Resource Pack:

Cost-Effectiveness of Screening and Treatment for Hypertension

https://repository.chds.hsph.harvard.edu/repository/collection/resource-pack-new-blood-pressure-guidelines-in-us

Overview

Hypertension is a relevant example for teaching clinical decision making, diagnostic test performance, positivity criterion, and cost-effectiveness analysis. This resource pack provides examples of decision analyses and cost-effectiveness analyses for the management and treatment of hypertension, with a predominant focus on the U.S. Analyses are included that predate the 2017 American College of Cardiology/American Heart Association Clinical Practice Guidelines, along with more recent examples that followed release of the guidelines. Resources are also included that provide an overview of empiric data underlying the 2017 guidelines and that review the main differences between the 2014 and 2017 guidelines.

Newer analyses include cost-effectiveness analyses evaluating strategies for clinic, home, or ambulatory blood pressure measurement, pharmacist prescribing for managing hypertension, screening and treatment of masked hypertension, and intensive vs. standard blood pressure control among older patients.
Selected Resources – At a Glance

**Article. Cost-Effectiveness of Intensive vs. Standard Blood Pressure Control Among Older Patients**
https://doi.org/10.1001%2Fjamanetworkopen.2023.0708

**Article. Cost-Effectiveness of Pharmacist Prescribing for Managing Hypertension**
https://doi.org/10.1001%2Fjamanetworkopen.2023.41408

**Article. Cost-Effectiveness of Masked Hypertension Screening and Treatment**

**Article. Systematic Review of Patient Preferences, Expectations, and Values for Management and Treatment of Hypertension**

**Article. Cost-Effectiveness of Hypertension Treatment by Pharmacists in Black Barbershops**
Bryant KB, Moran AE, Kazi DS et al. Cost-Effectiveness of Hypertension Treatment by Pharmacists in Black Barbershops. Circulation 2021; 143: 2384-2394. https://doi.org/10.1161/CIRCULATIONAHA.120.051683

**Article. Cost-Effectiveness of Clinic, Home, or Ambulatory Blood Pressure Measurement for Hypertension Diagnosis**
https://doi.org/10.1161/hypertensionaha.118.11715

**Article. Association of BP Classification Using 2017 Guidelines with Cardiovascular Events Later in Life**
Yano Y, Reis JP, Colangelo LA et al. Association of Blood Pressure Classification in Young Adults Using the 2017 American College of Cardiology/American Heart Association Blood Pressure Guideline with Cardiovascular Events Later in Life. JAMA 2018; 320 (17): 1774. 
https://jamanetwork.com/journals/jama/fullarticle/2712542

**Article. Association of Hypertension Guidelines with Cardiovascular Events and Deaths in US Adults**

https://doi.org/10.1016/j.jacc.2016.11.004

Article. Benefit and Harm of Intensive Blood Pressure Treatment: Derivation and Validation of Risk Models Using Data from the Sprint and Accord Trials

Article. Benefits and Harms of Intensive Blood Pressure Treatment in Adults Aged 60 Years or Older
Not Open Access

Article. Cost-Effectiveness of Intensive versus Standard Blood-Pressure Control

Guidelines. Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults

Article. Cost-Effectiveness of Screening for Hypertension and Counseling for Prevention

Article. Personalizing the Intensity of Blood Pressure Control, Modeling the Heterogeneity

Guidelines. Summary: 2017 Guideline for Management of High Blood Pressure in Adults

Article. Cost-Effectiveness of Blood Pressure Treatment Guidelines in Adults 35-74
Article. Cost-Effectiveness of Intensive Blood Pressure Management  

Article. Cost-Effectiveness of Hypertension Therapy According to 2014 Guidelines  

Article. Cost-Effectiveness of Blood Pressure Screening in Adolescents in the U.S.  
Not Open Access

Article. Cost-Effectiveness of First-Step Treatment for Hypertension: ALLHAT Trial  
Not Open Access

Article. Cost-Effectiveness Analysis of Hypertension Guidelines in South Africa  
Annotated Bibliography

Article. Cost-Effectiveness of Intensive vs. Standard Blood Pressure Control Among Older Patients
CHDS repository link: https://repository.chds.hsph.harvard.edu/repository/3979
This economic analysis explored the cost-effectiveness of intensive vs standard blood pressure control in older hypertensive patients between 60 and 80 years in China, the US, and the UK. Treatment outcome data from the Trial of Intensive Blood-Pressure Control in Older Patients with Hypertension (STEP trial) and different cardiovascular risk assessment models for a hypothetical cohort of STEP-eligible patients were used. Costs and utilities were obtained from published sources.
A Markov model was used to estimate quality-adjusted life-years (QALYs), costs, and incremental cost-effectiveness ratios (ICERs). Two treatment approaches were compared: one targeting systolic blood pressure at 110-130 mm Hg and the other at 130-150 mm Hg. The analysis used a healthcare payer's perspective.
The results showed that intensive blood pressure control produced fewer cardiovascular events and was associated with incremental cost-effectiveness ratios that were well below the cost per QALY gained, reflecting typical willingness-to-pay thresholds in each of the countries. These general results were consistent across sensitivity and subgroup analyses.

Article. Cost-Effectiveness of Pharmacist Prescribing for Managing Hypertension
CHDS repository link: https://repository.chds.hsph.harvard.edu/repository/3982
This study estimates the cost-effectiveness of implementing a pharmacist-prescribing intervention to improve blood pressure control in the US. A cost-effectiveness analysis was conducted using a Markov model based on the pharmacist-prescribing intervention used in The Alberta Clinical Trial in Optimizing Hypertension (or RxACTION). Outcomes included cardiovascular (CV) events, end-stage kidney disease events, life years, quality-adjusted life years (QALYs), lifetime costs, and lifetime incremental cost-effectiveness ratio (ICER). Costs were based on reimbursement rates, published literature, national surveys and pricing data sets. Quality of life was from published EQ-5D utility values.
Over a 30-year time horizon, the pharmacist-prescribing intervention yielded 2,100 fewer cases of CV disease and 8 fewer cases of kidney disease per 10,000 patients. The cost savings were $10,162 per person due to fewer CV events with the pharmacist-prescribing intervention, even after the cost of the visits and medication adjustments. At the population level, a 50% intervention uptake was associated with a $1.14 trillion in cost savings and would save an estimated 30.2 million life years over 30 years.
Article. Cost-Effectiveness of Masked Hypertension Screening and Treatment
CHDS repository link: https://repository.chds.hsph.harvard.edu/repository/3981
The study assessed the health and economic outcomes of screening and treating masked hypertension in U.S. adults using the Cardiovascular Disease (CVD) Policy Model, a microsimulation model. The model simulated 100,000 adults suspected of having masked hypertension (office blood pressure [BP] of 120–129/<80 mm Hg, not on antihypertensive medications, and without a history of CVD).
Interventions included: usual care alone, usual care with ambulatory BP monitoring (ABPM), and usual care with home BP monitoring (HBPM). Outcomes included total direct healthcare costs (in 2021 USD), quality-adjusted life years (QALYs), and incremental cost-effectiveness ratios, with future costs and QALYs discounted at 3% annually. Secondary outcomes included the number of CVD events and serious adverse events related to treatment.
The results indicated that adding ABPM or HBPM to usual care could prevent 14.3 and 20.5 CVD events per 100,000 person-years, respectively, although was associated with an increase in treatment-related serious adverse events and an increase in mean total costs. Compared with usual care, adding ABPM was estimated to cost $85,200 per QALY gained, but adding HBPM resulted in lower QALYs than usual care due to increased treatment-related adverse events and pill-taking disutility.

Article. Systematic Review of Patient Preferences, Expectations, and Values for Management and Treatment of Hypertension
CHDS repository link: https://repository.chds.hsph.harvard.edu/repository/3983
This analysis summarized the evidence on the preferences, expectations, and values of hypertension management and treatment in hypertensive patients. The authors reviewed 24 studies involving 8,701 participants. Despite varying areas of focus, common themes included (1) patients often obtain hypertension information from their physicians and prefer shared patient-centered decision-making, and (2) side effects, cost, and convenience are important factors for patients when selecting a treatment regimen for hypertension.

Article. Cost-Effectiveness of Hypertension Treatment by Pharmacists in Black Barbershops
Bryant KB, Moran AE, Kazi DS et al. Cost-Effectiveness of Hypertension Treatment by Pharmacists in Black Barbershops. Circulation 2021; 143: 2384-2394. https://doi.org/10.1161/CIRCULATIONAHA.120.051683
CHDS repository link: https://repository.chds.hsph.harvard.edu/repository/3980
The Los Angeles Barbershop Blood Pressure Study (LABBPS) examined the effectiveness and cost of a one-year pharmacist-led hypertension care intervention in Black-owned barbershops in Los Angeles County, focused on non-Hispanic Black men with uncontrolled hypertension. Using a discrete event simulation, the researchers projected the 10-year health outcomes and health care costs associated with the intervention compared to a control group. The costs and quality-adjusted life-years (QALYs) were calculated from a health care sector perspective, with future costs and QALYs discounted at 3% annually.
The results showed that over 10 years, the intervention had an incremental cost-effectiveness ratio of $42,700 per QALY gained. Further, there was a high probability (58%) of it being highly cost-effective (<$50,000 per QALY) and an even higher probability (96%) of being at least intermediately cost-effective (less than $150,000 per QALY). The cost-effectiveness improved significantly when only generic drugs were used, and was reduced if pharmacists spent more time traveling to barbershops.

Article. Cost-Effectiveness of Clinic, Home, or Ambulatory Blood Pressure Measurement for Hypertension Diagnosis
https://doi.org/10.1161/hypertensionaha.118.11715
CHDS repository link: https://repository.chds.hsph.harvard.edu/repository/3984
This study compared three methods of blood pressure (BP) measurement for diagnosing hypertension in primary care settings, accounting for the possibility of false-positive (white-coat hypertension) and false-negative (masked hypertension) clinic measurements. Outcomes included quality-adjusted life years (QALYs) and lifetime costs associated with clinic BP measurement, home BP monitoring, and ambulatory blood pressure monitoring (ABPM) under two scenarios: positive and negative initial screening. Data were from published literature, public data sources, and expert input.

In the screen-positive scenario, ABPM was the dominant strategy among all age and sex groups. Compared with clinic BP measurement, this strategy was associated with cost-savings ranging from $77 to $5,013 depending on age. In the screen-negative scenario, ABPM was also the dominant strategy in all men and women with cost-savings ranging from $128 to $2,794 depending on age. Sensitivity analyses showed that results were sensitive to test specificity and antihypertensive medication costs.

Article. Association of BP Classification Using 2017 Guidelines with Cardiovascular Events Later in Life
Yano Y, Reis JP, Colangelo LA et al. Association of Blood Pressure Classification in Young Adults Using the 2017 American College of Cardiology/American Heart Association Blood Pressure Guideline with Cardiovascular Events Later in Life. JAMA 2018; 320 (17): 1774.
https://jamanetwork.com/journals/jama/fullarticle/2712542
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CHDS repository link: http://repository.chds.hsph.harvard.edu/repository/3317
This article aimed to assess whether young adults who developed hypertension, defined by the 2017 American College of Cardiology (ACC)/American Heart Association (AHA) blood pressure (BP) guideline, before age 40 years have higher risk for CVD events compared with those who maintained normal BP. The study enrolled 5115 African American and white participants aged 18 to 30 years from 4 US field centers. Each participant was categorized as having normal BP (n = 2574); elevated BP (n = 445); stage 1 hypertension (n = 1194); or stage 2 hypertension (n = 638). The outcomes of the study were fatal and nonfatal coronary heart disease (CHD), heart failure, stroke, transient ischemic attack, or intervention for peripheral artery disease (PAD).

The results indicated that over a median follow-up of 18.8 years, 228 incident CVD events occurred (CHD, 109; stroke, 63; heart failure, 48; PAD, 8). CVD incidence rates for normal BP, elevated BP, stage 1 hypertension, and stage 2 hypertension were 1.37, 2.74, 3.15, and 8.04 per 1000 person-years, respectively. Based on these findings the authors concluded that, among young adults, those with elevated blood pressure, stage 1 hypertension, and stage 2 hypertension before age 40 years, as defined by the blood pressure classification in the 2017 American College of Cardiology/American Heart Association (ACC/AHA) guidelines, had
significantly higher risk for subsequent cardiovascular disease events compared with those with normal blood pressure before age 40 years. The ACC/AHA blood pressure classification system may help identify young adults at higher risk for cardiovascular disease events.

**Article. Association of Hypertension Guidelines with Cardiovascular Events and Deaths in US Adults**


Not Open Access

CHDS repository link: [http://repository.chds.hsph.harvard.edu/repository/3315](http://repository.chds.hsph.harvard.edu/repository/3315)

This article aimed to compare the 2017 American College of Cardiology/American Heart Association hypertension guideline to the 2014 evidence-based hypertension guideline in terms of the proportion of US adults defined as being hypertensive or recommended for antihypertensive treatment and with risk reduction of major cardiovascular disease (CVD) and all-cause mortality.

Results indicated that, according to the 2017 hypertension guideline, the prevalence of hypertension (BP level ≥130/80 mm Hg) was 45.4%, representing 105.3 million US adults, which was significantly higher than estimates per the 2014 hypertension guideline (BP level ≥140/90 mm Hg): 32.0% or 74.1 million individuals, respectively. Additionally, the proportion of individuals recommended for antihypertensive treatment was significantly higher according to the 2017 hypertension guideline compared with the 2014 hypertension guideline.

Achieving the 2017 hypertension guideline SBP treatment goals is estimated to reduce 610,000 CVD events and 334,000 total deaths in US adults 40 years and older. Corresponding estimates after achieving the 2014 hypertension guideline SBP treatment goals were 270,000 and 177,000, respectively. Implementing the 2017 hypertension guideline is estimated to increase 62,000 hypotension and 79,000 acute kidney injury or failure events. Based on these findings the authors concluded that, compared with the 2014 hypertension guideline, the 2017 hypertension guideline was associated with an increase in the proportion of adults recommended for antihypertensive treatment and a further reduction in major CVD events and all-cause mortality, but a possible increase in the number of adverse events in the United States.


CHDS repository link: [http://repository.chds.hsph.harvard.edu/repository/3019](http://repository.chds.hsph.harvard.edu/repository/3019)

This report presents evidence on effective strategies to enhance the adoption of clinical practice guidelines from the published literature. This report was produced as part of a larger effort to update existing clinical practice guidelines on cholesterol, blood pressure, and overweight/obesity that the National Heart, Lung, and Blood Institute convened in 2008.

The authors conducted a systematic review on 4 questions focused on the adoption and effectiveness of 4 interventions: (1) reminders, (2) educational outreach visits, (3) audit and feedback, and (4) provider incentives. Strategies of audit and feedback and educational outreach visits were generally found to be
effective in improving care and clinical outcomes. Reminders and provider incentives evidence showed mixed effectiveness or were found ineffective.

The authors could reach no general conclusion about cost effectiveness, but important gaps were found on the effectiveness of implementation interventions, specifically regarding clinical outcomes, cost effectiveness and contextual issues affecting successful implementation.

**Article. Benefit and Harm of Intensive Blood Pressure Treatment: Derivation and Validation of Risk Models Using Data from the Sprint and Accord Trials**


CHDS repository link: [http://repository.chds.hsph.harvard.edu/repository/2738](http://repository.chds.hsph.harvard.edu/repository/2738)

Intensive blood pressure (BP) treatment can avert cardiovascular disease (CVD) events but can cause some serious adverse events. The authors sought to create risk calculators to estimate individual patients’ chances of benefit and harm from intensive treatment.

They developed statistical models of cardiovascular events and serious adverse events from individual participant data from the Systolic Blood Pressure Intervention Trial (SPRINT) of intensive blood pressure treatment (N = 9,069 with complete covariate data) and validated them on individual participant data from the ACCORD-BP trial of intensive blood pressure treatment (N = 4,498 with complete covariate data). They used the models to calculate the absolute reduction in probability of CVD events (benefit) and absolute increase in probability of serious adverse events (harm) for individuals from intensive BP treatment. They found that the models could identify groups with high and with low absolute risk reduction in cardiovascular events and, similarly, identify groups with high and with low absolute risk increase in serious adverse events.

**Article. Benefits and Harms of Intensive Blood Pressure Treatment in Adults Aged 60 Years or Older**


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CHDS repository link: [http://repository.chds.hsph.harvard.edu/repository/2735](http://repository.chds.hsph.harvard.edu/repository/2735)

Recent guidelines recommend a systolic blood pressure (SBP) goal of less than 150 mm Hg for adults aged 60 years or older, but the balance of benefits and harms is unclear in light of newer evidence. The purpose of this study was to systematically review the effects of more versus less intensive BP control in older adults.

Authors reviewed 21 randomized, controlled trials comparing BP targets or treatment intensity, and 3 observational studies that assessed harms. Nine trials provided high-strength evidence that BP control to less than 150/90 mm Hg reduces mortality (relative risk [RR], 0.90 [95% CI, 0.83 to 0.98]), cardiac events (RR, 0.77 [CI, 0.68 to 0.89]), and stroke (RR, 0.74 [CI, 0.65 to 0.84]). Six trials yielded low- to moderate-strength evidence that lower targets (≤140/85 mm Hg) are associated with marginally significant decreases in cardiac events (RR, 0.82 [CI, 0.64 to 1.00]) and stroke (RR, 0.79 [CI, 0.59 to 0.99]) and non-significantly fewer deaths (RR, 0.86 [CI, 0.69 to 1.06]). Low- to moderate-strength evidence showed that lower BP targets do not increase falls or cognitive impairment.

Treatment to at least current guideline standards for BP (<150/90 mm Hg) substantially improves health outcomes in older adults. There is less consistent evidence, largely from 1 trial targeting SBP less than 120
mm Hg, that lower BP targets are beneficial for high-risk patients. Lower BP targets did not increase falls or cognitive decline but are associated with hypotension, syncope, and greater medication burden.

**Article. Cost-Effectiveness of Intensive versus Standard Blood-Pressure Control**


CHDS repository link: [http://repository.chds.hsph.harvard.edu/repository/3314](http://repository.chds.hsph.harvard.edu/repository/3314)

Based on data from the Systolic Blood Pressure Intervention Trial (SPRINT), the authors of this article compared the cost-effectiveness of intensive versus standard control in adults at high risk for cardiovascular disease who received intensive systolic blood-pressure control. A microsimulation model was used to project lifetime costs of treatment and monitoring, cardiovascular disease events and subsequent treatment costs, treatment-related risks of serious adverse events and subsequent costs, and quality-adjusted life-years (QALYs) for the two strategies.

Results demonstrated that the mean number of QALYs would be 0.27 higher among patients who received intensive control than among those who received standard control and would cost approximately $47,000 more per QALY gained if there were a reduction in adherence and treatment effects after 5 years; the cost would be approximately $28,000 more per QALY gained if the treatment effects persisted for the remaining lifetime of the patient. Intensive treatment would be cost-effective (51 to 79% below the willingness-to-pay threshold of $50,000 per QALY and 76 to 93% below the threshold of $100,000 per QALY), regardless of whether treatment effects were reduced after 5 years or persisted for the remaining lifetime.

Based on these findings the authors conclude that intensive systolic blood-pressure control prevented cardiovascular disease events and prolonged life and did so at levels below common willingness-to-pay thresholds per QALY, regardless of whether benefits were reduced after 5 years or persisted for the patient’s remaining lifetime.

**Guidelines. Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults**


CHDS repository link: [http://repository.chds.hsph.harvard.edu/repository/2733](http://repository.chds.hsph.harvard.edu/repository/2733)

In 2013, the National Heart, Lung, and Blood Institute (NHLBI) Advisory Council recommended that the NHLBI focus specifically on reviewing the highest-quality evidence and partner with other organizations to develop recommendations. Accordingly, the ACC and AHA collaborated with the NHLBI and stakeholder and professional organizations to complete and publish four guidelines in the domain of cardiovascular health, including this guideline.

In 2014, the American College of Cardiology (ACC) and American Heart Association (AHA), in partnership with several other professional societies, initiated a guideline on the prevention, detection, evaluation, and management of high blood pressure (BP) in adults. Under the management of the ACC/AHA Task Force, a Prevention Subcommittee was appointed to help guide development of the suite of guidelines on prevention of cardiovascular disease (CVD). These guidelines, which are based on systematic methods to evaluate and classify evidence, provide a cornerstone for quality cardiovascular care. They include recommendations about the assessment of cardiovascular risk, lifestyle modifications to reduce
cardiovascular risk, management of blood cholesterol in adults, and management of overweight and obesity in adults.

About half of U.S. adults are now considered to have high blood pressure under new guidelines. That’s up from 32%, or 72 million, under older guidelines. Most of those added people will be urged to change their diets, exercise more and make other lifestyle changes, rather than take medication. The guidelines also call on patients already in treatment to work toward the lower goal – a reading of no more than 130/80, down from the old standard, 140/90.

**Article. Cost-Effectiveness of Screening for Hypertension and Counseling for Prevention**


CHDS repository link: [http://repository.chds.hsph.harvard.edu/repository/3323](http://repository.chds.hsph.harvard.edu/repository/3323)

This article aimed to compare the health and economic impact of 3 services recommended by the US Preventive Services Task Force for the primary prevention of cardiovascular disease (CVD): (1) aspirin counseling for the primary prevention of CVD and colorectal cancer, (2) screening and treatment for lipid disorders (usually high cholesterol), and (3) screening and treatment for hypertension.

A microsimulation model was used to compare lifetime outcomes from the societal perspective for a U.S-representative birth cohort of 100,000 persons with and without access to each clinical preventive service. Primary outcomes of the model included lifetime quality-adjusted life years (QALYs) and cost-effectiveness, measured in incremental cost per QALY or cost savings per person in 2012 dollars. Results were also presented for population subgroups defined by sex and race/ethnicity.

The findings indicated that the health impact was highest for hypertension screening and treatment (15,600 QALYs) but was closely followed by cholesterol screening and treatment (14,300 QALYs). Aspirin counseling had a lower health impact (2,200 QALYs) but was found to be cost saving ($31 saved per person). Cost-effectiveness for cholesterol and hypertension screening and treatment was $33,800 per QALY and $48,500 per QALY, respectively. Findings favored hypertension over cholesterol screening and treatment for women, and opportunities to reduce disease burden across all services were greatest for the non-Hispanic black population.

Based on these findings the authors concluded that all 3 CVD preventive services continue to rank highly among other recommended preventive services for US adults, but individual priorities can be tailored in practice by taking a patient's demographic characteristics and clinical objectives into account.

**Article. Personalizing the Intensity of Blood Pressure Control, Modeling the Heterogeneity**

Patel KK, Arnold SV, Chan PS et al. Personalizing the Intensity of Blood Pressure Control, Modeling the Heterogeneity of Risks and Benefits from SPRINT (Systolic Blood Pressure Intervention Trial). Circulation: Cardiovascular Quality and Outcomes 2017; 10 (4). [https://doi.org/10.1161/CIRCOUTCOMES.117.003624](https://doi.org/10.1161/CIRCOUTCOMES.117.003624)

CHDS repository link: [http://repository.chds.hsph.harvard.edu/repository/2736](http://repository.chds.hsph.harvard.edu/repository/2736)

The Systolic Blood Pressure Intervention Trial (SPRINT) suggests that, on average, hypertensive patients at high cardiovascular risk would have less cardiovascular morbidity and mortality but higher treatment-related adverse events with an intensive blood pressure treatment strategy as compared with a standard blood pressure treatment strategy. Applying these population-level results to individual patients is challenging, as each patient may have different benefits and risks than the average patient in SPRINT.
Using patient-level data from SPRINT, the authors developed risk prediction models that estimate an individual patient’s risk of major adverse cardiovascular events or death and treatment-related Serious Adverse Events (SAEs) with intensive or standard BP control. This allowed for individualized BP treatment goals based on each patient’s projected risk and benefit of intensive versus standard BP control. Models were internally validated using bootstrap resampling and externally validated on 4,741 patients from an independent trial.

Application of these models could potentially be used to support clinicians and patients in selecting a treatment strategy based on the patient’s specific risk factors and treatment preferences, thereby targeting treatment to those most likely to benefit and minimizing potential risk.

**Guidelines. Summary: 2017 Guideline for Management of High Blood Pressure in Adults**


CHDS repository link: [http://repository.chds.hsph.harvard.edu/repository/2734](http://repository.chds.hsph.harvard.edu/repository/2734)

This report from the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines provides a detailed summary of the 2017 Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults.

**Sections:**

- Important Statistics
- Diagnosing Hypertension
- Measurement of BP
- Patient Evaluation and History
- Hypertensive Crises: Urgency vs Emergency
- Laboratory Tests and Other Diagnostic Procedures
- Out-of-Office Monitoring of BP
- Masked and White Coat Hypertension
- Treating Hypertension
- Blood Pressure Goal for Patients with Hypertension
- Drug Therapy
- Lifestyle Therapy
- Follow-up and Patient Adherence to Treatment
- Hypertension in Patients with Comorbidities
- Blood Pressure Components, Risk, and Comorbidities of Hypertension
- Coexistence of Hypertension and Related Chronic Conditions
- Prevalence and Lifetime Risk of Hypertension
- Special Patient Groups
- Primary Causes of Hypertension
- Secondary Causes of Hypertension
- Community Strategies to Improve Quality of Care
- Improving Quality of Care for Patients
In this article the authors used the CVD Policy Model to compare the cost-effectiveness of conservative versus intensive blood pressure treatment guidelines in adult hypertensive patients aged 35 to 74 years. Outcomes included in the study were CVD events, treatment costs, quality-adjusted life years, and drug and monitoring costs projected over the years 2016 to 2026.

The effectiveness and costs of hypertension were calculated for treatment according to the 2003 Joint National Committee (JNC)-7 or 2014 JNC8 guidelines, and then for adults aged ≥ 50 years, the authors assessed the cost-effectiveness of adding an intensive goal of systolic blood pressure < 120 mm Hg for patients with CVD, chronic kidney disease, or 10-year CVD risk ≥ 15%. Results indicated that JNC7 strategies treated more patients and were costlier to implement compared with JNC8 strategies. Adding intensive systolic blood pressure goals for high-risk patients prevented an estimated 43,000 and 35,000 annual CVD events incremental to JNC8 and JNC7, respectively.

Intensive strategies saved costs in men and were cost-effective in women compared with JNC8 alone. At a willingness-to-pay threshold of $50,000 per quality-adjusted life years gained, JNC8-intensive had the highest probability of cost-effectiveness in women (82%) and JNC7-intensive the highest probability of cost-effectiveness in men (100%). Assuming higher drug and monitoring costs, adding intensive goals for high-risk patients remained consistently cost-effective in men, but not always in women.

Based on these findings the authors concluded that among patients aged 35 to 74 years, adding intensive blood pressure goals for high-risk groups to current national hypertension treatment guidelines prevents additional CVD deaths while saving costs, provided that medication costs are controlled.

This article compared the cost-effectiveness of hypertension treatment in non-Hispanic blacks and non-Hispanic whites according to 2014 US hypertension treatment guidelines. The cardiovascular disease (CVD) policy model was used to simulate CVD events, quality-adjusted life years (QALYs), and treatment costs in 35- to 74-year-old adults with untreated hypertension. CVD incidence, mortality, and risk factor levels were obtained from cohort studies, hospital registries, vital statistics, and national surveys. The authors assumed a willingness-to-pay for health of $50,000/QALY.

Results indicated that treating 0.7 million hypertensive non-Hispanic black adults would prevent about 8,000 CVD events annually; treating 3.4 million non-Hispanic whites would prevent about 35,000 events. Overall, 2014 guideline implementation would be cost saving in both groups compared with no treatment. For stage 1 hypertension but without diabetes or chronic kidney disease, cost savings extended to non-Hispanic black males ages 35-44 but not same-aged non-Hispanic white males (ICER $57,000/QALY) and cost-effectiveness extended to non-Hispanic black females ages 35-44 (ICER $46,000/QALY) but not same-aged non-Hispanic white females (ICER $181,000/QALY).
Based on these findings the authors concluded that compared with non-Hispanic whites, cost-effectiveness of implementing hypertension guidelines would extend to a larger proportion of non-Hispanic black hypertensive patients.

**Article. Cost-Effectiveness of Intensive Blood Pressure Management**
CHDS repository link: [http://repository.chds.hsph.harvard.edu/repository/3321](http://repository.chds.hsph.harvard.edu/repository/3321)

This article aimed to evaluate the cost-effectiveness of intensive blood pressure management compared with standard management among 68-year-old high-risk adults with hypertension but not diabetes. A Markov cohort model was developed to estimate lifetime costs and quality-adjusted life-years (QALYs) discounted at 3% annually. The Systolic Blood Pressure Intervention Trial (SPRINT) was used to estimate treatment effects and adverse event rates. The authors used Centers for Disease Control and Prevention Life Tables to project age- and cause-specific mortality, calibrated to rates reported in SPRINT. They also used population-based observational data to model development of heart failure, myocardial infarction, stroke, and subsequent mortality. Costs were based on published sources, Medicare data, and the National Inpatient Sample.

Results indicated that standard management yielded 9.6 QALYs and accrued $155,261 in lifetime costs, while intensive management yielded 10.5 QALYs and accrued $176,584 in costs. Intensive blood pressure management cost $23,777 per QALY gained. In a sensitivity analysis, serious adverse events would need to occur at 3 times the rate observed in SPRINT and be 3 times more common in the intensive management arm to prefer standard management. Based on these findings the authors concluded that intensive blood pressure management is cost-effective at typical thresholds for value in health care and remains so even with substantially higher adverse event rates.

**Article. Cost-Effectiveness of Hypertension Therapy According to 2014 Guidelines**
CHDS repository link: [http://repository.chds.hsph.harvard.edu/repository/3313](http://repository.chds.hsph.harvard.edu/repository/3313)

Because many eligible adults with hypertension in the United States remain untreated, the authors of this article projected the cost-effectiveness of treating hypertension in U.S. adults according to the 2014 guidelines. The Cardiovascular Disease Policy Model was used to simulate drug-treatment and monitoring costs, costs averted for the treatment of cardiovascular disease, and quality-adjusted life-years (QALYs) gained by treating previously untreated adults between the ages of 35 and 74 years from 2014 through 2024.

Cost-effectiveness results were presented according to age, hypertension level, and the presence or absence of chronic kidney disease or diabetes. The results indicated that the full implementation of the new hypertension guidelines would result in approximately 56,000 fewer cardiovascular events and 13,000 fewer deaths from cardiovascular causes annually, which would result in overall cost savings. The projections showed that the treatment of patients with existing cardiovascular disease or stage 2 hypertension would save lives and costs for men between the ages of 35 and 74 years and for women between the ages of 45 and 74 years.

The treatment of men or women with existing cardiovascular disease or men with stage 2 hypertension but without cardiovascular disease would remain cost-saving even if strategies to increase medication adherence doubled treatment costs. The treatment of stage 1 hypertension was cost-effective (defined as
<50,000 per QALY) for all men and for women between the ages of 45 and 74 years, whereas treating women between the ages of 35 and 44 years with stage 1 hypertension but without cardiovascular disease had intermediate or low cost-effectiveness. Based on these findings, the authors conclude that the implementation of the 2014 hypertension guidelines for U.S. adults between the ages of 35 and 74 years could potentially prevent cardiovascular events and deaths, while saving costs. Controlling hypertension in all patients with cardiovascular disease or stage 2 hypertension could be effective and cost-saving.

**Article. Cost-Effectiveness of Blood Pressure Screening in Adolescents in the U.S.**


Not Open Access

CHDS repository link: [http://repository.chds.hsph.harvard.edu/repository/3312](http://repository.chds.hsph.harvard.edu/repository/3312)

This article compares the long-term effectiveness and cost-effectiveness of 3 approaches to managing elevated blood pressure (BP) in adolescents in the United States. These approaches are (1) no intervention, (2) "screen-and-treat," and (3) population-wide strategies to lower the entire BP distribution.

The authors obtained BP distributions from the National Health and Nutrition Examination Survey 1999-2004 and used childhood-to-adult longitudinal correlation analyses to simulate the tracking of BP. They then used the coronary heart disease policy model to estimate lifetime coronary heart disease events, costs, and quality-adjusted life years (QALY) for a cohort of 15-year-old U.S. adolescents.

The results showed that among screen-and-treat strategies, finding and treating the adolescents at highest risk (e.g., left ventricular hypertrophy) was most cost-effective ($18,000/QALY [boys] and $47,000/QALY [girls]). However, all screen-and-treat strategies were dominated by population-wide strategies such as salt reduction (cost-saving [boys] and $650/QALY [girls]) and increasing physical education ($11,000/QALY [boys] and $35,000/QALY [girls]).

Based on these findings the authors concluded that routine adolescents BP screening is moderately effective, but population-based BP interventions with broader reach could potentially be less costly and more effective for early cardiovascular disease prevention and should be implemented in parallel.

**Article. Cost-Effectiveness of First-Step Treatment for Hypertension: ALLHAT Trial**

Heidenreich PA, Davis BR, Cutler JA et al. Cost-Effectiveness of Chlorthalidone, Amlodipine, and Lisinopril as First-Step Treatment for Patients with Hypertension: An Analysis of the Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT). Journal of General Internal Medicine 2008; 23 (5): 509-516. [https://dx.doi.org/10.1007%2Fs11606-008-0515-2](https://dx.doi.org/10.1007%2Fs11606-008-0515-2)

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CHDS repository link: [http://repository.chds.hsph.harvard.edu/repository/3318](http://repository.chds.hsph.harvard.edu/repository/3318)

This article aimed to evaluate the cost-effectiveness of first-line treatments (lisinopril, amlodipine, and chlorthalidone) for hypertension. Uncertainty was evaluated using bootstrap resampling. Results indicated that over a patient’s lifetime, chlorthalidone was always least expensive (mean $4,802 less than amlodipine, $3,700 less than lisinopril). Amlodipine provided more life-years (LYs) than chlorthalidone in 84% of bootstrap samples (mean 37 days) at an incremental cost-effectiveness ratio of $48,400 per LY gained. Lisinopril provided fewer LYs than chlorthalidone in 55% of bootstrap samples (mean 7-day loss) despite a higher cost.

At a threshold of $50,000 per LY gained, amlodipine was preferred in 50%, chlorthalidone in 40%, and lisinopril in 10% of bootstrap samples, but these findings were highly sensitive to the cost of amlodipine and
the cost-effectiveness threshold chosen. Incorporating quality of life did not appreciably alter the results. Overall, no reasonable combination of assumptions led to 1 treatment being preferred in over 90% of bootstrap samples. Based on these findings the authors conclude that initial treatment with chlorthalidone is less expensive than lisinopril or amlodipine, but amlodipine provided a non-significantly greater survival benefit and may be a cost-effective alternative.

**Article. Cost-Effectiveness Analysis of Hypertension Guidelines in South Africa**


CHDS repository link: http://repository.chds.hsph.harvard.edu/repository/3311

This article aimed to investigate the cost-effectiveness of different strategies for initiation of drug treatment (i.e., guideline-based on blood pressure level or based on absolute cardiovascular disease (CVD) risk) in developing countries. The authors used a Markov CVD model to compare the following 6 strategies: 2 different blood pressure levels (160/95 and 140/90 mm Hg) and 4 different levels of absolute CVD risk over 10 years (40%, 30%, 20%, and 15%)—with one of no treatment.

A hypothetical cohort of all adults without CVD in South Africa was modeled over 10 years. The results showed that the incremental cost-effectiveness ratios for treating those with 10-year absolute risk for CVD _40%, 30%, 20%, and 15% were $700, $1,600, $4,900, and $11,000 per quality-adjusted life-year gained, respectively. Strategies based on a target blood pressure level were dominated by treatment decisions based on the strategy that used absolute CVD risk of 15%. The rankings of the strategies were robust in sensitivity analysis of cost of treatments, prevalence estimates of risk factors, and benefits expected from treatment.

Based on these findings, the authors conclude that current South African guidelines based on blood pressure levels are both more expensive and less effective than guidelines based on absolute risk of cardiovascular disease. The use of quantitative risk-based guidelines for treatment of hypertension could free up major resources for other pressing needs, especially in developing countries.