lower use of fixed-dose combination drugs at CHCs in areas where health plan coverage for these drugs is available.

CONCLUSION

Examination of current practice patterns in different clinic settings can inform quality improvement efforts to improve BP control. This study examined treatment practices in HTN management in office visits to U.S. physicians and found that primary care physicians at CHCs were more likely to intensify treatment for Medicaid patients but less likely to use fixed-dose combination drugs for patients taking multiple medications. Increased use of fixed-dose combination antihypertensive drugs and evidence-based treatment of

resistant HTN at CHCs may represent appropriate targets in national efforts to reduce disparities and improve population control of HTN in areas where health plan coverage for these drugs is available.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.
Appendix SA2: Appendix Tables.