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Original Research

An Evaluation of a Clinical Pharmacy-Directed Intervention on Blood Pressure Control

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ABSTRACT*

Objective: To compare short and long term blood pressure control with clinical pharmacy specialist involvement to traditional physician management.
Setting: A non-profit health maintenance organization in the United States covering approximately 385,000 lives.
Methods: This analysis utilized a prospective parallel design. Adult patients with a baseline Blood pressure≥140/90 mmHg and receiving at least one antihypertensive medication were eligible for the study. Eligible hypertension management patients at one medical office were referred to the office's clinical pharmacy specialist (intervention cohort) while at another comparable medical office they received usual physician-directed care (control cohort). The primary outcome measure was achievement of a goal BP (<140/90 mmHg) during a six month follow-up. Medical records were also reviewed approximately 1.5 years post enrollment to assess long-term BP control after clinical pharmacy-managed patients returned to usual care. Multivariate analyses were performed to adjust for baseline cohort differences.
Results: One hundred-thirteen and 111 subjects in the intervention and control cohorts completed the study, respectively. At the end of the follow-up period, clinical pharmacy-managed subjects were more likely to have achieved goal BP (64.6%) and received a thiazide diuretic (68.1%) compared to control subjects (40.7% and 33.3%, respectively) (adjusted p=0.002 and p<0.001, respectively). The proportion of clinical pharmacy-managed subjects with controlled BP decreased to 22.2% after returning to usual care (p<0.001).
Conclusion: Clinical pharmacy involvement in hypertension management resulted in increased BP control. Loss of long-term control after discontinuation of clinical pharmacy management supports a change in care processes that prevent patients from being lost to follow-up.

Keywords: Blood pressure. Hypertension. Pharmaceutical Services. Professional Role.

RESUMEN

Objetivo: Comparar en control a corto y largo plazo de la presión arterial incluyendo un especialista en farmacia clínica a la atención tradicional médica.
Ubicación: Un servicio sanitario privado sin ánimo de lucro en Estados Unidos que cubre aproximadamente 385.000 personas.
Métodos: Este análisis utilizó un diseño paralelo prospectivo. Eran elegibles los adultos con una presión arterial inicial ≥140/90 mmHg y que recibían al menos un medicamento antihipertensivo. Los pacientes elegibles de una clínica se remitieron a la consulta de un especialista en farmacia clínica (grupo intervención) mientras que otra clínica similar recibió la atención directa tradicional del médico (grupo control). La medida de resultado primario era conseguir una presión arterial de (<140/90) durante un periodo de seis meses de seguimiento. Se revisaron los historiales médicos de aproximadamente 1,5 años después de la inclusión para evaluar el control a largo plazo de la presión arterial una vez que los pacientes con atención del farmacéutico clínico volvieron a la atención tradicional. Se realizó un análisis multivariante, realizándose un ajuste de las diferencias iniciales de los grupos.
Resultados: Completaron el estudio 113 y 111 personas en los grupos intervención y control, respectivamente. Al final del seguimiento, los individuos atendidos por el farmacéutico clínico tenían más probabilidad de alcanzar el objetivo de presión arterial (64,6%) y de recibir diuréticos tiazídicos (68,1%) que los individuos del grupo control (40,7% y 33,3%), respectivamente). La proporción de pacientes (ajustado, p=0,002 y p<0,001, respectivamente). La proporción de pacientes atendidos por el farmacéutico clínico con presión arterial controlada descendió al 22,2% después de volver a la atención tradicional (p<0,001).
Conclusión: La inclusión de un farmacéutico clínico en la atención de la hipertensión produjo un aumento de control de la presión arterial. La pérdida de control después de cesar en la atención del farmacéutico clínico apoya la existencia de un cambio en el proceso de atención que evite que los pacientes abandonen el seguimiento.

Palabras clave: Presión arterial. Hipertensión. Servicios farmacéuticos. Papel profesional.

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INTRODUCTION

The prevalence of hypertension is estimated to be 28% in North American countries and 44% in European countries.[1] Hypertension accounts for 6% of deaths worldwide.[2] The clinical importance of controlling blood pressure (BP) is widely recognized as the incidence of cardiovascular disease and stroke are reduced with improved BP control.[3-4] Achievement of goal blood pressure in the majority of the population is challenging. Data indicate that less than 30% of persons with hypertension in the United States have their BP controlled to below 140/90 mmHg.[5] A review of surveys on hypertension treatment and control in Europe and North America showed BP control (<140/90 mmHg) was approximately 10% in European countries.[6]

BP control is suboptimal even among patients who receive regular medical care. In a study of five Veterans Affairs clinics in the United States, 75% of patients had documented BP measurements that exceeded national guidelines and less than 7% of hypertension-related visits resulted in an increase in antihypertensive medications.[7] Examination of the third National Health and Nutrition Examination Survey data found that most cases of uncontrolled hypertension occur in patients greater than 65 years of age who had good access to healthcare and relatively frequent contact with physicians.[8] A more intensive approach to hypertension management is warranted.

The utilization of clinical pharmacists to support physicians may facilitate a solution. Studies consistently demonstrate that BP control rates increase when pharmacists are included in hypertension management.[9-12] The role of the pharmacist varies with the practice setting. In many Veterans Affairs medical centers in the United States, physicians refer patients to pharmacist-managed hypertension clinics for long-term BP management and monitoring.[13] In one Veterans Affairs medical center study, hypertensive patients were randomly assigned to a pharmacist-managed hypertension clinic or usual physician care.[9] The clinical pharmacist had prescribing authority and made drug therapy changes, in addition to educating patients. At the end of the six-month study period, 81% of patients in the pharmacist-managed cohort achieved their BP goal compared to 30% of patients in the usual care cohort ($p<0.0001$). Although the clinical pharmacist was very successful in this study, a minority of pharmacists practice in this setting.

Other studies have demonstrated success in hypertension management when clinical pharmacists partner with physicians.[10-12] In this role, clinical pharmacists complete medication histories, educate patients, assess adherence, and answer questions. Additionally, clinical pharmacists evaluate pharmacotherapy and make recommendations to physicians regarding medication changes. BP control rates were significantly greater in patients co-managed by pharmacists and physicians (55% to 60%) compared to patients managed by only physicians (20% to 43%).[10-12] Although the above studies demonstrate improved BP control with clinical pharmacy involvement, it is unknown if BP control is maintained when patients return to usual physician care.

The purpose of this study was to compare hypertension control with clinical pharmacy specialist involvement to traditional physician-directed management in a large health maintenance organization. This study also reviewed whether BP control was maintained after patients returned to traditional physician-directed management without long-term clinical pharmacy specialist follow-up.

METHODS

This was a six-month prospective, parallel evaluation of care processes conducted at a non-profit health maintenance organization covering approximately 385,000 lives in the Denver/Boulder metropolitan area. As risk to patients was considered minimal since patient care was not changed at the medical offices, the study was not reviewed by the Kaiser Permanente Institutional Review Board. Nevertheless, this research was performed in accordance with the Helsinki Declaration of 1975 regarding use of personal health information for program evaluation.

Study enrollment occurred over a six-week period between October 21, 1996 and December 1, 1996. All patients ≥18 years of age who had routine appointments at one KPCO medical office during the enrollment period were eligible for inclusion if they presented with a BP reading ≥140/90 mmHg and were currently taking at least one antihypertensive medication (clinical pharmacy-managed cohort). All patients with uncontrolled hypertension at this medical office were referred by physicians or the nursing staff to the clinical pharmacy specialist for hypertension management. This was considered routine care for patients with hypertension at this medical office. Initial BP elevations were confirmed with a subsequent measurement by the clinical pharmacy specialist prior to enrollment.

Adult hypertensive patients ≥18 years of age who presented to a comparable KPCO medical office (similar number of patients, staff, and physicians, patient socioeconomic status, and geographic location) during the study enrollment period were eligible for inclusion. Patients in this cohort were identified retrospectively from administrative data using the International Classification of Diseases, Ninth Revision diagnosis code 401 for hypertension. Included patients (control subjects) were receiving at least one antihypertensive medication and had presented with a BP reading ≥140/90 mmHg during the study enrollment period. Control subjects received traditional physician-directed care without intervention from a clinical pharmacy specialist and were followed until BP control was achieved

(<140/90 mmHg) or six months had lapsed, whichever came first.

Clinical pharmacy-managed subjects were provided the option to receive follow-up BP monitoring by one of three methods: 1) at the clinic, 2) in their home, or 3) the use of free services offered within the community. Blood pressure monitors (LifeSource Model 3UA702-V) were available for loan to these subjects who wanted to monitor their BP at home but opted not to purchase a kit. Subjects who were loaned BP monitors were allowed to keep the monitors at the end of the study. The clinical pharmacy specialist instructed the subject on the use of the BP cuff and confirmed understanding by patient demonstration. Blood pressure was then taken by auscultation to ensure that self-measured and clinical pharmacy specialist-measured readings were similar (within 2 mmHg).

For those clinical pharmacy-managed subjects interested in checking their own BP within the community, a list of four area community/senior centers was provided. Blood pressures were checked by registered nurses free of charge at these centers. Subjects using either home BP or community monitoring were instructed to phone their readings to the clinical pharmacy specialist at prearranged dates. The readings were used to further evaluate the severity of hypertension and the effectiveness of treatment. Subjects who were not using the above two methods of monitoring were seen in the medical office by the clinical pharmacy specialist. In addition to the subject's BP readings obtained by other healthcare professionals during medical office visits, the clinical pharmacy specialist also measured at least one BP at each visit. Severity of hypertension and effectiveness of treatment were evaluated based on these clinical pharmacy specialist-obtained measurements.

Recommendations for changes in hypertension medications for clinical pharmacy-managed subjects were made by the clinical pharmacy specialist. National guidelines were consulted as a reference,[14] and formulary agents were used preferentially. Laboratory monitoring was also performed by the clinical pharmacy specialist as indicated by the specific medication regimen (e.g., serum potassium was monitored in patients receiving angiotensin-converting enzyme inhibitors). Nonpharmacologic treatments (e.g., diet, exercise) were also recommended when appropriate. The clinical pharmacy specialist determined the subject's follow-up interval. Subjects were contacted if appointments or scheduled phone calls were missed. At a minimum, subjects were seen or reported BPs monthly until BP control was achieved. At the time of the study, blood pressure control was defined as < 140/90 mmHg based on the Fifth Report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (JNC V) regardless of patients other disease states.[14]

Clinical pharmacy-managed subjects' primary care physicians co-signed the clinical pharmacy specialist's notes, approved medication changes, and managed their other medical problems. These subjects were followed for six months or until BP control was achieved, whichever came first. However, if a subject's BP was controlled and subsequently became uncontrolled during the follow-up period, they were referred back to the clinical pharmacy specialist for further hypertension management and reassessed again for achieving BP control at the end of the follow-up period. For subjects referred back to the clinical pharmacy specialist, only the final observation in the follow-up period after referral back to the clinical pharmacy specialist was included in the outcomes analysis.

Outcome Measures and Statistical Analysis

Study variable measures were extracted from medical charts. Age, sex, diabetes status, lowest or latest systolic and diastolic BPs, and BP medications were collected at enrollment (baseline). Lowest or latest systolic and diastolic BPs and BP medications were collected during the six months after enrollment (outcome) and lowest or latest systolic and diastolic BPs were collected at approximately 1.5 year follow-up (long term BP control). The primary study outcome was achievement of a goal BP of < 140/90 mmHg (BP control) during the initial six-month follow-up. Secondary outcome measures included changes in systolic and diastolic BP from baseline, antihypertensive medication use at baseline and follow-up, method of BP monitoring (clinic versus home) at follow-up, and counts of BP-related office visits and telephone interactions during the initial six-month follow-up period. Subjects without a six-month follow-up BP measure were excluded from the controlled and changes in systolic and diastolic BP analyses. Long term BP control was assessed with subjects' lowest blood pressure reading recorded in 1998 (approximately 1.5 years post enrollment). Only subjects with a six-month follow-up BP and a BP reading recorded in 1998 were included in this analysis. In order to assess if a "white coat effect" (i.e., abnormal blood pressure reading when taken by a physician/health care professional and a normal reading with ambulatory or home monitoring)[15] occurred, a sensitivity analysis was performed to compare rates of BP control between the clinical-pharmacy managed (n=52) and control (n=84) subjects who had had their follow-up BP measurement performed in a medical office.

Independent sample t-tests were used to analyze mean differences in interval-level variables (diastolic and systolic BPs, age at enrollment, and counts of BP-related office visits and telephone interactions) between the study cohorts. Associations between nominal-/ordinal-level variables (sex, BP control, BP monitoring location, diabetes status, and hypertension medication use) and the study cohorts were analyzed using chi-square tests. Within groups analysis of long term BP control was performed with the McNemar's test. Multivariate regression analyses were performed to assess the relationships between study cohort and achievement of BP control and changes in systolic and diastolic BP while adjusting for age and gender

and variables with statistically significant between-groups' baseline differences. The alpha level was set at 0.05.

RESULTS

One hundred-thirteen patients were initially enrolled in both the clinical pharmacy-managed and control cohorts. Two subjects in the control cohort died during the study period and were not included in the final analysis. Both subjects' BPs were uncontrolled at the time of death. Twenty-five and zero subjects in the control and clinical pharmacy-managed arms, respectively, did not have follow-up BPs. The mean time to initial follow-up BP reading was 54.0 and 103.9 days in the clinical pharmacy-managed and control cohorts, respectively (p<0.001). The mean age and sex distribution of the clinical pharmacy-managed and control cohorts were equivalent at baseline (Table 1). At baseline, a greater proportion of control subjects had a diagnosis for diabetes (p=0.019) and were treated with alpha blockers (p=0.009), while clinical pharmacy-managed subjects had higher mean baseline systolic (p=0.009) and diastolic (p<0.001) BPs.

Table 1. Baseline Patient Characteristics

Characteristic	Control (n=111)	Clinical Pharmacy-Managed (n=113)	P-value
Mean Age in Years (SD)	64.8 (12.4)	64.5 (11.8)	0.875
Female (%)	58.6	66.4	0.227
Blood Pressure			
Mean Systolic (SD) (mmHg)	159.9 (15.3)	166.2 (20.0)	0.009
Mean Diastolic (SD) (mmHg)	90.2 (10.8)	98.2 (11.2)	< 0.001
Diabetes (%)	19.8	8.9	0.019
Medication (%)			
Thiazide Diuretic	33.3	41.6	0.202
Loop Diuretic	5.4	2.7	0.295
Beta Blocker	35.1	42.5	0.260
ACE Inhibitor	33.3	30.1	0.602
Alpha Blocker	9.9	1.8	0.009
Dihydropyridine Ca++ Blocker	10.8	10.6	0.963
Non- Dihydropyridine Ca++ Blocker	18.0	22.1	0.443
Central Acting Agent	6.3	6.2	0.973

ACE = angiotensin-converting enzyme, Ca++ = calcium, SD = standard deviation

Table 2. Patient Outcomes

Outcome	Control (n=111)	Clinical Pharmacy-Managed	P-value (n=113)
Blood Pressure			
BP Controlled (%)	40.7	64.6	0.002[1]
Mean Systolic mmHg Δ (SD)	-17.6 (21.0)	-28.4 (23.6)	0.048[1]
Mean Diastolic mmHg Δ (SD)	-6.6 (10.7)	-16.5 (11.9)	<0.0011
Medication (%)			
Thiazide Diuretic	33.3	68.1	<0.001
Loop Diuretic	5.4	2.7	0.295
Beta Blocker	36.0	47.8	0.075
ACE Inhibitor	37.8	37.2	0.918
Alpha Blocker	9.0	1.8	0.009
Dihydropyridine Ca++ Blocker	13.5	15.0	0.743
Non- Dihydropyridine Ca++ Blocker	18.0	22.1	0.443
Central Acting Agent	8.1	10.6	0.519
Mean Count of BP-Related Office Visits (SD)	1.8 (0.8)	1.3 (1.0)	0.020
Mean Count of BP-Related Phone Calls (SD)	0.2 (0.7)	1.6 (2.2)	<0.001
Home/Community BP Monitoring (%)	1.8	54.5	<0.001

1 - Adjusted for age, sex, pre-period systolic BP, pre-period diastolic BP, diabetes status, and alpha blocker use
ACE = angiotensin-converting enzyme, BP = blood pressure, Ca++ = calcium, Δ = change, SD = standard deviation

Adjusting for age, sex, pre-period systolic and diastolic BPs, diabetes status, and alpha blocker use, clinical pharmacy-managed subjects were more likely to have achieved BP control at the end of the six-month follow-up compared to control subjects (p=0.002) and had greater mean reductions in systolic (p=0.048) and diastolic (p=<0.001) BPs compared to control subjects (Table 2). Among subjects whose six-month follow-up BP was measured in a medical office, clinical-pharmacy managed subjects (59.6%) were more likely to have achieved BP control compared to control subjects (40.5%) after adjusting for age, sex,

pre-period systolic and diastolic BPs, diabetes status, and alpha blocker use (p=0.018).

After six months of follow-up, a greater proportion of clinical pharmacy-managed subjects were prescribed thiazide diuretics compared to control subjects (p<0.001). Control subjects had a higher mean count of BP-related office visits during the follow-up period compared to clinical pharmacy-managed subjects (p=0.020). This translated into 31 fewer office visits among the clinical pharmacy-managed subjects during the six-month follow-up. In contrast, the mean count of BP-related telephone calls was higher for clinical pharmacy-managed subjects (p<0.001). Additionally, home/community monitoring was utilized more often by clinical pharmacy-managed than control subjects (p<0.001).

Eighty-one (71.7%) clinical pharmacy-managed and 72 (64.7%) control subjects, respectively, had a long term follow-up BP reading recorded in 1998. The mean time to long term BP reading was 613.8 and 532.7 days in the clinical pharmacy-managed and control cohorts, respectively (p<0.001). Blood pressure control decreased long term when clinical pharmacy-managed subjects returned to usual care (p<0.001). Blood pressure control was maintained in only 22.2% and 20.8% of the clinical pharmacy-managed and control subjects, respectively, who had achieved BP control during the 6-month follow-up (p=0.835).

DISCUSSION

In this study, we found that patients managed by a clinical pharmacy specialist achieved greater BP control than patients receiving usual care. Additionally, we found that when clinical pharmacy-managed patients were returned to usual care for long term follow-up, BP control decreased significantly. Hypertension control rates in our study were increased approximately 59% compared to usual physician care and were comparable to the results reported for other studies evaluating the impacts of clinical pharmacy-directed interventions on BP control.[9-12]

One such study compared hypertension management with a physician and pharmacist team approach to usual physician care.[11] Clinical pharmacists met with patients prior to each physician visit to collect a medication history and encourage adherence. Recommendations for antihypertensive drug therapy changes were attached to the patient's medical record. These researchers reported that while 55% of patients in the clinical pharmacy-managed arm achieved BP control, only 20% of subjects in the control arm achieved BP control (p<0.001). In another study, clinical pharmacists reviewed antihypertensive therapy with patients, and made evidence-based recommendations in drug regimens to physicians.[10] With this clinical pharmacy-managed intervention, 65% of patients attained goal BP compared to 43% of patients receiving usual physician care (p=0.02).

Subjects in our study had the option to self monitor their BPs. Almost half of the clinical pharmacy-managed subjects chose this method of BP monitoring. As patients with uncontrolled hypertension who measured their BPs with a self-monitoring device in combination with pharmacist intervention were reported to have had significant improvements in BP control compared to usual care,[12] this method of monitoring may have contributed to better BP control in our study. Nevertheless, when comparing only subjects in our study whose six-month follow-up BP was measured in a medical office, we found that the rate of BP control was still higher in the clinical-pharmacy managed cohort. This finding suggests that other component(s) of the clinical pharmacy specialist-directed intervention was/were the primary contributor(s) to better BP control.

Increased use of home monitoring may have also contributed to our finding of fewer BP-related office visits for subjects in our clinical pharmacy-managed cohort. This finding is noteworthy since the annual rate of medical office visits in the United States is higher for hypertension than for any other chronic condition.[16] By lowering the BP-related office visit rate while simultaneously increasing BP control, a reduction in healthcare costs may be realized.

Subjects in our clinical pharmacy-managed cohort were more likely to receive a thiazide diuretic as treatment for hypertension during the follow-up period. Thiazide diuretics were recommended in previous JNC guidelines[14,17] and are currently recommended as first-line therapy in the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) in patients with uncomplicated hypertension because of their ability to prevent cardiovascular complications.[18] Because of their low acquisition cost compared to other antihypertensive agents, preferential use of thiazide diuretics should also result in health care cost savings.[19] The high rate of thiazide diuretic use (approximately 68%) by intervention subjects indicates that the clinical pharmacy specialist-directed intervention used in our study was consistent with national guidelines.

Importantly, we found that BP control was not maintained when clinical pharmacy-managed subjects were returned to usual care for long term follow up. Improvements in clinical outcomes (e.g., reductions in stroke frequency) require sustained BP control over prolonged periods of time.[18] The loss of BP control after the return to usual care and the 22.5% rate of no follow-up six-month BPs in the control subjects compared to the 0.0% rate in the clinical pharmacy-managed subjects further demonstrate the value of a multidisciplinary, systematic approach to hypertension management where a clinical pharmacy specialist monitors hypertension patients, manages their pharmacotherapy, and prevents them from being lost to follow-up.

This study has several limitations. Subjects were not randomized but were assigned to the clinical pharmacy-managed or control cohort depending upon the medical office they received care. Multivariate analyses were used to adjust for

potential biases that may have resulted from this non-random assignment when evaluating study outcomes. Additionally, we did not have access to race/ethnicity data for our subjects. However, because the majority of hypertension patients receiving care at these medical offices were white, non-Hispanic, commercially-insured Medicare patients, race/ethnicity probably would not have been a factor in our analysis. Also, subjects were managed according to JNC V guidelines, which did not differentiate BP goals in patients with diabetes. Thus, BP was considered controlled in subjects with diabetes when it was <140/90 mmHg. Furthermore, because the count of BP readings was less in the control cohort, it is possible the control cohort had fewer chances for a BP reading that met the desired goal. As some recorded BPs in this study were from subject self-measurement, error in measuring and reporting self-measured BP values may be a source of potential bias. However, as patient-recorded BPs have been shown to be equivalent to monitor-stored values,[20] we are confident that any bias related to BP self-measurement was minimal.

CONCLUSION

This study provides evidence that involvement of clinical pharmacists in hypertension management results in better BP control rates and drug therapy selection that is more consistent with evidence-based guidelines. Additionally, this study demonstrates the need for changes in health care systems that prevent patients from being lost to long term follow-up. Attainment of hypertension control is difficult, therefore innovative strategies for the management of hypertension are needed. The findings from our study suggest that involvement of clinical pharmacists in hypertension management can significantly increase the number of patients who achieve their BP goal.

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