

Cost-effectiveness Evaluation of a Home Blood Pressure Monitoring Program

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Nearly \$51 billion in direct and indirect costs related to hypertension were spent in the United States in 2009, with much of it attributable to the health-related consequences of hypertension.¹ One in 3 adults in the United States has hypertension, and about half of those have uncontrolled blood pressure (BP), putting them at increased risk for acute myocardial infarction, stroke, renal disease, and congestive heart failure.^{1,4} Lowering BP has been shown to reduce the occurrence of these events.⁵

Despite effective therapeutic interventions to control BP, at least a quarter of patients with uncontrolled hypertension receive no pharmacologic treatment. Novel care delivery models using home BP monitoring have demonstrated improved BP control.⁶⁻¹² Demonstrating the benefits, costs, and cost effectiveness of such programs will help clinicians and policy makers to decide whether to invest in these programs.

Investigators at Kaiser Permanente Colorado (KPCO) conducted a randomized, controlled trial to evaluate the effectiveness of a home BP monitoring (HBPM) intervention that used the American Heart Association Heart360 Web interface (www.heart360.org) to send home BP readings to a clinical pharmacy specialist who managed the patient's medication therapy via phone or e-mail communication. The purpose of this study was to determine the cost-effectiveness of the HBPM program compared with usual care.

METHODS

Study Design and Setting

The study was conducted at KPCO, a group-model, closed-panel, nonprofit managed care organization that cares for more than 500,000 members in the Denver-Boulder metropolitan area. Outpatient medical services are provided at 18 primary care clinics spread geographically across the metropolitan area, 10 of which participated in the present study. Each clinic is staffed with 1 or more clinical pharmacy specialists who assist primary care providers with drug therapy management. With regard to hypertension management, clinical pharmacy specialists work under preapproved collaborative drug thera-

ABSTRACT

Objectives

To evaluate the health system cost of a home blood pressure monitoring (HBPM) program versus usual care in an integrated healthcare system.

Study Design

This cost-effectiveness analysis was based upon a previously completed randomized controlled trial of 348 hypertensive patients, in which mean systolic blood pressure (BP) was lowered 21 versus 8 mm Hg in the HBPM and usual care groups, respectively, and BP control was achieved in 54% versus 35% of patients ($P < .001$).

Methods

This analysis compared direct costs from the health plan perspective, including clinic visits, e-mail and telephone encounters, laboratory tests, medications, hospitalizations, and emergency department visits between the 2 groups. Primary outcomes were the incremental hypertension care-related cost of HBPM per mm Hg lowering of systolic BP per patient, per additional BP controlled, and per life-year gained.

Results

Median hypertension-related cost per patient over 6 months was \$455 in the HBPM group and \$179 for usual care ($P < .001$). This increase was attributable to additional e-mail and telephone encounters, greater antihypertensive medication use, additional laboratory monitoring, and the BP monitor. Median total cost per patient was \$1530 and \$1283 for the HBPM and usual care groups, respectively ($P = .034$). The HBPM program increased hypertension-related expenditures by \$20.50 per mm Hg lowering of systolic BP, \$1331 per additional patient achieving BP control at 6 months, and \$3330 per life-year gained.

Conclusions

The HBPM program requires investment in outpatient encounters, medications, and laboratory monitoring, but produces significantly improved BP control.

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py management protocols that permit them to initiate or change antihypertensive medications, adjust medication doses, and order laboratory tests related to medication monitoring. KPCO clinicians use a commercially available EpicCare electronic health record (EHR) as part of routine care delivery. The KPCO EHR has a feature called My Chart which allows patients and their providers to communicate electronically through a password-protected website.

The study was approved by the KPCO Institutional Review Board.

Home BP Monitoring Study

The HBPM study has been described in detail elsewhere.⁸ This was a randomized, controlled study of 348 patients with uncontrolled hypertension randomly assigned to the HBPM program or usual care. Patients in the HBPM group were provided with and trained to use a home BP monitor (Omron HEM-790IT monitor), and they were guided in establishing a Heart360 account and in how to automatically upload BP measurements from their monitor to their Heart360 account. Patients in the HBPM group also met with a clinical pharmacy specialist, who reviewed their current BP medication regimen, provided counseling on lifestyle changes, and adjusted or changed antihypertensive medications, as needed. Patients in the usual care group were instructed to follow up with their primary care physician for BP care. Patients in both groups returned at 6 months for an in-clinic BP measurement. Blood pressure goal was <140/90 mm Hg for all patients, except for those with diabetes mellitus or chronic kidney disease for whom the goal was <130/80 mm Hg. At 6 months, 54% of patients in the HBPM group attained their BP goal, compared with 35% in the usual-care group ($P < .001$). The HBPM group lowered their systolic blood pressure (SBP) by an average of 21 mm Hg compared with 8 mm Hg in the usual care group ($P < .001$).

Cost Measures

The economic analysis was conducted from the health plan perspective over the 6-month study period. Cost inputs included costs of the blood pressure cuff, clinic visits, e-mail and telephone encounters, laboratory tests, medications, hospitalizations, and emergency department (ED) visits. Indirect costs (eg, the administrative costs necessary

for day-to-day operations) were not included as they were not expected to differ between the groups.

Take-Away Points

This study highlights the cost-effective manner in which home-monitoring technology plus clinical pharmacy specialist involvement improves blood pressure (BP) control.

- Patients in the Home Blood Pressure Monitoring (HBPM) program had more overall telephone and email encounters with a pharmacist, but the same number of office visits with a pharmacist, and utilized more antihypertensive medications and laboratory monitoring compared with patients managed through usual care.
- The incremental 6-month cost of this intervention was \$20.50 per mm Hg of systolic BP lowered, \$1331 per additional BP controlled, and \$3330 per life-year gained compared with usual care.
- The incremental costs of this intervention compare favorably with other interventions, largely because the HBPM program was more effective than usual care.

Direct Costs / Data Sources

Healthcare utilization data were collected for 6 months prior to and after study enrollment using administrative databases maintained by KPCO. Data included all outpatient encounters (office visits, telephone contacts, e-mails), laboratory and radiology tests, prescriptions, ambulatory surgery, ED visits, and hospital admissions both within the KPCO system as well as claims for care that occurred outside KPCO. Costs were classified as hypertension-related if the primary *International Classification of Diseases, Ninth Revision, Clinical Modification* code associated with each expenditure was hypertension (401.9); hospitalizations, clinic encounters, and ED visits were reviewed manually to verify accurate categorization. Current procedural terminology codes were used to assign costs according to a fee schedule derived from the 2009 national Medicare fee schedule.¹³ Costs for professional claims were based on billed amounts. Prescriptions billed through insurance were collected during the same time frame, and costs were determined using discounted average wholesale price to approximate Medicare pricing, with the addition of an \$8 dispensing fee.¹⁴

Costs for the initial clinic visit, telephone encounters with a clinical pharmacy specialist, and all e-mail encounters were estimated by multiplying the time spent by each provider type by the hourly wage. Provider compensation rates were taken from the United States Census Bureau wages and compensation 2009 data plus 29.2% to account for benefits.¹⁵ The following hourly rates were used: pharmacist, \$74.14; medical assistant, \$19.39; registered nurse, \$44.09; and physician, \$99.72. The initial clinic visits differed in that the HBPM group required an additional 20 minutes of medical assistant time for training on the home BP monitor, setting up a Heart360

account, and downloading BP readings to the website, plus 20 minutes with a clinical pharmacy specialist to review antihypertensive medications and make any necessary dose adjustments. Based on a survey of the clinical pharmacy specialists participating in the study, pharmacist time was estimated at 10 minutes for each telephone follow-up encounter. E-mails from any provider were estimated at 6 minutes per e-mail encounter. All costs have been adjusted to reflect 2013 dollars using the Consumer Price Index rates for medical costs.¹⁶ The selected home BP monitor or a similar model can be purchased for approximately \$60.¹⁷

Cost-Effectiveness

Direct costs were grouped into the following categories: outpatient encounters (including in-person clinic visits, telephone calls, and e-mail exchanges); outpatient laboratory; pharmacy outpatient; and all other costs (ambulatory surgery, ED, hospitalizations, and outpatient radiology). Total healthcare costs for 6 months prior to enrollment were compared between groups to assess for baseline differences in costs and to adjust for such differences (if present) during the study period. Total and hypertension-related costs during the 6-month study period were calculated to demonstrate the relationship between hypertension-related and total healthcare costs and to capture any unintended increases in healthcare utilization (eg, due to adverse events) related to the study. Three incremental cost-effectiveness ratios (ICERs) were calculated: cost per mm Hg lowering of SBP per patient, cost per controlled BP achieved, and cost per life-year gained. To determine the cost of an additional 1 mm Hg lowering of SBP in a patient, the mean difference in 6-month costs for hypertension care was divided by the mean SBP change in each group. To determine the cost of 1 patient achieving BP control, the mean difference in 6-month hypertension-related costs was divided by the difference in the number of patients achieving control in each group.

Cost per life-year gained was determined by first calculating the discounted life expectancy (DLE) for each patient at baseline and after the intervention using the formula:

$$DLE = \sum_{t=age}^{90} P_s(t)(1 - r_t)^{(t-age)}$$

where $r_t=1.5\%$ is the discount rate for life years,¹⁸ age is the current age of the patient in years, and $P_s(t)$ denotes the probability of surviving until age t .

The survival probabilities are given by:

$$P_s(t) = \prod_{s=age}^{t-1} (1 - MortalityRate(s))$$

where $MortalityRate(s)$ denotes the 1-year risk of death for a patient of age s with the same gender and BP control level as the patient. (The symbol \prod denotes the product operator; for example $\prod_{k=1}^n A_k = A_1 \times A_2 \times \dots \times A_n$). The mortality rates were estimated from life expectancy data based on age, gender, and BP control level.¹⁸ The mortality rate for a patient of age s years was calculated by the formula:

$$MortalityRate(s) = (LifeExp(s + 1) + 1 - LifeExp(s)) / LifeExp(s + 1)$$

where $LifeExp(s)$ is the life expectancy of a patient of age s of the same gender and BP control level; this was determined by linear interpolation or extrapolation from Tables 3, **eAppendix A** and **B** of Franco et al.¹⁹

The mortality rate formula was derived by assuming that deaths occur at the end of each year so that:

$$LifeExp(s) = 1 + (\text{probability of surviving more than 1 year}) (LifeExp(s + 1)) = 1 + (1 - MortalityRate(s)) (LifeExp(s + 1))$$

We calculated the incremental hypertension care costs of the intervention for year 1 of the program plus subsequent years of follow-up. Total hypertension care cost in each group for year 1 was calculated by first estimating the increased cost of antihypertensive medications for the entire year for each patient. To account for expected follow-up needs in the second 6-month period, the costs for non-study-related outpatient encounters in the first 6 months was doubled and an additional e-mail encounter was added for intervention patients. Additional laboratory costs were not added for the second 6-month period because most antihypertensive medications require annual monitoring. To determine the incremental hypertension care cost for each intervention patient in year 1, the mean cost of a usual-care patient was subtracted from the actual cost for each intervention patient. Incremental cost for subsequent years was calculated as the average difference in costs for antihypertensive medication plus laboratory monitoring between groups plus the cost of 3 e-mail encounters in the intervention group.

The discounted cost of intervention for each patient in the intervention group was calculated by the formula

$$DC = c_1 + c_2 \left(\sum_{t=age+1}^{90} P_s(t)(1 - r_c)^{(t-age)} \right)$$

where $r_c = 3\%$ is the discount rate for costs,²⁰ c_1 is the incremental hypertension care cost for intervention patients in year 1 as described above, and c_2 is the incremental cost for each subsequent year.

Subset analyses were performed on the group of patients with diabetes mellitus to calculate the incremental cost-effectiveness ratios for this high-risk group.

Statistical Analysis

Cost comparisons between each group were reported as median and interquartile range values as cost data were not normally distributed. Wilcoxon rank sum was used to determine the significance of the between-group differences in cost. Level of significance was set at an α of 0.05. All statistical analyses were performed using SAS version 9.2 (SAS Institute, Carey, North Carolina).

RESULTS

The average age of the 348 study participants was 60 years; about 60% were male (Table 1). Almost half of the participants had either diabetes mellitus or chronic kidney disease (Table 1).

Compared with patients in the usual care group, patients in the HBPM group had significantly more e-mail (median 5 vs 1, $P < .001$) and telephone (median 4 vs 2, $P < .001$) encounters during the 6-month study period. There were no statistically significant differences between the 2 groups in the number of office visits, ED visits, or hospitalizations over the 6-month study period (Table 2).

There were no statistically significant differences in total costs for the intervention and usual care groups in the 6-month pre-enrollment period ($P = .828$ for total costs). Median total healthcare costs per patient during the 6-month study period were higher in the HBPM group (\$1590) than in the usual care group (\$1283; $P = .008$, Table 3). This difference was largely driven by higher outpatient encounter costs (\$481 vs \$381, $P = .006$) and higher medication costs (\$622 vs \$475, $P = .034$) for HBPM and usual care groups, respectively.

When only considering hypertension-related costs, all major cost categories were higher in the HBPM group (median hypertension-related care cost of \$455 per patient) compared with usual care (median cost \$179; $P < .001$, Table 3). The incremental hypertension-related cost per additional mm Hg reduction in SBP was \$20.50. The in-

cremental hypertension-related cost per patient who achieved BP control was \$1331 (Table 4).

Life expectancy increased in both groups due to lowering of SBP. The mean increase in life expectancy was 1.28 and 1.87 years ($P < .001$) in the control and intervention groups, respectively. The additional cost of providing care through the HBPM was calculated as \$1905, yielding a cost per life-year gained of \$3330 (Table 4).

For the 138 patients with diabetes mellitus, the mean hypertension-related costs in the intervention and control groups were similar to those in the total population (\$479.29 and \$207.74, respectively), but the relative improvements in SBP and the proportion of patients who achieved their target BPs were larger, so the respective ICERs were somewhat smaller (\$16.51 per additional mm Hg lowering of SBP and \$986 per additional controlled BP achieved). This relative greater effect on SBP in diabetes mellitus patients compared with the total population also resulted in a slightly greater gain in life expectancy in the diabetes mellitus study population versus usual care (2.34 vs 1.36 years, respectively, $P < .001$), and a lower cost per life-year gained of \$2272 (Table 4).

DISCUSSION

The HBPM intervention led to higher rates of BP control than usual care with modest increases in healthcare costs. Our study indicates that an investment of \$1331 over 6 months will result in 1 additional patient achieving controlled BP if enrolled in the HBPM program. The incremental hypertension-related cost of 1 additional mm Hg lowering of SBP was only \$20.50, while the cost per life-year gained was \$3330. This seems a worthwhile investment when considering the serious consequences of uncontrolled hypertension, including cardiovascular disease, stroke, and kidney failure, which can be prevented with sustained BP control.^{1,21}

The use of technology to support the care of hypertensive patients has shown promise in other studies as well. A recent meta-analysis of self-measured BP monitoring found strong evidence supporting self-measured BP monitoring combined with additional support versus usual care.²² Kaiser Permanente Northern California also demonstrated the benefit of a multifaceted intervention program to improve hypertension control,²³ with the hypertension control rate improving from 43.6% to 80.4% over an 8-year period. This large-scale program included a comprehensive hypertension registry; development and sharing of performance metrics; evidence-based guidelines; medical assistant visits for BP measurement; and

■ **Table 1. Patient Baseline Characteristics**

Demographic	Intervention N = 175	Usual Care N = 173
Age in years: mean, (SD)	60.0 (11.3)	59.1 (10.9)
Male: n (%)	108 (61.7)	102 (59.0)
Current smoker: n (%)	17 (9.7)	13 (7.5)
Diabetes and/or chronic kidney disease: n (%)	81 (46.3)	88 (50.9)
Hyperlipidemia: n (%)	99 (61.1)	112 (68.3)
Baseline SBP: mean, SD	148.8 (16.2)	145.5 (14.5)
Baseline DBP: mean, SD	89.6 (10.2)	88.0 (9.9)
6-month SBP: mean, SD	128.1 (15.2)	137.4 (14.6)
6-month DBP: mean, SD	79.1 (10.8)	83.1 (9.8)

DBP indicates diastolic blood pressure; SBP, systolic blood pressure.

■ **Table 2. Healthcare Utilization During 6-Month Study Period**

Healthcare utilization	Intervention N = 175	Usual Care N = 173	P
Emergency department visits	6	9	.415
Hospital visits	5	7	.543
Office encounters: median (IQR)	3 (2-4)	3 (2-4)	.660
E-mail encounters: median (IQR)	5 (3-7)	1 (0-4)	<.001
Telephone encounters: median (IQR)	4 (2-7)	2 (1-5)	<.001

IQR indicates interquartile range.

single-pill combination therapy. Another pharmacist-managed home BP telemonitoring program demonstrated improved BP control at 12 months and maintained control for 6 months following the intervention.²⁴ The estimated direct program cost was \$1350 per patient, which included telemonitoring services and care management but excluded patient time, pharmacy, laboratory tests, and nonstudy encounters.²⁴

Only a few economic analyses of technology-enabled hypertension care have been performed. A study of 778 patients at Group Health Cooperative demonstrated a 9 mm Hg lowering of SBP in the group receiving home BP monitoring and Web training plus pharmacist care, compared with usual care.²⁵ The reported ICER per additional 1 mm Hg reduction in SBP was \$65.29,²⁶ which is higher than the \$20.50 in our study, while the cost per life-year gained was \$1850 and \$2220 for men and women, respectively, which is comparable and slightly lower than the \$3330 per life-year gained that we report. Our study's relatively lower cost for the short-term outcome of SBP reduction may be attributable to the relatively lower costs for pharmacist care during the study period, as our electronic interface saved pharmacist time by obviating the need for pharmacists tabulating and averaging BP results, and screening out patients with controlled home BP. The

higher cost per life-year gained in our study is likely due to our inclusion of additional hypertensive care costs for follow-up care beyond the first year. In theory, utilizing a home monitoring system may actually reduce the need for in-person visits, resulting in lower follow-up costs; however, this was not observed over our 6-month study period.

One study of 636 hypertensive patients, which did not include medication costs, reported an ICER per additional 1 mm Hg reduction in SBP of \$107 over 2 years,²⁷ which is considerably higher than in our 6-month study, which would be about \$65 if continued over 2 years. The difference can be partly attributed to a more extensive intervention that included an expensive behavioral component, and partly to the fact that the intervention was less effective than ours. Compared with usual care, the prior study lowered BP by only 3.9 mm Hg compared with 12.5 mm Hg in our study.²⁷ Another study of 496 patients reported an ICER of \$36.25 per additional 1 mm Hg reduction in SBP for a 6-month intervention involving pharmacist and physician collaboration, which was much higher than reported in our study.²⁸ A British study evaluating the cost-effectiveness of home BP monitoring in 441 patients, 400 of whom completed the study and were included in the final analysis, demonstrated a far smaller BP difference compared with our study and concluded BP can be controlled to the

■ **Table 3.** Healthcare Direct Costs During 6-month Study Period

	Intervention N = 175	Usual Care N = 173	P
Total healthcare costs: median (25th, 75th percentile)			
Outpatient laboratory	\$122 (57, 230)	\$113 (27; 211)	.146
Outpatient encounters ^a	\$481 (194, 928)	\$381 (111, 726)	.006
Medications	\$622 (245, 1026)	\$475 (188, 837)	.034
Blood pressure cuff	\$60 (60, 60)	\$0 (0, 0)	<.001
Other ^b	\$0 (0, 391)	\$0 (0, 344)	.323
Total	\$1590 (934, 2841)	\$1283 (681, 2383)	.008
Hypertension-related costs: median (25th, 75th percentile)			
Outpatient laboratory	\$21 (0, 42)	0 (0, 0)	<.001
Outpatient encounters ^a	\$120 (98, 151)	\$15 (15, 15)	<.001
Medications	\$202 (107, 345)	\$130 (57, 244)	<.001
Blood pressure cuff	\$60 (60, 60)	\$0 (0, 0)	<.001
Other ^b	\$0 (0, 0)	\$0 (0, 0)	.159
Total	\$455 (316, 586)	\$179 (95, 282)	<.001

^aOutpatient encounters include office visits, telephone calls, and e-mails.
^bOther costs include ambulatory surgery, emergency department, hospital inpatient, hospital outpatient, and outpatient radiology.

■ **Table 4.** Cost-Effectiveness Analysis of the Home Blood Pressure Monitoring Program

	Total Population		DM Subset	
	Intervention N = 175	Usual Care N = 173	Intervention N = 67	Usual Care N = 71
Mean HTN-related cost per patient	\$467.26	\$211.02	\$470.29	\$207.74
Change in SBP (mm Hg)	-20.7	-8.2	-20.0	-4.1
Cost per mm Hg change in SBP	\$22.57	\$25.73	\$23.51	\$50.67
ICER per additional 1 mm Hg lowering of SBP	\$20.50		\$16.51	
Total HTN-related cost	\$81,771	\$36,506	\$31,509	\$14,749
Number of patients controlled	95	61	40	23
Cost per controlled BP	\$861	\$598	\$788	\$641
ICER per additional controlled BP achieved	\$1331		\$986	
Mean discounted (1.5%) additional lifetime HTN-related cost per patient	\$1965	\$0	\$2332	\$0
Mean discounted (3%) change in life expectancy (years)	1.87	1.28	2.34	1.36
ICER for life-years gained	\$3330 per additional life-year gained		\$2380 per additional life-year gained	

BP indicates blood pressure; DM, diabetes mellitus; HTN, hypertension; ICER, incremental cost-effectiveness ratio; SBP, systolic blood pressure.

same degree with either practice-based self-monitoring or usual care. This study calculated a statistically nonsignificant ICER of about \$9.02 (£5.62) for 1 additional mm Hg reduction in BP.²⁹ The robust results from the HBPM study give rise to the favorable ICER found in our analysis. To place the value of lowering SBP into perspective, note that a 10 mm Hg decrease in SBP reduces coronary heart disease events by 22% and stroke by 42%.³⁰

The advantageous economic results of this cost-effectiveness analysis can be attributed to combining clinical pharmacy specialists with Web-based software and technology to optimize resources and outcomes. Three principles drive the superior effectiveness and resultant favorable cost-effectiveness of the HBPM intervention: 1) right provider and right care: clinical pharmacy specialists are uniquely positioned to apply medication therapy

management skills and have been proved effective in managing patients with hypertension.^{6,31-33} By applying a clinical pharmacy specialist's skills to this population, physician time can be directed where it is needed more; 2) home monitoring: this methodology is more convenient for both patients and providers, and it conserves clinic appointments to serve patients with more complex needs. It also enables more frequent measurements in a setting familiar to the patient, potentially reducing misclassification due to "white-coat" or masked hypertension and prompting more timely action to address elevated BP; and 3) technology efficiency: "The dawning of the information age in ambulatory medicine"³⁴ has the potential to revolutionize the care of patients with hypertension, as demonstrated in this study. The free Web interface used by patients in the HBPM program, Heart360.org, provides education and direct feedback through graphs and charts. The population management software used by providers streamlines provider time by tabulating BP results and notifying providers when measurements fall outside of established goals. The system also generates phone call reminders to patients, ensuring monitoring is uninterrupted.

Some of the strengths of this analysis include the use of outcomes from a randomized controlled clinical trial.⁸ Several other economic analyses extrapolate data from short-term studies with minimal effect on BP or apply a model estimating long-term outcomes. This study also utilizes the freely available Heart360 Web application, which can be applied to many different settings and populations, including those that lack an integrated electronic medical record.

There are some limitations of this study. First, the duration was only 6 months, which included the concentrated care efforts (including telephone and e-mail contacts, medication changes, and laboratory tests) necessary to get a patient's BP under control. The costs of maintenance care after this time period had to be estimated based upon extrapolation of the 6-month data plus estimates of the number of pharmacist contacts needed per year during subsequent years. Second, the generalizability of this cost analysis to a fee-for-service environment may be limited because e-mail and telephone contacts with patients may not be reimbursable. Generalizability to all age groups may be somewhat limited as some elderly patients may not possess the computer skills necessary for this intervention. However, patients in our study ranged in age from 30 to 85 years. Third, this analysis did not take into account potential cost savings from a reduction in cardiac events and long-term complications, nor did it account for indirect or intangible costs such as travel time to clinic or time missed from work that would be relevant to an economic

analysis from the societal perspective. Hemodialysis costs over \$82,000 per person per year³⁵ and the cost of care for a patient for the first 90 days following a stroke is about \$15,000.³⁶ The inclusion of these cost elements would make the results even more favorable for the HBPM group, but even without their inclusion, the cost of \$3330 per life-year gained is favorable when compared with other societal interventions in the United States.³⁷

CONCLUSION

The HBPM program demonstrates clinically and statistically significant reductions in BP at an incremental cost of \$20.50 per additional mm Hg lowering of SBP, an incremental cost of \$1331 per additional BP controlled, and a cost of \$3330 per life-year gained. The additional costs were attributed to additional encounters with clinical pharmacy specialists, antihypertensive medications, and laboratory monitoring. Future studies of this or similar programs are needed to determine the cost of maintaining such a program over longer time periods.

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