# Coronary Heart Disease Events and Associated Costs in US Adults with Uncontrolled Hypertension and Multiple Cardiovascular Risk Factors

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## BACKGROUND

- Hypertension (HTN) is the leading risk factor for cardiovascular disease (CVD) mortality:[1]
  - CVD now accounts for approximately 30% of all deaths worldwide.[1]
- Most hypertensive patients also have additional cardiovascular (CV) risk factors such as dyslipidemia (DYS).[2,3]
  - Only 22% of hypertensive men and 18% of hypertensive women had no other CV risk factors.[2]
- The estimated direct and indirect cost of high blood pressure in 2005 is predicted to reach $59.7 billion in the United States.[4]
- Numerous clinical trials and meta-analyses have demonstrated that antihypertensive and lipid-lowering agents can prevent CV events.[5-10]
- The Anglo-Scandinavian Cardiac Outcomes Trial-Lipid Lowering Arm (ASCOT-LLA) demonstrated that in patients with no clinical evidence of coronary heart disease (CHD) and a mean baseline low-density lipoprotein cholesterol (LDL-C) level of 133 mg/dL, in comparison with antihypertensive therapy alone, concomitant antihypertensive and statin therapy:
  - Reduced the risk of non-fatal myocardial infarction (MI) and fatal CHD by 36%.
  - Reduced the risk of stroke by 27%.
  - Reduced the risk of non-fatal MI alone by 45%.[7]
- Little is known about the prevalence of HTN and multiple CV risk factors, the frequency of preventable CHD events occurring in this high-risk population, and the total direct costs of these CHD events.

## STUDY OBJECTIVES

- To determine the prevalence of uncontrolled HTN with multiple CV risk factors in US adults.
- To estimate the frequency of preventable CHD events in this population.
- To calculate the direct medical costs of these preventable CHD events.

## METHODS

### Data Source

- Patient-level data were drawn from the Third National Health and Nutrition Examination Survey (NHANES III), Phase 2 (1991-1994).

### Study Population

- The following inclusion criteria were used to identify a cohort of US adults with uncontrolled HTN and multiple CV risk factors:
  - Adults ≥20 years.
  - Uncontrolled HTN:
    - If *untreated*: systolic blood pressure (SBP) ≥160 mm Hg or diastolic blood pressure (DBP) ≥100 mm Hg.
    - If *treated*: SBP ≥140 mm Hg or DBP ≥90 mm Hg.
- Patients were evaluated for the frequency of the following CV risk factors:
  - Abnormal electrocardiogram.
  - Age ≥55 years.
  - Diabetes.
  - Family history of premature CHD.
  - Left ventricular hypertrophy.
  - Male sex.
  - Microalbuminuria or proteinuria.
  - Previous stroke or transient ischemic attack.
  - Smoking.
  - Ratio of total cholesterol (TC) to high-density lipoprotein cholesterol (HDL-C) ≥6.

### Prevalence Estimates

- To ensure complete ascertainment of all CHD risk factors, only those subjects who completed the interview, examination, and fasting blood tests were included.
  - This excluded 15.3% of all subjects.
- NHANES population estimates (representing civilian, non-institutionalized, US adults) were upweighted to 2000 census estimates by multiplying the NHANES population estimates by the ratio of the total census population to the NHANES population with complete data.

### Event Risk and Preventable Events

- CHD events included MI (fatal or non-fatal), angina pectoris, and CHD-related death (sudden or non-sudden).
- Framingham risk equations were used to calculate the 4-year risk of CHD.[11]
- Risks were averaged over subjects in each age/sex stratum.
- Stratum-specific risks were multiplied by the number of prevalent cases (weighted to the 2000 census population) to generate the estimated number of subjects who would experience at least 1 CHD event within 4 years.
- HTN was then statistically "controlled" by recoding SBP to 139 mm Hg in cases where SBP >139 mm Hg.
- Lipid levels were also "controlled":
  - HDL-C: Recoded to 60 mg/dL where HDL-C <60 mg/dL.
  - TC: Recoded to 199 mg/dL where TC >199 mg/dL.
- Predicted CHD events were then recalculated; the difference in the absolute number of predicted CHD events between uncontrolled and controlled scenarios was deemed "preventable" events.[12,13]

### Costs

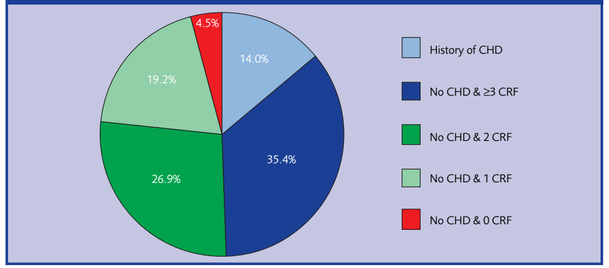
- First-year direct medical costs of preventable events were calculated based on event-specific cost figures from the literature.[14]

## RESULTS

### Patient Population

- Of the 8588 NHANES III subjects who completed the interview, examination, and fasting blood tests, 7031 had sufficient data for inclusion in our study.
  - 8.1% (SE = 0.4%) of these adults had uncontrolled HTN (882 subjects representing 16.3 million of the 2000 census population).
  - 14.0% (SE = 2.4%) of those with uncontrolled HTN had a history of CHD, and
  - 86.0% (SE = 2.4%) were free of CHD, including:
    - 4.5% (SE = 1.5%) with no CV risk factors.
    - 19.2% (SE = 2.0%) with 1 CV risk factor.
    - 26.9% (SE = 1.9%) with 2 CV risk factors.
    - 35.4% (SE = 3.0%) with ≥3 CV risk factors **(Figure 1)**.

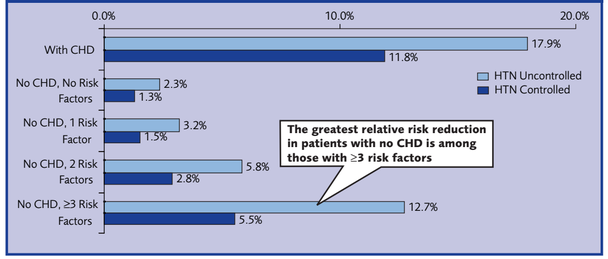
**Figure 1**. Prevalence of coronary heart disease (CHD) and cardiovascular risk factors (CRF) in adults with uncontrolled hypertension




### Predicted Events

- Mean 4-year risk of CHD in patients with uncontrolled HTN and a history of CHD **(Figure 2)** was 17.9% (SE = 0.96%), compared with:
  - 2.3% (SE = 0.33%) in subjects without CHD and no risk factors.
  - 3.2% (SE = 0.21%) in subjects without CHD and 1 risk factor.
  - 5.8% (SE = 0.33%) in subjects without CHD and 2 risk factors.
  - 12.7% (SE = 0.72%) in subjects without CHD and ≥3 risk factors.

**Figure 2**. Mean 4-year predicted risk of any coronary heart disease event in adults, by hypertension (HTN) control status and number of cardiovascular risk factors




- 1.5 million CHD events were predicted among uncontrolled hypertensive patients.
  - Among these patients, 741,006 events (49.0% of expected events) could be prevented over 4 years with SBP controlled to 139 mm Hg, HDL-C controlled to 60 mg/dL, and TC controlled to 199 mg/dL.
  - Among patients with uncontrolled hypertension and ≥3 additional CHD risk factors, 56.3% of expected events could be prevented over 4 years by controlling SBP to 139 mm Hg, HDL-C to 60 mg/dL, and TC to 199 mg/dL.

### Costs

- The first-year direct medical costs of preventable CHD events totaled $19.0 billion in 2004 dollars **(Table 1)**.

**Table 1.** Cost of preventable coronary heart disease events in patients with uncontrolled hypertension, by CHD risk category

| CHD Risk Factor Category | First-year Direct Medical Costs (2004 US $) |
|---|---|
| With CHD | 6,150,276,547 |
| No CHD, no CV risk factors | 199,671,259 |
| No CHD, 1 CV risk factor | 1,159,865,556 |
| No CHD, 2 CV risk factors | 2,959,186,626 |
| No CHD, ≥3 risk factors | 8,541,050,805 |
| **Total** | **19,010,050,793** |

CHD, coronary heart disease; US, United States

- Hypertensive patients with no CHD and ≥3 CV risk factors contribute the most to this total ($8.5 billion).

## LIMITATIONS

- The predicted numbers of CHD events and costs may be biased upward or downward due to missing data that prevented analysis of 15.3% of the total NHANES adult sample.
- Risk reductions estimated by serial application of risk equations based on epidemiologic data may not reflect true risk reductions possible with antihypertensive therapy.
- Current first-year costs of treating CHD events may be higher than estimated from the literature.

## CONCLUSIONS

- Among patients with uncontrolled HTN, those with ≥3 CV risk factors, but not CHD, incur more CHD events than any other subgroup studied.
  - 1 in 8 of these patients will experience a CHD event within 4 years.
- Patients with uncontrolled HTN and ≥3 CV risk factors also incur the largest direct medical costs:
  - $8.5 billion in first-year direct medical costs alone.
- More than half (56.3%) of the CHD events in patients with uncontrolled HTN and ≥3 CV risk factors could be prevented by controlling BP and lipid levels.
- Intensive efforts are needed to screen and treat patients who do not have a history of CHD, but who do have multiple, modifiable CV risk factors.

## DISCLOSURE

This study was supported by Pfizer Inc

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