Antihypertensive drugs: a perspective on the value of improved blood pressure control in the USA

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Aims: We estimated what the improved treatment of high blood pressure with antihypertensive drug therapy has contributed to U.S. public health, in terms of reductions in excess premature deaths from cardiovascular disease, myocardial infarctions, and strokes.

Methods and Results: Using national survey data to estimate blood pressures in the absence of antihypertensive therapy and comparing them with blood pressures actually observed in 1999-00, we inferred the impact of antihypertensive therapy on blood pressure. Using risk equations from the Framingham Heart Study, we estimated the impact of lowered blood pressures on the risk and number of myocardial infarctions and strokes (2002) and deaths (2001). Assigning a monetary value from the literature to the improvement in overall life expectancy related to antihypertensive therapy, we compared it to average spending on antihypertensives.

Conclusion: Antihypertensive therapy has had a major impact on U.S. public health. In the absence of antihypertensives, 1999–00 blood pressures for adults age 40+ would have been 10 to 13 percent higher, and 86,000 excess premature deaths from cardiovascular disease (2001), and 833,000 hospital discharges for stroke and myocardial infarction (2002) would have occurred. Treatment has generated a benefit-to-cost ratio of at least 6:1, but much more can be achieved.

The public health importance of blood pressure control in the USA

With cardiovascular and cerebrovascular diseases the number one and number three causes of death in the USA, respectively, the public health importance of improvements in the management of high blood pressure and in the care and prevention of cardiovascular disease is substantial. As Franklin Roosevelt’s cardiologist observed after his death, ‘I have often wondered what turn the subsequent course of human history might have taken if the modern methods for the control of hypertension had been available’.1,2 On a broad societal,
and the population has aged, all increasing the burden of cardiovascular disease. The risk of developing hypertension increases with age; lifetime risk is estimated at approximately 90% for people with normal blood pressures at ages 55 or 65, respectively, who survive to ages 80 or 85. Over 50 million US adults were hypertensive in 1999–2000, including 43% of adults aged 40 and over (i.e., had Stage I or II blood pressures, as defined by the Fifth Report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure or reported taking antihypertensive medications).6 Steps to better control hypertension, whether in the form of behavioural changes in diet and exercise, effective drug therapies well-matched to the characteristics of individual patients, or improved rates of outreach, diagnosis, treatment, and patient compliance with effective drug regimens, therefore have the potential to reduce rates of disease and the economic burden of this condition and its sequelae, including myocardial infarction (MI) and stroke.

What has been the effect of the improved treatment of high blood pressure on public health in the USA?

Estimating the value of medical innovation is a continual challenge. Although the medical literature reports results of many carefully designed clinical trials to estimate the relative impact of specific treatments on individuals in well-controlled settings, analysing the ‘real-world’ impacts of medical practice and public health innovation on the entire population is a more complex undertaking with ongoing policy relevance. Real-world experiences may differ from those in the highly controlled environment of clinical trials. Patient compliance rates with therapy may be lower. The overall population may be more heterogeneous and may not experience the same levels of clinical effect observed with the carefully selected populations participating in trials. Demographic factors, health habits, and other factors with an impact on rates of disease may differ or may change over time. Despite documented major strides in cardiovascular disease management, there has been limited systematic estimation of the total impact of antihypertensive therapy on health outcomes.

In a research programme in which methods and results are reported in-depth elsewhere, we addressed the question, ‘Without these improvements in treatment and prevention, but controlling for changes in risk factors such as smoking, obesity, and population age, what would cardiovascular morbidity and mortality have been in the USA?’ We quantified the impact of antihypertensive therapy on blood pressure in the US population, on the risk and number of heart attacks and strokes, and on deaths from cardiovascular disease. A complete discussion of the study’s methods and findings can be found in the work of Cutler et al.7 We also estimated the potential for further improvements in these measures if guideline care (i.e., blood pressures which reached guideline recommendations) were achieved for all.

We used national survey data to estimate the impact of drug treatment on average blood pressures and the best available published risk equations relating blood pressure to adverse outcomes from the Framingham Heart Study to estimate the impact on the risk and number of MI, strokes, and deaths. Data on 5046 individuals aged 30–79 from the 1959–62 National Health Examination Survey (NHES) and 2284 individuals aged 40–79 from the 1999–2000 National Health and Nutrition Examination Survey (NHANES) were used to estimate blood pressures in the year 2000 in the absence of antihypertensive therapy and were compared with actual, observed blood pressures for that year. Because the 1959–62 time period could be called ‘drug-naïve’ with respect to the widespread use of effective antihypertensive drug therapies, that sample was used to estimate blood pressures in the absence of antihypertensive therapy. After controlling for all available quantifiable factors affecting blood pressure, we calculated the impact of antihypertensive therapy as the unexplained difference in the year 2000 between the two blood pressures (actual and predicted). Published risk equations from the Framingham Heart Study, US life expectancy tables from the National Center for Health Statistics (NCHS), and hospital discharge figures from the National Hospital Discharge Survey (NHDS) were used to estimate the impact of lowered blood pressures on the number and risk of heart attacks, strokes, and deaths, for men and women. Finally, we used standard figures from the literature for the value of an additional year of life in good health to compare the monetary value of medication-related improvements in overall average population life expectancy with average spending on antihypertensives.

Our results are that without antihypertensive therapy, 1999–2000 average blood pressure for the US population aged 40 plus would have been 10–13% higher; 86 000 excess premature deaths from cardiovascular disease (2001) and 833 000 hospital discharges for stroke and heart attacks (2002) would have occurred. Placing the estimated reduction of approximately 86 000 deaths in context, US deaths from all accidents, the fifth leading cause of death in 1999–2000, totalled approximately 98 000, and deaths from influenza and pneumonia, a leading cause of death in the elderly and the seventh leading overall cause of death, totalled approximately 64 000.8 If all had achieved guideline blood pressures (i.e., blood pressure targets recommended by JNC 7, the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure), we estimate there would have been 89 000 fewer premature deaths from cardiovascular disease (2001) and 420 000 fewer hospital discharges for stroke and heart attack (2002) than were actually observed. Our analysis suggests that antihypertensive therapy has had a significant impact on cardiovascular health outcomes, but that there is much left to achieve; mortality gains would have been approximately twice as high if guideline care had been achieved for all. These results are generally consistent with two sets of findings in the literature: (i) cohort study findings of substantial
mortality, stroke, and MI benefits from better controlled blood pressures and (ii) individual randomized clinical trial results which document reductions to blood pressure goal are possible from a programme of antihypertensive treatments.\textsuperscript{9,10}

Translating our figures for estimated avoided premature deaths from cardiovascular disease into gains in life expectancy and averaging over the entire US population, we estimate an increase of roughly one half year of longer life for every member of the US population. To value these improvements in dollars, we apply standard figures from the literature of approximately $90,000 for each additional year of life in good health, or $100,000 less $10,000 in average government support costs.\textsuperscript{1} When discounted over an average lifespan at a 3\% annual rate and compared with discounted lifetime spending on antihypertensive drugs, averaged across the treated and untreated population, we calculate a benefit-to-cost ratio of at least 6:1. Including the impact of better controlled blood pressure on hospitalizations for stroke and MI, in addition to life expectancy benefits, would increase the benefit-to-cost ratio further. These excluded benefits are substantial. Using data from the literature for the average hospitalization costs of coronary heart disease and cerebrovascular disease and assuming that hospitalization costs represent 70\% of direct medical costs in the year following stroke and MI, we estimate that direct medical costs avoided in 2002 as a result of fewer strokes and MI from better controlled blood pressure totalled approximately $16.5 billion (the authors’ calculations, applying approach from Hodgson and Cohen\textsuperscript{11}).

If these results are so substantial and the return on investment so attractive, why does not the USA do a better job at controlling hypertension?

Our estimates suggest that antihypertensive medication has a very attractive benefit-to-cost ratio of 6:1 for women and 10:1 for men. With the continued ageing of the population, the total burden of cardiovascular disease on society, individuals, and their families, already substantial, will only increase with time. As perhaps the major modifiable health risk (other than smoking cessation), and in the light of this attractive return on investment, efforts to improve the level of blood pressure control in the USA population should receive top priority from government and private payers alike. Why have not they? Although there have been improvements over time in the level of awareness, treatment, and control of blood pressure, why do we do better when the payoff is so great?

One of the reasons is lack of insurance coverage. The uninsured are less likely than insured individuals with similar other characteristics to be screened and diagnosed for high blood pressure and to comply fully with treatments recommended by physicians. As a result, they are more likely to suffer from potentially fatal acute cardiovascular episodes,\textsuperscript{1,12–16} in addition, to the degree that the uninsured are more likely to experience one or more risk factors for high blood pressure, this effect is compounded.

But even among the insured, underutilization of effective, cost-efficient therapy continues to be a major public health challenge. The current fragmented system of coverage and care management provides insufficient incentives to offset the tendency of individuals to put off necessary long-term changes in behaviour and to ‘underinvest’ in good health. Private insurance plans bear the current costs of preventive therapy, but may be unlikely to bear the future costs of acute treatment because of underutilization of effective therapy today, since plan members may move to other plans or may reach Medicare eligibility age before these adverse events occur. Until recently, the Medicare programme bore the cost of acute hospital and physician treatment for events such as heart attack and stroke, but not the cost of prescription drug therapy, which could delay or avoid these outcomes altogether. With the implementation in 2006 of the new Part D prescription drug benefit for aged and disabled beneficiaries, Medicare will have a historic opportunity to begin to align incentives in favour of preventive drug therapy. Thus far, Medicare has not taken advantage of that opportunity to any great degree. At the level of individual health plans, although some Medicare Advantage plans include both drug and medical benefits, and so are in a unique position to align incentives across prevention and acute treatment, the more common Prescription Drug Plans are responsible only for drug costs. In the case of plans that cover only drug costs, plan sponsors do not benefit from decisions that will increase spending on preventive drug therapy, in order to reduce acute medical costs in the future. As a result, they face the same lack of incentives to invest sufficiently in prevention as do other private insurance plans.

What else can be done to improve the level of blood pressure control in the USA?

Elsewhere in this Supplement, other authors discuss the contributions that initiatives of various types can make to improving effective blood pressure control, including manufacturer-sponsored programmes to support effective physician–patient cooperation, and active involvement of patient groups in self-monitoring and other preventive efforts. Within the realm of economic incentives, there are several opportunities worth investigating to align incentives in favour of effective preventive treatment. First, greater emphasis might be placed on the growth of comprehensive Medicare Advantage plans, with the aim of creating high-quality, comprehensive plans for Medicare beneficiaries encompassing both preventive and acute treatment. Secondly, the new Medicare Part D plans might be given incentives to adopt practices that would help encourage patients to control their blood pressures today and avoid adverse outcomes in the future. For instance, plans could reduce patient cost sharing on drugs for which there is a strong body of evidence that they represent best clinical practice and
are cost-saving treatments. ACE-inhibitors for diabetics are likely one such example.\textsuperscript{17} Our findings suggest that antihypertensives might be another.

Thirdly, greater experimentation by plans, led by Medicare, with pay-for-performance approaches that reward physicians for attaining blood pressure goals and maintaining patients at goal could help align incentives between physicians and plans in favour of cost-effective prevention. The Quality and Outcomes Framework incorporated into the contract between the National Health Service and general practitioners in the UK contains substantial financial incentives for the measurement, management, and effective control of blood pressure, cholesterol, and other cardiovascular risk factors. Financial incentives are paid to practices which achieve higher performance on a total point system. The administrative and clinical experience under this system may be an important source of learning for the Medicare programme in the USA, as well as for the many smaller scale experiments with pay-for-performance in place at individual managed care plans.

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