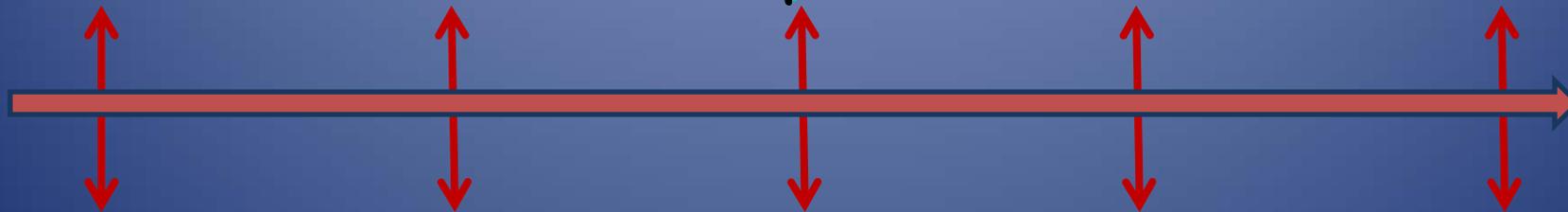


Trauma System Outcomes: How are we doing?

March 2011

Zeyno Shorter, PhD, MPH

Trauma System Continuum of Care Outcomes



Injury Prevention

Pre-hospital

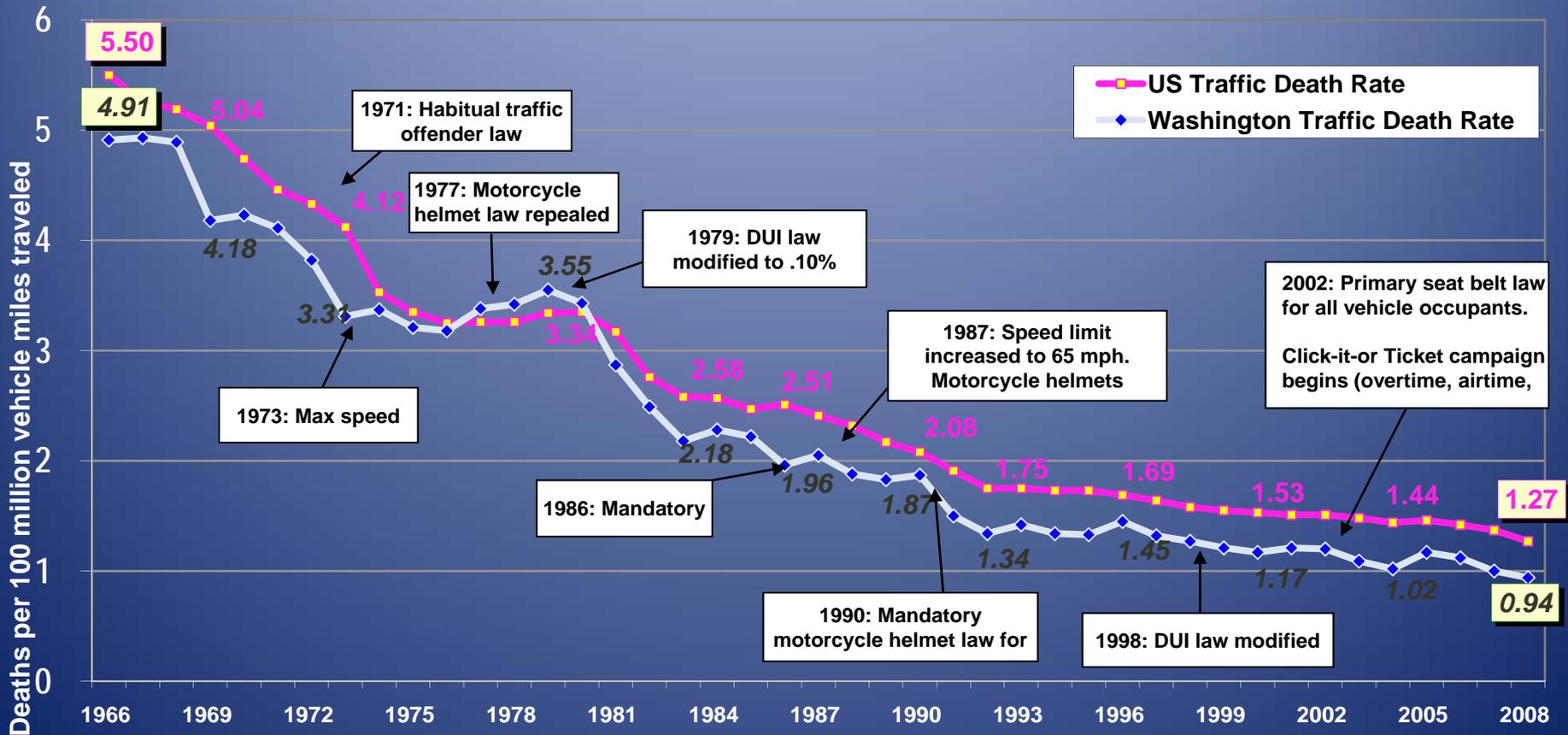
Hospital

Rehabilitation

System Evaluation

During 1966-2008, traffic fatality rates went down

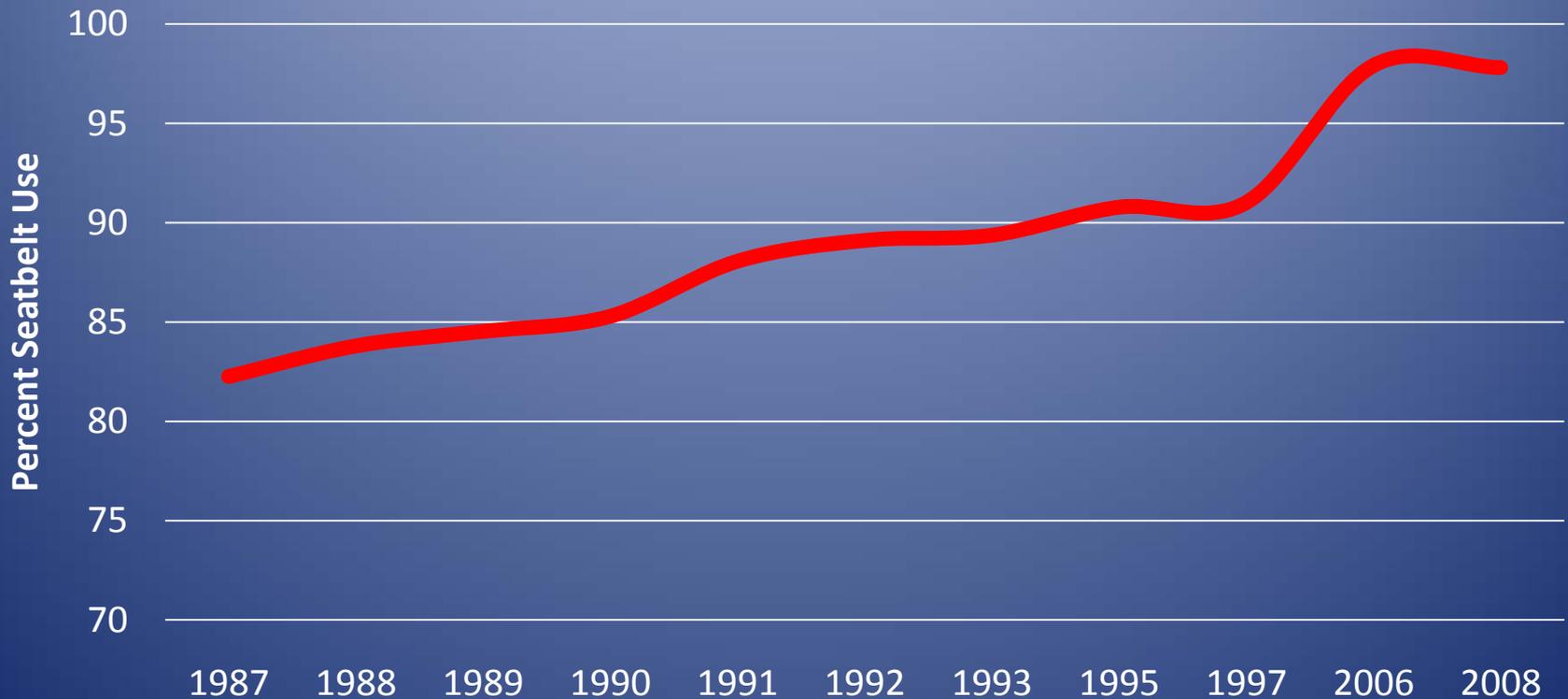
(U.S. and Washington State, Traffic fatalities per 100 million VMT)



Source: FARS, WSP, WSDOT, and NHTSA

For example, since the inception of mandatory seatbelt law in 1986, the percentage of adults (Age 18+) using seatbelts always or nearly always steadily increased.

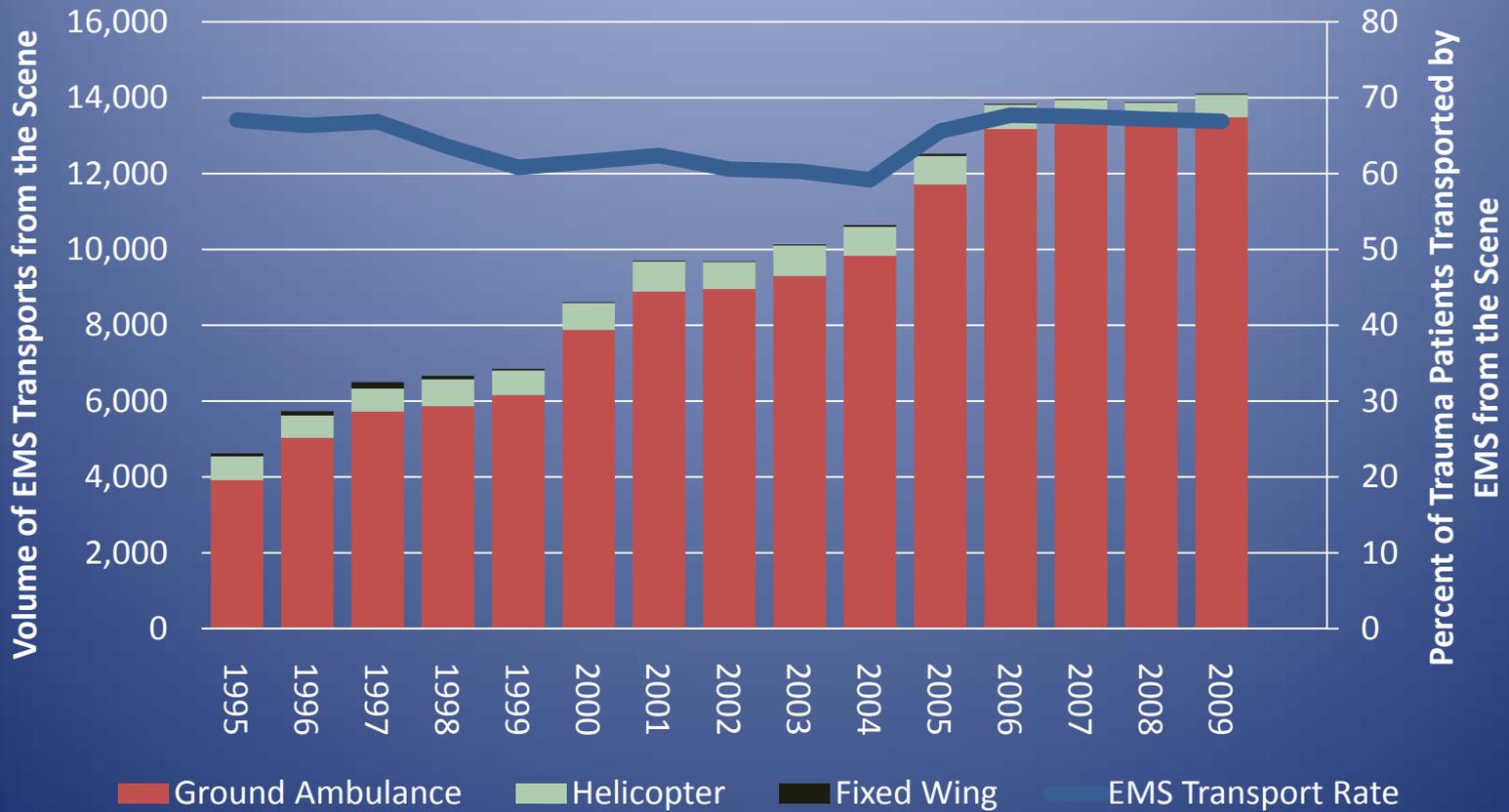
(WA DOH BRFSS)



Injury Prevention

The number of EMS transports from the scene nearly quadrupled while the proportion of transports that are EMS has stayed around 67% since 2006

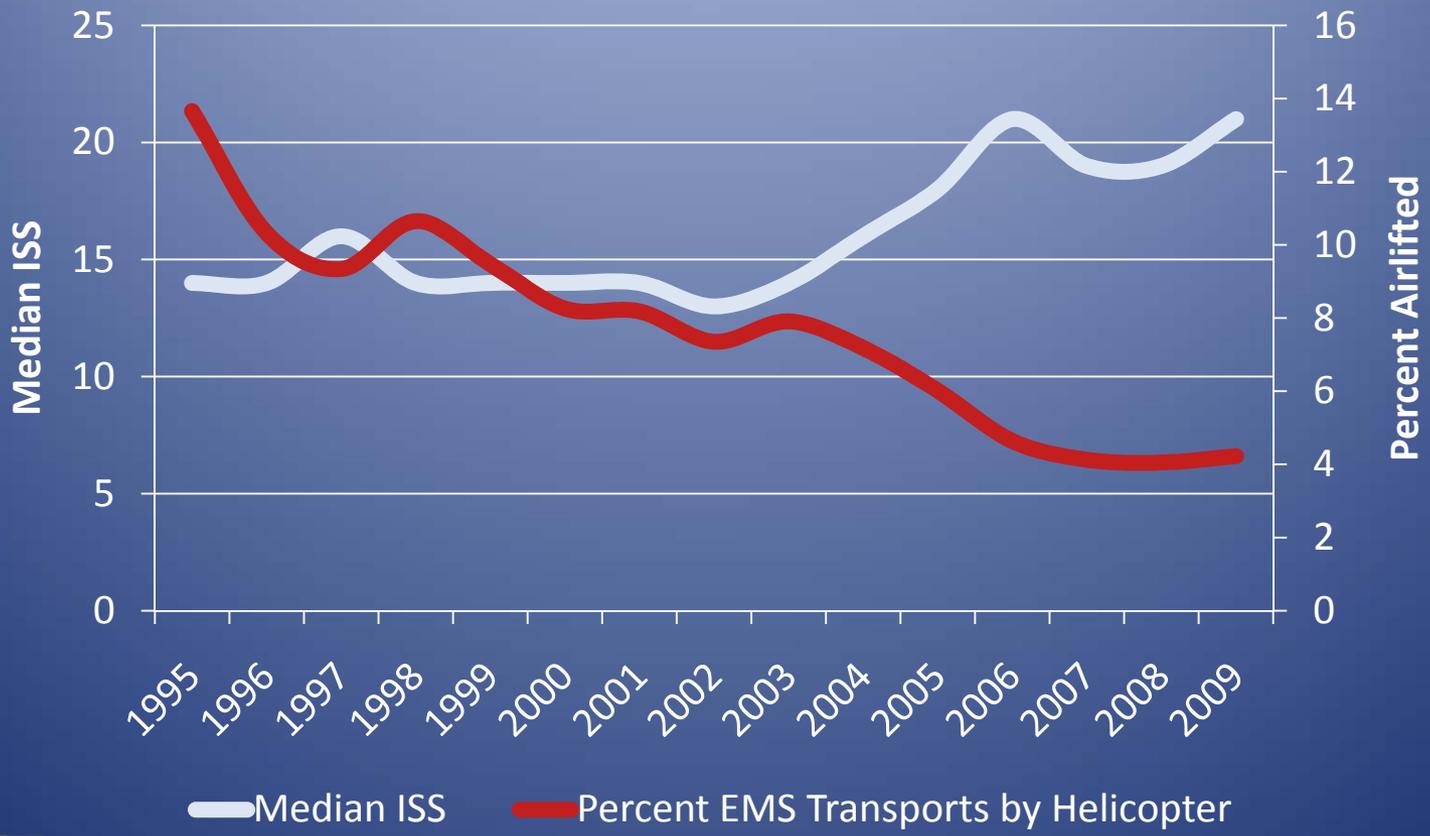
(DOH Criteria, Excluding transfers-in)



Pre-hospital Care

Over the years, percent of air transports from the scene declined while median ISS of airlift patients rose: hence better triage

(DOH Criteria, Excluding transfers-in)

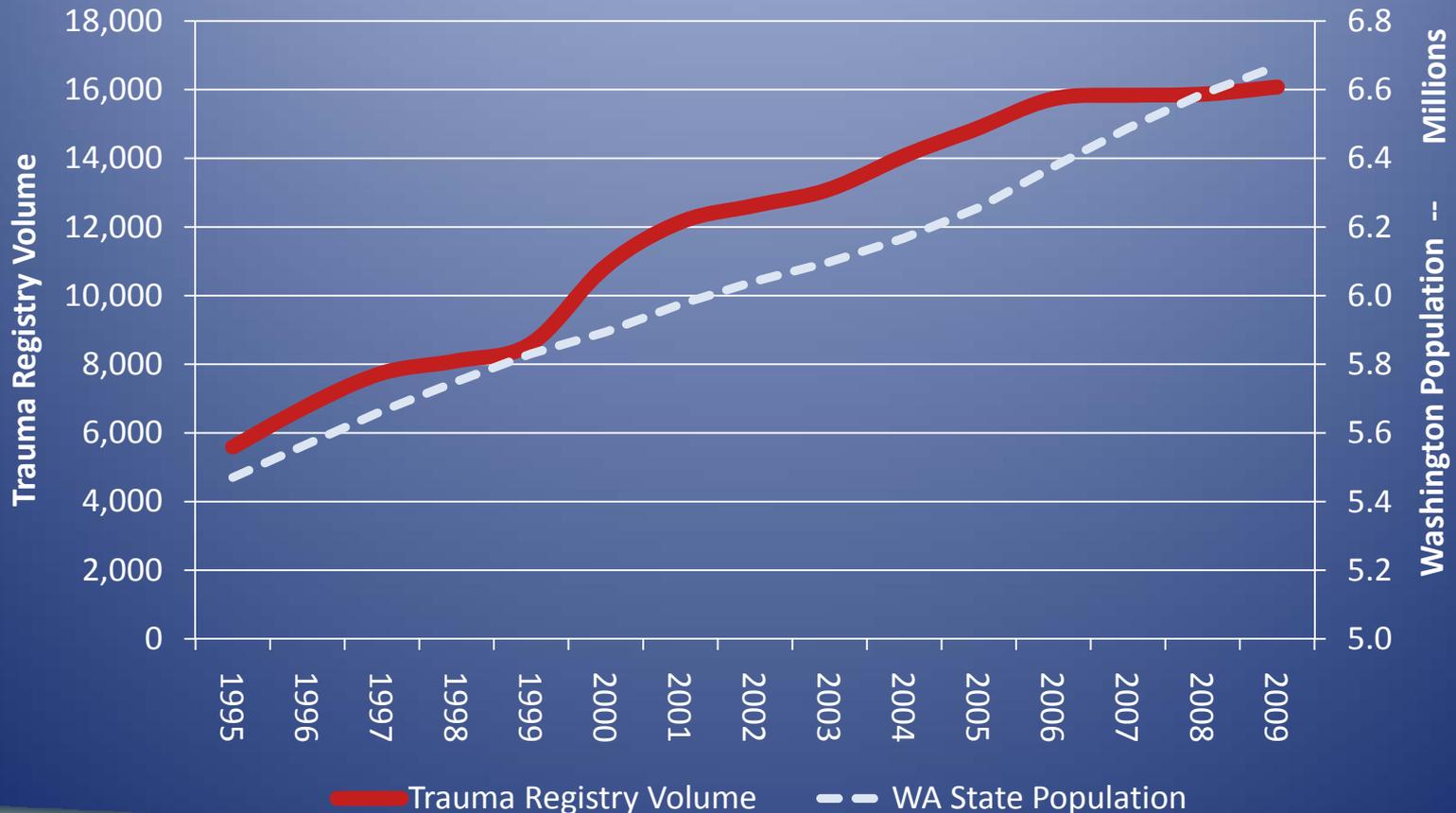


— Median ISS — Percent EMS Transports by Helicopter

Pre-hospital Care

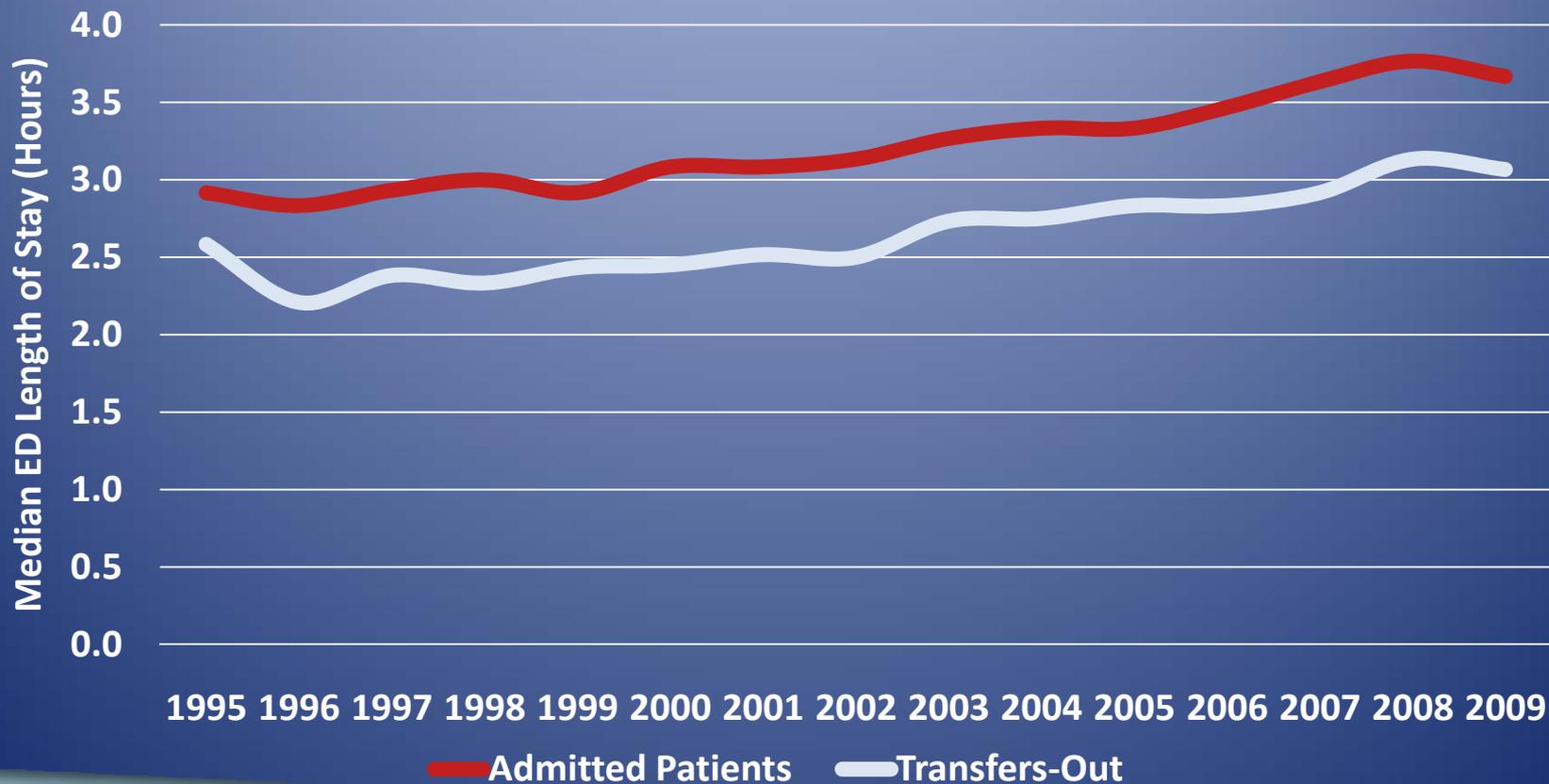
Since 1995, trauma registry volume had a three fold increase

(DOH Criteria, excluding transfers-in)



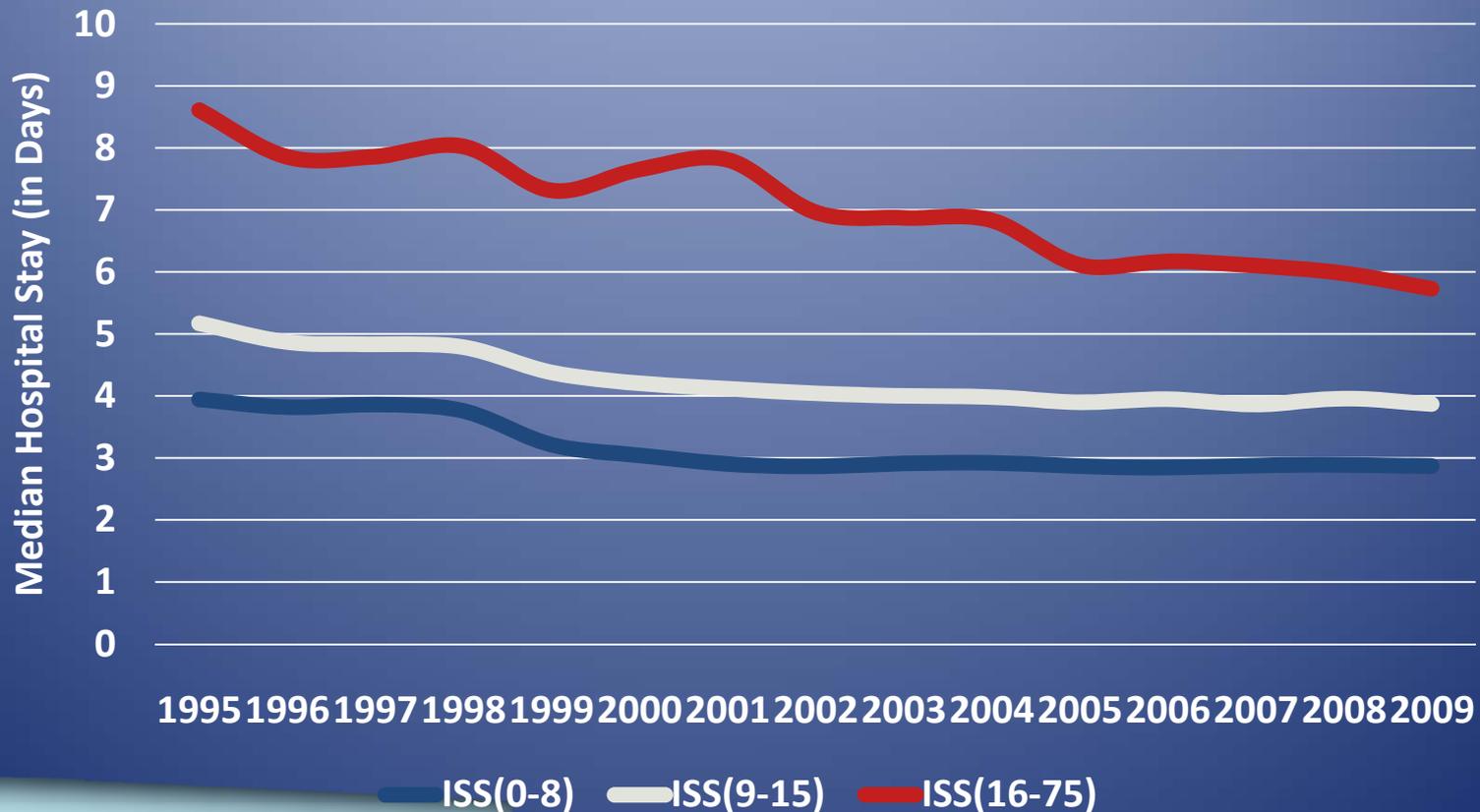
Median ED LOS for both admitted and transferred out patients rose during 1995-2009 while transfer-out patients had a shorter ED stay in general

(DOH Criteria)



During the same period, median hospital length of stay declined for all ISS levels

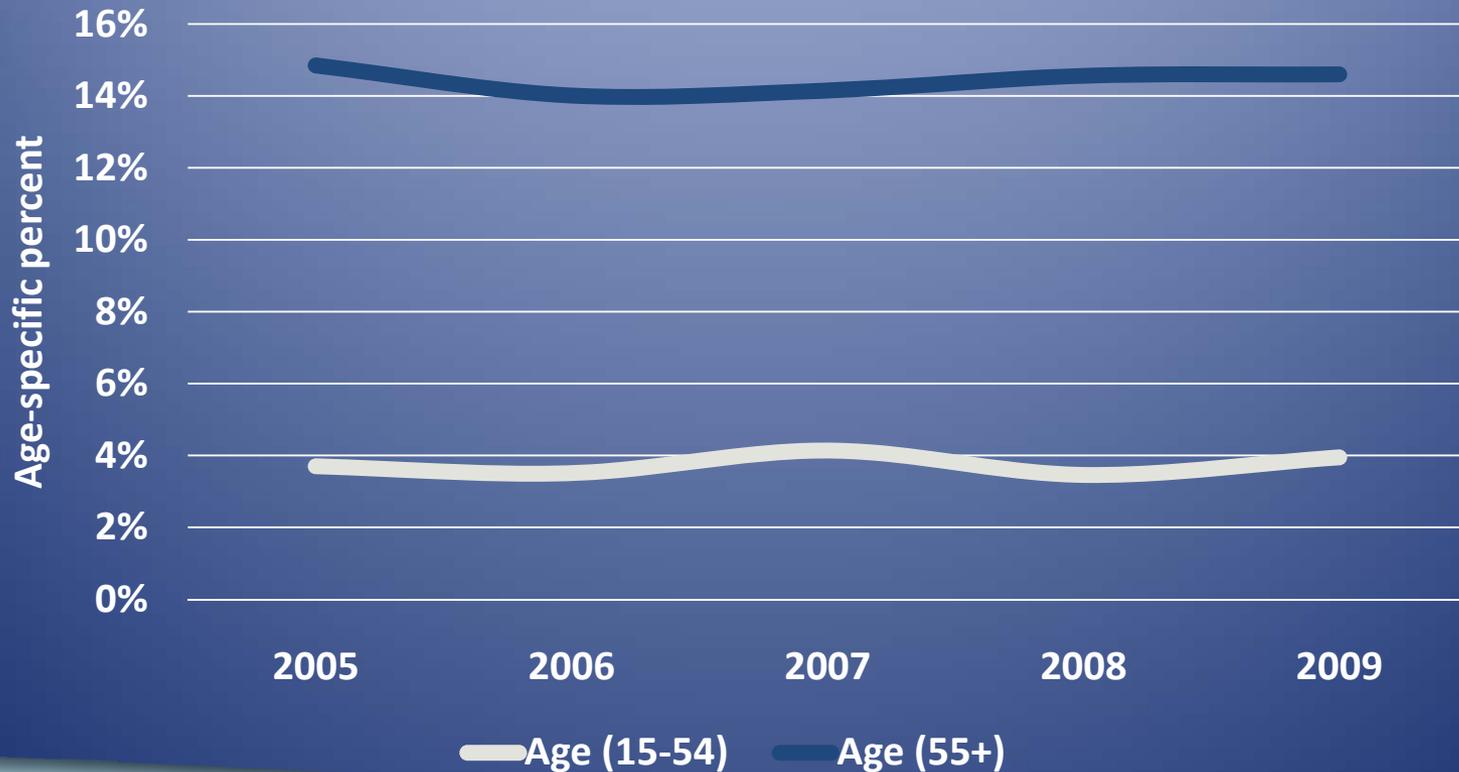
(DOH Criteria, Admitted patients only)



Hospital Care

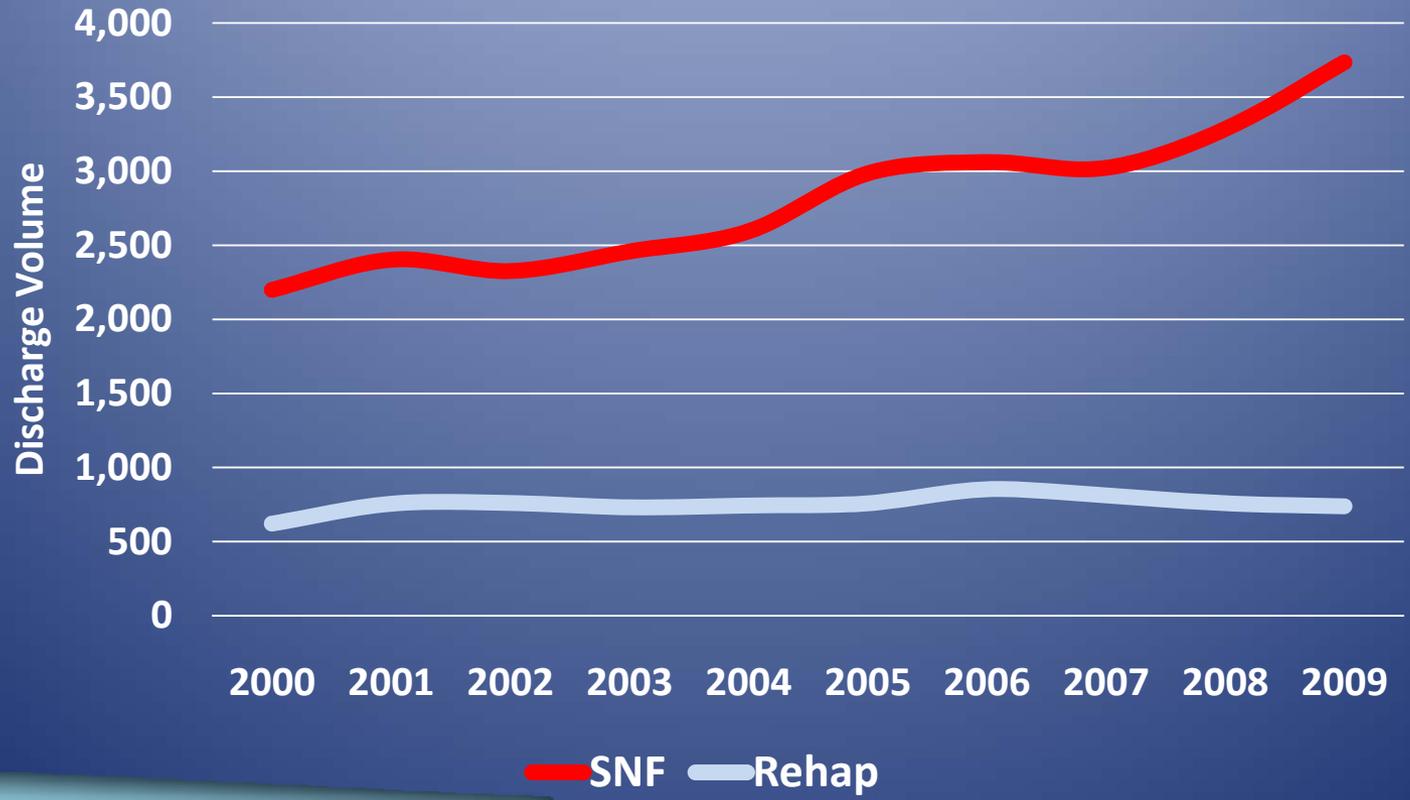
The percentage of live trauma patients discharged with a GCS less than 15

(DOH Criteria, admitted patients only, excluding isolated hip fractures)



Hospital Care

While the number of admitted live patients discharged to SNF increased significantly, discharges to rehab centers remained stable around 700-800 patients per year (DOH Criteria, admitted patients only, excluding isolated hip fractures)



Rehabilitation

Comparison of patient characteristics

(DOH Criteria, admitted patients only, excluding isolated hip fractures)



1 Patients Discharged to Skilled Nursing Facility

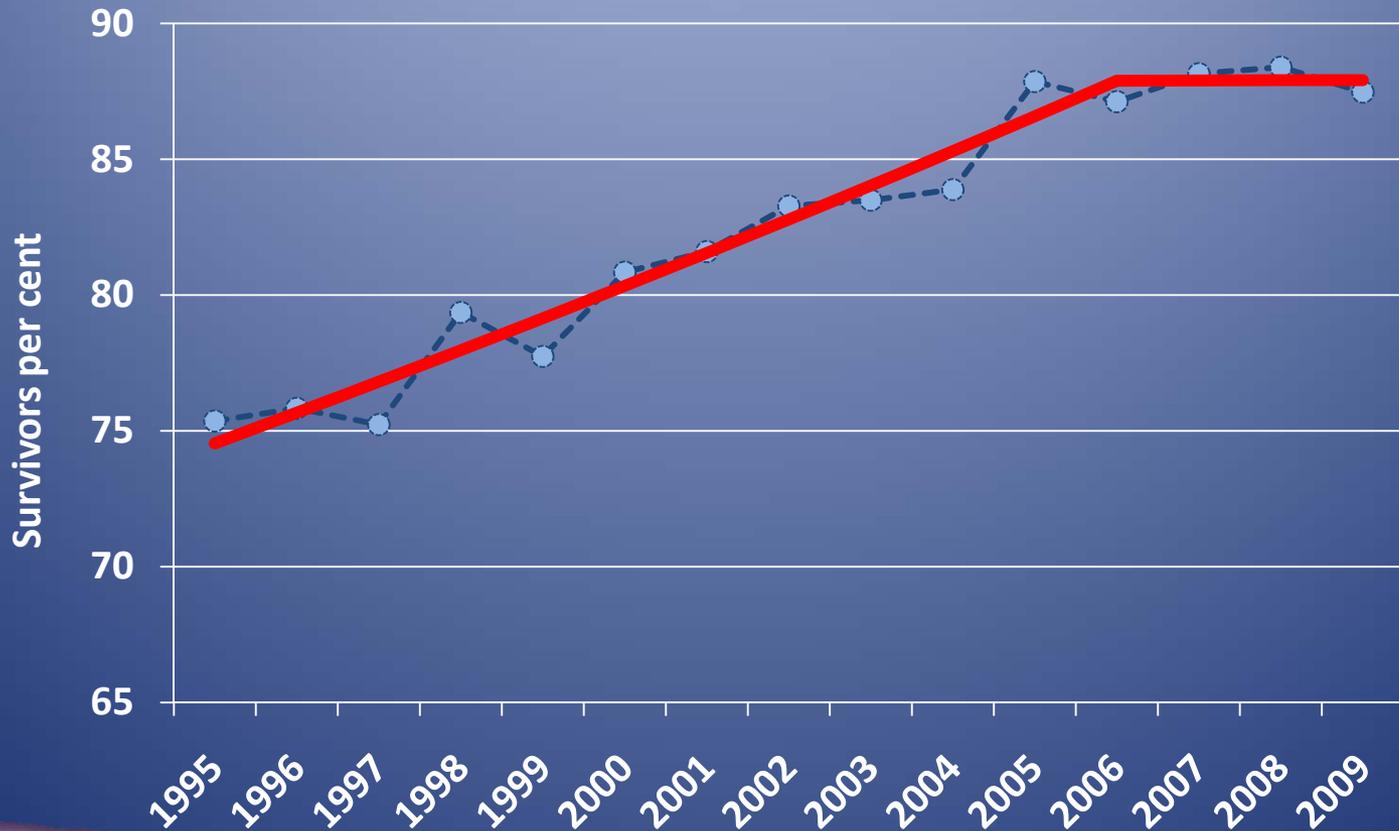
1. Male: 36%
2. Age 65+: 78%
3. Falls: 83%
4. TBI diagnosis: 21%
5. Median ISS: 9
6. Discharged from a level I Facility: 20%
7. Discharged from a level II Facility: 19%
8. Discharged from a level III Facility: 43%

2 Patients Discharged to Rehab Facility

1. Male: 61%
2. Age 65+: 27%
3. Falls: 52%
4. TBI Diagnosis: 52%
5. Median ISS: 17
6. Discharged from a level I Facility: 32%
7. Discharged from a level II Facility: 37%
8. Discharged from a level III Facility: 23%

Survival rate of seriously injured (ISS 16+) trauma patients increased during 1995-2005 while it has leveled out since 2006

(DOH Criteria, excluding transfers-in)

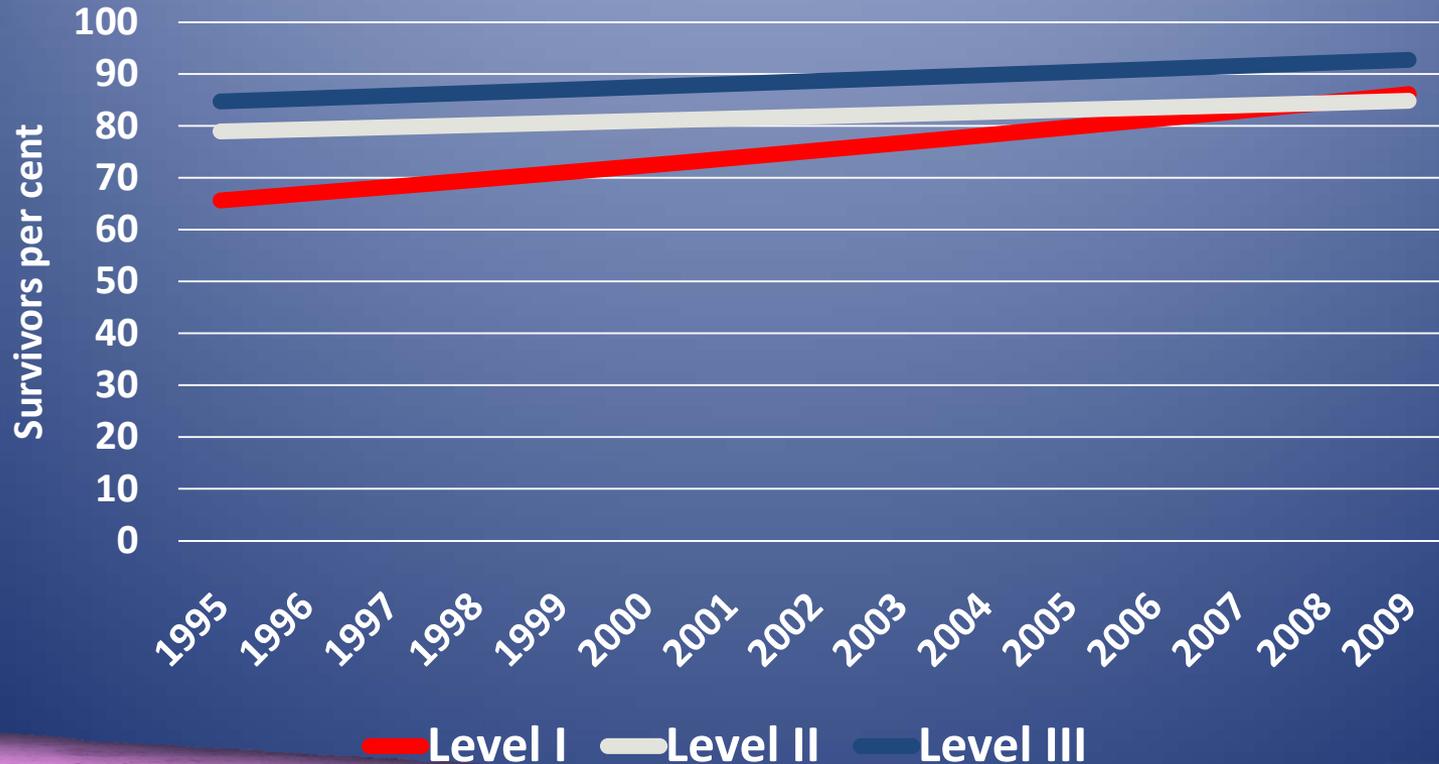


Survival rates of seriously injured (ISS 16+) trauma patients by level of trauma service

(DOH Criteria, excluding transfers-in)



Time Series Models



System Evaluation

Case-fatality rate of seriously injured (ISS 16+) patients by level of trauma service and ISS

	Level I				Level II				Level III			
	ISS	ISS	ISS	ISS	ISS	ISS	ISS	ISS	ISS	ISS	ISS	ISS
	16-24	25-34	35-44	45+	16-24	25-34	35-44	45+	16-24	25-34	35-44	45+
1996	4.9%	41.9%	68.9%	74.6%	9.1%	25.0%	25.0%	66.7%	11.3%	35.3%	45.5%	76.9%
1997	3.8%	46.5%	58.1%	84.7%	9.0%	42.9%	32.3%	31.3%	9.4%	42.3%	28.6%	78.6%
1998	4.7%	40.9%	56.3%	80.9%	4.4%	31.8%	39.4%	52.6%	9.8%	30.3%	14.3%	75.0%
1999	4.5%	43.4%	50.0%	77.1%	9.6%	30.4%	29.4%	61.4%	10.9%	34.8%	22.2%	36.4%
2000	5.6%	36.6%	46.7%	68.1%	5.4%	36.6%	41.0%	60.0%	11.6%	35.8%	16.7%	83.3%
2001	4.5%	36.9%	47.5%	64.6%	7.1%	22.9%	39.3%	71.4%	13.4%	30.1%	16.7%	66.7%
2002	9.3%	31.7%	28.7%	47.2%	5.7%	26.6%	42.6%	70.9%	6.9%	28.4%	55.6%	60.0%
2003	7.5%	31.7%	31.7%	37.3%	5.8%	29.0%	48.4%	65.2%	10.3%	34.2%	14.3%	61.5%
2004	7.9%	29.8%	32.6%	62.1%	5.9%	29.5%	30.5%	67.9%	9.3%	30.1%	55.6%	63.6%
2005	2.7%	11.4%	21.2%	49.5%	4.5%	19.9%	32.4%	67.9%	8.4%	25.2%	20.0%	75.0%
2006	2.6%	10.5%	19.2%	47.7%	5.8%	23.0%	32.0%	64.1%	7.7%	30.2%	38.5%	55.6%
2007	1.5%	12.9%	19.0%	43.2%	3.5%	23.0%	32.8%	58.1%	8.0%	32.5%	25.0%	77.3%
2008	2.3%	9.8%	19.3%	49.7%	5.0%	25.4%	40.8%	58.1%	5.6%	30.5%	52.4%	52.2%
2009	2.5%	14.5%	22.4%	42.0%	5.8%	24.4%	36.4%	53.8%	6.8%	28.8%	30.0%	62.5%

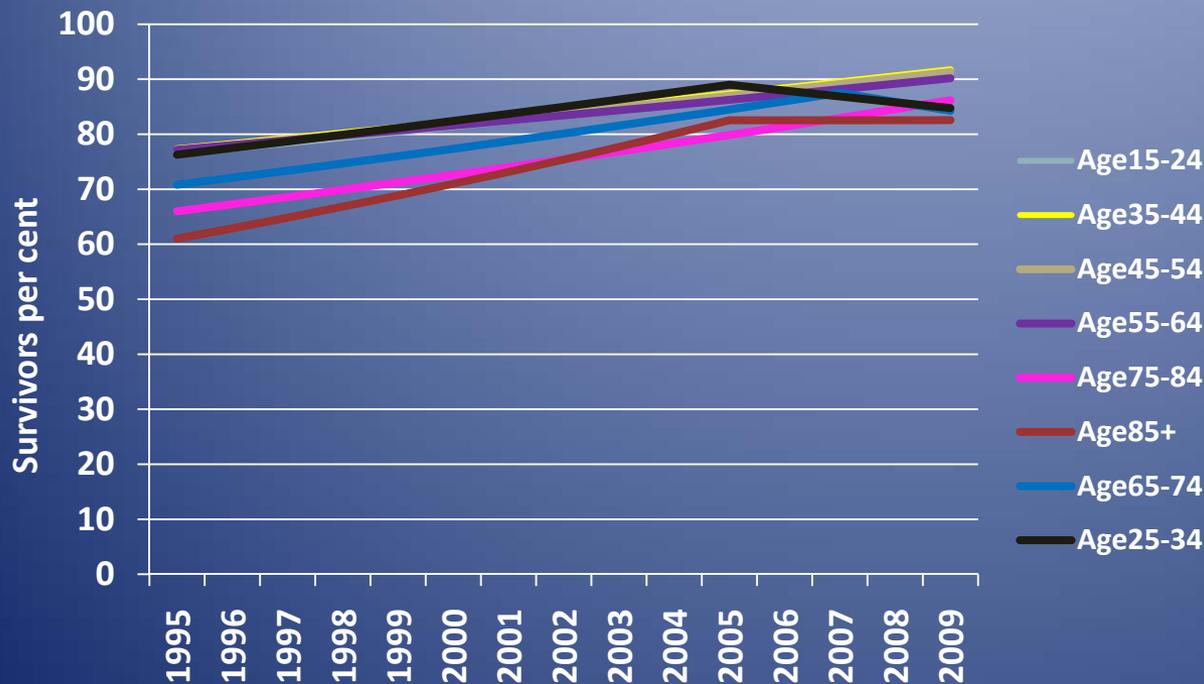
Comparison of general characteristics of trauma fatalities among seriously injured patients (ISS 16+) by year and level of trauma service

	Level I				Level II				Level III			
	N Died	Median Age	Median ISS	TBI Diagnosis	# Died	Median Age	Median ISS	TBI Diagnosis	N Died	Median Age	Median ISS	TBI Diagnosis
1996	222	38.5	33	76.1%	61	43.5	25	79%	53	36	25	70%
1997	265	41	29	72.8%	97	40	25	83%	76	35	25	78%
1998	233	42	33	71.7%	90	43.5	25	77%	51	53	25	84%
1999	229	42	29	64.2%	131	45	25	74%	58	53.5	25	72%
2000	210	46.5	29	68.6%	159	38.5	27	85%	69	70	25	84%
2001	246	44	29	68.7%	143	48.5	26	76%	65	65.5	21	71%
2002	211	44	25	69.7%	175	46.5	29	77%	57	63	25	81%
2003	216	47	25	75.0%	187	47	26	79%	64	74	25	86%
2004	253	47	26	73.1%	176	49	26.5	78%	71	65	25	79%
2005	257	53	38	77.0%	139	48	29	78%	73	64	25	84%
2006	284	53	41	75.7%	152	51.5	25	80%	107	65	25	73%
2007	261	53	35	77.8%	138	46	26	83%	113	57	25	76%
2008	237	51	38	77.6%	139	51	26	73%	110	61	25.5	85%
2009	255	57	34	76.9%	161	56	26	83%	114	61.5	25	86%

Survival rates of seriously injured (ISS 16+) trauma patients by ten –year age groups (DOH Criteria, excluding transfers-in)



Time Series Models



Old challenge:

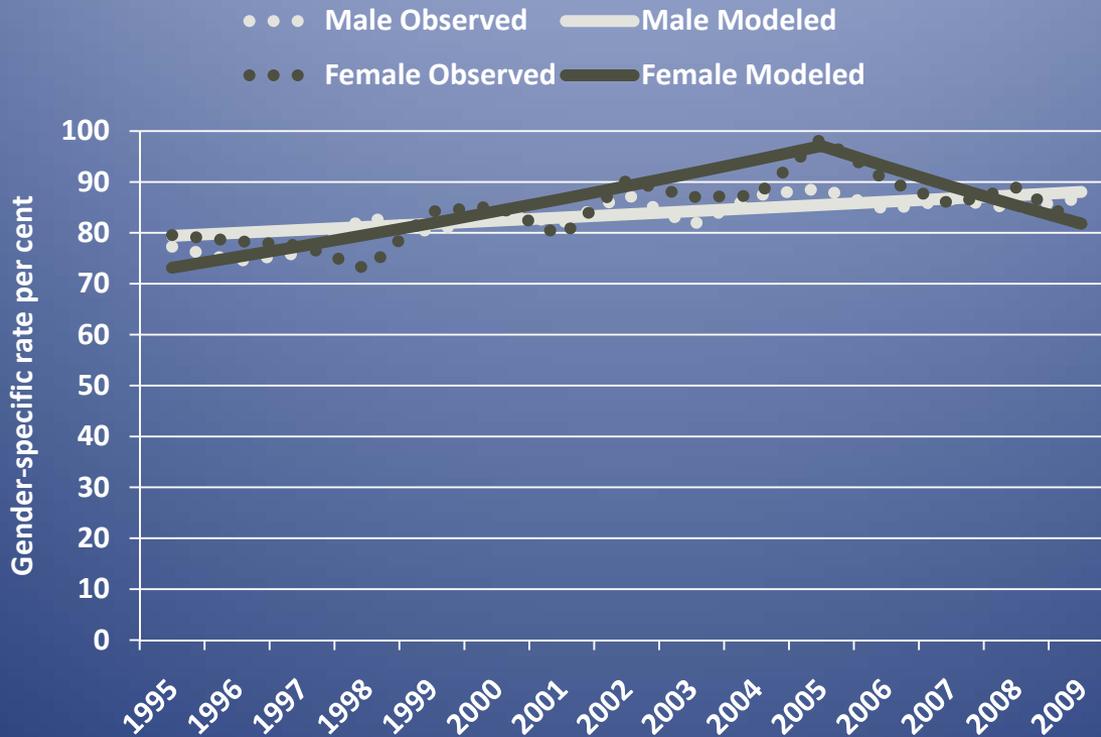
- How to improve the survival rate of elderly (Age 65+) trauma patients who are seriously injured (ISS 16+).

New Challenge:

- How to prevent the survival rate of the young (age 25-34) trauma patients from trending down.

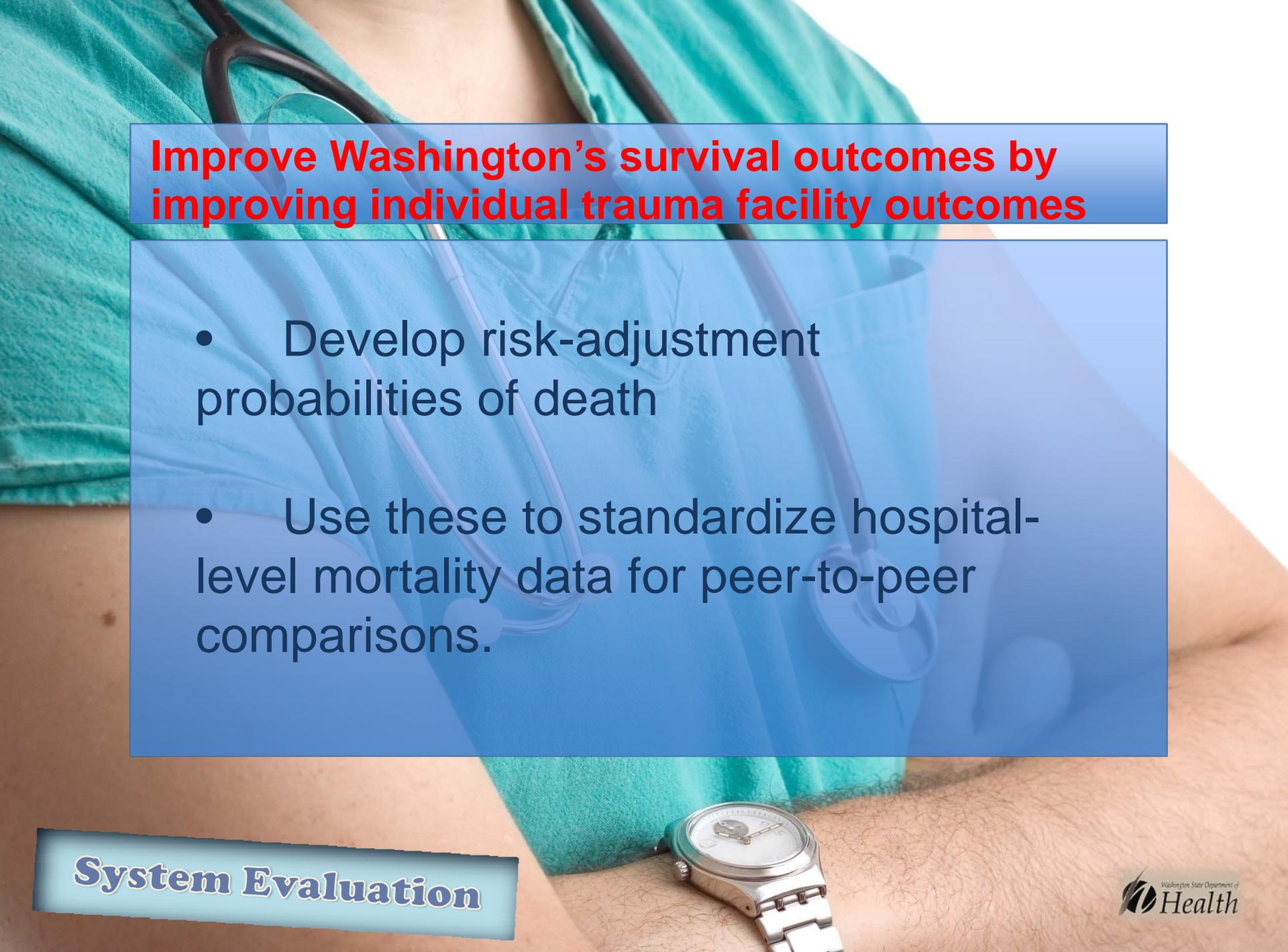
Survival rates of severely injured (ISS 16+) patients age 25-34 by gender

(DOH Criteria, excluding transfers-in)



Comparison of general characteristics of females age 25-34 who died to those who survived

	Died					Survived				
	N	Median Age	Median ISS	TBI Diagnosis	Penetrating Injury	N	Median Age	Median ISS	TBI Diagnosis	Penetrating Injury
1996	12	31	27.5	66.7%	0.0%	43	31	24	61%	0.0%
1997	13	28	38	84.6%	0.0%	52	30	20.5	40%	0.0%
1998	20	31	38	65.0%	0.0%	65	30	19	54%	1.5%
1999	7	31	42	28.6%	0.0%	49	30	20	49%	0.0%
2000	11	31	34	54.5%	0.0%	61	29	21	59%	0.0%
2001	16	27	37	81.3%	0.0%	75	30	22	56%	0.0%
2002	7	28	38	71.4%	0.0%	74	30	21.5	45%	1.4%
2003	7	30	25	85.7%	28.6%	76	30	22	54%	0.0%
2004	9	32	33	66.7%	0.0%	81	29	22	67%	1.2%
2005	2	28	70.5	100.0%	0.0%	101	29	25	62%	0.0%
2006	8	29.5	39.5	62.5%	0.0%	108	29	21	60%	0.0%
2007	14	28.5	42.5	64.3%	21.4%	108	27	22	61%	1.9%
2008	8	28.5	43.5	87.5%	0.0%	81	28	25	57%	1.2%
2009	20	31	36.5	70.0%	10.0%	98	29	22	63%	3.1%



Improve Washington's survival outcomes by improving individual trauma facility outcomes

- Develop risk-adjustment probabilities of death
- Use these to standardize hospital-level mortality data for peer-to-peer comparisons.

System Evaluation

WHY?

The case mix is usually different in trauma facilities providing the same level of care.

- Risk-adjustment provides a level ground for comparisons.
- Such comparisons are helpful for the QI activities at system and regional levels

Methods

- **Retrospective analysis of Washington State, Trauma Registry data from 2005 to 2009.**
- **59,660 adult trauma patients with non-penetrating injuries.**

System Evaluation

Exclusion Criteria

- **Age less than 15**
- **Patients with serious burn injuries (ICD9 940-949 with ISS <9)**
- **Patients transferred out to another facility from ED**
- **Patients with penetrating injuries.**

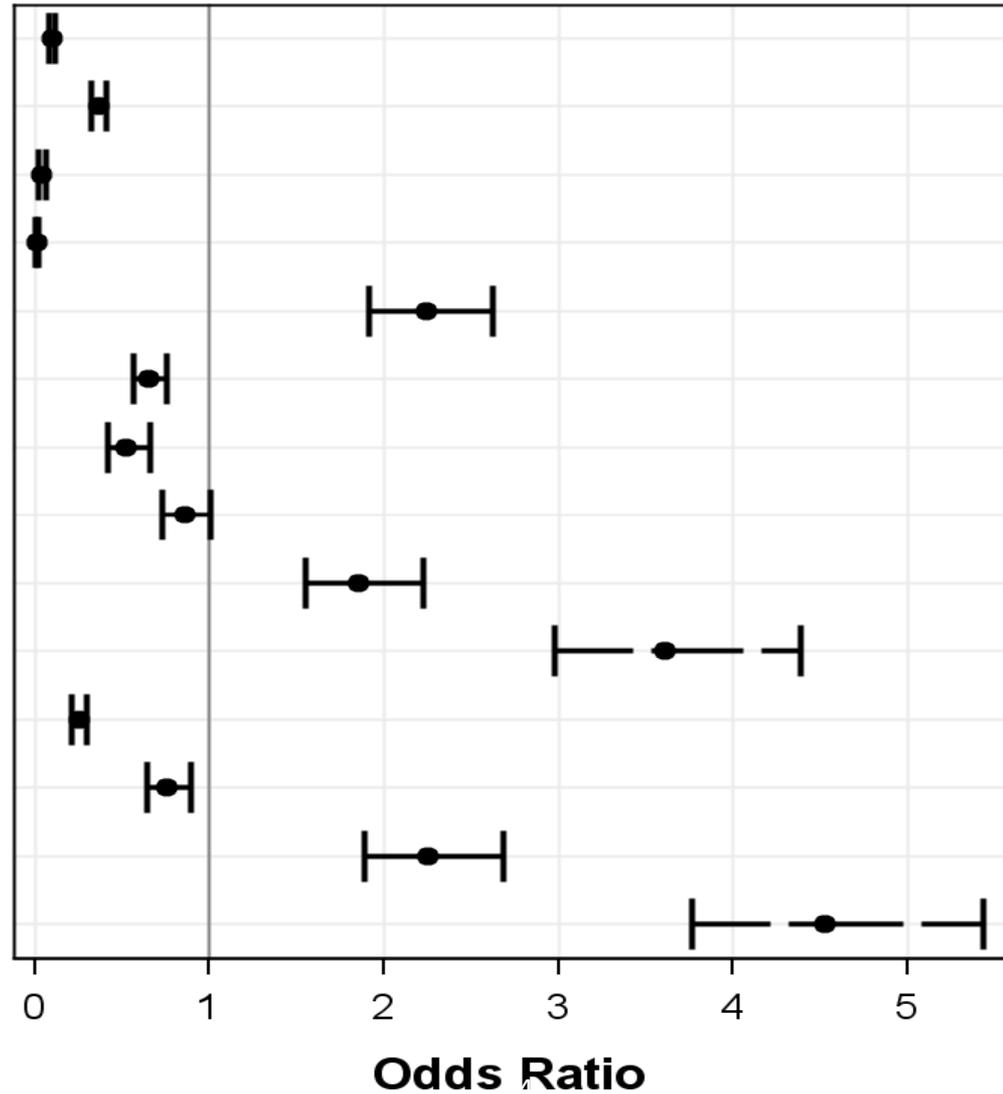
System Evaluation

Risk-Adjustment Model

For non-penetrating Trauma Mortality

Odds Ratios with 95% Wald Confidence Limits

Age Groups	Age (15-54) vs Age(80+)
Age Groups	Age (55-79) vs Age(80+)
Sys Blood Pressure	bp (60-89) vs bp (<=59)
Sys Blood Pressure	bp (90+) vs bp (<=59)
Heart Rate	pulse(0-59) vs pulse(>=60)
Patient Intubated	vs Not Intubated
MaxAISHead	(1-2) vs No Head Inj.
MaxAISHead	(3-4) vs No Head Inj.
MaxAISHead	(5-6) vs No Head Inj.
Glasgow Coma Scr	GCS(3-8) vs GCS(9-13)
Glasgow Coma Scr	GCS(14-15) vs GCS(9-13)
Injury Severity Score	ISS(0-8) vs ISS(9-15)
Injury Severity Score	ISS(16-24) vs ISS(9-15)
Injury Severity Score	ISS(25-75) vs ISS(9-15)

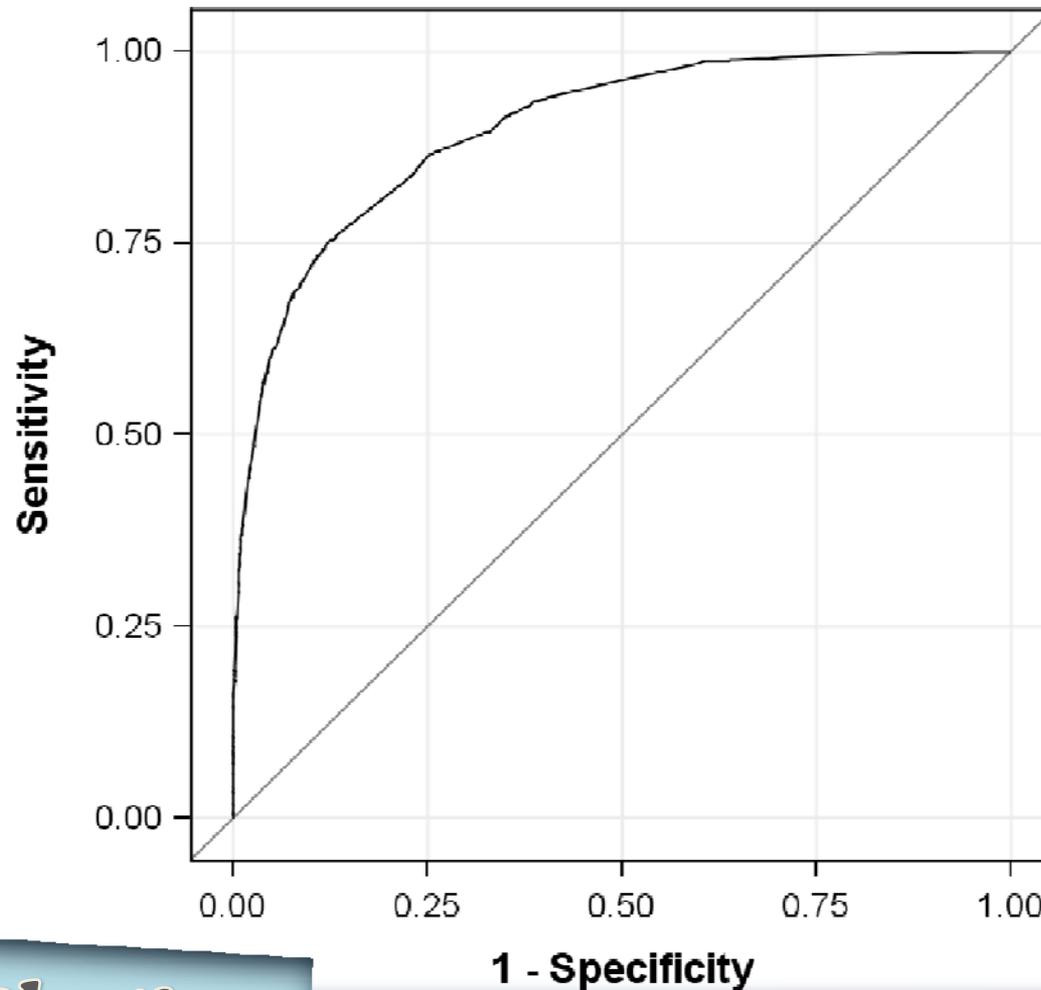


Risk-Adjustment Model

For non-penetrating Trauma Mortality

ROC Curve for Model

Area Under the Curve = 0.9005



System Evaluation

Adjusted Non-Penetrating Trauma Mortality Rate Comparison Of Level I and II Trauma Centers, Trauma Data from 2005 to 2009

Observed Mortality Rate (%)

6.6

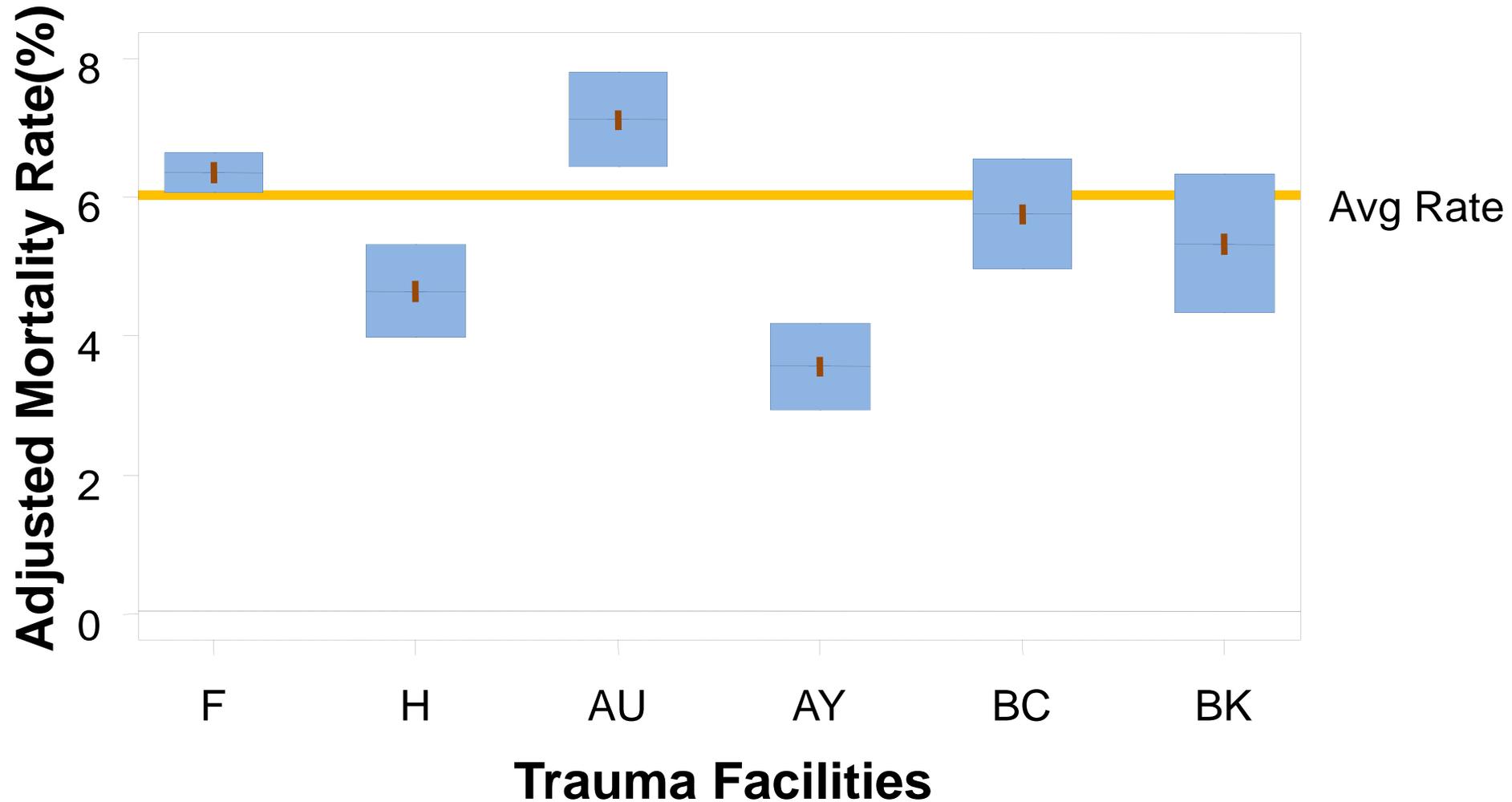
4.7

5.5

3.8

4.9

4.2



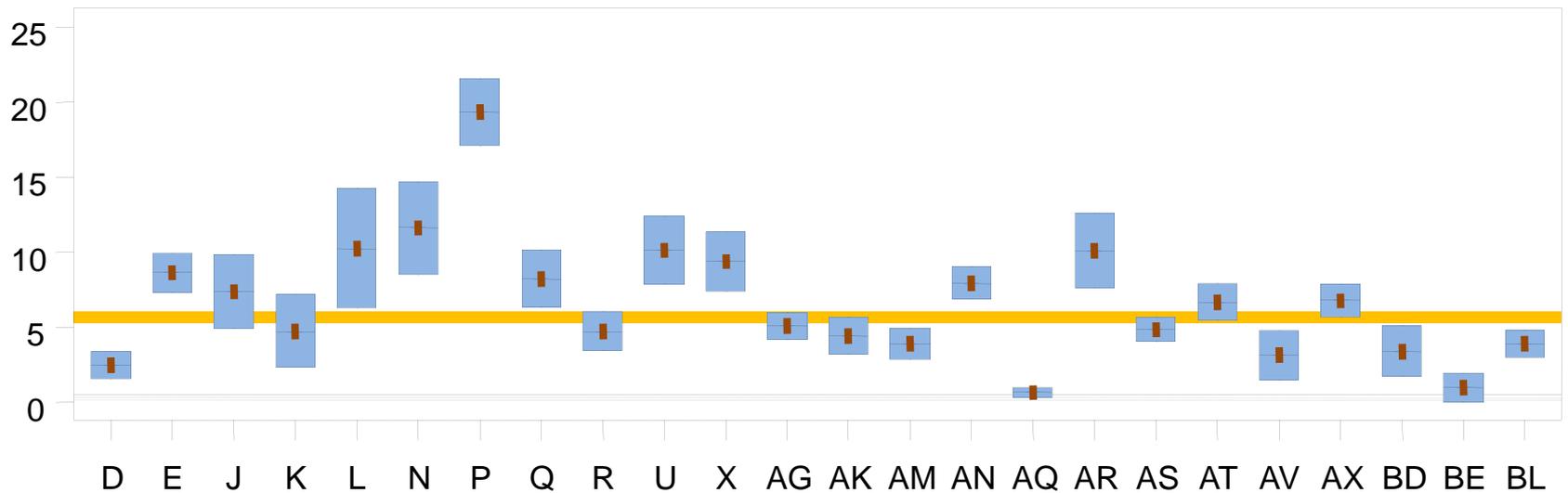
Adjusted Non-Penetrating Mortality Rate Comparison

Of Level III Hospitals, Trauma Data from 2005 to 2009

Observed Mortality Rate (%)

2.5	5.2	4.9	3.9	5.8	8.3	10.2	5.5	3.8	6.3	5.7	4.2	3.5	3.3	6.2	1.2	8.2	3.7	5.4	3.3	5.3	2.7	1.3	4.0
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Adjusted Mortality Rate(%)



Avg Rate

Trauma Facilities

Some notable points regarding the mortality analysis:

1. Considerable variation in risk-adjusted mortality rates exists across similarly designated trauma facilities.
2. Especially among Level IIIs, such variation for non-penetrating trauma mortality is apparent. Observing some Level IIIs with risk-adjusted mortality rates over 10% is concerning from a systems perspective.

Thank You!

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www.doh.wa.gov/hsga/emstrauma/commpeg1.htm