

The Treatment of Hypertension: A Remarkable Success Story

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One of the most successful public health programs in the past century provides an example of what can be accomplished when the government, the private sector, academia, and community organizations work together. The results of 4 decades of activities of the National High Blood Pressure Education Program (NHBPEP) can be measured in several ways. The public's awareness, treatment, and control have increased remarkably. Hypertension is the primary reason adults visit physicians. Age-adjusted mortality for heart disease and stroke has

declined by 70% and 80%, respectively, since the beginning of the program. The decline in heart and stroke deaths is seen in both sexes and blacks and whites, and is particularly evident in people who reside in the southeastern portion of the United States, which once had the highest mortality rates of stroke in the United States. This dramatic decrease in strokes and heart disease has occurred despite the substantial increase in obesity and diabetes in the United States. *J Clin Hypertens (Greenwich)*. 2013; 15:88–91 © 2012 Wiley Periodicals, Inc.

One of the most successful public health programs in the past century provides an example of what can be accomplished when the government, the private sector, academia, and community organizations work together.^{1,2} The year 2012 marks the 40th anniversary of the establishment of the National High Blood Pressure Education Program (NHBPEP) of the National Heart Lung and Blood Institute. It is timely and appropriate to assess how this public/private partnership has significantly contributed to the very large reduction (70% to 80%) in strokes and heart attacks in the United States and why it is considered one of the 10 greatest public health achievements of the 20th century.³ The NHBPEP is arguably one of the nation's most successful national health education campaigns.

The program was designed to translate scientific studies into practical and useful education programs that would increase awareness about the benefits of treating hypertension and motivate the American people, physicians, nurses, pharmacists, and public health workers and to do a better job of managing this prevalent disease. Then, as now, there were different interpretations of science and medical opinions regarding hypertension. There were differences of opinion regarding the definition of high blood pressure (BP), how BP should be measured and by whom, and how it should be treated. Starting in 1972, the NHBPEP used a consensus process to bring together 45 major professional, voluntary, and federal agencies into one cohesive national policymaking body: the NHBPEP Coordinating Committee. Committee members were charged with sharing their views and disseminating the unified position to their constituents. The improvement in hypertension treatment and control and the reduction in heart and stroke deaths were seen almost

immediately. This approach proved to be an effective education and technology transfer tool.

It should be noted that even though there have been marked improvements in detection and treatment, high BP remains an important public health problem. For an individual 55 years or older, the lifetime risk of developing high BP is approximately 90%.⁴ It is the primary reason adults visit their physician.⁵ Despite the sharp decrease in mortality, heart disease remains the number one cause of death in the United States and in most developed countries and causes more death than all cancers combined.⁶ This is true for both men and women and in both the black and white races. The good news is that the decline in deaths from heart disease, which began in about 1972, has continued for nearly 4 decades.⁷ It is estimated that during this period the decline has averted deaths in more than 1.5 million Americans.⁸

The NHBPEP has succeeded in improving hypertension control and reducing death and disability from heart disease and stroke. It has also succeeded in meeting another important goal. It demonstrates that an initial large federal effort as the means to prevent, treat, and control a major disease can lead to ongoing care as the program is downsized. Today, the treatment of hypertension has become part of routine care and the domain of primary care physicians, nurses, public health workers, and public health departments. Shifting the need for a large focus of the federal government as the primary lead for hypertension prevention and control to existing medical care and local community health services will most likely result in a further decline in heart disease and stroke.

The history of the treatment of hypertension is truly remarkable and is replete with stories of prominent public individuals who had elevated BP and experienced all of its complications, such as strokes and heart failure, as well as heart attacks and progression of kidney disease.

President Woodrow Wilson, for example, who had hypertension, experienced several strokes when he was president of Princeton University and governor of New

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DOI: 10.1111/jch.12033

Jersey. Finally, as president, he experienced a near fatal stroke that left him a severe invalid for the last years of his presidency.⁹

Franklin Roosevelt is another example of the effects of untreated hypertension. His BP began to rise in the 1930s to above normal levels. Recorded levels were >150 mm Hg to 160/90 mm Hg in the 1930s and rose to levels exceeding 220/130 mm Hg during the last year of his life. Roosevelt exhibited all of the complications that used to occur in people with untreated hypertension. Small strokes developed and severe enlargement of his heart, heart failure, and progressive kidney disease occurred. He died of a massive cerebral hemorrhage in April 1945 at the young age of 63.¹⁰

The doctors taking care of Wilson, Roosevelt, and other national leaders such as Stalin, failed to recognize the dangers of hypertension, but even if they had, there was little treatment to offer hypertensive patients prior to the 1940s. In some cases of malignant hypertension, longevity was measured in terms of months or at most a year. There were experimental treatments available in the 1930s and 1940s. For example, Dr Kempner in North Carolina demonstrated that an extremely low sodium diet of fruit juice and rice would lower BP and prolong life in these severely ill patients. Indeed, this treatment did dramatically lower BP and prolong life but subjected the patients to a difficult lifestyle.¹¹ Today, reduced salt diets, along with diets containing foods rich in potassium, are part of any treatment program for hypertension.

Other treatments in the 1940s included sympathectomies. Dr Reginald Smithwick had some success in prolonging life with this extensive surgical procedure in patients with malignant hypertension.¹² But taking care of these patients after surgery, which often entailed 4 to 6 weeks of hospitalization, was extremely difficult. Postural hypotension and severe constipation were common. Removal of the adrenal glands was also done in some cases of malignant hypertension, but postoperative management was difficult and surgery was not always successful.

Many renowned physicians around the world in the 1930s and 1940s failed to recognize the seriousness of elevated BP. Some believed in 1937 that in older people, elevated BP was necessary to get blood to the brain: "Hypertension may be an important compensatory mechanism which should not be tampered with."¹³ In the 1940s, others believed that people with high BP were psychoneurotic. It was "best to leave the BP alone and not attempt to lower it unless it was extremely high (>200 mm Hg)." A BP of anything below 200/100 mm Hg was considered mild and benign and that "reassurance, mild sedation and weight reduction were indicated."^{14,15} These opinions, of course, were tempered by the fact that the available treatments were dramatic, sometimes debilitating, and not usually successful over the long-term.

Dr Irvine Page of the Cleveland Clinic and Dr Ed Freis in Washington, pioneers in early treatment,

induced high fevers in patients with malignant hypertension by using typhoid bacilli or malaria-related substances.^{16,17} High fevers with temperatures of up to 104°C to 105°C resulted in lowering BPs as blood vessels dilated. These dramatic procedures may appear to be primitive but were the only approaches that were available in the early 1940s.

In the 1950s, more physicians began to recognize the seriousness of elevated BP. The Framingham Massachusetts Study confirmed that hypertension is a major cause of heart enlargement, heart failure, strokes, and kidney failure.¹⁸

In the late 1940s and early 1950s, one of us (M.M.) was fortunate enough to begin research on several drugs, such as phenoxybenzamine, an adrenergic blocker, and hexamethonium, a ganglion-blocking drug.^{19,20} Since that time, hundreds of other medications have been tested and approved to lower BP. Unfortunately, some of the early medications also blocked nerves that controlled urinary and bowel activity,²⁰ but many of the complications of hypertension were reversed. Over time, patients with less severe hypertension were treated with newer medications with fewer side effects as we gained experience.

The Veterans Administration Study, which reported its results in the late 1960s, demonstrated that reducing BP with available drugs, eg, diuretics, reserpine, and hydralazine, dramatically reduced the complications of hypertension.²¹ Subsequently, many large-scale well-conducted BP-lowering clinical trials conducted throughout the world, using different types of drugs in different populations, confirmed the clear benefits of treating hypertension. With these clinical, actuarial, and epidemiology studies as a background, the National Institutes of Health was directed by the Secretary of the then Department of Health Education and Welfare to launch the NHBPEP. This program brought numerous disciplines together to further advance efforts to lower BP in more people and dramatically reduce cardiovascular events.

While research for new medications with fewer side effects continued in the 1960s and 1970s, the NHBPEP was actively coordinating the National Program. One of us (E.R.) was the Director of the program from 1983 to 2007 and the other (M.M.) served as the Senior Medical Consultant of the program from 1974 to 2002. The Coordinating Committee planned the national agenda for hypertension prevention, detection, and control; developed national guidelines for health agencies and clinicians; and developed the national hypertension treatment objectives for the nation.²² Through the years, more than 2000 community programs participated in the effort to raise awareness about the importance of detecting and treating hypertension.

In 1977, the program released the first in a series of guidelines for the evaluation and treatment of hypertension.²³ One of us (M.M.) chaired this first guideline committee, which produced the first clinical guideline based on evidence and collective clinical opinion when

evidence was contradictory or lacking. There had never been a national evidence-based consensus recommendation for the evaluation and treatment of any disease prior to this report. The NHBPEP treatment guidelines, which are updated periodically, with an eighth report to be released soon, have become the national and international standard to evaluate, prevent, and manage hypertension.²⁴ The hypertension treatment guidelines first published in 1977 have served as models for other guidelines for treatment of cholesterol abnormalities, obesity, diabetes, asthma, heart failure, and sickle cell disease.

The increase in visibility of hypertension as a public health problem resulted in an increase in the number of laboratory and clinical studies designed to determine the mechanism and best treatments for high BP. As a result, hypertension control rates continued to improve and mortality rates declined faster as more science was translated into action.

The NHBPEP identified racial and regional variations in hypertension control and stroke mortality in the United States and developed a successful action plan to reduce this disparity.²⁵ It was the main contributor to the founding of the World Hypertension League, which uses its template to develop hypertension societies in more than 150 countries.

Shortly after the NHBPEP began, national survey data indicated that only one quarter of the public knew the relationship between high BP, stroke, and heart disease. Less than half of the population was aware that their BP was elevated. Less than one quarter of the population was being treated and only 10% had their BP controlled.²⁶ A mass media campaign on radio, television, and print was developed, much of it performed as a public service by the media and industry. Community health screening and educational interventions were initiated in churches, firehouses, and community events.²⁷ This program was one of the earliest health education efforts at work settings in the automobile and insurance industry.²⁸

Three decades later, more than 90% of the public is aware of the relationship between high BP, stroke, and heart disease. Every 6 months, three quarters of the population has their BP measured and virtually every American has had their BP measured at least once. Within the past 2 decades, visits to physicians for hypertension have increased 10-fold while visits to physicians for all causes have remained relatively stable, a clear indication that patients have heard the message to see their doctor.²⁹ Hypertension is the primary reason adults visit their physicians.

More effective medications with fewer side effects have been developed and most physicians are actively treating patients with less severe degrees of elevated BP. Today, 81% of Americans are being treated and >50% have their BP controlled at levels <140/90 mm Hg.³⁰

The results of 4 decades of activities of the NHBPEP can be measured in other ways.²⁷ For example, age-

adjusted mortality for heart disease and stroke has declined by 70% and 80%, respectively, since the beginning of the program. Since the initiation of the NHBPEP in the early 1970s, the decline in heart disease deaths has been steady.^{26,31} Better awareness, treatment, and control of hypertension have contributed to these mortality declines, especially in relationship to strokes and heart failure. Of interest today, malignant or accelerated hypertension is rarely seen. Other factors such as a decrease in smoking and better management of lipid abnormalities may have contributed to the decline, but the active campaign to lower cholesterol levels began more than a decade after the NHBPEP. The decline in heart and stroke deaths is seen in both sexes and blacks and whites and is particularly evident in people who reside in the southeastern portion of the United States, which once had the highest mortality rates for strokes in the United States. This dramatic decrease in strokes and heart disease has occurred despite the substantial increase in obesity and diabetes in the United States. Most authorities agree that the contributions of the NHBPEP have been significant for hypertension control not only in the United States but throughout the world. Of importance is the fact that the diagnosis and treatment of hypertension in most patients is relatively inexpensive and does not involve the use of expensive technology or hospitalizations.

NHLBI ROLE IN PROMOTING LIFESTYLE CHANGES

It is clear that lifestyle changes may prevent or slow the progressive rise in BP that occurs as people get older. Reducing salt intake, losing weight if overweight, moderating alcohol consumption, and increasing physical activity may also help to lower BP.³² Whether society is willing to adopt these lifestyle changes over a long term is unclear. Despite the success in reducing cardiovascular disease, heart disease, and stroke remain the first and third cause of death in the United States, but death rates alone cannot describe the burden of these events. In 2011, the total cost of cardiovascular disease in the United States was estimated at \$444 billion. Treatment of these diseases accounts for about \$1 of every \$6 spent on healthcare. It is probable that without the NHBPEP's additional efforts in promoting lifestyle changes and specific medical therapy to lower BP, several million more people would have died or suffered the disabilities of heart or kidney disease and stroke. The results of the NHBPEP have exceeded the expectations of its architects, Mrs Mary Lasker, Secretary of Health Elliott Richardson, Dr Michael DeBakey, and our colleagues in the program, Drs Ed Freis, Ted Cooper, Ray Gifford, Sheldon Sheps, Charles Curry, Aram Chobanian, Martha Hill, Harriet Dustan, Robert Levy, Mitchell Perry, Graham Ward, Claude Lenfant, and many others who devoted so much of their time and energies to make this program a success.

The NHBPEP demonstrates that vision and commitment can result in major social and medical changes.

Disclosures: The authors report no specific funding in relation to this research and no conflicts of interest to disclose. Marvin Moser, MD, was senior medical consultant, National High Blood Pressure Education Program (NHBPEP) 1974–2002, and Edward Roccella, PhD, MPH, was coordinator of the NHBPEP 1983–2007.

References

- Roccella EJ, Ward G. The national high blood pressure education program: a description of its utility as a generic program model. *Health Educ Q.* 1984;11:225–242.
- Jones DW, Hale JE. The national high blood pressure education program: thirty years and counting. *Hypertension.* 2002;39:941–942.
- Centers for Disease Control and Prevention (CDC). Ten greatest public health achievements—United States, 1900–1999. *MMWR.* 1999;48:241–243.
- Vasan RS, Beiser A, Seshadri S, et al. Residual lifetime risk for developing hypertension in middle-aged women and men. The Framingham Heart Study. *JAMA.* 2002;287:1003–1010.
- Centers for Disease Control and Prevention. Ambulatory care use and physician visits. <http://www.cdc.gov/nchs/fastats/docvisit.htm>. Accessed November 1, 2012.
- Centers for Disease Control and Prevention. Leading causes of death. <http://www.cdc.gov/nchs/fastats/lcod.htm>. Accessed November 1, 2012.
- Egan BM, Zhao Y, Axon RN. US trends in prevalence, awareness, treatment and control of hypertension, 1988–2008. *JAMA.* 2010;303:2043–2050.
- National Heart Lung and Blood Institute. NHLBI Fact Book. <http://www.nhlbi.nih.gov/about/factbook>. Accessed November 1, 2012.
- Moses J, Cross L. *Presidential Courage*. New York, NY: Norton; 1980.
- Bruenn HG. Clinical notes on the illness and death of President Franklin D. Roosevelt. *Ann Intern Med.* 1970;72:579–591.
- Kempner W. Treatment of kidney disease and hypertensive vascular disease with rice diet. *NC Med J.* 1944;5:125–127.
- Smithwick R. The effects of sympathectomy upon the mortality and survival rates of patients with hypertensive cardiovascular disease. In: Bell ET, ed. *Hypertension*. Minneapolis, MN: Minnesota Press; 1951:429–457.
- White PD. *Heart Disease*, 2nd edn. New York: Macmillan; 1937:326.
- Friedberg CK. *Diseases of the Heart*. Philadelphia, PA: Saunders; 1949.
- Moser M. *Misconceptions and Heroics—The Story of the Treatment of Hypertension from the 1930s*, 2nd ed. Darien, CT: LeJacq Communications Inc.; 2002.
- Page IH, Taylor RD. Pyrogens in the treatment of malignant hypertension. *Mod Concepts Cardiovasc Dis.* 1949;18:51–52.
- Freis ED, Wilkins RW. Effect of pentaquine in patients with hypertension. *Proc Soc Exp Biol Med.* 1947;64:731–736.
- Kannel WB, Schwartz MJ, McNamara PM. Blood pressure and risk of coronary heart disease: the Framingham study. *Dis Chest.* 1969;56:43–52.
- Haimovici H, Moser M, Krakower H. The effect of oral 688A on the blood pressure and pulse rate in normotensive and hypertensive subjects. *Proc Soc Exper Biol Med.* 1951;77:477.
- Moser M, Reppert E, Prandoni AC, Mattingly TW. Autonomic blocking agents in cardiovascular disease. *Postgrad Med.* 1955;17:362.
- Veterans Administration Cooperative Study Group on Antihypertensive Agents: effect of treatment on morbidity in hypertension: Results in patients with diastolic blood pressure averaging 115 through 129 mm Hg. *JAMA.* 1967;202:1028–1034.
- Moser M. Evolution of the treatment of hypertension from the 1940s to JNC V. *Am J Hypertens.* 1997;10:2S–8S.
- Moser M, Guyther JR, Finnerty F, et al. Report of the Joint National Committee on detection, evaluation and treatment of high blood pressure (JNC I). *JAMA.* 1977;237:255–261.
- Moser M. From JNC I to JNC 7 – what have we learned? *Prog Cardiovasc Dis.* 2006;48:303–315.
- Perry MH, Roccella EJ. Conference report on stroke mortality in the southeastern United States. *Hypertension.* 1998;31:1206–1215.
- Burt VL, Cutler JA, Higgins M, et al. Trends in prevalence, awareness, treatment and control of hypertension in the adult US population: data from the Health Examination Surveys, 1960 to 1991. *Hypertension.* 1995;26:60–69.
- He J, Muntner P, Chen J, et al. Factors associated with hypertension control in the general population of the United States. *Arch Intern Med.* 2002;162:1051–1058.
- Foote A, Erfurt JC. Controlling hypertension: a cost effective model. *Prev Med.* 1977;6:319–343.
- Horan MJ. The national high blood pressure education program: measuring progress and assessing its impact. *Health Psychol.* 1988;7(suppl):297–303.
- Moser M, Franklin SS. Hypertension management: results of a new national survey for the hypertension education foundation: Harris interactive. *J Clin Hypertens.* 2007;9:316–323.
- Cutler JA, Sorlie PD, Wolz M, et al. Trends in the prevalence, awareness, treatment and control of hypertension in the US adults between 1988–1994 and 1999–2004. *Hypertension.* 2008;52:801–827.
- Whelton PK, He J, Appel LJ, et al. Primary prevention of hypertension: clinical and public health advisory from the National High Blood Pressure Education Program. National High Blood Pressure Education Program Coordinating Committee. *JAMA.* 2002;288:1882–1888.