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Modeling the Health and Budgetary Impacts of a Team-based Hypertension Care Intervention That Includes Pharmacists

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Abstract

Objective: The objective of this study was to assess the potential health and budgetary impacts of implementing a pharmacist-involved team-based hypertension management model in the United States.

Research Design: In 2017, we evaluated a pharmacist-involved team-based care intervention among 3 targeted groups using a microsimulation model designed to estimate cardiovascular event incidence and associated health care spending in a cross-section of individuals representative of the US population: implementing it among patients with: (1) newly diagnosed hypertension; (2) persistently (≥ 1 year) uncontrolled blood pressure (BP); or (3) treated, yet persistently uncontrolled BP—and report outcomes over 5 and 20 years. We describe the spending thresholds for each intervention strategy to achieve budget neutrality in 5 years from a payer's perspective.

Results: Offering this intervention could prevent 22.9–36.8 million person-years of uncontrolled BP and 77,200–230,900 heart attacks and strokes in 5 years (83.8–174.8 million and 393,200–922,900 in 20 years, respectively). Health and economic benefits strongly favored groups 2 and 3. Assuming an intervention cost of \$525 per enrollee, the intervention generates 5-year budgetary cost-savings only for Medicare among groups 2 and 3. To achieve budget neutrality in 5 years across all groups, intervention costs per person need to be around \$35 for Medicaid, \$180 for private insurance, and \$335 for Medicare enrollees.

Conclusions: Adopting a pharmacist-involved team-based hypertension model could substantially improve BP control and cardiovascular outcomes in the United States. Net cost-

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savings among groups 2 and 3 make a compelling case for Medicare, but favorable economics may also be possible for private insurers, particularly if innovations could moderately lower the cost of delivering an effective intervention.

Keywords

patient care team; hypertension; pharmacist; cost and cost analysis; economics; blood pressure; cardiovascular; disease; medicare; medicaid

The association between increased blood pressure (BP) and cardiovascular disease (CVD) risk has been well established, with increases in systolic blood pressure (SBP) being the greatest predictor of elevated risk.^{1–3} Hypertension affects ~29% of US adults, and despite a substantial number of pharmacologic options to lower BP and potentially reverse risk for CVD, only about half of US adults with hypertension have their BP controlled.⁴ Furthermore, around 90% of the 40.2 million US adults with uncontrolled BP report having a usual source of health care.^{5,6} Team-based care interventions, which incorporate a multidisciplinary team of health care professionals to deliver more personalized patient-centered care, have been found to be an effective approach to improving BP control.^{7,8} In particular, recent evidence indicates that involving pharmacists on the care team can significantly improve control.^{7,9,10}

A recent study by Dehmer et al⁸ estimated that nationwide adoption of a program involving referral of patients with treated but persistently uncontrolled BP to adjunct care by a team that included a pharmacist or nurse could over 10 years: improve the BP control rate by 10 percentage points, prevent over 600,000 CVD events, reduce associated health care costs borne by payers, and in some cases generate net budgetary savings, specifically for Medicare. This study builds on this previous work in 4 important ways. First, it examines the impact of a team-based hypertension management intervention involving a pharmacist, which is an evidence-based but underutilized model of team-based care.¹¹ Second, the intervention is targeted among 3 different patients groups commonly encountered in clinical practice to assess for differences in expected health outcomes and costs. Third, compared with the previous study which only reported 10-year impacts among the overall target population, this analysis reports differential impacts across age-stratified and race-stratified subgroups over 5 years in the primary analysis—a shorter timeframe that is often of interest to payers—as well as over 20 years in the supplemental analysis to better assess how upfront costs are matched by downstream benefits. Finally, a break-even analysis was conducted to determine how varying select key parameters would affect costs borne by the various payers, and whether or when budget neutrality might occur from a specific payer's perspective.

METHODS

Analyses were conducted in 2017 using the HealthPartners Institute ModelHealth: Cardiovascular disease (ModelHealth: CVD) microsimulation model. Methods to estimate risk of disease outcomes and costs in ModelHealth: CVD were consistent with those used by Dehmer et al.⁸ Briefly (see Methods, Supplemental Digital Content 1, <http://links.lww.com/MLR/B874>), the model iterates through annual cycles simulating the lifespan and natural history of CVD among a dynamic cohort of 100,000 individuals representative

of the United States. Hypothetical individuals enter the analytic frame at age 35 years and exit the model either by reaching age 100 years or through a CVD-related or non-CVD-related death.

Population-based survey data were used to develop the initial demographic characteristics (American Community Survey), employment-related characteristics (Current Population Surveys), and CVD risk profile (National Health and Nutrition Examination Survey and National Health Interview Survey) of the baseline population (Table 1).⁸ Disease outcomes were predicted by 1-year risk equations estimated specifically for the model from Framingham Heart Study data. Event risk was based on age, sex, body mass index, SBP, blood cholesterol levels, smoking status, and history of CVD. Incident and ongoing disease costs from a previous event were differentiated and estimated from actual expenditures by using Medical Expenditure Panel Survey data (see Table 1, Supplemental Digital Content 1, <http://links.lww.com/MLR/B8748>). Initial insurance status was derived from Current Population Survey data and year-to-year transitions were determined from Survey of Income and Program Participation data. Primary health outcomes reported include the number of person-years with uncontrolled BP (defined as SBP \geq 140 mm Hg) and the number of incident myocardial infarctions, strokes, and total CVD-related events and deaths.¹³ Economic outcomes reported include intervention costs, CVD-related costs, and net budgetary costs borne by payers, such as Medicaid, Medicare, and private insurers. All monetary measures are presented in 2012 US dollars.

A hypothetical intervention was designed to involve referral to a team-based hypertension management program involving a pharmacist, where the pharmacist worked with the patient to improve their medication adherence and could adjust the patient's medication regimen to improve their BP. An updated literature search was conducted to identify randomized-controlled trials (RCTs) examining team-based hypertensive care interventions with pharmacists published through 2016. Further details of the search and on the methods used to derive the effectiveness of the interventions are included in the Supplemental Methods (see Supplemental Digital Content 1, <http://links.lww.com/MLR/B874>).⁸ From the 20 RCTs identified from our search,^{14–33} we estimated and assumed the average benefit of participating in the team-based intervention involving pharmacists was an 8.5 mm Hg reduction in SBP. As many adults with hypertension have other risk factors for CVD or chronic conditions (eg, dyslipidemia)—and hypertension is unlikely to be managed in isolation—we assumed our intervention led to an average 8.1 mg/dL reduction in low-density lipoprotein cholesterol and had no effect on high-density lipoprotein cholesterol among patients taking medications for lipid management based on studies of similar interventions that measured these outcomes (see Methods, Supplemental Digital Content 1, <http://links.lww.com/MLR/B874>).^{22,26,34–36}

The intervention was targeted and evaluated among 3 separate groups of adults aged 35 years or older: group 1, all newly diagnosed hypertensive patients; group 2, patients, regardless of treatment status, with persistent, uncontrolled hypertension, defined as SBP \geq 140 mm Hg for \geq 1 year; and group 3, patients included in group 2 who had adhered to treatment (ie, taking medication) for $>$ 1 year, but remained uncontrolled (ie, the approach used in Dehmer et al's⁸ previous publication). As in the previous study, we assumed that

90% of persons offered the program participated, the persisting treatment effect in each subsequent year would be 80% of the previous year, and patients in groups 2 and 3 were eligible to re-enroll in the program every 5 years if their BP remained or became uncontrolled.⁸ Furthermore, we assumed the intervention involved an average of 1-hour long intake visit, three 15-minute in-person visits, and eight 15-minute phone visits in 1 year, with an average annual cost of \$525 per person enrolled.⁸ The costs incurred were in addition to the usual care costs of managing hypertension, which was assumed to be the same regardless of the addition of the intervention.

For each targeted group, the model generated outcomes in 2 otherwise parallel simulation arms over 5 years and, for the supplemental analysis, over 20 years—1 arm received the intervention and the other arm did not. Health impacts and costs reflect the difference between these 2 arms and are representative of and scaled to the US population aged 35 years or older. Furthermore, the intervention cost, intervention effectiveness, or disease costs were varied to estimate threshold values at which each of the payers could break even in terms of achieving budget neutrality in 5 years when implementing the intervention among each group.

RESULTS

Our initial simulated cohort consisted of 162.8 million adults aged 35 years or older (Table 1). Among the baseline population, 20.0% had uncontrolled BP, with 44.5% of those receiving pharmacologic treatment. At the time of enrollment, characteristics of the program enrollees differed by implementation strategy. Persons enrolled in group 1 (N = 25.8 million) were younger, less obese, had a higher proportion of persons enrolled with private insurance, and had a lower mean SBP, a lower proportion of persons treated for elevated low-density lipoprotein cholesterol, and a lower proportion of persons diagnosed with CVD (Table 1). Persons enrolled in groups 2 (N = 33.2 million) and 3 (N = 30.2 million) were similar across demographics and health characteristics.

Five years after intervention implementation, we would expect to reduce uncontrolled BP by 22.9, 36.8, and 32.8 million person-years when targeting groups 1–3, respectively (Table 2). The intervention had the largest effect on reducing myocardial infarctions (91,900), strokes (139,000), and CVD deaths (115,400) for group 2. The intervention had a slightly lower impact on these health outcomes for group 3 (3%–11% less compared with group 2), and considerably less impact (45%–75% less compared with group 2) for group 1. Patterns observed in the health impacts were similar across age and racial/ethnic groups for each of the targeted groups (Table 3). We estimated that the largest reductions in person-years with uncontrolled BP and CVD events would take place among Medicare beneficiaries in targeted groups 2 and 3, but not in group 1, for which the greatest reductions were among persons with private insurance.

Overall, the net cost per person enrolled (ie, total cost of the intervention minus costs averted by preventing events divided by the total population receiving the intervention) was considerably lower when implemented among groups 2 and 3 at \$156 and \$141 per person, respectively, compared with group 1, which was almost double at \$322 per person (Table 2).

Similarly, the net cost per person achieving BP control was more favorable among persons in groups 2 and 3 (\$246 and \$223 vs. \$690 in group 1). The disease costs averted over 5 years fall short of the costs of delivering the intervention for all age and race-ethnic subgroups except among persons aged 75 years or older across all targeted groups (Table 4). Examining cost impacts disaggregated by payer indicates that disease costs averted outweigh the intervention costs over 5 years among Medicare beneficiaries only for groups 2 and 3 (net savings/enrollee of \$62 and \$61, respectively). Whereas, the net cost of the intervention, when implemented among group 1, was estimated to be \$190 per person enrolled. For the other major payers (ie, private insurers and Medicaid), the intervention would not yield cost-savings for any of the targeted groups over 5 years. Net costs per person enrolled range from \$291 to \$346 for private insurers and were higher for Medicaid (range: \$454–\$493).

Table 5 presents results from the break-even analysis for each targeted group over 5 years. The most direct means to achieve budget neutrality would be to deliver the intervention at a lower cost per enrollee. For Medicare, intervening among persons with persistently uncontrolled BP (groups 2 and 3) would be cost-saving; however, when directed towards patients with newly diagnosed hypertension (group 1), the intervention cost would have to be below \$335 per enrollee to be cost-saving; or, alternatively, the effectiveness of the intervention would need to be 65% higher or disease costs would need to be 60% higher. Private insurers could break-even in 5 years if the intervention could be delivered at or below \$180, \$220, or \$230 per enrollee for each of the 3 targeted groups, respectively. For Medicaid, the intervention would have to be delivered at \$35, \$70, and \$55 per enrollee, respectively. Similarly, the net balance in costs over 5 years could be affected by the magnitude in disease costs that could be averted. We found that disease treatment costs would need to greatly exceed the average to achieve cost neutrality for private insurers and Medicaid (range from +125% to +1505%). Achieving cost-savings for these payers through a more effective intervention would require average improvements in SBP > 20 mm Hg.

From the supplemental analysis, which assessed the effects of the intervention over 20 years, we would expect to reduce the number of person-years with uncontrolled BP by 83.8, 174.8, and 157.8 million person-years in the targeted groups 1–3, respectively (see Table, Supplemental Digital Content 2, <http://links.lww.com/MLR/B875>). Similar to our primary analyses, implementing the intervention among group 2 had the largest health and economic impact. Over 20 years, the disease costs averted outweigh the cost of the intervention for targeted groups 2 and 3 for Medicare and private insurers.

DISCUSSION

This analysis demonstrates that broad implementation of a team-based care intervention involving a pharmacist among patients with newly diagnosed hypertension or persistently uncontrolled BP could prevent at least 22.9 million person-years of uncontrolled BP, 40,600 heart attacks, 36,600 strokes, and 63,400 CVD deaths over 5 years in the United States. Targeting the intervention among patients with persistently uncontrolled BP (groups 2 and 3) likely will generate greater health impacts compared with targeting newly diagnosed hypertensive patients (group 1), and should achieve cost-savings for Medicare within 5 years (~\$0.9 billion). The greater impact (ie, prevented events and reduced health care spending)

of the intervention when implemented among groups 2 and 3 was driven largely by the baseline CVD risk of the targeted populations eligible for the intervention, as patients in groups 2 and 3 tended to be older and have higher baseline BPs compared with group 1. Enrollees with Medicare coverage had the lowest net intervention cost per enrollee across all targeted groups due to their higher age and BP at baseline that resulted in relatively more preventable events by way of intervention.

Achieving budget neutrality or cost-savings within 5 years is likely an important consideration for health plans considering widespread use of this intervention among its enrollees; however, these thresholds were not achieved across most of the payer types and among each targeted group. Finding a more effective intervention is an unlikely approach to achieve budget neutrality in 5 years across all payer types, as attaining a SBP reduction of > 20 mm Hg is only supported by 2 of the studies used to inform the intervention effect size applied in this study (range across studies: 3.5–27.5 mm Hg).^{14–18,20,22–33} However, it does appear possible to deliver a similarly effective intervention at a lower cost than the \$525 per enrollee assumed in this study. For example, an economic analysis by the Community Preventive Services Task Force found that based on evidence from 20 studies, the median team-based intervention cost was \$284 per enrollee.³⁷ If the intervention cost could be lowered to \$180 through the use of existing or emerging technology (eg, electronic health records, web-based/smartphone communications, etc.),⁹ net savings could be attained within 5 years for Medicare and private insurers across all targeted groups. For example, tailoring the duration of the intervention to each patient's need to achieve BP control could substantially reduce the resources needed to deliver an effective intervention.³⁸ Although this may be outside the time horizon important to most payers, sustaining the intervention over 20 years yields cost-savings for Medicare and private insurers among all targeted groups. The intervention would have to be offered at a considerably lower cost to achieve budget neutrality for Medicaid programs regardless of the group or timeframe used. However, the societal benefits of improving BP control among Medicaid enrollees, a younger population who typically has a greater health and economic burden of hypertension and other chronic diseases compared with similarly aged peers, may support the intervention's use even if achieving budget neutrality is likely unattainable.³⁹

High-performing multidisciplinary care teams are emerging as essential tools for more patient-centered, coordinated, and effective health care delivery systems.⁴⁰ Integrating pharmacists on teams and allowing them to provide care to the full extent of their professional training, can help address shortages in primary care clinician and cardiologist availability while promoting safe medication use and optimizing therapeutic outcomes.^{11,41–43} As members on a multidisciplinary team, pharmacists can provide: comprehensive medication management (ie, initiating, modifying, synchronizing, and discontinuing medication to address identified problems), education on proper use of medication regimens, and additional opportunities for patient screening and assessment (ie, identifying barriers to adherence and measuring BP to ensure BP control goals are being achieved).

Although there is compelling evidence demonstrating that team-based care models with pharmacists are effective in improving BP control, variation exists in how these models are constructed and used.^{7,37} For example, in the 20 RCTs assessed for this study,^{14–33}

pharmacist involvement in medication management differed, in that some pharmacists could act autonomously (ie, they could initiate, change, or discontinue medications independent of the primary care clinician); whereas, others could provide recommendations and/or make changes with the primary care clinician's approval. In addition, how pharmacists were included on the team differed, as some were embedded directly on the team as an employee of a practice or health care system; whereas others were community pharmacists who participated in the team via other mechanisms. For example, community pharmacists can establish collaborative practice agreements with a practice or health care systems, which can support the delivery of collaborative care by identifying which functions are delegated to pharmacists, specifying how care will be coordinated, and establishing trust between pharmacists and primary care clinicians by following a mutually agreed upon, evidence-based protocol.^{5,44} Although having heterogeneity in how teams are constructed and used may be appropriate to account for differences in the needs and preferences of the patient populations being managed, this heterogeneity could lead to variation in the outcomes assessed in this study. Hence, there is likely benefit for continued study on how to optimize use of team-based care models with pharmacists for hypertension management to achieve the greatest health and economic benefits across diverse patient populations.

Pharmacists can contribute considerably to value-based payment reform as they can help better align the services provided by the primary care team with specific pay-for-performance metrics, such as those for clinical services or medication utilization.⁴⁵ For instance, pharmacists have the opportunity to offer and extend their services with several improvement activities in Centers for Medicare and Medicaid Services merit-based incentive payment system. These include, but are not limited to, medication management practice improvements and implementation of chronic disease self-management support program.⁴⁶ Furthermore, in 2016, Centers for Medicare and Medicaid Services unveiled a new enhanced medication therapy management initiative to better integrate pharmacists in the Medicare Part D program in an effort to improve medication choices, adherence, and ultimately, health outcomes among seniors.⁴⁷

Although this study builds on Dehmer and colleagues' previous work by providing findings specific to the use of a team-based model of care involving pharmacists—a considerably underutilized evidence-based intervention¹¹—it shares many of the same potential limitations as the earlier report.⁸ First, we are limited by our model assumptions related to the design, costs, and effects of the intervention, as well as, to the adherence to the intervention. As described above, components of a team-based care intervention (ie, team members, health care settings, eligible population, protocols, etc.) differed among the studies used to develop our effect size, and the average effect size used in our model may not be applicable for different populations or settings. Second, we required patients to meet specific conditions to be eligible for our targeted groups; however, these stipulations were not always prerequisites employed in the studies we derived the effects of our interventions from. Third, while findings for 5- and 20-year time horizons provide a better understanding how upfront costs are offset by downstream benefits, the latter may not be as meaningful to some payers because of high enrollee churn (eg, Medicaid) or shorter-term planning horizons (eg, private insurers). Fourth, the assumption of a 90% participation rate was chosen to reflect a potentially plausible “full uptake” of the intervention but may be “stretch” goal for many

settings. If the intervention had less reach but was delivered in a way that the group of patients selected to receive the intervention had a similar distribution of CVD risk and likelihood of benefitting from the intervention as those who received the intervention in our main analyses, then the overall results would simply scale down with no changes in findings for the net-cost-per-patient and break-even analyses. For example, if participation was 70% rather than the assumed 90%, the intervention costs and averted disease costs would be about 22% lower, but their relative scales and break-even points would remain unchanged. However, this assumption is not valid if the intervention was delivered among a group of patients whose overall characteristics differed from those of the originally selected patients (eg, if targeted to patients with higher baseline CVD risk). Finally, the current analysis does not apply the criteria outlined within the newly released 2017 American College of Cardiology and American Heart Association Hypertension Guideline,⁴⁸ which lowered the recommended BP thresholds to initiate pharmacology therapy and to achieve BP control used in this study.¹³ Lowering these thresholds would increase the number of patients receiving the intervention in each targeted group and lead to additional events being prevented. However, it could produce a less advantageous net change in disease costs as the population newly eligible for the interventions would likely be at lower risk for having an event compared with those previously eligible.

This analysis shows that the adoption of a team-based hypertension management model of care involving pharmacists could greatly improve BP control rates and CVD outcomes in the United States across all 3 groups assessed. The greatest health and budgetary benefits were produced when the intervention was implemented among patients with persistently uncontrolled BP, leading to cost-savings for Medicare within 5 years. Private insurers could achieve budget neutrality by lowering intervention costs or implementing the intervention over a longer time horizon. Including pharmacists on care teams and allowing them to practice to the full extent of their professional training can support the medication management of hypertension, as well as other chronic conditions, leading to improved health for patients while remaining economically feasible.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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TABLE 1.

Baseline Characteristics of the Simulated US Population Cross-Section and Program Participants Who Enrolled Within the First 5 Years, Adults 35 Years or Older

Characteristics	Baseline Value	Target Group 1 (Newly Diagnosed Hypertension)	Target Group 2 (Persistently Uncontrolled Blood Pressure)	Target Group 3 (Treated, But Persistently Uncontrolled Blood Pressure)
Population size (millions) *	162.8	25.8	33.2	30.2
SBP (mean) (mm Hg) [†]	126.0	145.3	153.4	152.8
% uncontrolled BP [‡]	20.0	100.0	100.0	100.0
% treated [‡]	21.7	0	93.2	100.0
Treated SBP (mean) (mm Hg)	141.7	NA	152.6	152.8
% treated but uncontrolled	44.5	0	100.0	100.0
Age (%) *				
35–44	25.8	12.0	7.2	5.9
45–54	27.4	26.1	18.3	17.5
55–64	22.4	30.5	27.9	27.2
65–74	13.3	20.6	24.7	26.0
75+	11.2	10.8	21.8	23.4
Female (%) *	52.3	52.5	57.6	58.6
Insurance status (%) [§]				
Private	53.1	47.4	37.8	35.9
Medicaid	4.1	4.0	3.1	2.8
Medicare	25.0	30.5	44.4	47.2
Uninsured	15.1	14.8	12.3	11.7
Other/multiple	2.7	3.3	2.5	2.4
BMI (mean) (kg/m ²) [†]	29.1	28.9	29.9	29.9
% overweight	73.3	73.5	77.3	77.4
% obese	41.4	40.0	46.0	46.0
LDL (mean) (mg/dL) [†]	120.6	120.6	120.4	119.3
% over the treatment goal	28.4	43.2	49.4	49.0

Characteristics	Baseline Value	Target Group 1 (Newly Diagnosed Hypertension)	Target Group 2 (Persistently Uncontrolled Blood Pressure)	Target Group 3 (Treated, But Persistently Uncontrolled Blood Pressure)
% treated	22.2	32.0	39.2	42.6
Smokers (%) [#]	16.4	17.1	14.2	13.8
Diabetes (%) [‡]	18.9	23.1	26.5	26.6
Previous CVD (%) [‡]	13.0	15.7	20.0	20.9

^{*} *Source:* American Community Survey (ACS).

[‡] *Source:* National Health and Nutrition Examination Survey (NHANES).

[‡] Uncontrolled BP is defined as systolic BP 140 mm Hg. Treated refers to the proportion of persons with systolic BP 140 mm Hg and on antihypertensive medication.

[§] *Source:* Current Population Survey (CPS).

^{//} Overweight is defined as BMI 25 kg/m² and obese is defined as BMI 30 kg/m².

[¶] LDL treatment goals were based on risk categories presented in Table 5 of the Adult Treatment Panel (ATP) III Therapeutic Lifestyle Guidelines.¹²

[#] *Source:* National Health Interview Survey (NHIS).

BMI indicates body mass index; BP, blood pressure; CVD, cardiovascular disease; LDL, low-density lipoprotein; NA, not applicable; SBP, systolic blood pressure.

TABLE 2.

Health and Cost Impacts of Implementing the Team-based Care Hypertension Intervention Involving Pharmacists on a Simulated Sample Representative of the US Population Over 5 Years Compared With Usual Care, by Targeted Population Group

	Target Group 1 (Newly Diagnosed Hypertension)	Target Group 2 (Persistently Uncontrolled Blood Pressure)	Target Group 3 (Treated, But Persistently Uncontrolled Blood Pressure)
Person-years with uncontrolled BP (millions) *	-22.9	-36.8	-32.8
Incident myocardial infarction (thousands)	-40.6	-91.9	-87.8
Incident stroke (thousands)	-36.6	-139.0	-134.5
Incident cardiovascular death (thousands)	-63.4	-115.4	-107.9
Disease costs (billions USD)	-5.3	-12.3	-11.6
Intervention costs (billions USD)	13.6	17.4	15.9
Net cost per person enrolled (USD)	322	156	141
Net cost per person achieving BP control (USD)	690	246	223

* Uncontrolled blood pressure was defined as systolic blood pressure \geq 140 mm Hg. BP indicates blood pressure.

TABLE 3.

Health Impacts of the Team-based Hypertension Program Involving Pharmacists Compared With Usual Care Over 5 Years Among the 3 Targeted Population Groups, by Age Group, Race/Ethnic Group, and Health Insurance Type

Targeted Population *	Age Group (y)						Race/Ethnicity			Health Insurance Type		
	35-44	45-54	55-64	65-74	75+	NH-White	NH-Black	Hispanic	Other	Private Insurance	Medicare	Medicaid
Persons enrolled (millions)												
Group 1	3.3	6.4	7.7	5.5	3.0	17.2	4.0	3.2	1.4	12.3	7.9	1.0
Group 2	2.5	5.5	9.0	8.5	7.8	22.0	6.2	3.1	1.9	12.5	14.8	1.0
Group 3	1.8	4.7	8.1	8.1	7.6	20.2	5.5	2.8	1.7	10.9	14.3	0.9
Person-years with uncontrolled BP (millions) †												
Group 1	-2.3	-5.7	-7.4	-5.0	-2.7	-15.5	-3.5	-2.8	-1.2	-11.2	-6.6	-0.8
Group 2	-3.2	-6.8	-10.5	-8.8	-7.6	-24.5	-6.5	-3.7	-2.2	-15.6	-13.8	-1.1
Group 3	-2.2	-5.6	-9.3	-8.3	-7.4	-22.0	-5.6	-3.2	-2.0	-13.2	-13.3	-1.0
Incident myocardial infarction (thousands)												
Group 1	0	-1.8	-21.8	-5.9	-11.2	-31.4	-2.9	-3.6	-2.6	-23.4	-16.1	0
Group 2	0	-3.2	-24.3	-23.2	-41.3	-66.1	-14.3	-4.7	-6.9	-26.5	-61.7	0
Group 3	0	0	-24.3	-23.2	-40.3	-66.1	-12.6	-4.1	-5.1	-24.8	-60.8	0
Incident stroke (thousands)												
Group 1	0	-0.8	-13.2	-6.2	-16.4	-24.5	-5.8	-4.5	-1.9	-14.6	-22.1	0
Group 2	0	0	-16.6	-36.0	-86.3	-103.7	-17.7	-10.7	-6.9	-32.6	-103.3	-0.6
Group 3	0	0	-16.6	-35.5	-82.4	-99.9	-17.1	-10.7	-6.9	-32.6	-98.8	-0.6
Incident cardiovascular death (thousands)												
Group 1	0	0	-9.0	-30.5	-24.0	-53.5	-3.4	-5.8	-0.7	-12.1	-51.0	0
Group 2	-0.9	0	-32.8	-22.3	-59.4	-86.1	-14.9	-8.8	-5.6	-43.8	-67.4	-0.9
Group 3	-0.9	0	-25.6	-22.3	-59.1	-79.3	-14.5	-8.6	-5.6	-36.9	-66.8	-0.9

* Implement and evaluate the effects of the intervention among population group 1: patients with newly diagnosed hypertension; population group 2: patients with persistently uncontrolled blood pressure; and population group 3: patients with treated, but persistently uncontrolled blood pressure.

† Uncontrolled blood pressure was defined as systolic blood pressure ≥ 140 mm Hg.

BP indicates blood pressure; NH, non-Hispanic.

TABLE 4.

Budgetary Impacts of the Team-based Hypertension Program Involving Pharmacists Compared With Usual Care Over 5 Years among the 3 Targeted Groups, by Age Group, Race/Ethnic Group, and Health Insurance Type

Strategy Used*	Age Group (y)						Race/Ethnicity			Health Insurance Type		
	35-44	45-54	55-64	65-74	75+	NH-White	NH-Black	Hispanic	Other	Private Insurance	Medicare	Medicaid
Disease costs (billions USD)												
Group 1	0	-0.2	-1.7	-1.1	-2.1	-3.7	-0.5	-0.8	-0.3	-2.2	-2.6	0
Group 2	0	-0.5	-2.3	-3.2	-6.3	-8.8	-1.7	-0.9	-0.9	-2.8	-8.7	-0.1
Group 3	0	-0.3	-2.1	-3.1	-6.1	-8.4	-1.6	-0.9	-0.8	-2.6	-8.4	-0.1
Intervention costs (billions USD)												
Group 1	1.7	3.3	4.0	2.9	1.6	9.0	2.1	1.7	0.7	6.4	4.1	0.6
Group 2	1.3	2.9	4.7	4.5	4.1	11.6	3.2	1.6	1.0	6.6	7.8	0.5
Group 3	0.9	2.5	4.2	4.3	4.0	10.6	2.9	1.5	0.9	5.7	7.5	0.5
Net cost (billions USD)												
Group 1	1.3	2.6	1.8	1.6	-0.6	4.4	1.3	0.7	0.3	3.3	1.3	0.5
Group 2	1.3	2.4	2.4	1.3	-2.2	2.8	1.5	0.7	0.1	3.8	-0.9	0.4
Group 3	0.9	2.2	2.1	1.2	-2.1	2.2	1.3	0.6	0.1	3.1	-0.9	0.4
Net cost per person enrolled (USD)												
Group 1	518	438	242	235	-132	313	340	294	300	346	190	493
Group 2	518	401	228	119	-228	128	245	233	63	301	-62	454
Group 3	530	421	229	114	-223	109	239	216	80	291	-61	466
Net cost per person achieving BP control (USD) [†]												
Group 1	1345	926	508	498	-278	657	861	665	680	730	395	1252
Group 2	704	582	348	208	-415	200	414	347	98	431	-110	704
Group 3	721	613	348	199	-406	170	405	326	122	417	-108	706

* Implement and evaluate the effects of the intervention among population group 1: patients with newly diagnosed hypertension; population group 2: patients with persistently uncontrolled blood pressure; and population group 3: patients with treated, but persistently uncontrolled blood pressure.

[†] Controlled BP was defined as systolic BP <140 mm Hg.

BP indicates blood pressure; NH, non-Hispanic.

TABLE 5.

Results of Break-even Analysis Demonstrating Threshold Values of Key Parameters to Achieve Budget Neutrality Within 5 Years Among the 3 Targeted Groups, by Payer Type

Modeling Parameters by Payer	Break-even Thresholds to Achieve Budget Neutrality		
	Target Group 1 (Newly Diagnosed Hypertension)	Target Group 2 (Persistently Uncontrolled Blood Pressure)	Target Group 3 (Treated, But Persistently Uncontrolled Blood Pressure)
Private Insurance			
Intervention cost per enrollee (\$)	180	220	230
Intervention effect on SBP (mm Hg)	>20.0	>20.0	>20.0
Change in disease costs (\pm %) *	+195	+135	+125
Medicare			
Intervention cost per enrollee (\$)	335	585	585
Intervention effect on SBP (mm Hg)	14.0	7.5	8.0
Change in disease costs (\pm %) *	+60	-10	-10
Medicaid			
Intervention cost per enrollee (\$)	35	70	55
Intervention effect on SBP (mm Hg)	>20.0	>20.0	>20.0
Change in disease costs (\pm %) *	+1505	+635	+645

* These values represent the change in the cost to care for the events prevented that would be required to offset the costs of the intervention and achieve budget neutrality.

SBP indicates systolic blood pressure.