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# The Value of Antihypertensive Drugs: A Perspective on Medical Innovation

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# "The Value of Antihypertensive Drugs: A Perspective On Medical Innovation"

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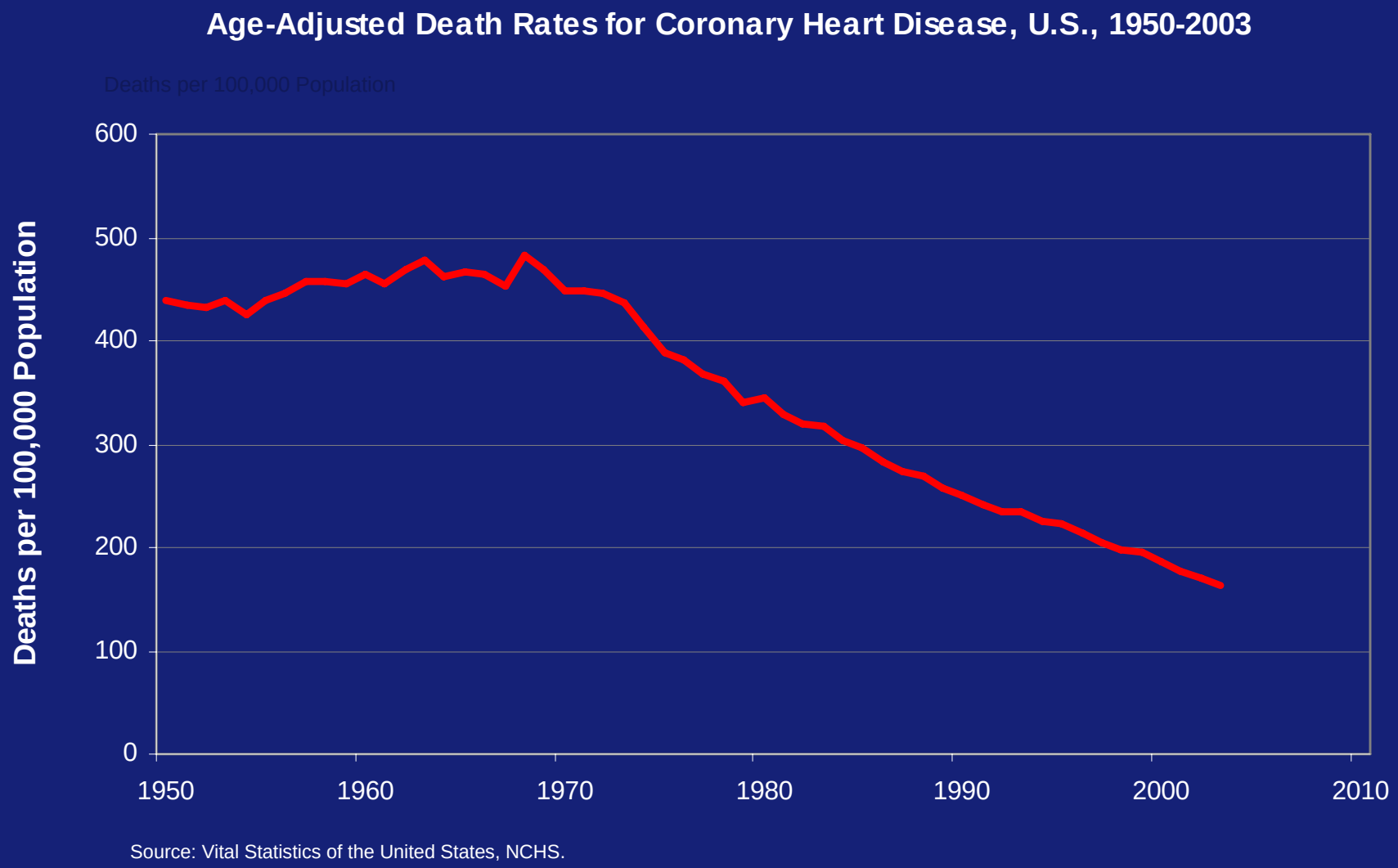
## Study Citation


**D Cutler, G Long, E Berndt, et al., "The Value of Antihypertensive Drugs: A Perspective On Medical Innovation," Health Affairs 2007;26(1): 97-110.**

# U.S. age-adjusted death rates from coronary heart disease have fallen by two-thirds since the 1960s




Source: Vital Statistics of the United States, NCHS.

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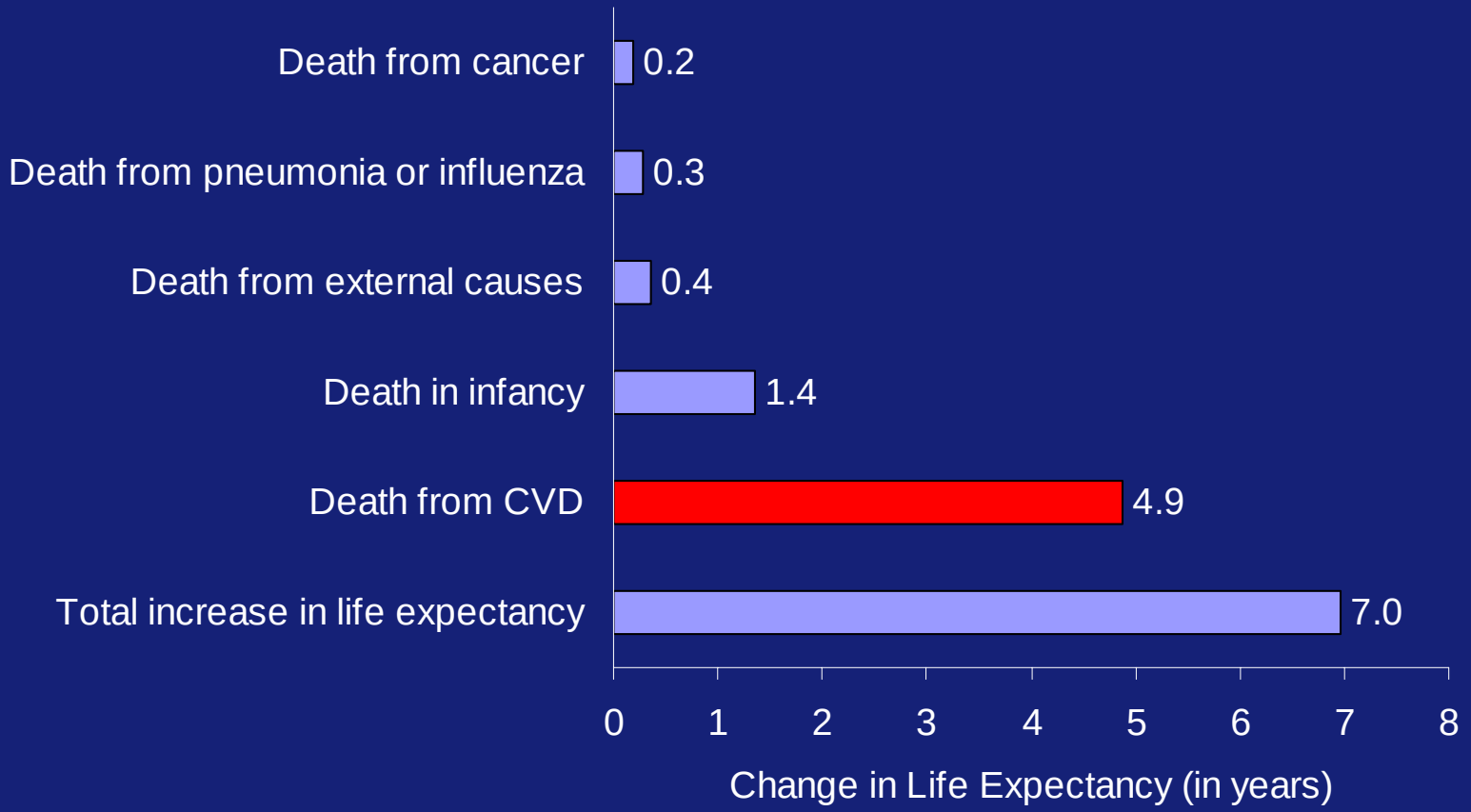
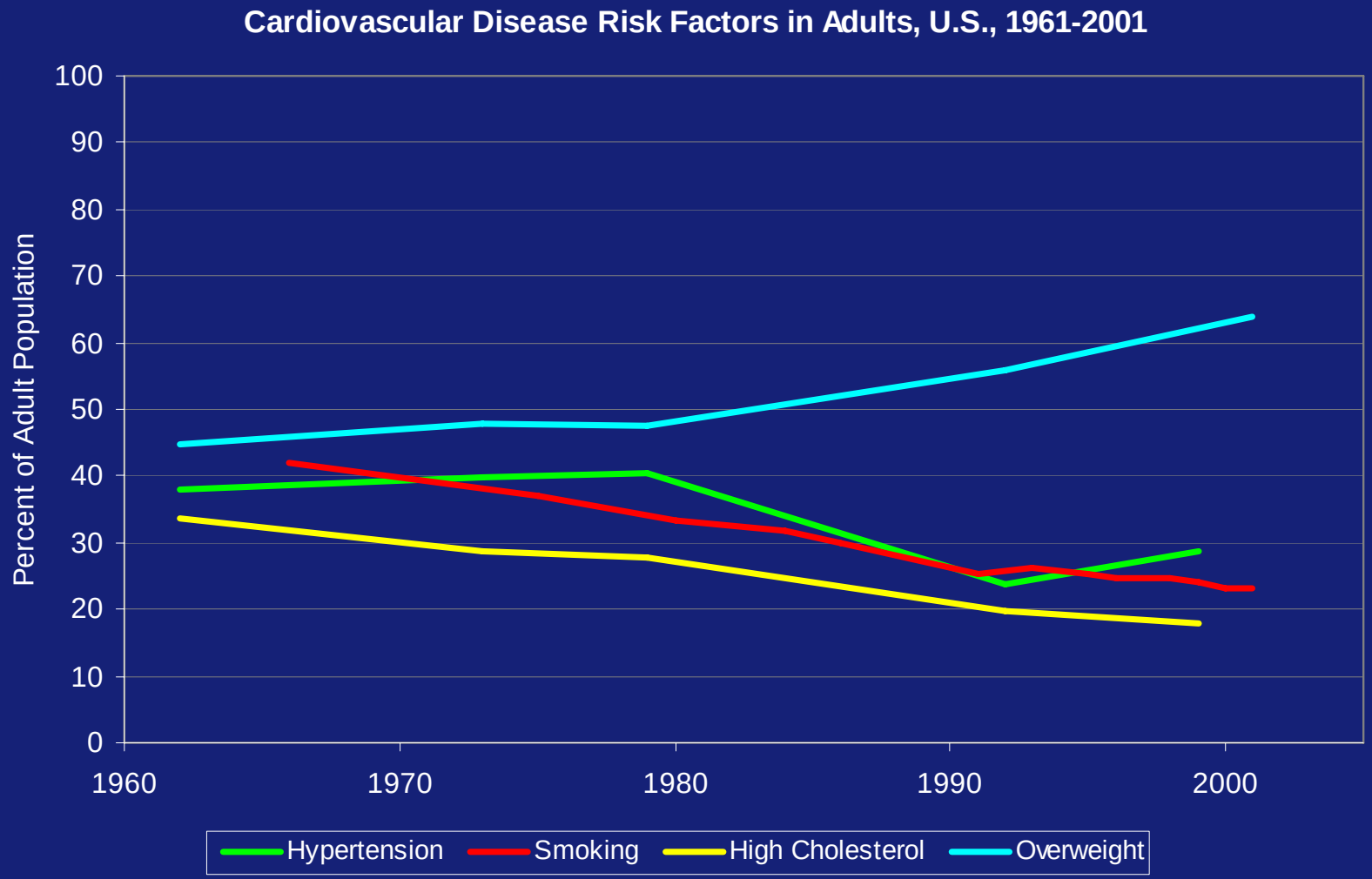
# 70% of the improvement in life expectancy over this period was due to cardiovascular disease improvement

**Causes of increases in U.S. life expectancy in newborns: 1960-2000**




Source: Calculations from D Cutler, A Rosen, S Vijan. The Value of Medical Spending in the United States, 1960-2000. *N Engl Med* 2006 Aug;355:920-27.

# Risk factor progress is mixed: smoking, high cholesterol and hypertension are down, but overweight is up




Note: Hypertension is systolic blood pressure ≥ 140 mm Hg, diastolic blood pressure is ≥ 90 mm Hg, or on antihypertensive medication. High cholesterol is 240+ mg/dl. Overweight is BMI 25+ kg/m$^2$.

Source: NHIS for smoking (age 18+) and NHANES for the other risk factors (ages 20–74). As summarized in NHLBI Fact Book, 2005.

# Our study questions

- **Given current risk factors and behavior, what would blood pressures (BP) have been in the absence of antihypertensive therapy?**
- **What has been the impact of better controlled blood pressure on:**
  - Number of heart attacks and strokes?
  - Deaths from heart attack and stroke?
- **How much better could we do if all attained guideline blood pressures?**
- **What is the cost-benefit of investments in antihypertensive therapy?**
  - In terms of life expectancy; excludes benefits from avoided medical costs, productivity losses

# The research challenges

## "Real world" experience may differ from that in clinical trials:

- Patient compliance rates may be lower
- Overall population may be more heterogeneous and may not experience the same clinical effect as a carefully selected study population
- Other factors affecting rates of disease (e.g., demographics, health habits) may differ or change over time

## Many factors may have contributed to improvements observed:

- Other primary and secondary prevention efforts
- Improvement in acute treatment
- Changes in behavior and risk factors

# Research approach: holding other factors constant to isolate the impact of better-controlled BP

## Estimate regression model for untreated blood pressure

- Estimated from the "drug naïve" 1959-62 NHANES survey to model what BP would be without today's treatments
- Blood pressure = a function of (age, race, gender, BMI, $BMI^2$, diabetes)

## Predict untreated BP and compare to observed BP for 1999-00

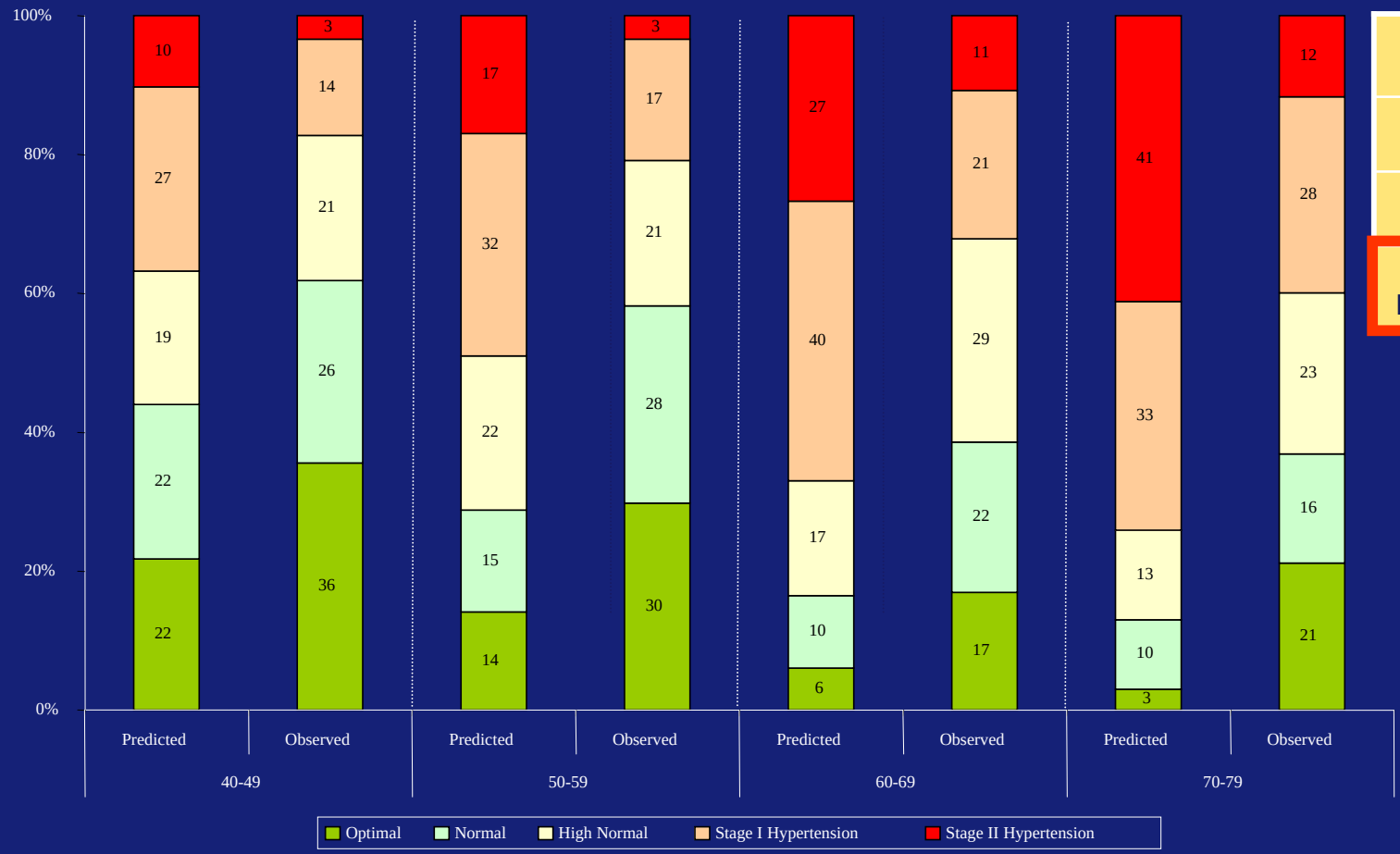
- Apply model to current risk and demographic factors from the NHANES 1999-2000 survey to estimate what BPs would be in absence of treatment
- Compare to observed, actual blood pressures – the difference is attributed to the impact of antihypertensives

## Calculate impact of improvement in BP on risk and number of deaths (2001), heart attack and stroke hospitalizations (2002)

- Using Framingham Heart Study risk equations, population life tables, hospital discharge figures
- Assign a monetary value to reductions in mortality and compare to average expenditures on antihypertensive medication to calculate a cost-benefit ratio

# Results: antihypertensive therapy reduced average BP for U.S. men by 10 - 11%

## Predicted and Observed Blood Pressure, Men, 1999-2000

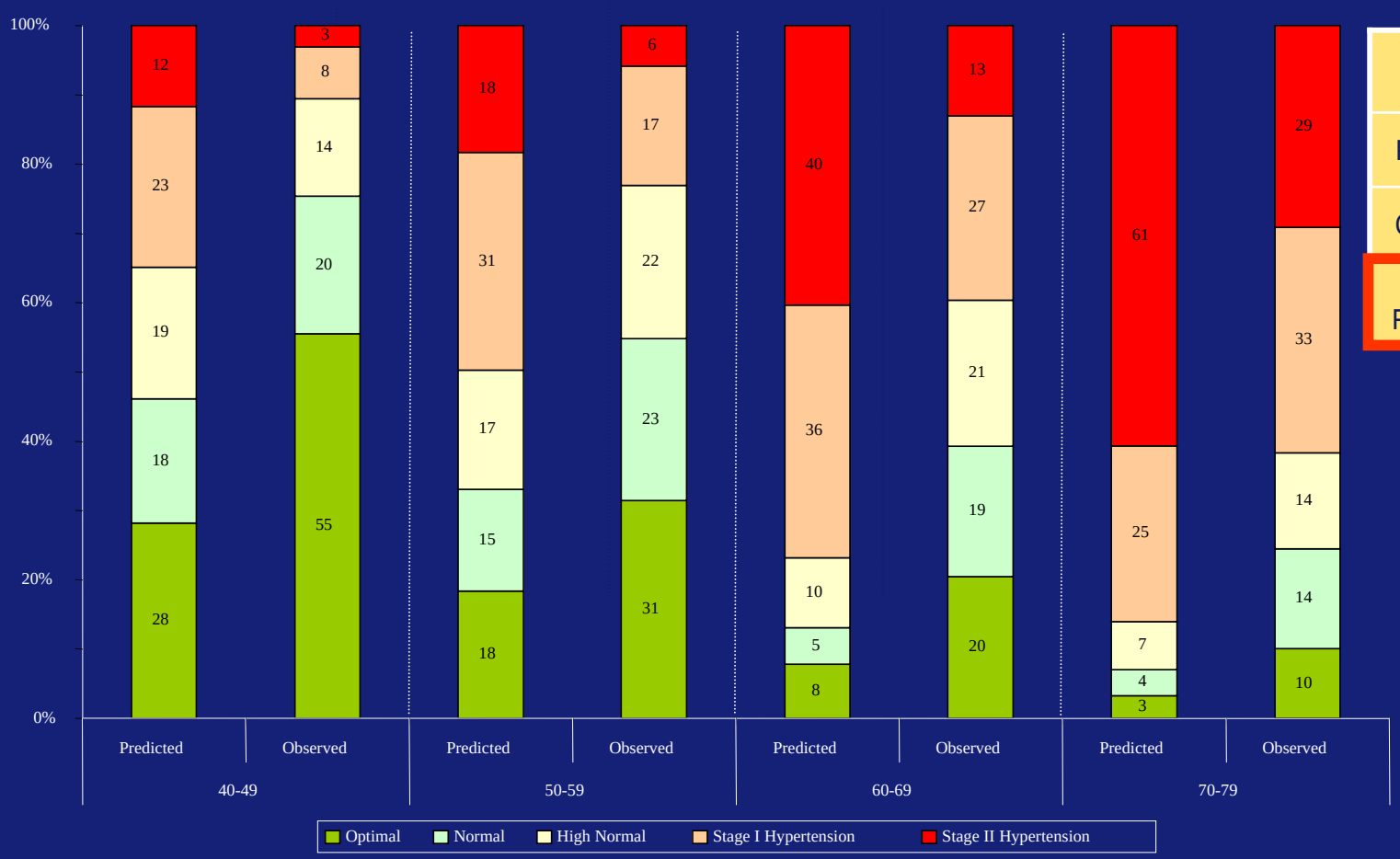



| Average BP | Systolic | Diastolic |
|---|---|---|
| Predicted | 141.3 | 84.9 |
| Observed | 127.1 | 75.8 |
| % Reduction | 10.0% | 10.7% |

Definitions: Optimal: SBP<120, DBP<80; Normal: SBP 120-129, DBP 80-84; High Normal: SBP 130-139, DBP 85-89; Stage I: SBP 140-159, DBP 90-99; Stage II Hypertension: SBP>=160, DBP>= 100

# Results: antihypertensive therapy reduced average BP for U.S. women by 10 - 13%

## Predicted and Observed Blood Pressure, Women, 1999-2000




| Average BP | Systolic | Diastolic |
|---|---|---|
| Predicted | 143.0 | 83.5 |
| Observed | 128.1 | 72.7 |
| % Reduction | 10.4% | 12.9% |

Definitions: Optimal: SBP<120, DBP<80; Normal: SBP 120-129, DBP 80-84; High Normal: SBP 130-139, DBP 85-89; Stage I: SBP 140-159, DBP 90-99; Stage II Hypertension: SBP>=160, DBP>= 100

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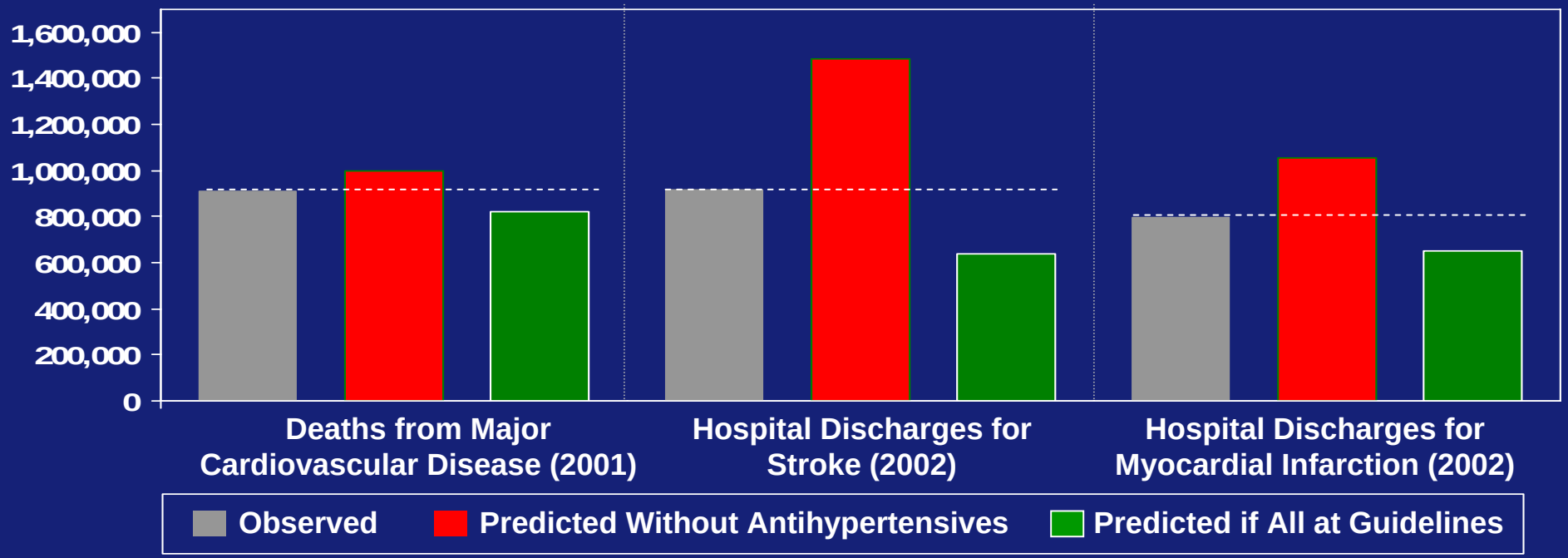
# Research results: Impact on U.S. health outcomes

**86,000 excess premature deaths from CVD avoided (2001)**

**572,000 hospital discharges for stroke avoided (2002)**

**261,000 hospital discharges for heart attack avoided (2002)**

**Predicted and Observed Deaths, 2001, and Hospital Discharges for Stroke and MI, 2002, Men and Women**



# How significant are these estimated reductions relative to some other causes of mortality ?

- Would have approached  all deaths from accidents (98,000, the 5th largest cause of death in 1999-00)
- Would have exceeded all deaths from influenza and pneumonia (64,000, the 7th largest cause of death)
- Roughly equivalent to the number of people who are estimated to die of medical errors annually
- Would have exceeded all deaths from motor vehicle accidents (42,000 in 2001)

# There are still significant opportunities for improvement

**If all untreated patients with Stage I or II hypertension had been treated and all achieved normal blood pressures**

- An additional ***89,000 fewer excess premature deaths from major cardiovascular disease*** in the U.S. in 2001
- An estimated ***278,000 fewer US hospital discharges for stroke*** and ***142,000 fewer discharges for myocardial infarctions*** in 2002 than actually occurred

➢ **So far, we have achieved *approximately half* of the potential health gains**

# Cost benefit: we calculate an approximate benefit-to-cost ratio of 10:1 for men and 6:1 for women

- **Assume each year of additional life in good health is worth $90,000 a year**
- **Compare discounted lifetime costs for antihypertensive drugs with discounted benefits of additional years of life**
- **Including benefits other than extended life would increase calculated net benefits further:**
  - Reduced hospitalizations for stroke and MI
  - Impact of antihypertensive drugs on quality of life, work productivity

# Implications

**With an aging population, the total burden of cardiovascular disease will increase:**

- As one of the most significant modifiable health risks, and in light of the attractive cost-benefit ratio, hypertension control should be prioritized for outreach, education, and compliance efforts
- Under-utilization of effective, cost-efficient therapies continues to be a major public health challenge

# Caveats

- **Residual analysis – factors not controlled for could affect BP trends**
  - Sensitivity analyses on sodium intake and exercise conducted; neither increased explanatory power of the model significantly
- **Due to potential competing risks, estimates represent reductions in premature deaths due to cardiovascular disease**
  - Reductions in total mortality from all causes in a given year may be lower