

# Healthcare Utilization and Costs of Veterans Screened and Assessed for Traumatic Brain Injury

Kevin T. Stroupe, Ph.D

Center for Management of Complex Chronic Care  
Hines VA Hospital  
Program in Health Services Research  
Department of Medicine  
Loyola University Health System

**June 27, 2012**

VETERANS HEALTH ADMINISTRATION

# Acknowledgements

**Bridget M. Smith, Ph.D**

**Timothy P. Hogan, Ph.D**

**Justin R. St. Andre, MA**

**Theresa Pape, DrPH, MA**

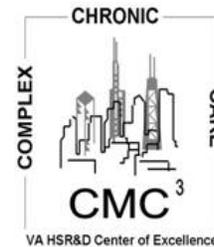
**Monica L. Steiner, MD**

**Eric Proescher, Psy.D**

**Zhiping Huo, MS**

**Charlesnika T. Evans MPH, Ph.D**

**Funding: VA HSRD SDR 08-409: Evaluation of TBI Screening Processes and Healthcare Utilization (PI: B. Smith)**



**Stritch  
School of  
Medicine**



# Background: Mild Traumatic Brain Injury

- 15% to 20% of Services Members in the Afghanistan (Operation Enduring Freedom [OEF]) and Iraq (Operation Iraqi Freedom [OIF]) conflicts have had mild traumatic brain injury (TBI)
- Mild TBI can manifest as affective, somatic, and cognitive
  - Headaches
  - Problems with sleep
  - Balance and/or Memory
  - Irritability
  - Sensitivity to light

## Background: Screening of TBI

- VA implemented a national clinical reminder (CR) in 2007 to screen for TBI
- Veterans who screen positive are referred for a comprehensive TBI evaluation (CTBIE)
- TBI diagnosis is made after completion of CTBIE

# Objectives

- To identify healthcare utilization and cost patterns of OEF/OIF Veterans following screening for TBI
- To determine the association of patient characteristics with healthcare utilization and costs of OEF/OIF Veterans following screening for TBI

# Study Design

- We examined healthcare utilization and costs over a 12-month period following an *index date*
- *Index date*
  - For Veterans with TBI screen: Date of TBI screening
  - For Veterans without TBI screen: Date of first VA healthcare utilization after separation from the military and after April 14, 2007

## Study Design (Cont.)

- All Veterans were categorized into TBI screening groups by whether they had:
  - No TBI screen
  - Negative Screen
  - Positive Screen
- Among Veterans with positive TBI screen who received the CTBIE, we categorized Veterans into CTBIE result groups:
  - Negative comprehensive TBI evaluation (CTBIE)
  - Positive comprehensive TBI evaluation (CTBIE)

## Methods: Sample

- OEF/OIF Veterans were included if:
  - Member of the VA OEF/OIF roster
  - Military service separation date was after September 11, 2001 and before September 30, 2008
  - Had a VA inpatient or outpatient visit between April 14, 2007 and September 30, 2008
  - Indicated “yes” on the TBI screen that they had been deployed in Afghanistan and/or Iraq
- Final sample derived from this national population included 170,681 OEF/OIF Veterans

# Methods: Data Sources

- OEF/OIF Roster
  - To identify subjects
  - Demographic data
- VA National TBI Health Factors database
  - To create the index date for each Veteran
- Comprehensive TBI Evaluation database
- VA Medical Inpatient and Outpatient Datasets
- VA Decision Support System (DSS) National Data Extracts (NDEs)
- VA Fee Basis Databases

# Methods: Measures of Healthcare Utilization and Costs

- Outpatient utilization and cost categorizes included (based on clinic stop codes in DSS NDEs) :
  - Primary care
  - Rehabilitation care
  - Polytrauma care
  - Mental health care
  - Other specialty care
  - Non-VA outpatient (from Fee Basis files)
- We assessed costs on
  - Day of index visit
  - Day of comprehensive TBI evaluation (CTBIE)

# Methods: Measures of Healthcare Utilization and Costs (Cont.)

- Outpatient pharmacy utilization and costs were from DSS NDEs
- Inpatient utilization and cost categories included (based on bed section):
  - Short-term medical/surgical
  - Spinal cord injury (SCI)
  - Psychiatric
  - Rehabilitation
  - Intensive Care Unit
  - Long-term care
  - Non-VA care financed by VA (from the VA Fee Basis files)

# Methods: Measures of Healthcare Utilization and Costs (Cont.)

- Total costs per patient during 12 months following index date included
  - Total outpatient
  - Total outpatient pharmacy
  - Total inpatient
- All costs were adjusted to 2008 dollars using Consumer Price Index

## Methods: Analyses

- We compared the 3 TBI screening groups and 2 comprehensive TBI evaluation result groups
  - Chi-Square: To compare Veteran characteristics
  - ANOVA : To compare unadjusted utilization and costs
  - Logistic regression: To compare hospitalization controlling for patient characteristics
  - Negative Binomial Models: To compare outpatient visits controlling for patient characteristics
  - Generalized linear models with gamma distribution and log link function: To compare total costs

## Sample Description: By TBI Screening Groups

- 170,681 Veterans met inclusion criteria:
  - 14,266 (8%) had no TBI screen
  - 124,335 (73%) screened negative
  - 32,080 (19%) screened positive

## Patient Characteristics: By TBI Screening Groups

Characteristic	No TBI Screen	Screened Negative	Screened Positive
GENDER: male	<b>86.9%</b>	<b>85.9%</b>	<b>94.0%</b>
AGE			
Under 25	<b>19.4%</b>	<b>20.0%</b>	<b>25.4%</b>
25-29	<b>35.8%</b>	<b>31.3%</b>	<b>32.9%</b>
30-34	<b>13.5%</b>	<b>12.8%</b>	<b>13.2%</b>
35+	<b>31.3%</b>	<b>36.0%</b>	<b>28.5%</b>
MARRIED	<b>43.7%</b>	<b>46.8%</b>	<b>47.3%</b>
RACE/ETHNICITY			
White	<b>68.2%</b>	<b>70.5%</b>	<b>74.5%</b>
Black	<b>16.7%</b>	<b>17.0%</b>	<b>13.9%</b>
Hispanic	<b>12.3%</b>	<b>11.7%</b>	<b>11.8%</b>

## Patient Characteristics : By TBI Screening Groups

Characteristic	No TBI Screen	Screened Negative	Screened Positive
<b>EDUCATION</b>			
High School/GED or less	<b>81.1%</b>	<b>78.5%</b>	<b>85.3%</b>
Some College	<b>9.8%</b>	<b>10.8%</b>	<b>8.6%</b>
College	<b>7.0%</b>	<b>8.3%</b>	<b>5.0%</b>
Beyond College	<b>2.1%</b>	<b>2.4%</b>	<b>1.2%</b>
<b>SERVICE CONNECTED DISABILITY</b>	<b>33.8%</b>	<b>35.5%</b>	<b>41.9%</b>

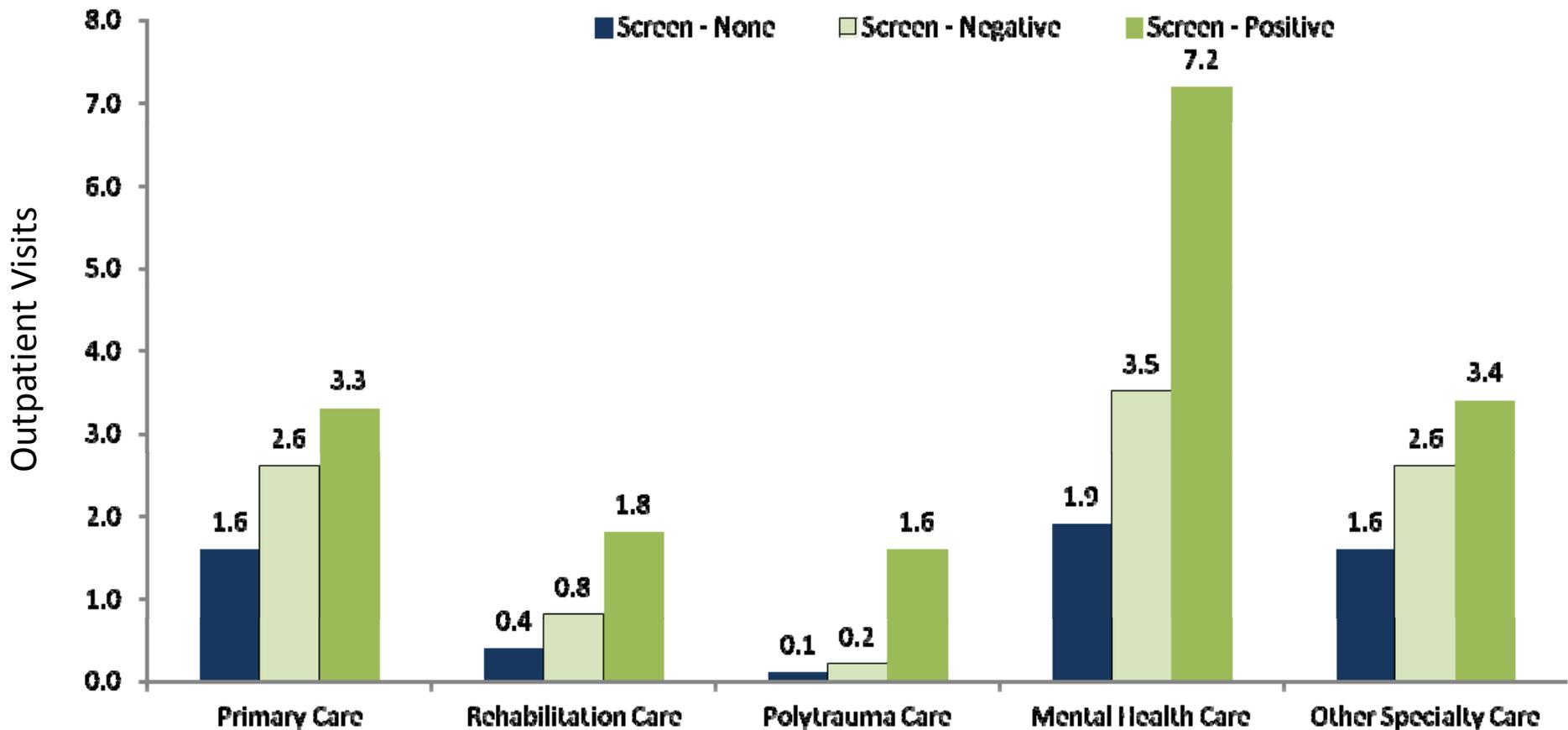
## Patient Characteristics : By TBI Screening Groups

Characteristic	No TBI Screen	Screened Negative	Screened Positive
<b>COMORBIDITIES</b>			
Anxiety Disorder	<b>5.8 %</b>	<b>5.7%</b>	<b>8.3%</b>
Adjustment Disorder	<b>5.5%</b>	<b>5.2%</b>	<b>7.2%</b>
Substance Use Disorder	<b>5.4%</b>	<b>4.6%</b>	<b>8.5%</b>
Psychosexual Disorder	<b>0.9%</b>	<b>0.9%</b>	<b>1.2%</b>
Psychoses	<b>0.7%</b>	<b>0.6%</b>	<b>0.7%</b>
Post Traumatic Stress Disorder (PTSD)	<b>15.4%</b>	<b>14.2%</b>	<b>30.7%</b>
Depression	<b>11.6%</b>	<b>11.7%</b>	<b>17.7%</b>

## : By TBI Screening Groups

Characteristic	No TBI Screen	Screened Negative	Screened Positive
LOST CONSCIOUSNESS			
Did Lose Consciousness	<b>0%</b>	<b>1.6%</b>	<b>13.8%</b>
Did Not Lose Consciousness	<b>0%</b>	<b>2.3%</b>	<b>23.7%</b>
Unknown	<b>100%</b>	<b>96.1%</b>	<b>62.4%</b>
EVACUATED FROM THEATER	<b>0%</b>	<b>0.9%</b>	<b>6.5%</b>
ETIOLOGY			
Bullet	<b>0%</b>	<b>0.2%</b>	<b>2.1%</b>
Fall	<b>0%</b>	<b>1.1%</b>	<b>11.7%</b>
Vehicular Accident	<b>0%</b>	<b>1.1%</b>	<b>11.4%</b>
Blast	<b>0%</b>	<b>3.5%</b>	<b>34.3%</b>

# Healthcare Outpatient Utilization 12 Months Following Index Date by TBI Screening Groups (Unadjusted)

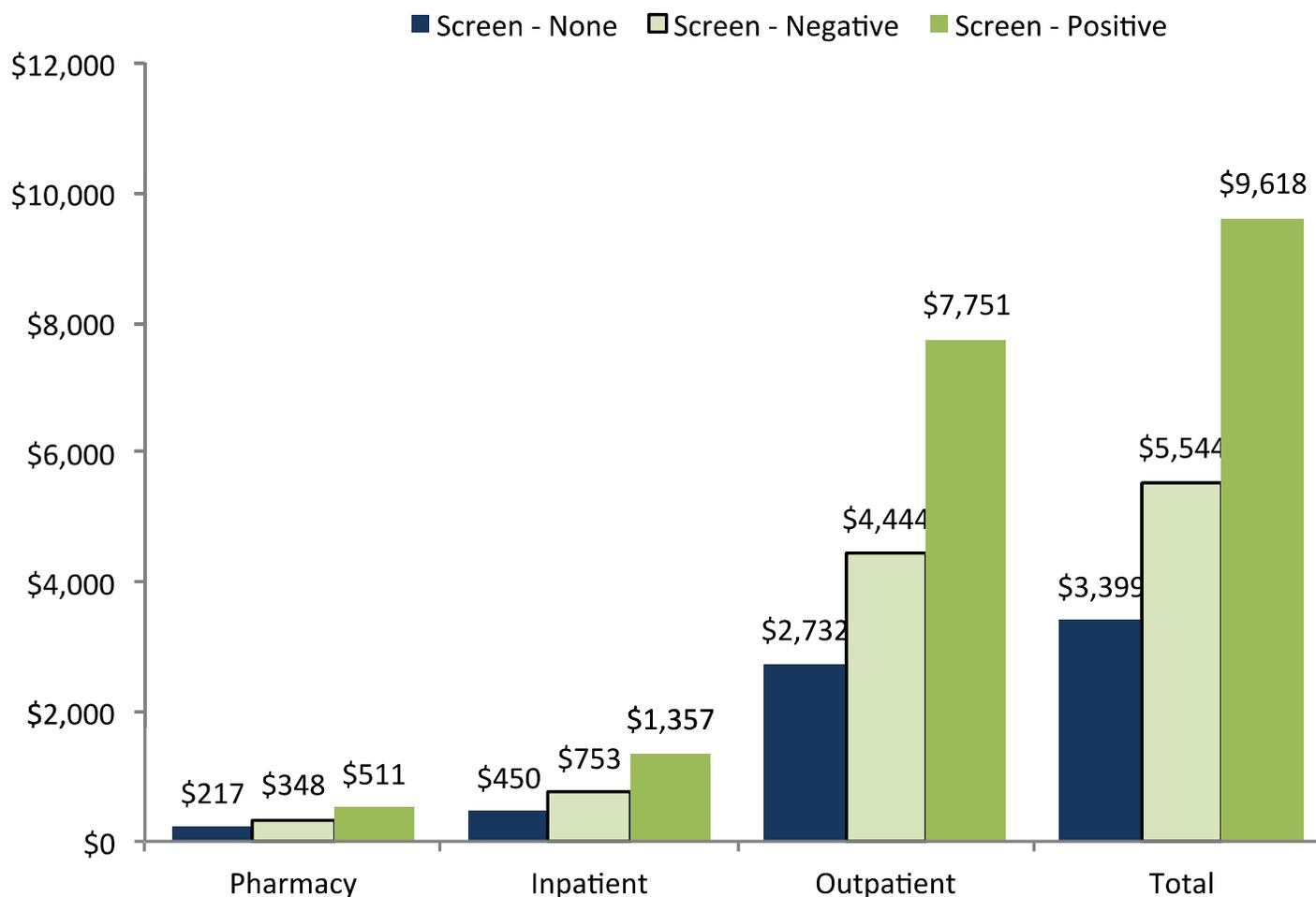


For each type of outpatient visits:  $P < 0.001$  for comparison of screening groups

## Results: Utilization By TBI Screening Groups (Unadjusted)

Healthcare Utilization	No TBI Screen	Screened Negative	Screened Positive
VA OUTPATIENT PHARMACY	<b>7.0</b>	<b>14.1</b>	<b>20.2</b>
INPATIENT ADMISSIONS			
Acute Care Days	<b>0.2</b>	<b>0.4</b>	<b>0.7</b>
Rehabilitation Days	0.02	0.01	0.01
Spinal Cord Injury (SCI) Days	0.01	0.02	<0.01
Mental Health Days	<b>0.2</b>	<b>0.4</b>	<b>1.0</b>
Intensive Care Unit (ICU) Days	0.01	0.01	0.01
Long-Term Care Days	0.02	0.03	0.03
Other Non-Acute Care Days	<b>0.1</b>	<b>0.3</b>	<b>0.7</b>
Non-VA Days	0.05	0.06	0.07

# Healthcare Costs 12 Months Following Index Date by TBI Screening Groups (Unadjusted)



For each type of cost: P < 0.001 for comparison of screening groups

## Results: Costs 12 Months after Index Date By TBI Screening Groups (Unadjusted)

Healthcare Cost	No TBI Screen	Screened Negative	Screened Positive
OUTPATIENT COSTS, TOTAL	<b>\$2,732</b>	<b>\$4,444</b>	<b>\$7,751</b>
INDEX EVALUATION	<b>\$349</b>	<b>\$404</b>	<b>\$449</b>
COMPREHENSIVE TBI EVALUATION	<b>0</b>	<b>\$27</b>	<b>\$293</b>
OTHER OUTPATIENT COSTS			
Primary Care	<b>\$448</b>	<b>\$705</b>	<b>\$931</b>
Rehabilitation Costs	<b>\$71</b>	<b>\$144</b>	<b>\$353</b>
Polytrauma Costs	<b>\$36</b>	<b>\$71</b>	<b>\$696</b>
Mental Health Care	<b>\$446</b>	<b>\$834</b>	<b>\$1,806</b>
Specialty Care	<b>\$603</b>	<b>\$950</b>	<b>\$1,243</b>
Other Outpatient Costs	<b>\$616</b>	<b>\$1,048</b>	<b>\$1,638</b>
Non-VA Outpatient Costs	<b>\$162</b>	<b>\$263</b>	<b>\$342</b>

## Results: Costs 12 Months after Index Date By TBI Screening Groups (Unadjusted)

Healthcare Cost	No TBI Screen	Screened Negative	Screened Positive
INPATIENT COSTS, TOTAL	<b>\$450</b>	<b>\$753</b>	<b>\$1,357</b>
Acute Care Costs	<b>\$174</b>	<b>\$297</b>	<b>\$506</b>
Rehabilitation Costs	\$18	\$12	\$15
Spinal Cord Injury Costs	\$11	\$15	\$5
Mental Health Costs	<b>\$97</b>	<b>\$178</b>	<b>\$452</b>
Intensive Care Unit Costs	\$17	\$22	\$25
Long-Term Care Costs	\$9	\$16	\$15
Non-Acute Care Costs	<b>\$51</b>	<b>\$119</b>	<b>\$226</b>
Non-VA Costs	\$75	\$93	\$112
HEALTHCARE COSTS, TOTAL	<b>\$3,399</b>	<b>\$5,544</b>	<b>\$9,618</b>

## Results: Association between TBI screening group and healthcare utilization and costs (Adjusted)

- After adjusting for patient characteristics, there continued to be associations between TBI screening group and healthcare utilization and costs during the 12 months after the index date
- For Veterans who screened positive compared to Veterans with no TBI screening, there were:
  - 1.7 times more primary care visits
  - 1.7 times more rehabilitation visits
  - 2.5 times more polytrauma visits
  - 1.5 times more mental health visits
  - 1.6 times more other specialty care outpatient visits
  - Total healthcare costs were \$4,550 higher

## Results: Association of patient characteristics with healthcare utilization and costs (Adjusted)

Characteristic	Hospitalized Odds Ratio	Primary Care Visits IRR	Rehabilitation Care Visits IRR	Polytrauma Care Visits IRR	Mental Health Care IRR	Other Specialty Care Visits IRR	Total Costs
MALE	<b>0.8</b>	<b>0.7</b>	<b>1.1</b>	<b>1.3</b>	<b>0.9</b>	<b>0.8</b>	<b>-\$905</b>
EVACUATION FROM THEATER	<b>1.1</b>	<b>1.1</b>	<b>1.2</b>	<b>1.2</b>	1.0	<b>1.2</b>	<b>\$1,222</b>
BLAST INJURY	<b>1.3</b>	<b>1.1</b>	<b>1.3</b>	<b>1.5</b>	<b>1.2</b>	<b>1.2</b>	<b>\$1,607</b>
COMORBIDITIES							
Psychoses	<b>3.2</b>	<b>1.2</b>	<b>0.9</b>	1.0	<b>1.8</b>	1.0	<b>\$4,903</b>
Substance Use Disorder	<b>3.1</b>	<b>1.0</b>	<b>0.9</b>	<b>0.9</b>	<b>1.3</b>	<b>0.9</b>	<b>\$2,436</b>
Depression	<b>1.6</b>	<b>1.1</b>	<b>1.0</b>	<b>1.1</b>	<b>1.5</b>	<b>1.1</b>	<b>\$1,609</b>
PTSD	<b>1.4</b>	<b>1.1</b>	<b>1.1</b>	<b>1.2</b>	<b>1.7</b>	<b>1.1</b>	<b>\$1,493</b>

## Sample Description: By CTBIE Result Groups

- Among those who screened positive and received the CTBIE:
  - 6,163 (46%) tested positive for TBI
  - 7,305 (54%) tested negative for TBI

## Patient Characteristics: By CTBIE Result Groups

Characteristic	CTBIE-Negative	CTBIE-Positive
GENDER: male	<b>94.1%</b>	<b>95.3%</b>
AGE		
Under 25	<b>23.1%</b>	<b>27.0%</b>
25-29	<b>31.4%</b>	<b>34.2%</b>
30-34	<b>13.2%</b>	<b>12.9%</b>
35+	<b>32.3%</b>	<b>25.9%</b>
MARRIED	48.4%	47.5%
RACE/ETHNICITY		
White	<b>73.3%</b>	<b>76.8%</b>
Black	<b>15.0%</b>	<b>11.4%</b>
Hispanic	11.6%	11.3%

## Patient Characteristics: By CTBIE Result Groups

Characteristic	CTBIE-Negative	CTBIE-Positive
<b>EDUCATION</b>		
High School/GED or less	<b>83.9%</b>	<b>86.5%</b>
Some College	<b>9.6%</b>	<b>7.7%</b>
College	<b>5.2%</b>	<b>4.6%</b>
Beyond College	<b>1.3%</b>	<b>1.3%</b>
<b>SERVICE CONNECTED DISABILITY</b>	<b>41.3%</b>	<b>43.5%</b>

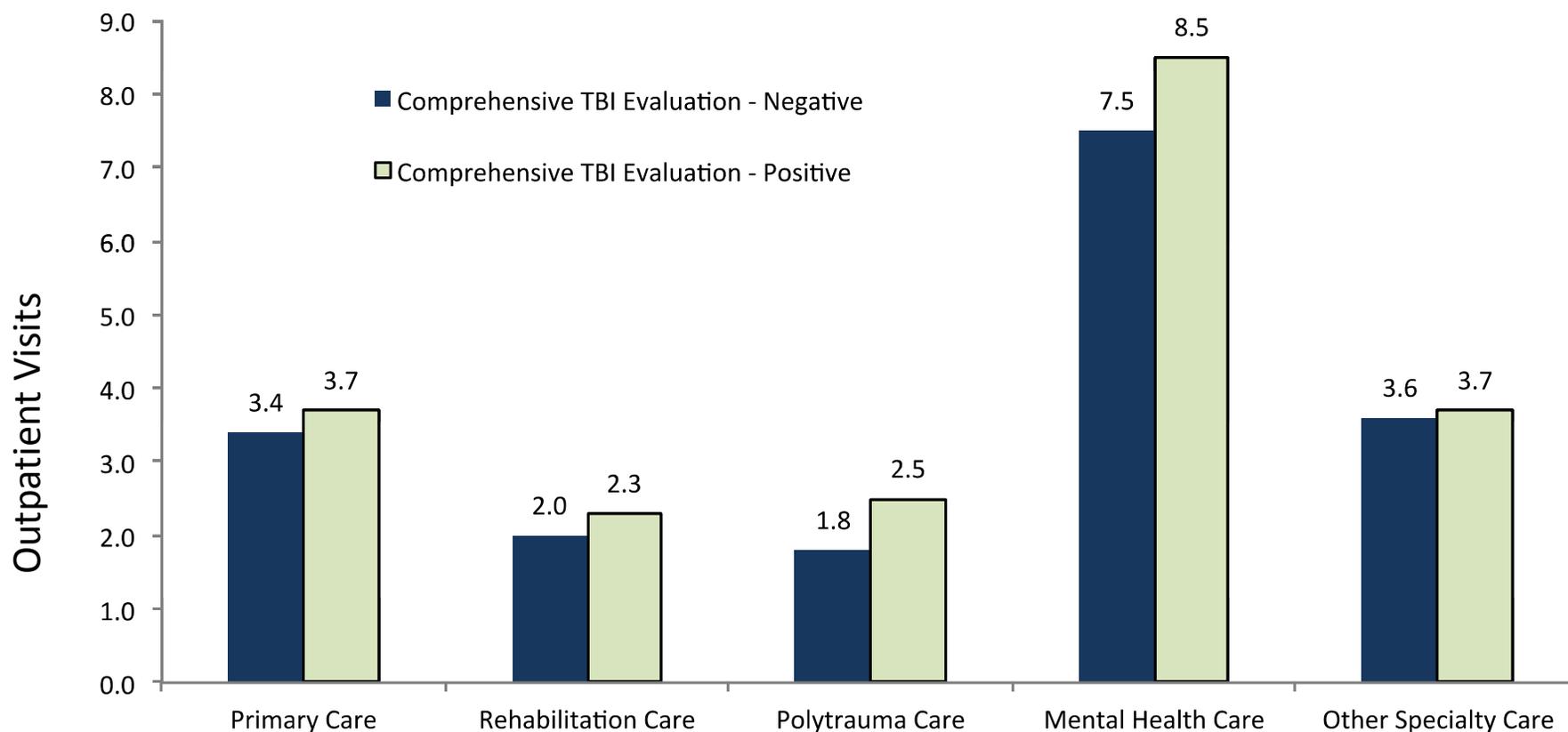
# Patient Characteristics: By CTBIE Result Groups

Characteristic	CTBIE-Negative	CTBIE-Positive
<b>COMORBIDITIES</b>		
Anxiety Disorder	7.2%	7.6%
Adjustment Disorder	6.8%	6.5%
Substance Use Disorder	7.7%	8.5%
Psychosexual Disorder	1.1%	1.1%
Psychoses	0.6%	0.7%
PTSD	<b>26.6%</b>	<b>31.4%</b>
Depression	15.7%	16.7%

# Patient Characteristics: By CTBIE Result Groups

Characteristic	CTBIE-Negative	CTBIE-Positive
<b>LOST CONSCIOUSNESS</b>		
Did Lose Consciousness	<b>18.2%</b>	<b>48.9%</b>
Did Not Lose Consciousness	<b>69.8%</b>	<b>38.2%</b>
Unknown	<b>11.9%</b>	<b>13.0%</b>
<b>EVACUATED FROM THEATER</b>	<b>11.5%</b>	<b>19.2%</b>
<b>ETIOLOGY</b>		
Bullet	<b>4.3%</b>	<b>5.1%</b>
Fall	<b>25.6%</b>	<b>28.5%</b>
Vehicular Accident	<b>23.4%</b>	<b>29.0%</b>
Blast	<b>74.8%</b>	<b>85.3%</b>

# Healthcare Outpatient Utilization 12 Months Following Index Date by Comprehensive TBI Evaluation Result Group (Unadjusted)

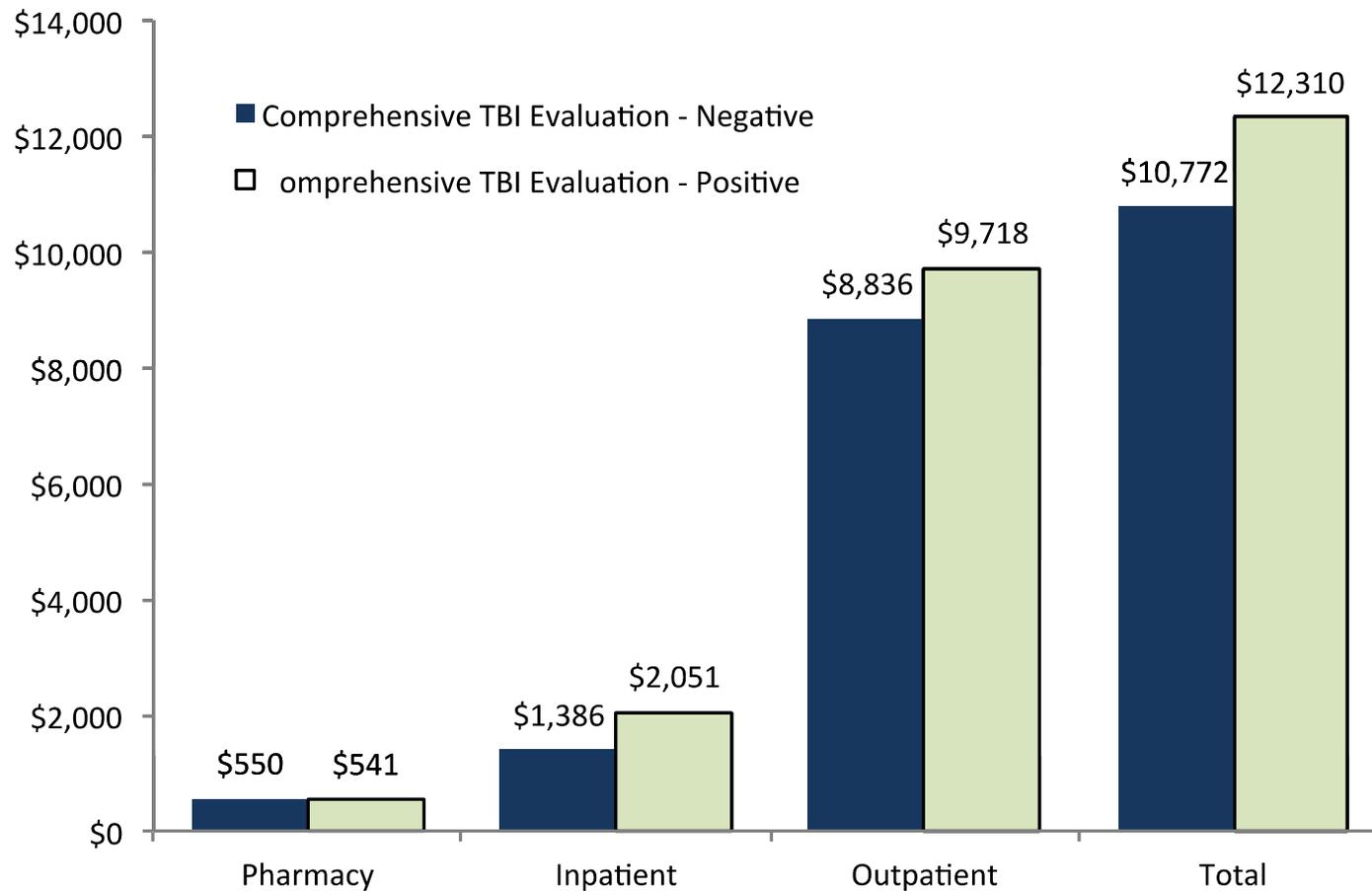


For each type of outpatient visits:  $P < 0.001$  for comparison of CTBIE result groups, except for other specialty care ( $p = 0.32$ )

## Results: Utilization By CTBIE Result Groups (Unadjusted)

Healthcare Utilization	CTBIE-Negative	CTBIE-Positive
VA OUTPATIENT PHARMACY	20.7	21.4
INPATIENT ADMISSIONS		
Acute Care Days	<b>0.9</b>	<b>1.3</b>
Rehabilitation Days	<0.01	0.01
SCI Days	0.01	<0.01
Mental Health Days	<b>0.9</b>	<b>1.3</b>
ICU Days	0.01	0.01
Long-Term Care Days	0.03	0.05
Other Non-Acute Care Days	0.7	0.7
Non-VA Days	<b>0.04</b>	<b>0.11</b>

# Healthcare Costs 12 Months Following Index Date by Comprehensive TBI Evaluation Result Group (Unadjusted)



For each type of cost:  $P < 0.001$  for comparison of CTBIE result groups, except for pharmacy ( $P = 0.89$ )

## Results: Costs 12 Months after Index Date By CTBIE Result Groups (Unadjusted)

Healthcare Cost	CTBIE-Negative	CTBIE-Positive
OUTPATIENT COSTS, TOTAL	<b>\$8,836</b>	<b>\$9,718</b>
INDEX EVALUATION	\$460	\$468
COMPREHENSIVE TBI EVALUATION	\$709	\$666
OTHER OUTPATIENT COSTS		
Primary Care	<b>\$993</b>	<b>\$1,111</b>
Rehabilitation Costs	<b>\$412</b>	<b>\$455</b>
Polytrauma Costs	<b>\$912</b>	<b>\$1,144</b>
Mental Health Care	<b>\$1,888</b>	<b>\$2,255</b>
Specialty Care	\$1,314	\$1,311
Other Outpatient Costs	<b>\$1,776</b>	<b>\$1,975</b>
Non-VA Outpatient Costs	\$370	\$333

## Results: Costs 12 Months after Index Date By CTBIE Result Groups (Unadjusted)

Healthcare Cost	CTBIE-Negative	CTBIE-Positive
INPATIENT COSTS, TOTAL	<b>\$1,386</b>	<b>\$2,051</b>
Acute Care Costs	<b>\$626</b>	<b>\$971</b>
Rehabilitation Costs	\$4	\$14
SCI Costs	\$4	\$0.2
Mental Health Costs	<b>\$424</b>	<b>\$598</b>
ICU Costs	\$30	\$17
Long-Term Care Costs	\$23	\$24
Non-Acute Care Costs	\$203	\$230
Non-VA Costs	<b>\$73</b>	<b>\$197</b>
HEALTHCARE COSTS, TOTAL	<b>\$10,772</b>	<b>\$12,310</b>

## Results: Association between CTBIE result group and healthcare utilization and costs (Adjusted)

- There continued to be associations between CTBIE result group and healthcare utilization and costs during the 12 months after the index date, after adjusting for patient characteristics
- For Veterans with a positive comprehensive TBI evaluation:
  - 1.1 times more rehabilitation visits
  - 1.2 times more polytrauma visits
  - 1.04 times more mental health visits
  - Total healthcare costs were \$972 higher

## Results: Association between other factors and healthcare utilization and costs (Adjusted)

- Other patient and facility characteristics associated with healthcare utilization and costs included
  - Male
    - 0.8 times fewer primary care visits
    - 0.8 time fewer other specialty care visits
    - Total costs were \$1,524 lower
  - Being evacuated from the theater
    - 1.1 times greater odds of hospitalization
    - 1.1 times more primary care visits
    - 1.1 times more rehabilitation visits
    - 1.2 times more other specialty care visits
    - Total costs were \$1,482 higher

# Results: Association between comorbidities and healthcare utilization and costs (Adjusted)

- Psychoses
  - 2.1 times greater odds of hospitalization
  - \$6,820 higher costs than Veterans without this condition
- Substance use disorder
  - 3.0 times greater odds of hospitalization
  - \$3,930 higher costs than Veterans without this condition

# Summary

- Veterans with a positive TBI screen had
  - Over 70% higher healthcare costs than Veterans who screened negative: \$9,618 (Screened Positive) vs. \$5,544 (Screened Negative)
  - Over 180% higher costs than Veterans with no TBI screening: \$9,618 (Screened Positive) vs. \$3,399 (No TBI Screening)
- Veterans who received CTBIE and had a positive diagnosis of TBI had
  - 14% higher total costs than for those without a TBI diagnosis: \$12,310 (Positive TBI diagnosis) vs. \$10,772 (Negative TBI diagnosis)

# Summary

- Substantial portion of services used were for mental health care during 12 months following index date
  - Largest number of outpatient visits were to mental health clinics
  - Over 40% of inpatient days in VA facilities were for mental health care
  - Veterans with blast TBI etiologies, psychoses and substance use have significantly higher odds of hospitalization after the index date

# Implications

- This study highlights the additional resources needed to provide care for Veterans with TBI relative to other Veterans
  - Over 20% of Veterans had positive TBI screen but accounted for over 30% of total cost (\$308 million) among Veterans who received the screening (\$997 million )
  - Average annual cost of Veterans with TBI confirmed through CTBIE (\$12,310) was more than twice the average cost for all VA users (\$5,765)

# Implications

- Given the prevalence of TBI in OEF/OIF Veterans, evidence regarding the resources needed for Veterans screened for TBI is crucial for healthcare planning
- Substantial portion of care following the index visit was directly mental health related, particularly for patients who screened positive for TBI
- Results from TBI screening may assist in anticipating the scope and type of healthcare services needed by OEF/OIF Veterans

# Limitations

- CTBIE was not universally available or fully utilized across the system
- Some Veterans may have had private insurance and received non-VA care that was not captured in the VA Fee Basis files
- The duration of repeat service use was not examined beyond 12 months

# Conclusions

- Over 12 months following their initial evaluation,
  - Veterans with a positive result on the on the TBI screen had over 60% higher total costs than Veterans who screened negative and more than double total costs of Veterans with no TBI screening
- Understanding healthcare utilization and cost patterns following TBI screening is important for policymakers as they address the on-going and future healthcare needs of returning OEF/OIF Veterans

# References

- Tanielian T, Jaycox LH, eds. *Invisible Wounds of War: Psychological and Cognitive Injuries, Their Consequences, and Services to Assist Recovery*. Santa Monica, CA: RAND Corporation; 2008.
- Hoge CW, McGurk D, Thomas JL, et al. Mild traumatic brain injury in U.S. soldiers returning from Iraq. *N Engl J Med* 2008;358:453–463.
- Wilk JE, Bliese JD, Kim PY, et al. Relationship of combat experiences to alcohol misuse among U.S. soldiers returning from the Iraq war. *Drug Alcohol Depend* 2010;108:115–121.
- Vanderploeg RD, Curtiss G, Luis CA, et al. Long-term morbidities following self-reported mild traumatic brain injury. *Journal of Clinical Experimental Neuropsychology* 2007;29:585-598.
- VHA Directive 2010-012. Screening and evaluation of possible traumatic brain injury in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) Veterans. Department of Veterans Affairs. Veterans Health Administration. Washington, DC 20420. March 8, 2010. Available at: [http://www.va.gov/vhapublications/ViewPublication.asp?pub\\_ID=2176](http://www.va.gov/vhapublications/ViewPublication.asp?pub_ID=2176). Accessed February 15, 2012.
- Goldberg MS. CBO Testimony: Projecting the Costs to Care for Veterans of U.S. Military Operations in Iraq and Afghanistan. Congressional Budget Office 2007; 1-19.
- Seal KH, Metzler TJ, Gima KS, et al. [Trends and risk factors for mental health diagnoses among Iraq and Afghanistan veterans using Department of Veterans Affairs health care, 2002-2008](#). *American Journal of Public Health* 2009;99:1651-1658.
- VIReC Research User Guide: FY2002 VHA Medical SAS® Inpatient Datasets. Edward J. Hines, Jr. VA Hospital, Hines, IL: Veterans Affairs Information Resource Center, April 2003a.
- VIReC Research User Guide: FY2002 VHA Medical SAS® Outpatient Datasets. Edward J. Hines, Jr. VA Hospital, Hines, IL: Veterans Affairs Information Resource Center, January 2003b.
- US Department of Veterans Affairs (VA). VA Polytrauma System of Care > Care Facilities. Washington, DC: U.S. Department of Veterans Affairs. September 16, 2011. Available at: <http://www.polytrauma.va.gov/system-of-care/care-facilities/>. Accessed October 21, 2011.
- Bazzoli GJ, Shortell SM, Dubbs NL, et al. A taxonomy of health networks and systems: bringing order out of chaos. *Health Serv Res* 1999;33:1683-1717.

# References

- Dubbs NL, Bazzoli GJ, Shortell SM, et al. Reexamining organizational configurations: an update, validation, and expansion of the taxonomy of health networks and systems. *Health Serv Res* 2004;39:207-220.
- Hagedorn HJ, Heideman PW. The relationship between baseline Organizational Readiness to Change Assessment subscale scores and implementation of hepatitis prevention services in substance use disorders treatment clinics: a case study. *Implement Sci* 2010;5:46.
- Phibbs C, Barnett P, Harden C, King S. Research Guide to Decision Support System National Cost Extracts. Department of Veterans Affairs, Menlo Park, California: Health Economics Resource Center of Health Service R&D Services; 2008.
- Smith MW, Chow A. Fee Basis Data: A Guide for Researchers. Menlo Park, CA: VA Palo Alto, Health Economics Resource Center; 2010.
- VIRc Research User Guide: VHA Pharmacy Prescription Data, 2nd Edition. Edward J. Hines, Jr. VA Hospital, Hines, IL: Veterans Affairs Information Resource Center; 2008.
- SAS software, Version 9.2 of the SAS System for Windows. Copyright © 2002-2008 SAS Institute Inc. Cary, NC, USA.
- StataCorp. 2011. Stata Statistical Software: Release 12. StataCorp LP: College Station, TX.
- Barber J, Thompson S. Multiple regression of cost data: use of generalised linear models. *J Health Serv Res Policy* 2004;9:197-204.
- McCullagh P, Nelder J. *Generalized Linear Models*. 2nd Edition ed. London: Chapman and Hall; 1989.
- Manning WG, Mullahy J. Estimating log models: to transform or not to transform? *J Health Econ* 2001;20:461-494.
- Taylor BC, Hagel EM, Carlson KF, et al. Prevalence and costs of co-occurring traumatic brain injury with and without psychiatric disturbance and pain among Afghanistan and Iraq War Veteran VA users. *Med Care* 2012. [Epub ahead of print]
- Congressional Budget Office. The Veterans Health Administration's treatment of PTSD and traumatic brain injury among recent combat Veterans. February 2012.
- Sayer NA, Cifu DX, McNamee S, et al. Rehabilitation needs of combat-injured service members admitted to the VA Polytrauma Rehabilitation Centers: the role of PM&R in the care of wounded warriors. *PM R* 2009;1:23-28.
- Seal KH, Bertenthal D, Miner CR, et al. Bringing the war back home: mental health disorders among 103,788 US veterans returning from Iraq and Afghanistan seen at Department of Veterans Affairs facilities. *Arch Intern Med* 2007;167:476-482.

# References

- Dunn AS, Julian T, Formolo LR, et al. Preliminary analysis of posttraumatic stress disorder screening within specialty clinic setting for OIF/OEF veterans seeking care for neck or back pain. *J Rehabil Res Dev*. 2011;48:493-502.
- Iverson JM, Hendricks AM, Kimerling R, et al. Psychiatric diagnoses and neurobehavioral symptom severity among OEF/OIF VA patients with deployment-related traumatic brain injury: a gender comparison. *Womens Health Issues*. 2011;21:S210-7.
- Kennedy JE, Leal FO, Lewis JD, et al. Posttraumatic stress symptoms in OIF/OEF service members with blast-related and non-blast-related mild TBI. *NeuroRehabilitation*. 2010;26:223-231.
- Otis JD, McGlinchey R, Vasterling JJ, et al. Complicating factors associated with mild traumatic brain injury: impact on pain and posttraumatic stress disorder treatment. *J Clin Psychol Med Settings* 2011;18:145-154.
- Frayne SM, Chiu VY, Iqbal S, et al. Medical care needs of returning veterans with PTSD: their other burden. *J Gen Intern Med* 2011;26:33-39.
- Andersen J, Wade M, Possemato K, et al. Association between posttraumatic stress disorder and primary care provider-diagnosed disease among Iraq and Afghanistan veterans. *Psychosom Med* 2010;72:498-504.
- Homaifar BY, Harwood JE, Wagner TH, et al. Description of outpatient utilization and costs in group of veterans with traumatic brain injury. *J Rehabil Res Dev* 2009;46:1003-1010.

Questions?