Incremental Expenditure of Treating Hypertension in the United States

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Hypertension in United States

- **Most commonly diagnosed disease in the United States**
- **Important health problem and is associated with costly CVD events including cardiovascular, cerebrovascular, and peripheral vascular disease**
- **Risk of cardiovascular, cerebrovascular, and peripheral vascular disease increases 2-3 times with high blood pressure**

Hypertension expenditures in United States

- **Ranging from $15.0 billion-$60.0 billion**
- **Using the primary diagnosis approach or the attributable risk approach**
- **Precise estimates not obtained**

Incremental Cost Approach

- **Excess medical cost of treating a person with the disease in comparison to cost of treating a person without the disease**
- **Case-matching**
- **Regression**

  --adjust for confounders in the model

Objectives of the Study

- **Estimate incremental expenditure of treating patients with hypertension in the United States**

- **Estimate consumption of medical resources by patients with hypertension in the United States**

Data Source

- **2001 Medical Expenditure Panel Survey (MEPS) consisting of 33,556 individuals representing total U.S. population of approx. 284 million**

- **Combination of in-person, telephone and mailed surveys**

- **Consists of 3 component surveys:**
  - **Household Component (HC)**
  - **Medical Provider Component (MPC)**
  - **Insurance Component (IC)**

Identification of Patients with Hypertension

Inclusion criteria:

- **Respondents 18 years or older with ICD-9 codes in the medical conditions file or in any of the medical events files**

  401.xx: Essential hypertension

  402.xx: Hypertensive heart disease

  403.xx: Hypertensive renal disease

  404.xx: Hypertensive heart and renal disease

  405.xx: Secondary hypertension

Identification of Patients with Hypertension contd.

Inclusion criteria contd.:

- **Respondents reporting hypertension in the full-year consolidated data file**

- **Respondents receiving a medication that may be used for hypertension from the prescribed medicines file**

  -Thiazide diuretics

  -ACE inhibitors

  -Beta blockers

  -Calcium channel blockers

  -Angiotensin receptor blockers

  -Aldosterone antagonists

  -Alpha blockers

Identification of Patients with Hypertension contd.

Exclusion criteria:

- **Respondents prescribed an ACE inhibitor for CHF (428.xx) or MI (410.xx,412.xx)**
- **Respondents prescribed a beta blocker for MI (410.xx,412.xx) or angina (413.xx) or CHF (428.xx)**
- **Respondents prescribed a calcium channel blocker for angina (413.xx) or cardiac arrhythmia (427.xx)**
- **Respondents prescribed an aldosterone antagonist for CHF (428.xx)**
- **Respondents prescribed a thiazide diuretic for CHF (428.xx)**
- **Respondents prescribed an angiotensin receptor blocker for CHF (428.xx)**

Statistical Methods

- **Least squares regression**
- **Dependent variable was log of total direct expenditure**
- **Independent variables were hypertension, age, gender, race, education, Charlson co-morbidity index, and other co-morbidities**

Statistical Methods contd.

- **SAS 8.1 software**
- **Proc surveymeans and proc surveyreg**
- **SUDAAN 9.0 : ‘smearing estimator’ to prevent re-transformation bias**
- **A priori alpha = 0.05**

Results

4,098 individuals with hypertension ICD-9 codes

+

1,395 individuals who self-reported hypertension

+

845 individuals who were prescribed a medication that may be used for hypertension

(261 on calcium channel blockers, 163 on beta blockers, 208 on ACEI's, 87 on aldosterone antagonists, 105 on thiazide diuretics, and 21 on angiotensin receptor blockers)

=

Total of 6,338 included individuals

Results contd.

6,338 potential hypertensives

-

221 individuals who were prescribed a calcium channel blocker for either angina/cardiac arrhythmia

-

108 individuals who were prescribed a beta blocker for either CHF/angina/MI

-

160 individuals who were prescribed ACEI's for either CHF/MI

-

52 individuals who were prescribed aldosterone antagonists for CHF

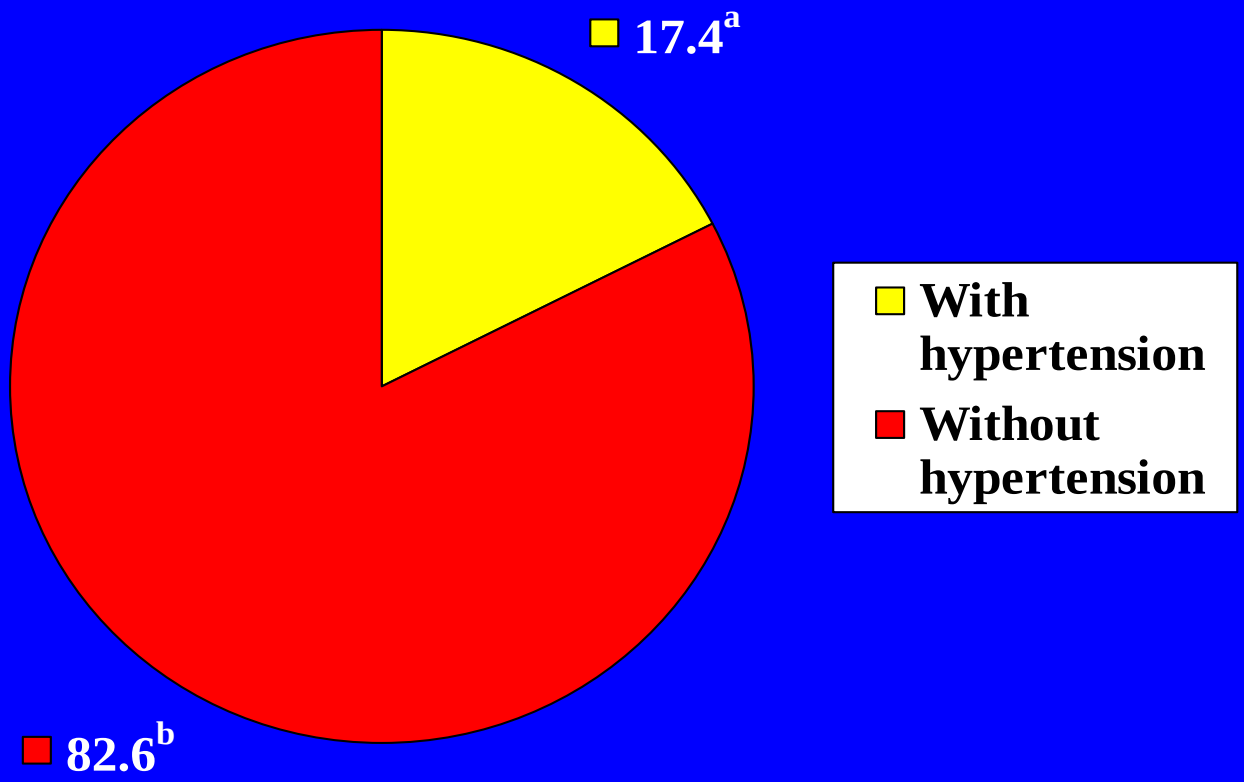
-

60 individuals who were prescribed a thiazide diuretic for CHF

=

5,737 individuals identified as having hypertension

Hypertension Prevalence



With hypertension: [a](95% C.L. 16.2% to 18.3%)
Without hypertension: [b](95% C.L. 80.9% to 84.2%)

Based on 29,581 respondents
Stratified sample estimates projected to a population of 281,786,957 persons

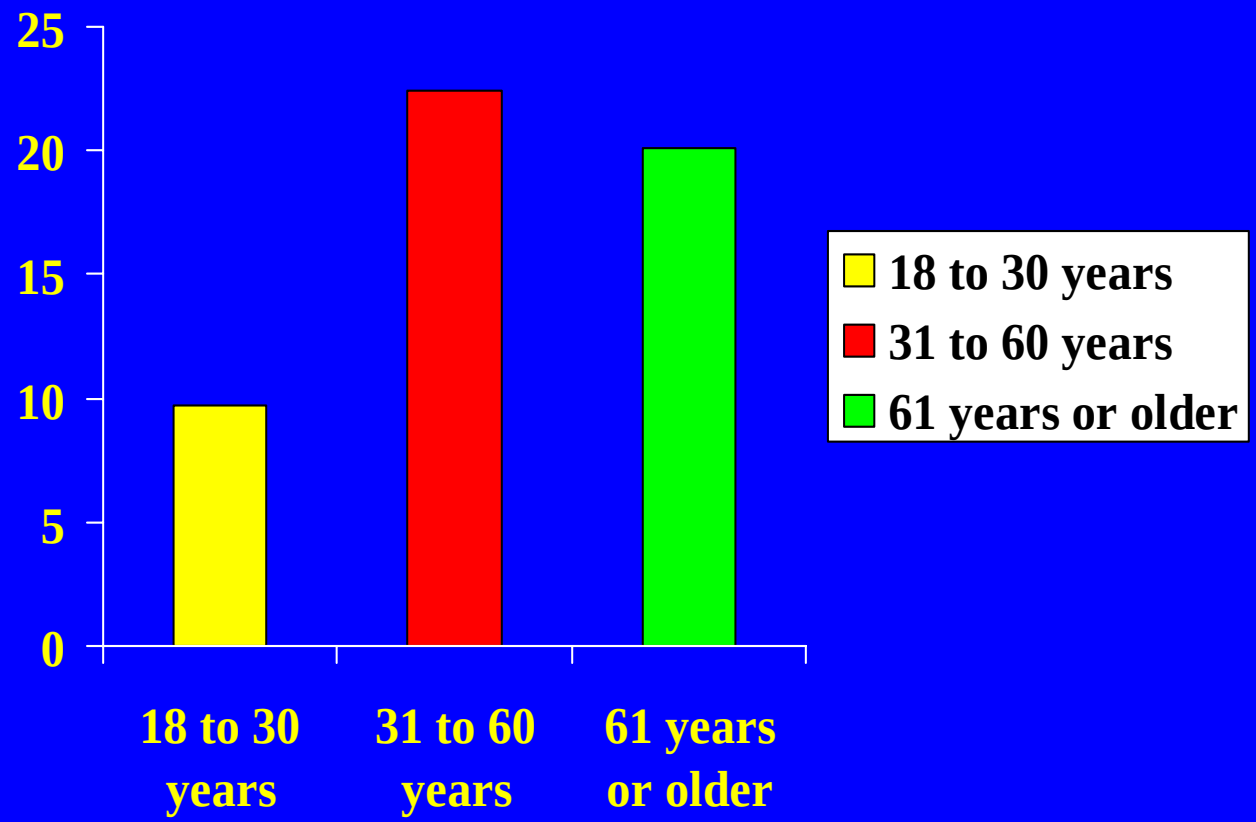
Comparison of Demographic Characteristics

Demographic Characteristic	Hypertensives[1] %	Non-hypertensives[2] %	p-value
Age			
18 to 30 years	5.14	51.57	<0.0001
31 to 60 years	49.58	39.59	<0.0001
61 years and older	45.27	8.83	<0.0001
Gender			
Male	45.02	49.58	<0.0001
Female	54.98	50.42	<0.0001
Race			
White	82.81	82.21	0.2763
Black	13.31	12.47	0.0432
Other Race	3.88	5.32	<0.0001

[1] Stratified sample estimates projected to a population of 49,048,231 hypertensive persons

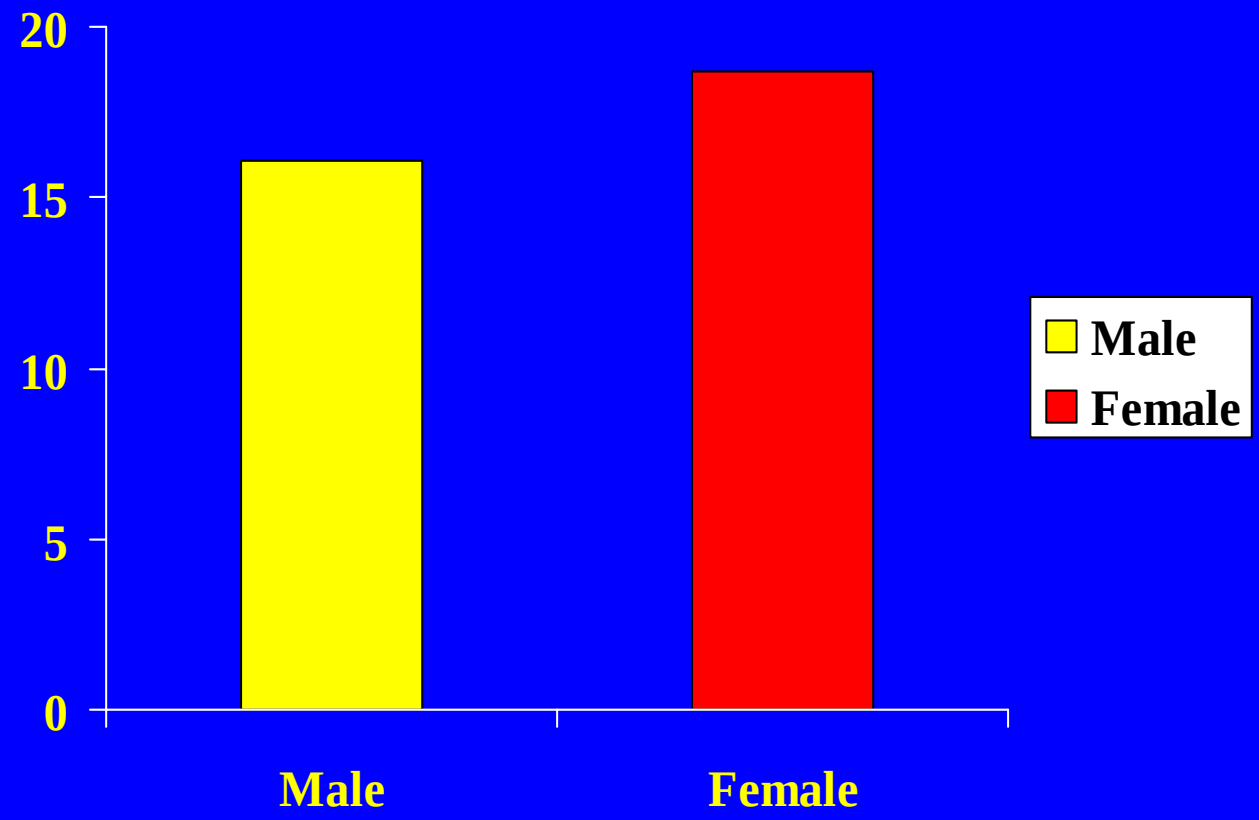
[2] Stratified sample estimates projected to a population of 232,738,726 non-hypertensive persons

Comparison of Hypertension Prevalence across Respondents by Age Groups



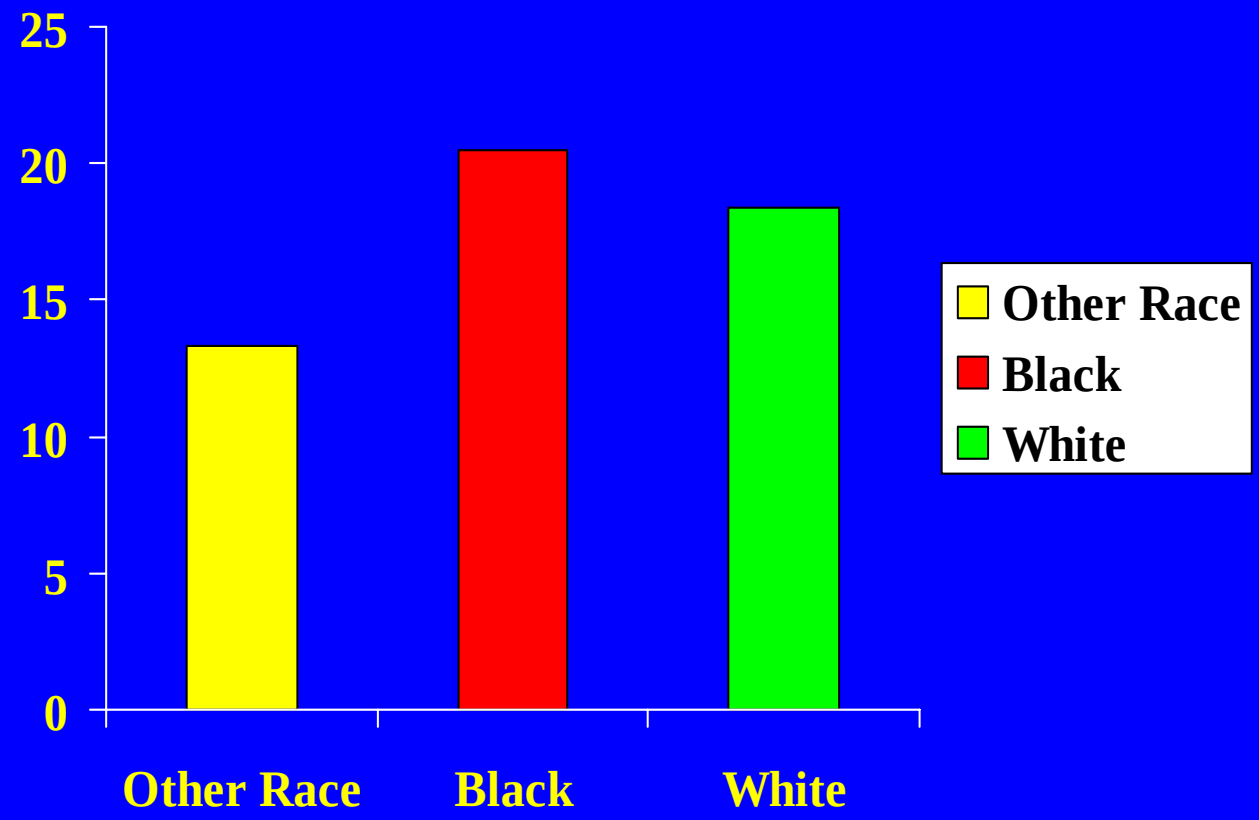
18 to 30 years: 9.72% (95% C.L. 8.78 to 9.97)
31 to 60 years: 22.40% (95% C.L. 20.96 to 23.68)
61 years or older: 20.08% (95% C.L. 18.42 to 21.78)

Comparison of Hypertension Prevalence across Respondents by Gender Groups



Male: 16.08% (95% C.L. 15.23 to 17.44)
Female: 18.72% (95% C.L. 17.47 to 19.77)

Comparison of Hypertension Prevalence across Respondents by Race Groups



Black: 20.48% (95% C.L. 19.32 to 21.38)
White: 18.37% (95% C.L. 17.41 to 19.51)
Other Race: 13.35% (95% C.L. 12.16 to 14.45)

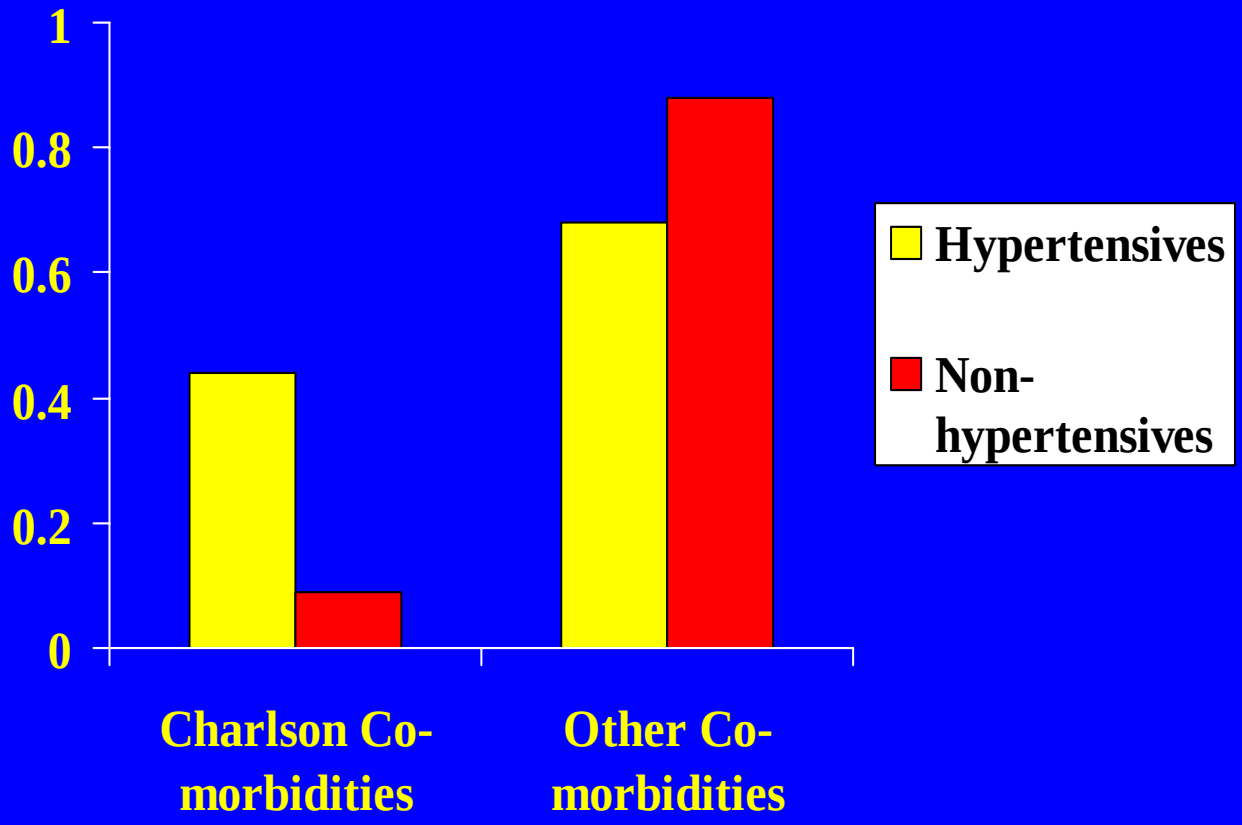
Co-morbidities among Hypertensive and Non-hypertensive Persons

Co-morbidity	Hypertensives[1]	95% C.L.	Non-hypertensives[2]	95% C.L.
Myocardial Infarction	0.32	0.15 to 0.48	0.03	0.002 to 0.06
Congestive Heart Failure	1.55	1.14 to 1.96	0.17	0.11 to 0.23
Peripheral Vascular Disease	1.38	1.03 to 1.73	0.29	0.21 to 0.37
Dementia	0.30	0.11 to 0.50	0.05	0.02 to 0.09
Cerebrovascular Disease	0.54	0.27 to 0.80	0.08	0.04 to 0.12
Chronic Pulmonary Disease	**5.35**	4.60 to 6.10	**2.59**	2.34 to 2.83
Connective Tissue Disease	0.94	0.61 to 1.26	0.27	0.19 to 0.34
Ulcer Disease	0.95	0.66 to 1.24	0.19	0.13 to 0.25
Mild Liver Disease	0.41	0.23 to 0.59	0.05	0.03 to 0.07
Hemiplegia	1.60	1.24 to 1.80	0.22	0.15 to 0.28
Moderate/Severe Renal Disease	0.45	0.24 to 0.66	0.03	0.01 to 0.05
Diabetes	**8.50**	7.64 to 9.36	**1.12**	0.99 to 1.25
Any Tumor	**4.32**	3.62 to 5.00	**1.03**	0.88 to 1.18
Leukemia	0.07	-0.008 to 0.2	0.03	0.0006 to 0.06
Lymphoma	0.19	0.06 to 0.32	0.02	0.005 to 0.03
Metastatic Solid Tumor	0.25	0.11 to 0.40	0.13	0.08 to 0.18

[1] Stratified sample estimates projected to a population of 49,048,231 hypertensive persons

[2] Stratified sample estimates projected to a population of 232,738,726 non-hypertensive persons

Charlson Co-morbidity Index and Other Co-morbidities among Hypertensive[1] and Non-hypertensive[2] Persons



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Charlson Co-morbidities: Hypertensives – 0.44, Other co-morbidities – 0.68

Charlson Co-morbidities: Non-hypertensives – 0.09, Other co-morbidities – 0.88

Comparison of Proportion of Hypertensive and Non-hypertensive Persons Experiencing Various Medical Encounters

Event	Hypertensives[1] %	Non-hypertensives[2] %	p-value
Office-based medical provider	92.3	76.6	< 0.0001
Prescription medicines	77.7	71.8	< 0.0001
Other medical	34.3	19.4	< 0.0001
Out-patient visits	30.0	13.7	< 0.0001
Emergency room visits	18.9	15.3	< 0.0001
In-patient visits	16.3	7.5	< 0.0001
Home health visits	6.9	1.7	< 0.0001

[1] Stratified sample estimates projected to a population of 49,048,231 hypertensive persons

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Results of Bivariate Regression Models with Log of Total Direct Cost as Dependent Variable and Individual Demographic Characteristics as Independent Variable

Demographic	R-square[2]	F[2]	p-value
Age	0.07	32.84	< 0.0001
Hispanic Ethnicity	0.003	188.46	< 0.0001
Education	0.01	58.86	< 0.0001
Marital status	0.04	280.70	< 0.0001
Race	0.002	28.56	< 0.0001
Gender	0.002	37.51	< 0.0001
Occupation	0.005	8.99	< 0.0001

[1] Based on 29,581 respondents

[2] Stratified sample estimates projected to a population of 281,786,957 persons

Multivariate Regression Model with Log of Total Direct Cost as Dependent Variable and Demographic Characteristics and Co-morbidities as Independent Variables

Parameter	Estimate[2]	S.E[2]	p-value
Intercept	525.1	148.7	0.0012
Hypertension	1130.7	184.8	< 0.0001
Age	48.1	3.7	< 0.0001
Male	-508.2	83.9	0.0045
Black	-283.1	110.3	0.0180
Other	-491.2	173.9	0.0092
GED	-2310.8	76.9	<0.0001
Bachelor's Degree	33.3	141.1	0.8274
Master's Degree	-703.9	114.5	< 0.0001
Doctorate Degree	-449.9	120.6	0.0006
Other Degree	365.7	129.1	0.0091
No degree	-198.1	126.8	0.1488
Charlson Co-morbidity Index	3314.8	227.8	< 0.0001

[1] Based on 29,581 respondents

[2] Stratified sample estimates projected to a population of 281,786,957 persons

Smearing estimator of 1.08 was used for re-transformation

Total Incremental Direct Cost of Treating Hypertension

- **After adjusting for demographics and co-morbidities $1130.7*49,048,231 = $55,458,834,792**

Limitations

- **Identification of hypertension patients through ICD-9 codes**

- **Not all patients with hypertension are diagnosed, so there may be a potential under-estimation**

Summary

- **Approximately 17.4 percent of the population or 49,048,231 individuals had hypertension in 2001**
- **Patients with hypertension had greater medical event encounters than patients without hypertension in each of the seven medical events**
- **Incremental direct cost of treating hypertension: exceeded $55.0 billion in the United States in 2001**

Conclusions

- **With incremental direct treatment costs exceeding $55.0 billion in 2001, hypertension costs represent a significant amount of healthcare expenditures**

Acknowledgements

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Questions?