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Pharmacist Intervention for Blood Pressure Control in Patients with Diabetes and/or Chronic Kidney Disease

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Abstract

Objectives—The objectives of this study were to 1) determine if hypertensive patients with comorbid diabetes mellitus (DM) and/or chronic kidney disease (CKD) receiving a pharmacist intervention had a greater reduction in mean blood pressure (BP) and improved BP control at 9 months compared to those receiving usual care and 2) compare Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-7) guideline and 2014 guideline (JNC-8) BP control rates in patients with DM and/or CKD.

Methods—This cluster, randomized trial included 32 medical offices in 15 states. Clinical pharmacists made treatment recommendations to physicians at intervention sites. This post-hoc analysis evaluated mean BP and BP control rates in the intervention and control groups.

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Main results—The study included 335 patients (227 intervention, 108 control) when mean BP and control rates were evaluated by JNC-7 inclusion and control criteria. When JNC-8 inclusion and control criteria were applied, 241 patients (165 intervention, 76 control) remained and were included in the analysis. The pharmacist-intervention group had significantly greater mean SBP reduction compared to usual care at 9 months (8.64 mm Hg [95% Confidence interval (CI)= −12.8, −4.49, p<0.001]). The pharmacist-intervention group had significantly higher BP control at 9 months than usual care by either the JNC-7 or JNC-8 inclusion and control groups (adjusted odds ratio (OR) 1.97 [95% CI= 1.01, 3.86]; p=0.0470 and 2.16 [95%CI= 1.21, 3.85]; p=0.0102, respectively).

Principal conclusions—This study demonstrated that a physician-pharmacist collaborative intervention was effective in reducing mean systolic BP and improving BP control in patients with uncontrolled hypertension with DM and/or CKD, regardless of which BP guidelines were used.

Clinical Trial Registration Information—NCT00935077: http://clinicaltrials.gov/ct2/show/NCT00935077

Keywords

team-based care; diabetes; chronic kidney disease; hypertension

Hypertension (HTN) affects roughly one out of every three adults in the United States and contributed to more than 400,000 deaths in 2014.[1)] In addition, hypertension increases the risk for cardiovascular disease, including myocardial infarction and stroke.[2] Independently, diabetes mellitus (DM) and chronic kidney disease (CKD) are responsible for a high degree of cardiovascular complications.[3–6] Hypertension with DM or CKD multiplies the risk for cardiovascular-related death, myocardial infarction (MI), angina pectoris, and stroke.[7,8]

Self-reported data found that 11.9% of individuals in the United States have either physician-diagnosed or undiagnosed DM.[9] Among patients with both hypertension and DM, only 29.6% meet their blood pressure (BP) goal.[10] Blood pressure control reduces cardiovascular complications in patients with both hypertension and DM.[11,12] For each 10 mm Hg decrease in mean systolic BP (SBP) there is an associated 12% reduction in diabetic complications, 15% reduction in deaths related to DM, 11% reduction in myocardial infarction, and 13% reduction in microvascular complications.[13]

National Health and Nutrition Examination Survey data found that the prevalence of CKD in those with undiagnosed and diagnosed hypertension was 22.0% and 27.5%, respectively.[14] Population-based data suggest that awareness, control, and adequate treatment of other cardiovascular complications are suboptimal in those with CKD. Studies have shown that even small elevations of BP place patients at increased risk for progression to end-stage renal disease.[15, 16]

Team-based care including pharmacists and nurses is a proven method to improve BP control.[17–20] The physician-pharmacist collaborative management (PPCM) model involves **close collaboration** within primary care settings to optimize drug therapy and promote preventative health measures.[21] Studies have shown that addition of **pharmacists** to the health care team improves BP in those with DM.[22–24] Although there are examples of

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randomized controlled trials that have examined pharmacist contributions to BP outcomes in those with DM, many studies were conducted in community pharmacies, outside the United States, or with limited numbers of medical offices.[25, 26]

The Collaboration Among Pharmacists and Physicians To Improve Blood Pressure Now (CAPTION) study was a cluster-randomized implementation trial measuring the impact of PPCM on patients with uncontrolled hypertension in 32 medical offices across the United States.[27] The primary end point in CAPTION did not achieve statistical significance; BP control was 43% in the intervention group and 34% in the control group at 9 months (adjusted odds ratio (OR) 1.57 [95% CI 0.99–2.50], p=0.059).[27] The CAPTION trial defined BP control for those with DM and CKD as less than 130/80 mm Hg based on the, then current, Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-7) guidelines.[28] Additionally, the Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial, which was published during the CAPTION trial, did not find evidence to support a goal SBP below 140 mm Hg in patients with diabetes.[29] Some clinicians in the CAPTION trial anecdotally expressed discomfort with the JNC-7 goals.

The CAPTION investigators conducted a sensitivity analysis using the definitions from the newer 2014 evidence-based guidelines for the management of high BP in adults (JNC-8), which recommended higher BP goals (140/90 mm Hg) for patients who are older than 60 years of age and for patients who suffer from DM or CKD.[30] When the higher goals were used, BP control was achieved in 61% of intervention patients and 45% of controls at 9 months (adjusted OR, 2.03 [95% CI 1.29–3.22], p=0.003). More than half of patients enrolled in CAPTION had either DM or CKD.[27] Therefore, it was theorized that the lower BP control rates might be explained by providers who lowered BP to a point close to the JNC-7 BP goal in those with DM or CKD but may not have quite reached the aggressive less than 130/80-mm Hg threshold.

The aims of the present CAPTION substudy are to 1) determine if hypertensive patients with comorbid DM and/or CKD receiving a pharmacist intervention had improved BP control and greater reduction in mean BP at 9 months compared to those receiving usual care and 2) compare JNC-7 and JNC-8 BP control rates in CAPTION patients with DM and/or CKD.

Materials and Methods

The main study design, baseline data, and results have been previously published.[27, 31] The CAPTION study included 32 medical offices from 15 U.S. states and was a prospective, cluster-randomized, multicenter clinical trial. Offices were stratified based on the level of pharmacy services provided and percent minority patients.[31, 32] Offices were then randomized to one of the three study arms: (i) usual BP care; (ii) a 9-month BP intervention; or (iii) a sustained, 24-month intervention. The two intervention arms were designed to be the same for the first 9 months so they could be combined and compared to usual care. The analyses for the present substudy were planned *post hoc* and included mean BP reduction and BP control during the first 9 months of the intervention for patients with comorbid DM and/or CKD.

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Patient Recruitment

The institutional review board (IRB) in each medical office approved this study. Patients were included if they: (i) were English- or Spanish-speaking males or females, over 18 years of age with diagnosed hypertension, (ii) had uncontrolled hypertension defined as a SBP 140 mm Hg or greater or diastolic BP (DBP) 90 mm Hg or greaterfor uncomplicated hypertension and a SBP of 130 mm Hg or greater or DBP 80 mm Hg or greater for patients with DM or CKD, and (iii) received care from one the participating medical clinics. A patient was classified as having DM/CKD if they had been diagnosed with either condition at baseline, as reported on the 'Diagnosed Conditions' electronic case report form. If neither condition was reported, a further examination of CKD was based on the calculated glomerular filtration rates from the patient's two most recent creatinine tests at baseline. Glomerular filtration rate was calculated using the Modification of Diet in Renal Disease Study equation.[33] In the present substudy, only patients with diagnosed DM, CKD, or both DM and CKD were included in the analysis. Patients could have either type 1 or type 2 DM. The study did not determine which type of DM these patients had, but the vast majority had type 2 DM.

Patients were excluded if they had (i) current signs of hypertensive emergency (acute angina, stroke, or renal failure); (ii) severe HTN (SBP >200 or DBP >114 mm Hg); (iii) history of MI, stroke, or unstable angina in prior 6 months; (iv) systolic dysfunction with left ventricular ejection fraction less than 35% determined by echocardiography, nuclear medication imaging, or ventriculography; (v) renal insufficiency as defined by GFR less than 20 mL/min or documented proteinuria greater than1 g/day; (vi) significant hepatic disease including cirrhosis, hepatitis B or C, or lab abnormalities (serum alanine transaminase or aspartate aminotransferase >2 upper limit of normal or total bilirubin >1.5 mg/dl) in the prior 6 months; (vii) pregnancy; (viii) diagnosis of pulmonary hypertension or sleep apnea; (ix) life expectancy estimated at less than 2 years; (x) residence in nursing home or diagnosis of dementia, and (xi) inability to give informed consent or impaired cognitive function (defined as ≥ 3 errors on the 10-item Pfeiffer).[34]

A study coordinator (generally a medical assistant or nurse) employed within each office recruited subjects and collected data. The study coordinator used billing records to identify patients with hypertension. Patient lists were then submitted to the biostatistician who randomized the list. The study coordinator then selected patients in order from the randomized list to avoid selection bias. All patients who agreed to participate signed written informed consent.

Data Collection

Study coordinators at all offices collected data at baseline, 9 and 24 months.[31] Study coordinators were trained in Iowa City in the following areas: (i) ethical treatment of human subjects; (ii) informed consent documents; (iii) protocol methods; and (iv) BP measurement using the automated Omron HEM 907-XL device (Omron healthcare; Bannockburn, Illinois, United States). [35] Blood pressure was measured three times in the sitting position using appropriate technique. The first BP reading was not used. The second and third BP measurements were averaged, but if the SBP or DBP values varied by more than 4 mm Hg, a

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fourth measurement was taken and the two closest readings between the second, third, and fourth measurement were averaged. Study coordinators then collected information regarding demographics and past medical history, including DM and CKD, from both patient report and the medical record.

All data were uploaded into an encrypted, web-based data management system designed and managed by the Data Coordinating Center (DCC). The DCC conducted a centralized evaluation of data to minimize errors. Staff from the DCC visited each office to perform data monitoring procedures to compare the database with the medical record source documents.

Pharmacist Intervention

Pharmacists at each medical office in the intervention arm completed a patient interview including: (i) medication history of all prescription, nonprescription, and herbal medications; (ii) an assessment of health literacy including patient knowledge of BP medications, indication of each medication, goals of therapy, medication dosages and frequency, and potential side effects; (iii) contraindications to each medication; and (iv) issues related to adherence and monitoring.

Pharmacists were encouraged first to assess medication knowledge, and then educate the patient on hypertension and the importance of properly following the pharmacotherapy plan. Pharmacists also provided recommendations on lifestyle modification, a wallet card listing all current medications and doses, and pharmacist contact information. In certain patients warranting additional adherence aid, pharmacists encouraged the use of medication logs or medication boxes. The pharmacist then created an individualized care plan with BP goal and medication recommendations. Care plans were presented to the physician either verbally or, if preferred by the physician, by electronic communication. If the physician decided to make modifications, the pharmacist finalized the plan. The proposed intervention included scheduled face-to-face visits with the patient at baseline, 1, 2, 4, 6, and 8 months and a telephone call at 2 weeks. Additional telephone calls were added as needed for those with uncontrolled hypertension. Although there was a protocol that was suggested to implement the intervention, the study was designed as a more pragmatic, effectiveness trial. Thus, clinical pharmacists were free to modify the intervention based on their professional judgment including the frequency of visits with patients. There were no treatment protocols and clinical pharmacists were only instructed to follow the JNC-7 guidelines. Investigators tracked the number of visits with the pharmacists to determine how closely pharmacists adhered to the proposed intervention frequency.

Analysis

The analysis for the present study compared mean SBP and DBP for patients with DM and/or CKD receiving a pharmacist intervention to those receiving usual care. An additional analysis was performed comparing BP control in patients with DM and/or CKD receiving the pharmacist intervention to those receiving usual care with JNC-8 inclusion and control criteria. The CAPTION trial enrolled patients with uncontrolled hypertension, giving consideration to diagnoses of DM or CKD based on the JNC-7 criteria. If patients had a diagnosis of hypertension and DM and/or CKD, their BP goal was 130/80 mm Hg. In order

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to evaluate the effect of the intervention using JNC-8 criteria, 94 of the initial 335 subjects from the trial were excluded based on the higher BP goals (<140/90 mm Hg). For this reason, fewer original patients met the criteria for uncontrolled BP using the JNC-8 criteria. The analyses were secondary, post-hoc, and comparable to the main CAPTION analyses.[27, 31]

Mean SBP and DBP were analyzed using a linear mixed model with random effects for office and patient within office. The center random effects were assumed to be normally distributed and have a compound symmetric covariance structure, and the nested within subjects errors were assumed to have an AR(1) covariance structure. Blood pressure control was analyzed using a nonlinear mixed effects model with the logit link function. Like the linear models, the office random effects were assumed to be normally distributed with a compound symmetric covariance structure and the nested within subjects errors were assumed to have an AR(1) covariance structure. Potential confounding variables at baseline were examined, and sensitivity analyses was performed to adjust for any covariates that differed across treatment groups.[27]

Blood pressure was assumed to be uncontrolled if a BP value was missing at 9 months. This approach has been used in many trials and is a conservative method to recognize that if a patient missed the visit, BP was more likely to be uncontrolled than controlled.[18, 36] No multiple imputation was used to account for missing BPs in the linear models. These same analyses were used for both the JNC-7 and JNC-8 analysis groups for mean BPs, the only difference being that patients in the original cohort with baseline BPs below the new threshold (<140/90 mm Hg) were not included in the JNC-8 cohort since those with controlled BP would not have met the original inclusion criteria for the study.

Results

There were 335 patients included in this study; 242 had DM, 43 had CKD, and 50 had both. Patient recruitment began March 2010 and the last patient completed the trial in June 2013 (Figure 1). Therefore, the JNC-7 guidelines were in place throughout the entire study. There were no differences in the intervention effect related to sex. Baseline demographic information for the patients included in the present study is displayed in Table 1.

Table 2 shows mean BP at baseline and 9 months between patients receiving the pharmacist intervention and usual care. The pharmacist-intervention group achieved a model-adjusted SBP and DBP reduction of 8.64 (95% CI= −12.8, −4.49, p<0.001) and 2.90 (95% CI= −5.55, −0.25, p=0.0323) mm Hg greater than that of the control group, respectively.

Table 3 shows BP control rates at 9 months between patients receiving the pharmacist intervention and those receiving usual care for both JNC-7 and JNC-8 BP goals. The pharmacist intervention, regardless of BP goal, was able to reach significant BP control compared to usual care in both the JNC-7 analysis (adjusted OR, 1.97 [95% CI=1.01, 3.86]; p=0.0470) and the JNC-8 analysis (adjusted OR, 2.16 [95% CI=1.21, 3.85]; p=0.0102).

The numbers and types of pharmacist recommendations and the medications used in the CAPTION trial were previously published.[37] There were no differences in medication

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classes used between intervention and control groups following the intervention with the exception that there was greater use of diuretics and aldosterone antagonists in the intervention group.

Discussion

This study demonstrated that a pharmacist intervention significantly reduced mean SBP in patients with uncontrolled hypertension and DM and/or CKD compared to usual care. Most importantly, the pharmacist-intervention group had significantly higher BP control at 9 months compared to usual care, regardless of which BP goal was used. The level of significance was higher in the JNC-8 analysis compared to that of the JNC-7 analysis. Findings based on race, income, education, and insurance status were previously published.[38] The pharmacist intervention had similar effects in these subgroups as with the entire study population including those previously taking three or more antihypertensive medications at baseline.[39] As anticipated, a considerable difference in control rates was found between pharmacist intervention and usual care when JNC-7 and JNC-8 BP goals were applied since JNC-8 relaxed goals for DM and CKD. We theorize that the pharmacist intervention was successful in getting most patients close to their 130/80-mm Hg threshold. However, because the ACCORD trial and other commentaries published during our study questioned these lower goals, some clinicians may have not felt comfortable lowering BP to these levels.[29]

In previous studies, PPCM has been shown to both reduce mean BP and increase BP control.[17] In the original CAPTION trial, the difference in mean BP between the pharmacist intervention and usual care for all study patients was−-6.1/−2.9 mm Hg ($p<0.001$ and $p=0.003$, respectively) at 9 months.[27] However, the primary outcome was BP control, and this did not quite achieve statistical significance ($p=0.059$), in part, due to greater interclinic variability than originally expected.[27] Newer studies and the most recent hypertension 2017 guidelines supported by multiple professional organizations recommend a BP of less than 130/80 mm Hg in almost all individuals with hypertension.[40, 41] These new goals will be difficult to achieve especially in patients with comorbidities and socioeconomic disadvantages.

Other investigators have examined the impact of team-based care in the treatment of multiple chronic conditions. The Fremantle Diabetes Study demonstrated positive BP control outcomes ($p=0.043$), but it should be noted that the investigators defined BP control as <135/85 mm Hg.[42] A group of investigators showed improved mean BP with a pharmacist intervention in North Carolina internal medicine offices.[24] The pharmacist-intervention group in this study had a mean BP reduction of 7 mm Hg over the course of 12 months, whereas the control group had a mean BP increase of 2 mm Hg, making the difference 9 mm Hg between groups. In contrast, the patient group receiving pharmacist intervention in the present study had a mean BP reduction of about 16 mm Hg, with the usual-care group achieving an 8 mm Hg reduction. A randomized study conducted in a community health center found a significant difference in mean BP after a 9-month pharmacist intervention, but baseline SBP for both intervention and control was already quite low (130.0 mm Hg and 130.7 mm Hg, respectively).[25] A study conducted with patients

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from 14 community pharmacies in Edmonton, Alberta, Canada, found that care from pharmacist-nurse teams significantly improved BP control and reduced mean BP in those with hypertension and DM.[26] By comparison, the patient population in the Canadian study had lower mean BP at baseline and considerably less BP reduction (5.6 mm Hg) than the present study. Several studies have found that the addition of a pharmacist to a primary care team was effective in reducing mean BP and meeting BP targets.[22, 23] Although patients in one of the studies achieved significantly improve BP control (p=0.02), the difference in mean BP between intervention and control groups was modest (4.9 mm Hg).[22]

The present study is unique because it was a cluster, randomized-controlled trial in patients enrolled from 32 medical offices across 15 U.S. states. One strength of the CAPTION trial was that it was designed as a more pragmatic, effectiveness trial. A standard practice, protocol, medications, or method of communication with physicians was not required. Some pharmacists used collaborative practice agreements to initiate and adjust therapy, whereas others had all medication changes approved by the physician. The only goal established for the pharmacist was to achieve BP control using JNC-7 criteria. Fifty-four percent of patients were from under-represented minority groups, with 71% being African American, 26% Hispanic, and 3% other.[27] Additionally, 49% had income less than $25,000/year and 25% used Medicaid, self-pay, or no insurance for their health care payment.[38] Finally, 27% of patients met the definition of treatment-resistant hypertension.[39] The intervention was as effective, or nearly as effective, for all these groups despite the challenges of achieving BP control in these patient groups. In this regard, the findings are generalizable to a broad range of practices and patient populations.

The most likely reason for improved BP in the intervention group was intensification of suboptimal regimens. There were significantly more medication changes (4.9 ± 5.1 vs 1.1 ± 1.6, p=0.0003) and medications added or doses increased (3.2 ±3.2 vs 0.7 ± 1.1, p=0.0002) in the intervention group compared to the control group, respectively.[37] The intervention group was treated with significantly more diuretics and aldosterone antagonists, the latter likely being used for patients with treatment-resistant hypertension.

The disadvantage of efficacy trials without compulsory treatment and care protocols is that the intervention may not be completely implemented and there may be significant variability across sites. For instance, BP control rates ranged from 20% to 71% in the 20 intervention offices, and there was no clear indication that higher numbers of patients from minority groups, with lower income, no insurance, less education, or with diabetes or CKD explained these variable results.[43] These findings suggest, but cannot prove, that variability in pharmacist practice styles may have contributed to the differences in BP control across sites.[44]

There are important limitations to this study. Fifteen percent of patients did not complete the 9-month visit, but this rate of missing data was actually lower than expected. A conservative approach was used to analyze missing data, which is a strength of the study. Additionally, this was a post-hoc analysis. However, the general findings in these patients with DM and/or CKD were similar to the overall study population that were prospectively enrolled. Despite

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these limitations, the addition of a pharmacist to the care team improved BP outcomes in groups at high cardiovascular risk who often have poor BP control.[45]

Conclusion

This study demonstrated that an intervention utilizing pharmacists embedded within medical offices who were members of the care team reduced mean SBP in those with uncontrolled hypertension and comorbid DM and/or CKD. Additionally, regardless of which guideline criteria were used to specify BP control, the pharmacist intervention improved patient BP control. Additional studies are warranted to support the effectiveness of PPCM in patients with hypertension, especially in light of the new hypertension guidelines that again suggest lower BP goals in patients with DM and CKD similar to the JNC-7 guidelines. Our findings suggest that a team-based care model including pharmacists can be implemented to improve BP control and reduce mean BP in patients with uncontrolled hypertension and DM and/or CKD.

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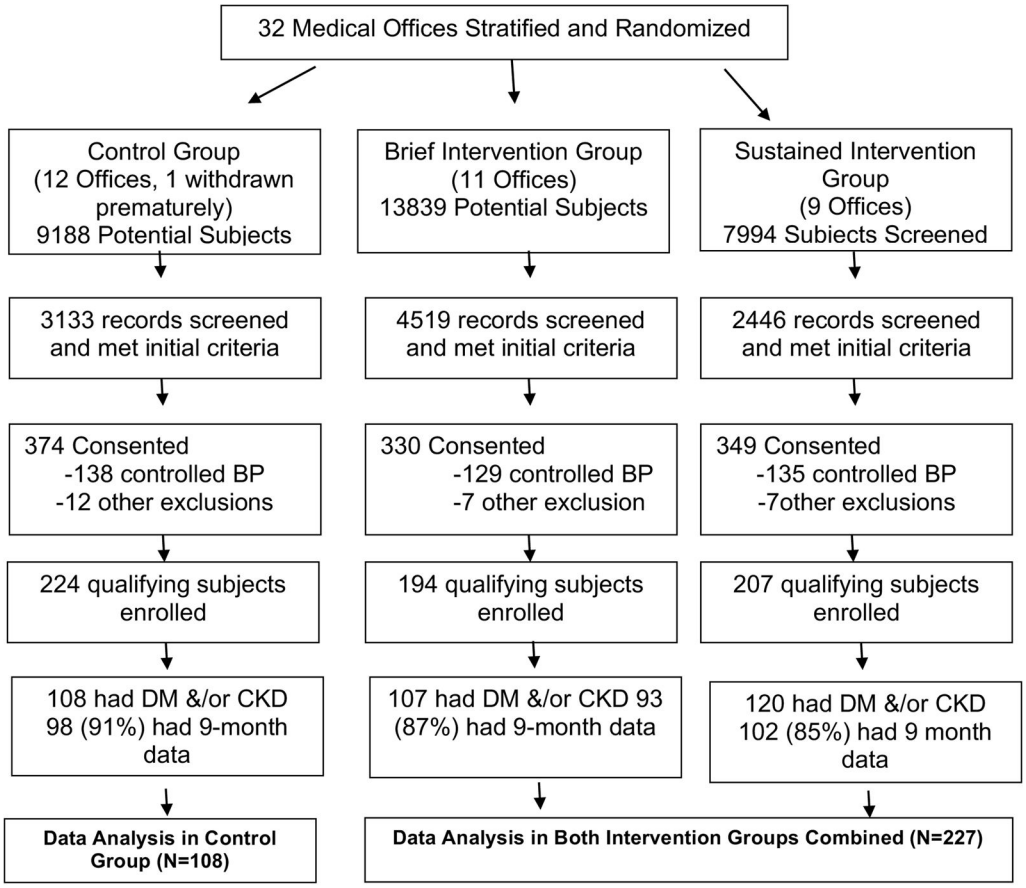

Figure 1.

CONSORT Statement of Clinic Randomization and Patient Participation

CONSORT: Consolidated Standards of Reporting Trials

BP: Blood pressure

DM: Diabetes mellitus

CKD: Chronic kidney disease

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Table 1

Demographic Characteristics at Baseline

Variable	Control (N=108) N (%)	Intervention (N=227) N (%)
Gender		
Male	37 (34.3%)	84 (37.0%)
Female	71 (65.7%)	143 (63.0%)
Race/Ethnicity		
Non-Hispanic Caucasian	34 (31.5%)	89 (39.2%)
Minority	73 (67.6%)	135 (59.5%)
Declined to answer/missing	1 (0.9%)	3 (1.3%)
Education		
<= 12 Years	65 (60.2%)	137 (60.4%)
> 12 Years	41 (38.0%)	89 (39.2%)
Marital status		
Married	45 (41.7%)	110 (48.5%)
Not married	63 (58.3%)	116 (51.1%)
Insurance coverage		
Medicare	40 (37.0%)	77 (33.9%)
Private and Other	41 (38.0%)	75 (33.0%)
Medicaid	19 (17.6%)	37 (16.3%)
Free and None/Self-Pay	8 (7.4%)	38 (16.7%)
Annual income		
< $25,000	60 (55.6%)	129 (56.8%)
>= $25,000	48 (44.4%)	97 (42.7%)
Smoking status		
Current smoker	14 (13.0%)	43 (18.9%)
Former smoker	33 (30.6%)	76 (33.5%)
Never smoker	60 (55.6%)	106 (46.7%)
Duration of high BP		
<= 3 years	11 (10.2%)	27 (11.9%)
> 3 – 10 years	41 (38.0%)	74 (32.6%)
> 10 years	56 (51.9%)	126 (55.5%)
Comorbidities		

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Variable	Control (N=108) N (%)	Intervention (N=227) N (%)
Diabetes	**75 (69.4%)**	**167 (73.6%)**
CKD	**15 (13.9%)**	**28 (12.3%)**
Diabetes and CKD	**18 (16.7%)**	**32 (14.1%)**
Hyperlipidemia	**81 (75.0%)**	**158 (69.6%)**
Arthritis/DJD/Chronic Pain	**60 (55.6%)**	**88 (38.8%)**
Depression or Anxiety	**29 (26.9%)**	**68 (30.0%)**
Asthma or COPD	**16 (14.8%)**	**39 (17.2%)**
Stroke or TIA	**8 (7.4%)**	**18 (7.9%)**
Coronary Artery Disease	**6 (5.6%)**	**18 (7.9%)**
Seizures/Other Neurologic Disorders	**9 (8.3%)**	**10 (4.4%)**
Heart Failure	**3 (2.8%)**	**12 (5.3%)**
Liver Disease	**2 (1.9%)**	**3 (1.3%)**
Peripheral Artery Disease	**0 (0.0%)**	**4 (1.8%)**
Number of Comorbidities		
Mean (SD)	3.0 **(1.2)**	2.8 **(1.4)**
Age (years)		
Mean (SD)	63.1 **(12.2)**	61.7 **(11.6)**
Min - Max	(28, 88)	(29, 93)
Baseline SBP (mm Hg)		
Mean (SD)	147.36 (16.26)	147.00 (15.71)
Min - Max	(117, 197)	(106, 198)
Baseline DBP (mm Hg)		
Mean (SD)	80.70 (12.09)	81.82 (11.65)
Min - Max	(53, 111)	(54, 114)
Weight (Kg)		
Mean (SD)	95.7 **(25.2)**	98.5 **(26.3)**
Min - Max	(40, 188)	(42, 181)
BMI		
Mean (SD)	34.4 **(8.0)**	35.3 **(8.7)**
Min - Max	(16, 61)	(19, 65)
Number of Antihypertensive Medications		
Mean (SD)	2.4 **(1.2)**	2.3 **(1.2)**
Min - Max	(1, 6)	(1, 6)

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Variable	Control (N=108) N (%)	Intervention (N=227) N (%)
Adverse Reaction Score		
Mean (SD)	34.5 **(25.4)**	39.5 **(30.0)**
Min - Max	(1, 133)	(0, 142)

BP: Blood pressure

SBP: Systolic blood pressure

DBP: Diastolic blood pressure

Min: minimum

Max: maximum

SD: standard deviation

CKD: Chronic Kidney Disease

BMI: Body mass index

COPD: chronic obstructive pulmonary disease

TIA: transient ischemic attack

DJD: degenerative joint disease

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Table 2

Mean blood pressure at Baseline and 9 months

	Baseline		9-months			
	Control (N=108)	**Intervention (N=227)**	**Control (N=108)**	**Intervention (N=227)**	**Model Based Difference (95% CI)**	**p-values**
SBP (mm Hg)						
Mean (SD)	147.36 (16.26)	147.00 (15.71)	139.29 (20.52)	130.65 (16.67)	−8.64 (−12.8, −4.49)	<0.001
DBP (mm Hg)						
Mean (SD)	80.70 (12.09)	81.82 (11.65)	76.16 (16.09)	74.23 (10.64)	−2.90 (−5.55, −0.25)	0.0323

SBP: Systolic blood pressure

DBP: Diastolic blood pressure

SD: Standard deviation

CI: Confidence interval

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Table 3

Blood pressure Control Rates With Pharmacist Intervention versus Usual Care at 9 months

BP Guideline	Control (N=108)	Intervention (N=227)	Adjusted Odds-Ratio (95% CI)	p-values
JNC-7 (130/80 mm Hg)	23 (21.3%; n=108)	77 (33.9%; n=227)	1.97 (1.01, 3.86)	0.0470
JNC-8 (140/90 mm Hg)	31 (40.8%; n=76)	96 (58.2%; n=165)	2.16 (1.21, 3.85)	0.0102

BP: Blood pressure

JNC: Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.