

# **Comparison of Quality, Cost, and Accessibility of Coronary Revascularization Procedures Provided by VHA and Community Contract Hospitals**

**Paul G. Barnett, PhD**  
**HERC Cyberseminar**  
**June 21, 2017**



# Acknowledgements

- Co-Authors

- Juliette S. Hong, MS

- Gary Grunwald, PhD

- Evan Carey, PhD

- Thomas M. Maddox, MD, MSc

- HSR&D IIR 11-049

# Background

- VHA Community Care (CC)
  - Community providers of Veteran care
  - \$5.6 billion in 2014, ~10% VHA budget
- Panel convened Veterans Choice Act recommended non-VHA health networks for most veteran healthcare

# Question

- Can VHA improve value and accessibility of elective cardiac revascularization services by expanded use of contract hospitals?
- Can VHA improve value by selecting hospitals based on proxy measures for quality?

# Design

- Coronary revascularization
    - Percutaneous Coronary Intervention (PCI)
    - Coronary Artery Bypass Graft (CABG)
  - Observational study
    - Excluded patients  $> 65$  years old as they frequently use Medicare
    - Excluded emergency services (these must be provided by the nearest hospital)
-

# Exposures

- VHA vs. Community Care (CC)
- Controlled for differences in cardiac risk factors
- Use propensity adjustment to consider referral/selection bias

# Proxy measures for quality

- Minimum annual volume  
(200 PCI, 125 CABG)
- Best 90% of hospitals according to  
Hospital Compare performance measure  
for acute myocardial infarction mortality

# Outcomes

- 30-day mortality
- 30-day readmission
- Travel distance and cost
- Procedure cost
- Total cost including patient and caregiver travel

# Community Care Data

- Identification of procedures
- Readmission in acute hospital
- Cost
- Location of care

# Travel burden

- Additional travel required by VA care arrangements
  - Actual distance travelled less
  - Distance to nearest hospital offering procedure
- Travel time and distance determined by ArcGIS

# Travel cost

- 41.5 cents per mile
- Time in transit valued at the Federal minimum wage
- Lodging cost lodging if travel > 40 miles
  - Caregiver lodging for each night of stay
  - Patient lodging for ambulatory PCI

# Sources of hospital measures

- Volume
    - VA data
    - National Cardiovascular Disease Registry, Leapfrog survey, Medicare data
  - Hospital Compare AMI mortality
    - Hospitals with the lowest 90% risk-adjusted mortality rates were considered good performers
-

# Risk factors

- Standard measures
  - Identified in national studies
  - Available in VA national data repository
  - Appropriate for low-risk (elective) patients

# Statistical method

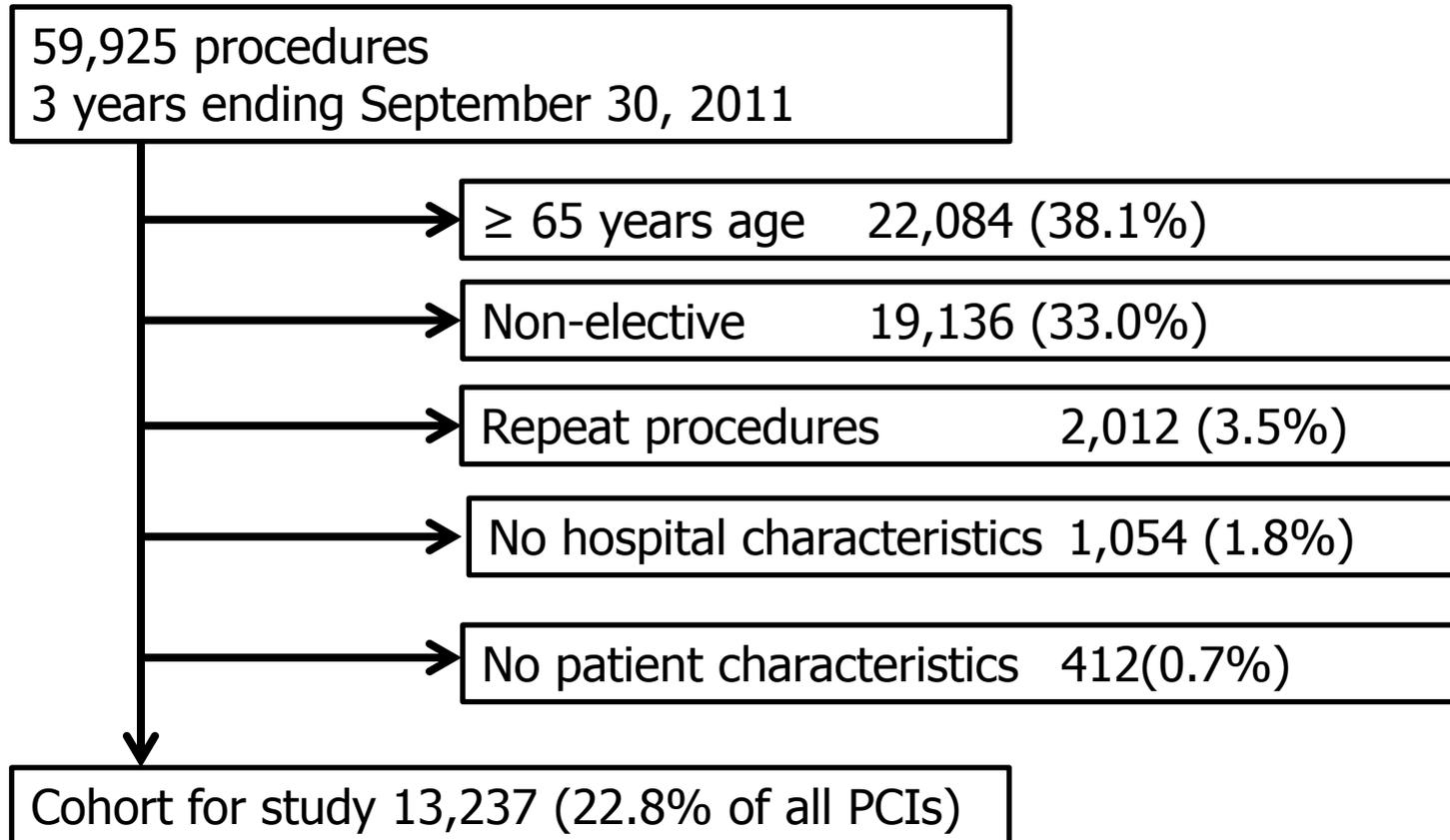
- Propensity weighting to control for referral bias
    - Weight was inverse of probability of treatment actually received
    - Before adjustment: few differences in case-mix
    - After adjustment, standardized difference < 10%
-

# Statistical method (cont.)

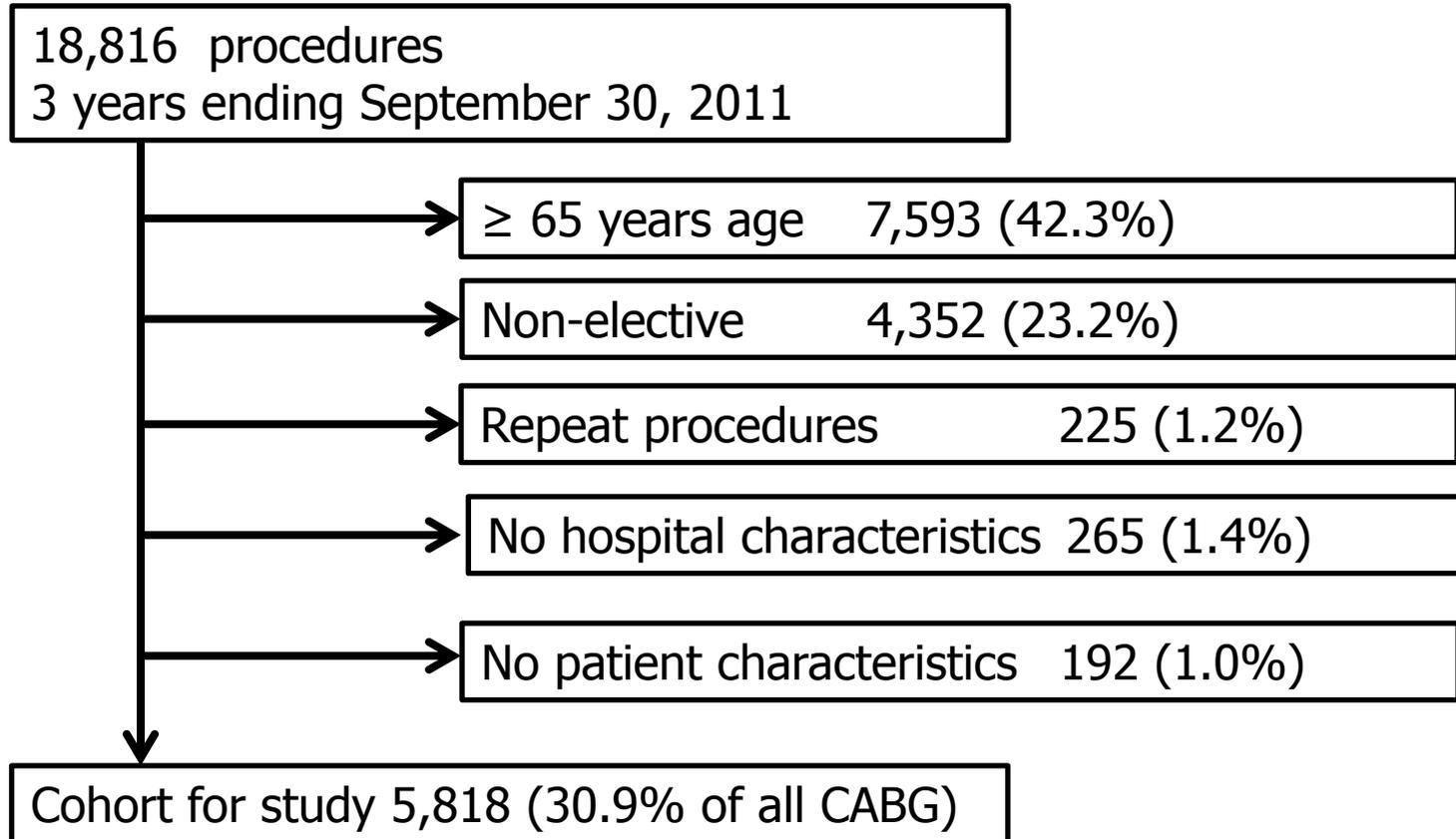
- Mortality and readmission
    - Log binomial models, to generate estimates of relative risk; preferred to odds ratio
  - Costs
    - Generalized linear regression with gamma distribution and log link
  - Correlation within hospital
    - Sandwich estimators
-

# **Cohort selection**

# PCI



# CABG



# Cohort

- PCI
  - 13,227 procedures
  - 79.1 % at VHA
- CABG surgery
  - 5,818 procedures
  - 83.6% at VHA

# **Patient characteristics**

# PCI

- VHA patients were more likely to have:
    - CHF (21.1% vs. 18.8%,  $p = .01$ )
    - 2-vessel procedure (15.0% vs. 6.6%,  $p < .001$ )
    - 3-vessel procedure (3.2% vs. 2.0%,  $p < .001$ )
    - 4-vessel procedure (1.0% vs. 0.5%,  $p = .02$ )
    - Care in low-volume hospital (41.7% vs 3.7%,  $p < .001$ )
-

# PCI

- CC patients, more likely to have:
  - Very low body mass index (0.7% vs. 0.4%,  $p=.01$ )
  - Worse kidney function (eGFR < 15 or on dialysis; 4.5% vs. 2.1%,  $p < .001$ )
  - Low cardiac output (ejection fraction EF < 30%; 7.5% vs. 5.7%,  $p=.005$ )
  - Care in high AMI mortality hospital (14.0% vs. 9.9%,  $p < .001$ )

# CABG

- **VHA patients were more likely to have:**
  - Atrial fibrillation  
(13.0% vs 8.1%,  $p < 0.001$ )
  - Care in low volume hospital  
(64.4% vs. 27.4%  $p < .001$ )

# CABG

- CC patients were more likely to have:
  - prior PCI (14.0% vs 9.1%,  $p < 0.001$ )
  - insulin-dependent diabetes  
(16.8% vs. 14.0%,  $p = 0.02$ )
  - 3-vessel procedure (27.0% vs. 22.2%  $p = .001$ )
  - 4-vessel procedure (10.9% vs. 5.6%,  $p < .001$ )
  - Low cardiac output  
(EF  $< 30\%$ ; 10.8% vs. 6.1%,  $p = 0.001$ )

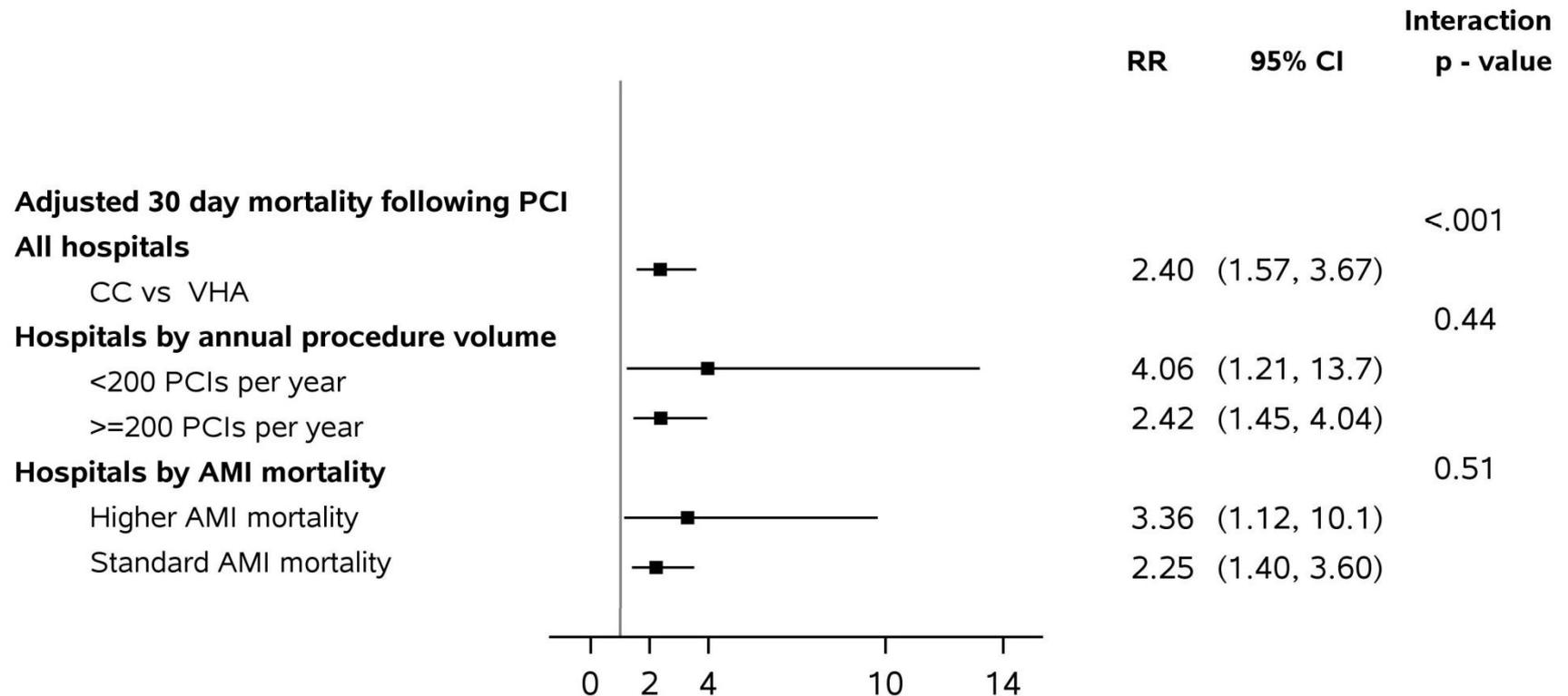
# Propensity adjustment

- Substantial overlap in predicted propensity to use CC
- After propensity adjustment
  - Standardized differences in risk factors had absolute value  $< 10\%$

**Outcome:  
30 day mortality**

# Relative 30 day mortality after PCI

Relative Risk and 95% Confidence Interval

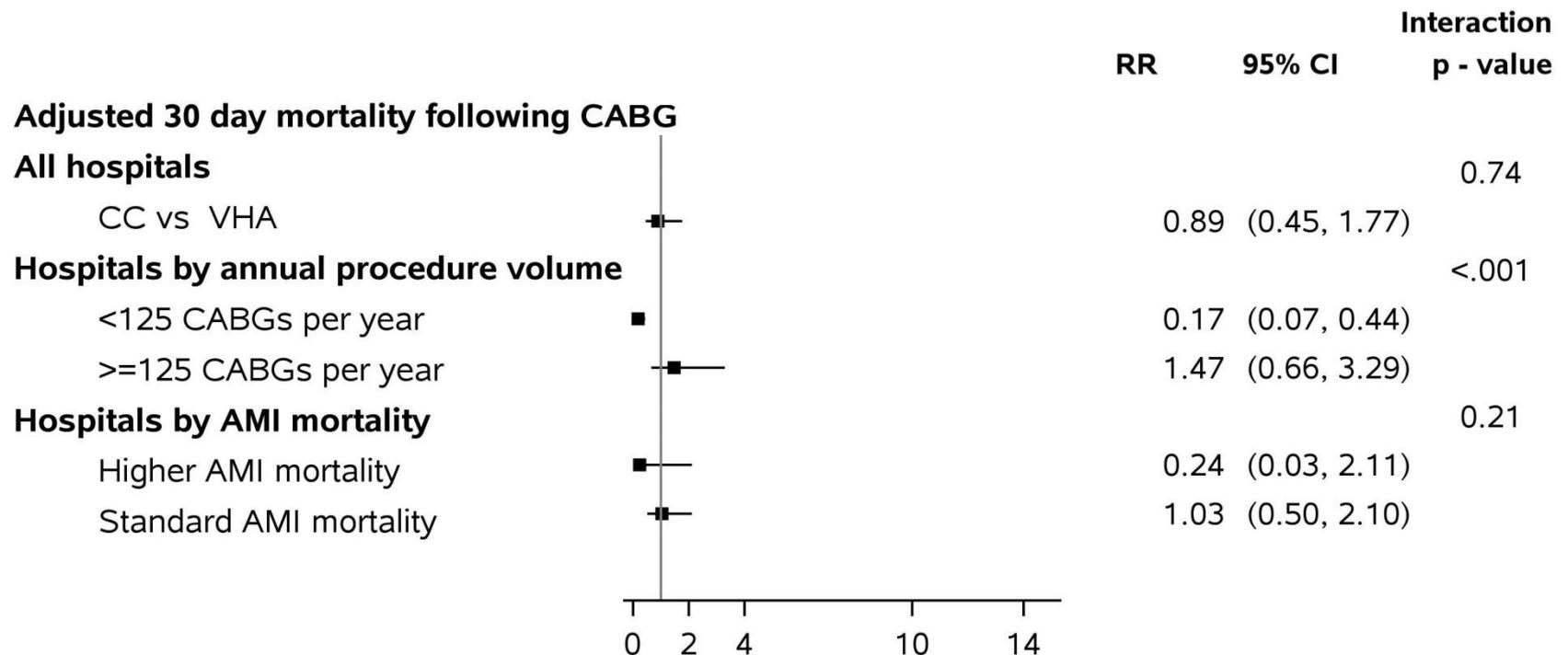


# Absolute 30 day mortality after PCI

	No. of Index Procedure N (%)	30 Day Mortality Rate (%)	
		VHA	CC
<b>Adjusted 30 day mortality following PCI</b>			
<b>All hospitals</b>			
CC vs VHA	13237 (100%)	0.65	1.54
<b>Hospitals by annual procedure volume</b>			
<200 PCIs per year	3006 (23%)	0.69	2.99
>=200 PCIs per year	10231 (77%)	0.62	1.49
<b>Hospitals by AMI mortality</b>			
Higher AMI mortality	1585 (12%)	0.61	2.16
Standard AMI mortality	11652 (88%)	0.65	1.44

# Relative 30 day mortality after CABG

Relative Risk and 95% Confidence Interval



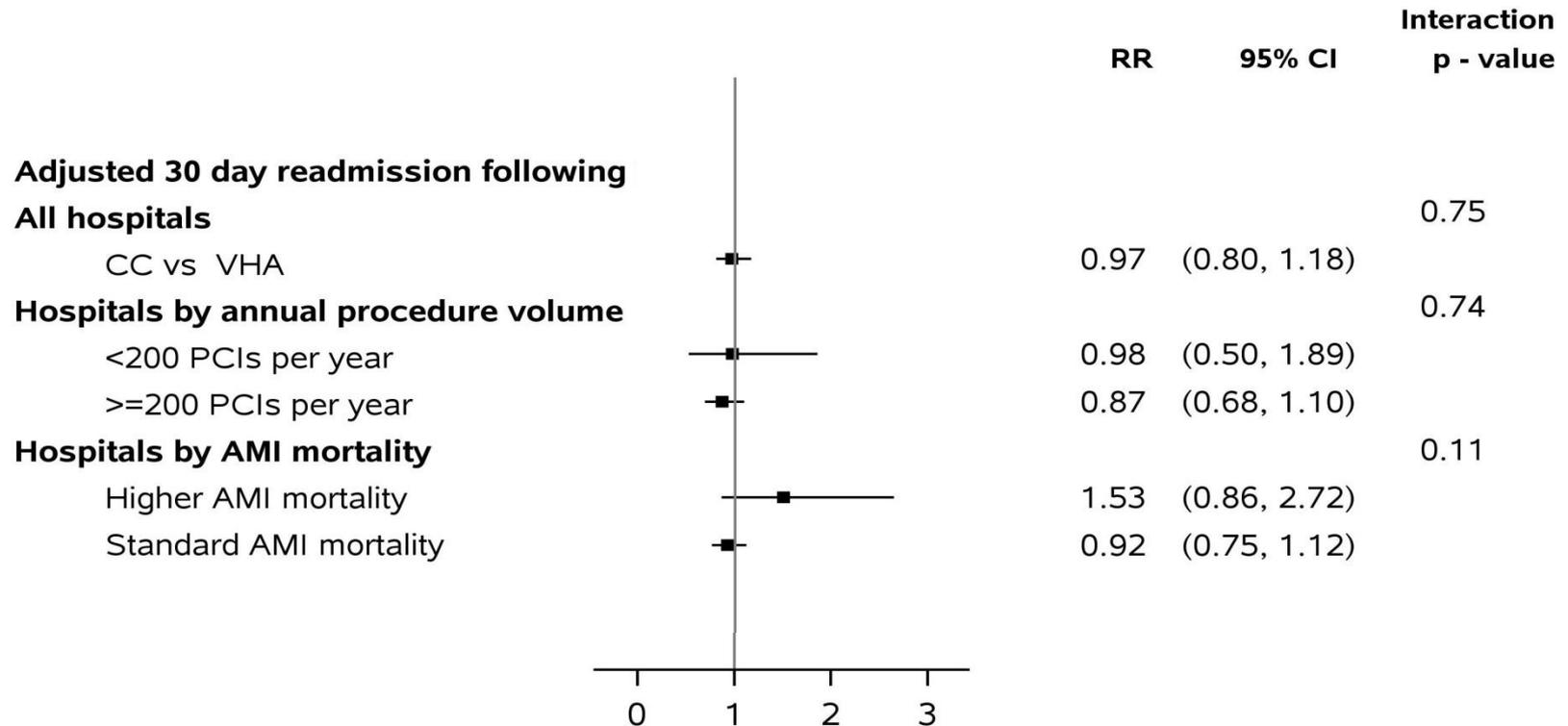
# Absolute 30 day mortality after CABG

	No. of Index Procedure N (%)	30 Day Mortality Rate (%) VHA	CC
<b>Adjusted 30 day mortality following CABG</b>			
<b>All hospitals</b>			
CC vs VHA	5818 (100%)	1.51	1.34
<b>Hospitals by annual procedure volume</b>			
<125 CABGs per year	2610 (45%)	1.71	0.27
>=125 CABGs per year	3208 (55%)	1.15	1.66
<b>Hospitals by AMI mortality</b>			
Higher AMI mortality	589 (10%)	2.74	0.68
Standard AMI mortality	5229 (90%)	1.38	1.41

**Outcome:  
30 day readmission**

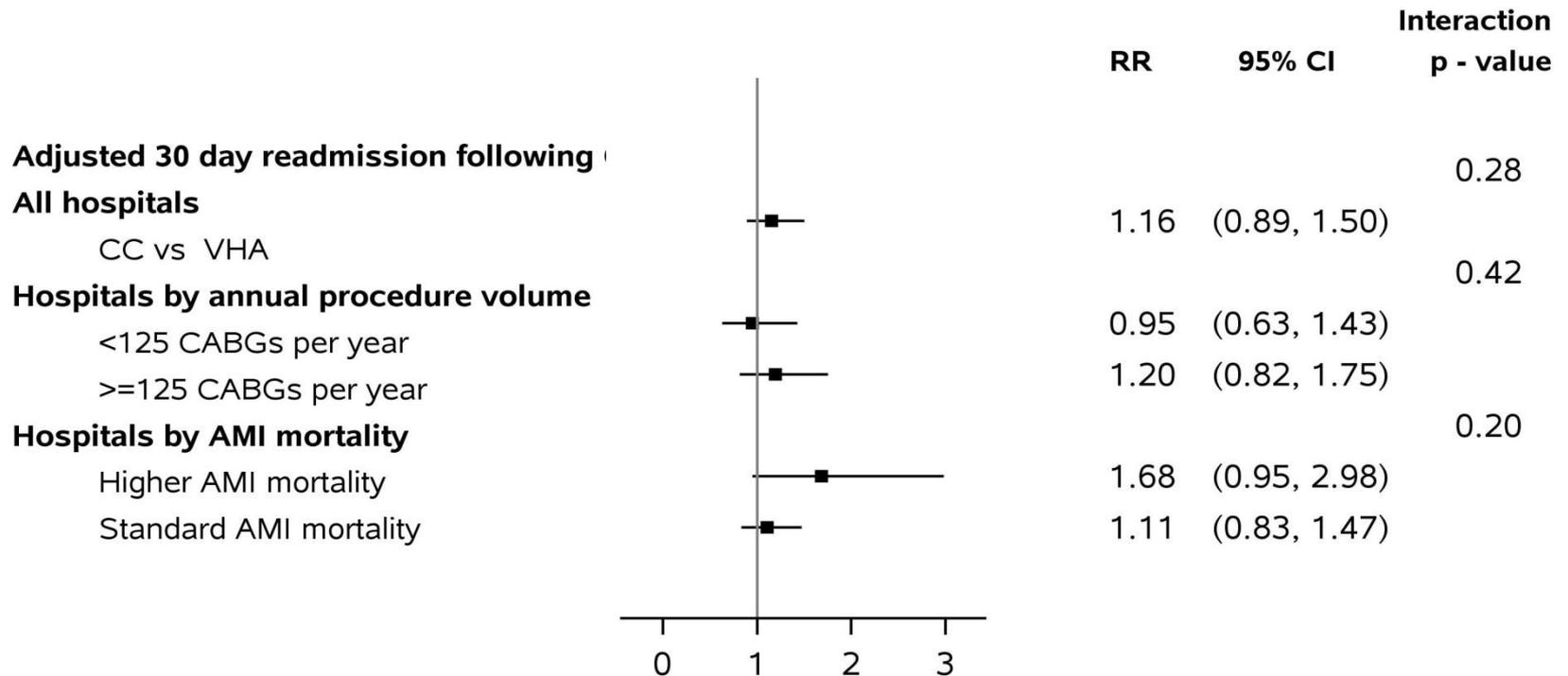
# 30 day readmission after PCI

Relative Risk and 95% Confidence Interval



# 30 day readmission after CABG

Relative Risk and 95% Confidence Interval



**Outcome:  
Travel distance & cost**

# PCI travel distance

<b>Travel distance (miles)</b>	<b>VHA</b>	<b>CC</b>	<b>p value</b>
<b>Actual distance traveled</b>	<b>90.8</b>	<b>60.1</b>	<b>&lt;.001</b>
<b>Distance to nearest hospital</b>	<b>18.5</b>	<b>41.5</b>	<b>&lt;.001</b>
<b>Extra travel distance</b>	<b>72.2</b>	<b>18.6</b>	<b>&lt;.001</b>

# PCI travel cost

<b>Travel cost (\$US 2011)</b>	<b>VHA</b>	<b>CC</b>	<b>p value</b>
<b>Actual travel cost incurred</b>	<b>238</b>	<b>198</b>	<b>0.004</b>
<b>Cost of travel to nearest hospital</b>	<b>50</b>	<b>167</b>	<b>&lt;.001</b>
<b>Extra travel cost incurred</b>	<b>187</b>	<b>31</b>	<b>&lt;.001</b>

# CABG travel distance

<b>Travel distance (miles)</b>	<b>VHA</b>	<b>CC</b>	<b>p value</b>
<b>Actual distance traveled</b>	<b>123.2</b>	<b>81.5</b>	<b>0.024</b>
<b>Distance to nearest hospital</b>	<b>22.2</b>	<b>53.8</b>	<b>&lt;.001</b>
<b>Extra travel distance</b>	<b>101</b>	<b>27.7</b>	<b>&lt;.001</b>

# CABG travel cost

<b>Travel cost (\$US 2011)</b>	<b>VHA</b>	<b>CC</b>	<b>p value</b>
<b>Actual travel cost incurred</b>	<b>958</b>	<b>630</b>	<b>&lt;.001</b>
<b>Cost of travel to nearest hospital</b>	<b>210</b>	<b>574</b>	<b>&lt;.001</b>
<b>Extra travel cost incurred</b>	<b>747</b>	<b>57</b>	<b>&lt;.001</b>

**Outcome:  
Total cost**

# PCI cost by source

<b>Cost (\$US 2011)</b>	<b>VHA</b>	<b>CC</b>	<b>p value</b>
<b>Procedure</b>	<b>15683</b>	<b>22050</b>	<b>&lt;.001</b>
<b>Readmissions</b>	<b>934</b>	<b>984</b>	<b>0.668</b>
<b>Travel</b>	<b>187</b>	<b>31</b>	<b>&lt;.001</b>
<b>Total</b>	<b>16771</b>	<b>23100</b>	<b>&lt;.001</b>

# PCI cost by hospital measure

	VHA	CC	p value
<b>Total cost by hospital procedure volume</b>			
<b>Below minimum volume</b>	<b>17044</b>	<b>30347</b>	<b>0.665</b>
<b>Meets minimum volume</b>	<b>16573</b>	<b>22269</b>	<b>&lt;.001</b>
<b>Total cost by hospital AMI mortality</b>			
<b>Higher AMI mortality</b>	<b>14447</b>	<b>29600</b>	<b>0.021</b>
<b>Standard AMI mortality</b>	<b>17028</b>	<b>22017</b>	<b>&lt;.001</b>

# CABG cost by source

<b>Cost (\$US 2011)</b>	<b>VHA</b>	<b>CC</b>	<b>p value</b>
<b>Procedure</b>	<b>63144</b>	<b>55526</b>	<b>0.006</b>
<b>Readmission</b>	<b>1215</b>	<b>990</b>	<b>0.444</b>
<b>Travel</b>	<b>747</b>	<b>57</b>	<b>&lt;.0001</b>
<b>Total</b>	<b>65264</b>	<b>56749</b>	<b>0.004</b>

# CABG cost by hospital measure

	VHA	CC	p value
<b>Total cost by hospital procedure volume</b>			
<b>Below minimum volume</b>	<b>65980</b>	<b>48705</b>	<b>0.060</b>
<b>Meets minimum volume</b>	<b>63977</b>	<b>59499</b>	<b>0.177</b>
<b>Total cost by hospital AMI mortality</b>			
<b>Higher AMI mortality</b>	<b>50286</b>	<b>55128</b>	<b>0.533</b>
<b>Standard AMI mortality</b>	<b>66936</b>	<b>56936</b>	<b>0.003</b>

# Summary of PCI Findings

- CC hospitals had worse mortality and higher costs
  - 30-day mortality 2.4 times Relative Risk (1.63% vs. 0.63% in VA,  $p < 0.001$ )
  - Cost was 37% greater (\$23,100 vs. \$16,771 in VHA,  $p < 0.001$ )
  - No differences in readmission

# Summary of CABG Findings

- CC hospitals had equivalent mortality and lower cost
  - 30 day mortality not different  
(1.26% in CC vs. 1.50% in VA,  $p=0.74$ ).
  - Cost 14% less in CC  
( $\$56749$  vs.  $\$65264$   $p < .01$ ).

# Summary of Findings

- No differences in readmission rates
- Quality proxy measures did not identify high value hospitals
- Patient and caregiver cost were small relative to procedure costs

# Limitations

- Possibility of undetected referral bias (rare event)
    - VHA and CC patients quite similar
    - Ejection fraction not available for many CC patients
    - Propensity adjustment had little effect
  - Reliance mortality as an outcome
  - Data lag 2008-2011
  - Excluded patients  $\geq 65$  years
  - Did not evaluate effect of travel distance on completing recommended procedures
-

# Implications

- VHA quality good despite small volume
  - Shift from VHA to contract hospitals would decrease value for PCI and increase value of CABG
  - Not feasible to do both: CABG surgery supports PCI quality
  - Available measures did not identify better hospitals
-

# Implications

- Measurable differences in quality, cost and accessibility of cardiac care provided by VHA and CC
- Other research is needed to learn if VHA should make or buy other services