Evaluation of crash-related fatalities and serious injuries associated with the Michigan Motorcycle Helmet Law Repeal Utilizing Linked Crash and Hospital-Level Data

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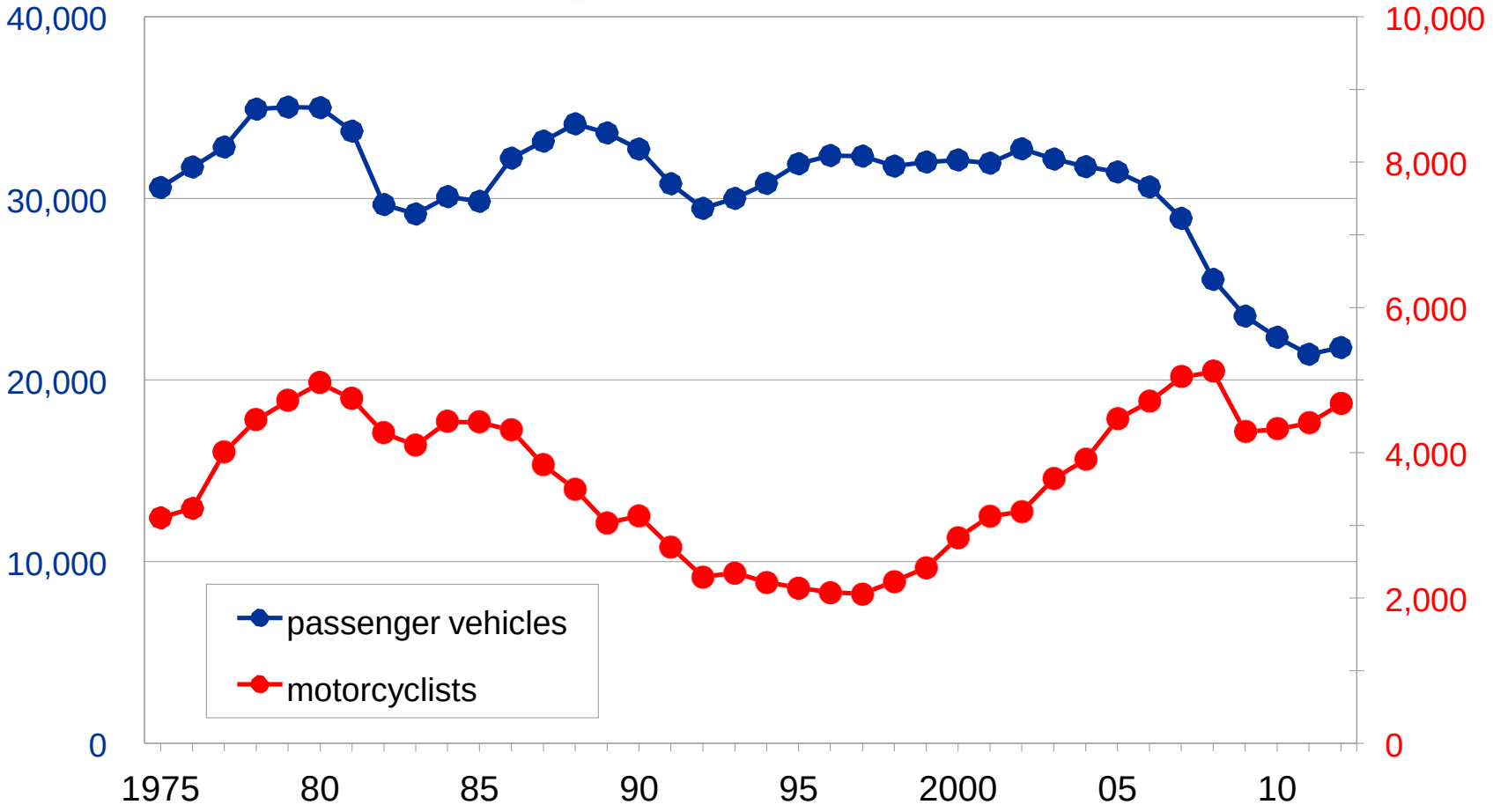
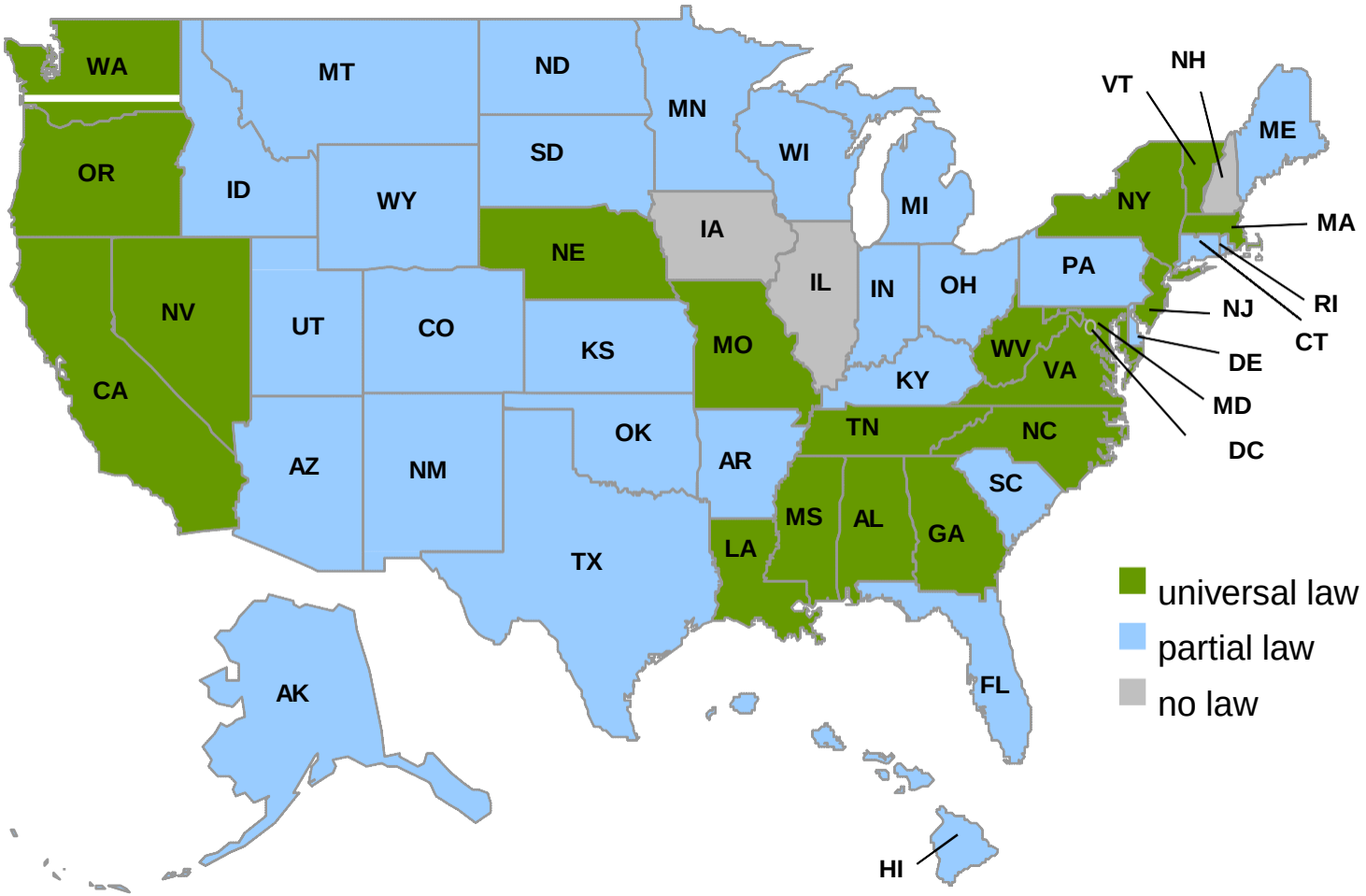
National picture

Deaths of motorcyclists and vehicle occupants in the US



Map of motorcycle helmet laws

March 2014



April 12, 2012

"Michigan law now allows motorcyclists to decide for themselves, if certain conditions are met, whether or not to wear a helmet.

To legally not wear a helmet, a motorcycle operator must:

- Be at least 21 years old.
- Have at least $20,000 in first-party medical benefits.
- Have held a motorcycle endorsement for at least two years, or have passed an approved motorcycle safety course."

Secretary of State, Department of State

http://www.michigan.gov/sos/0,4670,7-127-1585_50413-277037--,00.html

Project aims

- Examine impact of repeal of motorcycle helmet law:
  - crash data
  - trauma data
  - observation study

Trauma Registry Data

- From consortium, The Michigan Trauma Quality Improvement Program (MTQIP)
- 23 adult Level 1 and 2 Trauma Centers
- De-identified individual patient-level data
- Most complete source for a statewide assessment of hospital data

Michigan State Police (MSP) crash records

- Crashes:
  - occur on a public roadway
  - involve a personal injury or property damage of >$1000 or more.
- Record a measure of crash severity: fatal, disabling, nondisabling, possible injury, property damage only. Fatal crashes are within 30 days.
- Includes: location, circumstances, description of the crash, the vehicle, and occupants

Key definitions

- Motorcycle: two- / three-wheeled, motorized, with minimum engine size of 50cc road-legal vehicle
- Helmet: Identified in crash or trauma data as wearing a helmet

- Dataset dates: Jan 1, 2011 to Dec 31, 2013

Benefits to data linkage

- More complete picture – incorporates what happens at the scene and hospital
- Allows an understanding of where the crashes occur, the outreach of a hospital
- Allows us to examine change in deaths at the scene compared deaths in ED
- Allows validation of data – e.g. helmet wearing rates

Data linkage

- Used probabilistic linkage
- Includes all motorcyclists or moped riders
- Linked on age, sex, hour of crash (within 1hr)
- Included when one trauma record matches only one crash record
- Excludes motorcyclists who crashed and died at scene or were not transported to a Level-1/Level-2 hospital

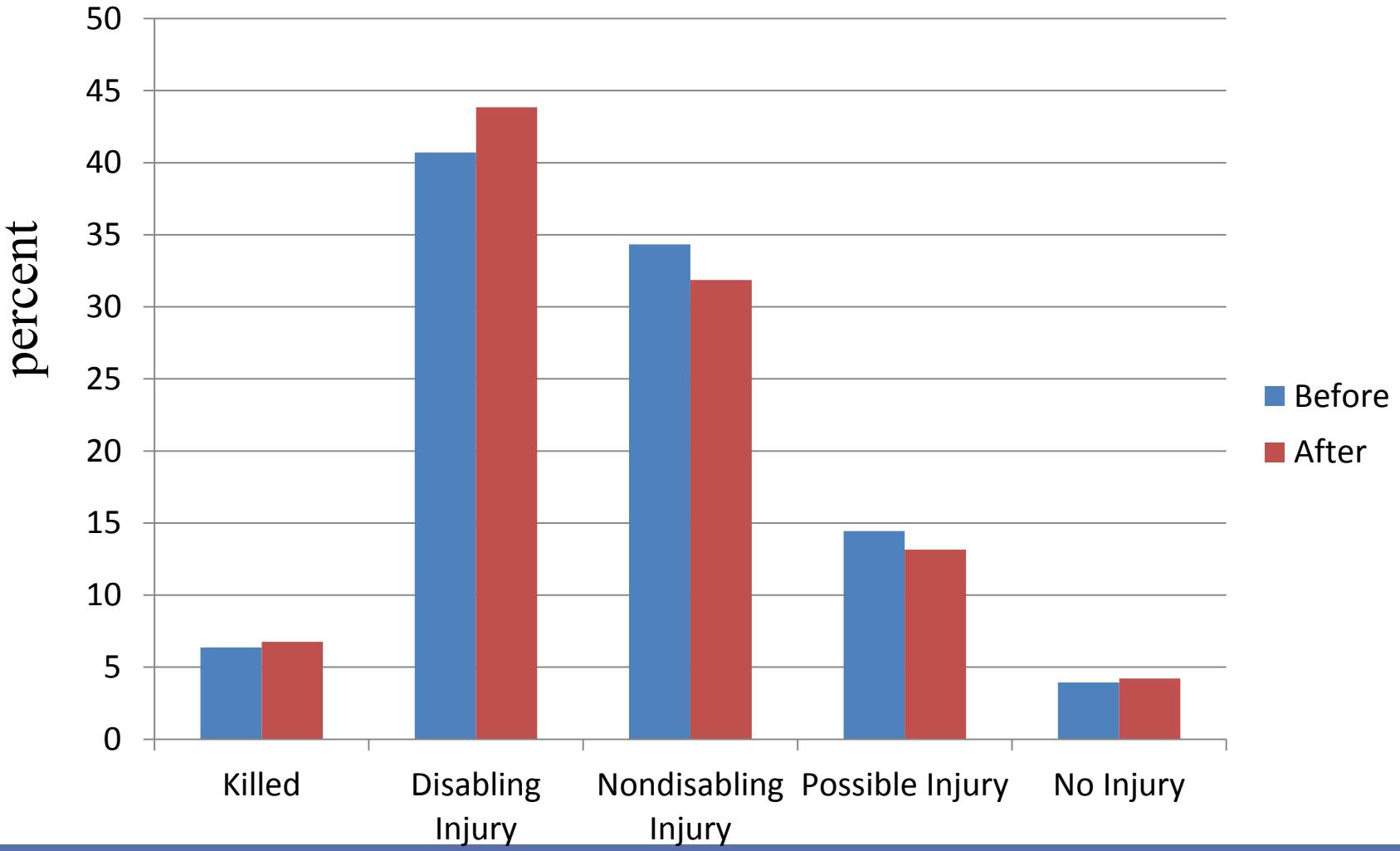
Data Linkage Challenges

- Transfer patients
  - there is a separate entry for each hospital case and need to link each person.
  - As transfer patients are not a random sample of injured motorcyclists it was important to link them.
  - Needed to hand code each transfer case.
- Ties – e.g. same crash, two motorcyclists, same year of birth.

Sample Demographics & Helmet Use

	Before	After
Mean age (years)	44.75	44.33
Percent helmet wearing	91.97	62.90
Males percent helmet wearing	85.08	63.73
Females percent helmet wearing	92.98	57.83

Crash Severity – Police Reported



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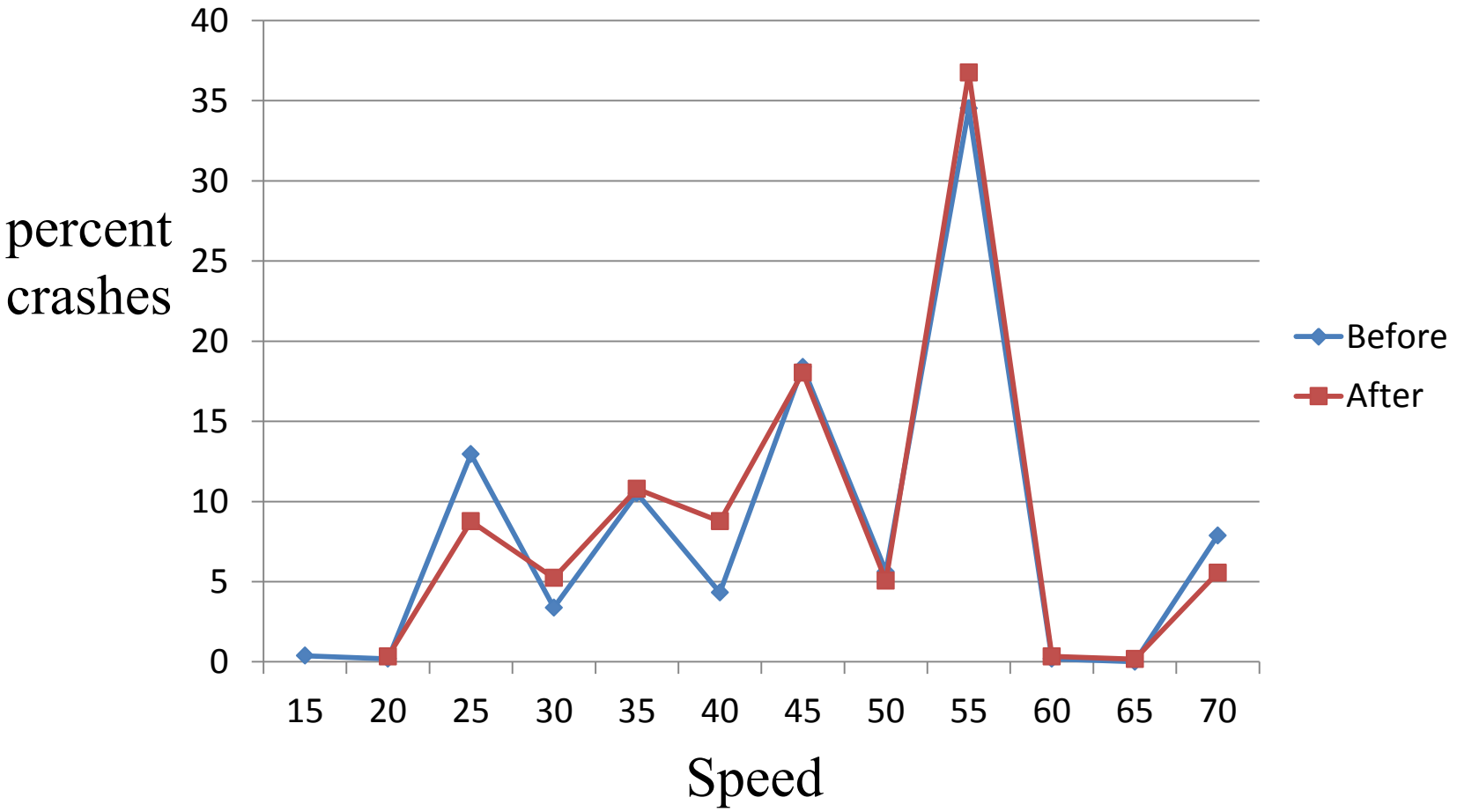
Percent of crashes by speed limit



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Fatality Rates

Percent	Before	After
Discharge from ED as death	3.00	2.19
Discharge from Hospital as death	5.82	5.39
Overall Crash data (includes death within 30 days of crash)	6.38	6.75

ISS Score, GCS Score, Surgical/ Operative Intervention

	Before	After
Mean ISS	15.18	15.19
% GCS >8	88.19	88.32
% Surgery	31.78	39.29

Clinical Case Definition (CDC)

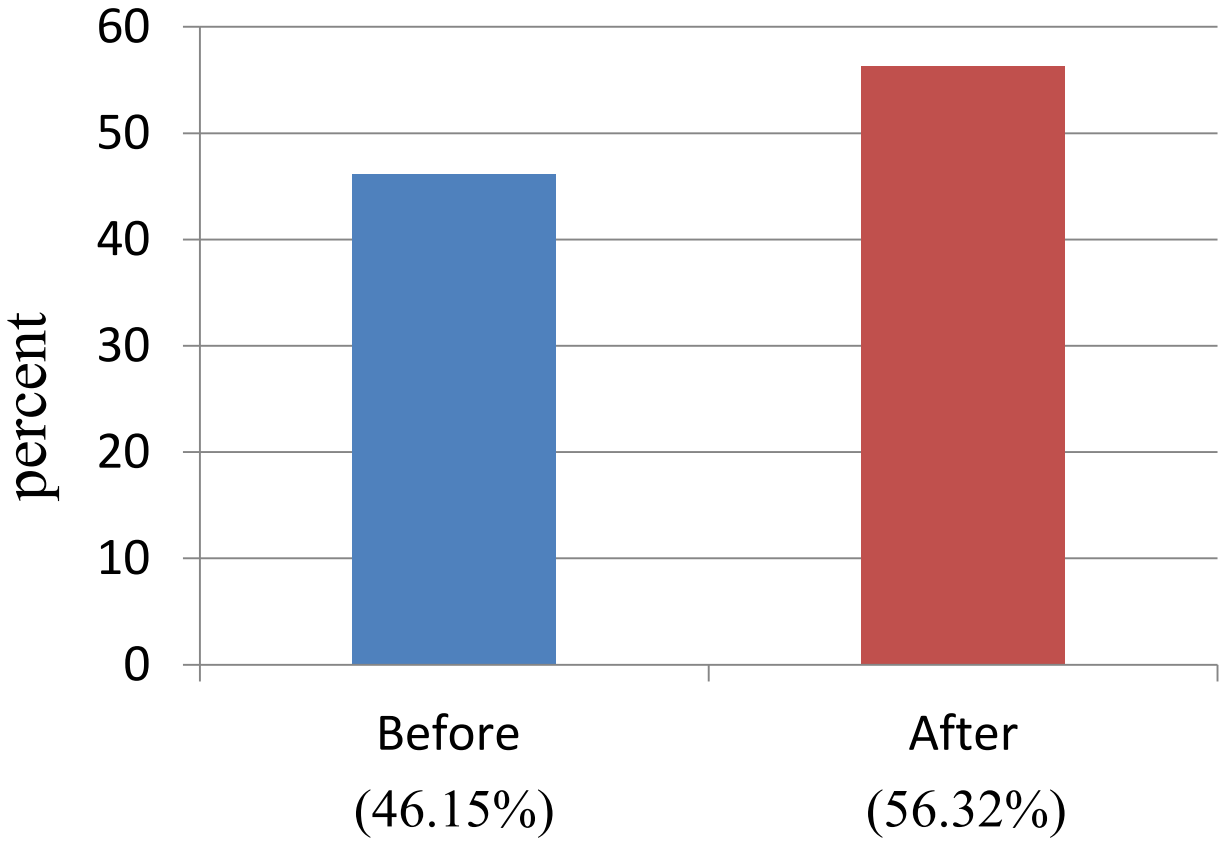
Occurrence of injury to the head with one or more of:

- Observed or self-reported decreased consciousness (i.e. Concussion)
- Amnesia
- Skull fracture
- Objective neurological or neuropsychological abnormality
- Diagnosed intracranial lesion (e.g. Epidural, Subdural, SAH, Intracerebral)

ICD-9 Codes

- 800.0-801.9 - Fracture of the vault or base of the skull
- 803.0-804.9 - Other and unqualified and multiple fractures of the skull
- 850.0-854.1 - Intracranial injury, including concussion, contusion, laceration, and hemorrhage.
- Additional TBI cases from death certificates: 873.0-873.9 Other open wound of head.

Overall head injury



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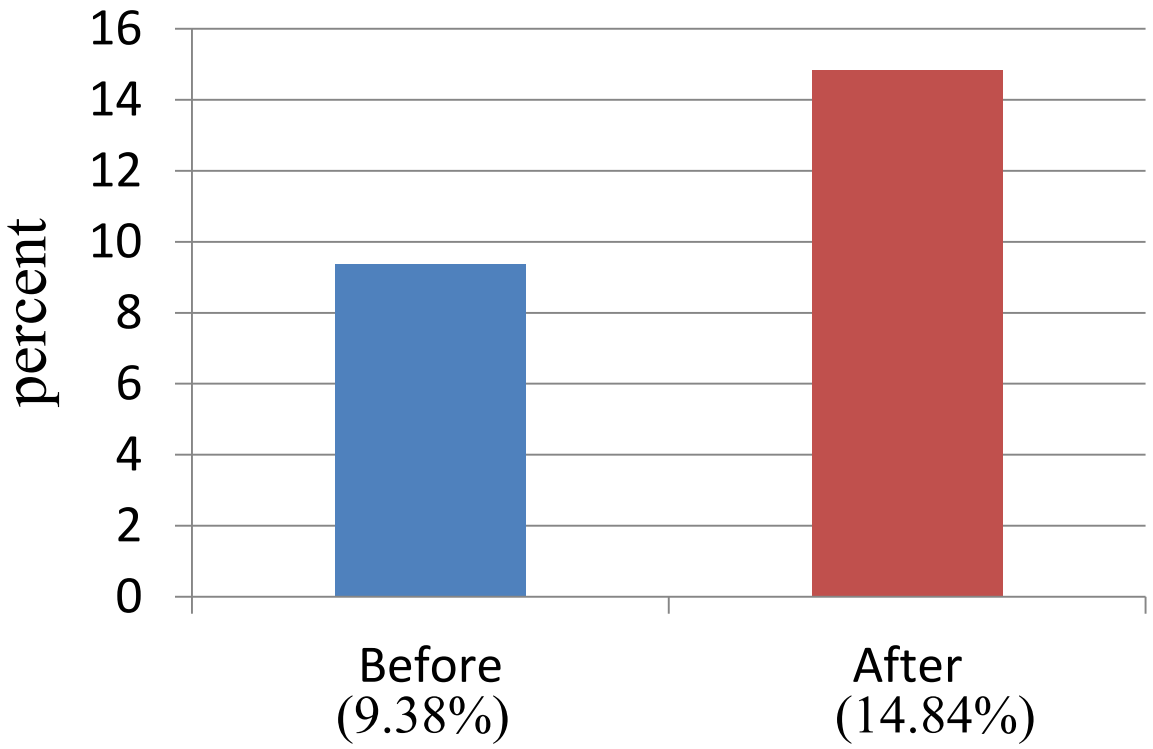
Skull fracture



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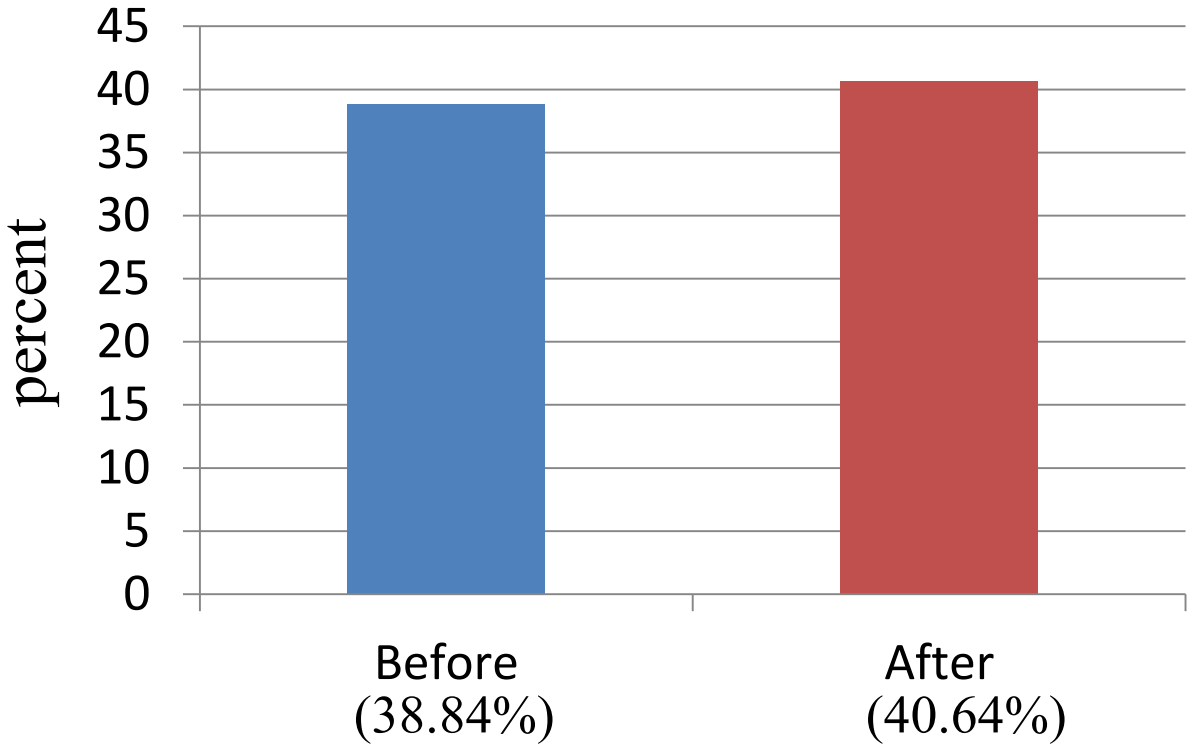
Intracranial injury



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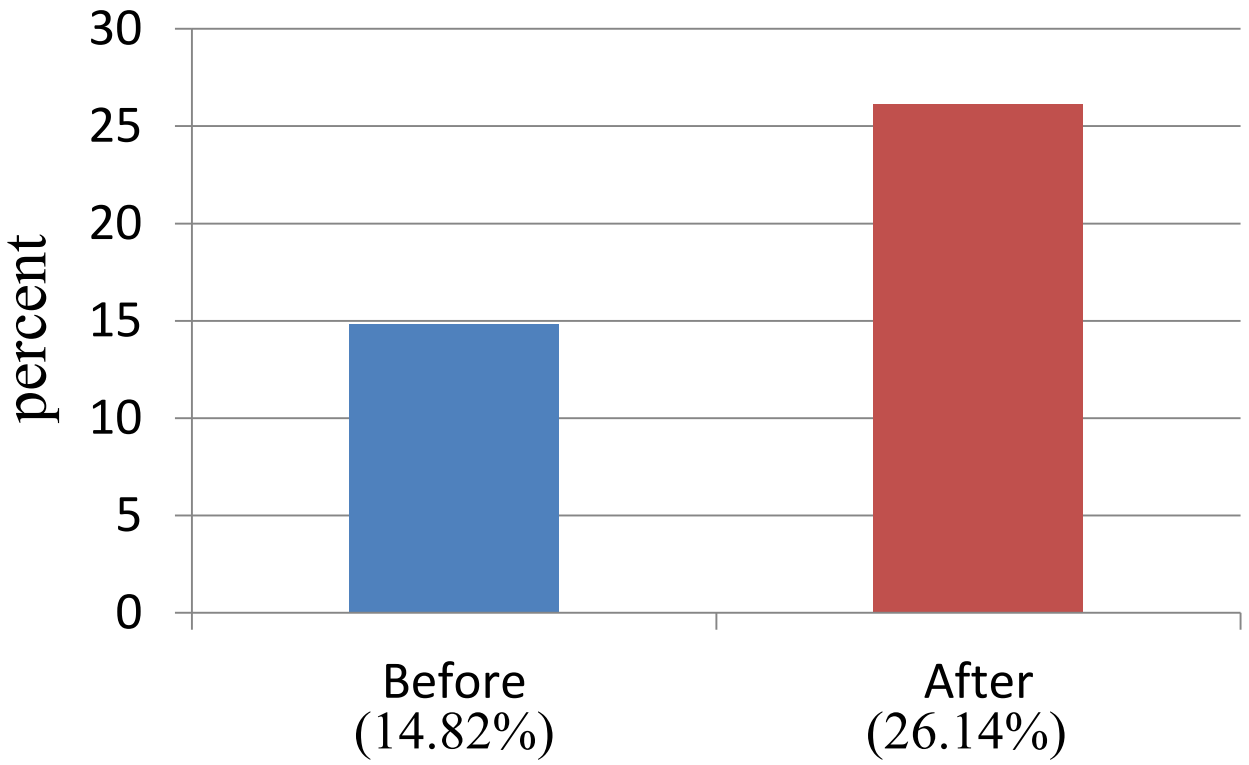
Open head wound



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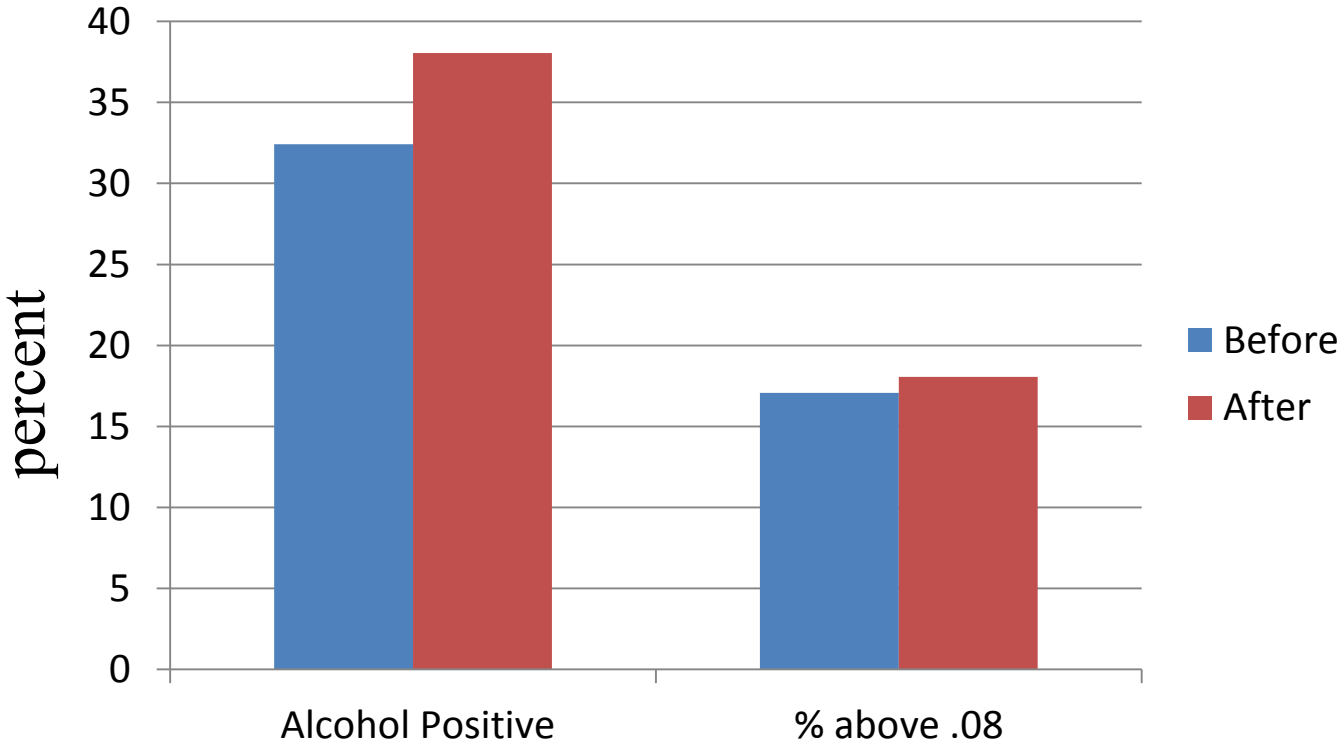
ICU & Ventilator Days

	Mean No. of Days	
	Before	After
ICU	2.604	2.897
Ventilator	1.465	1.582

Alcohol Involved Crashes



- Mean BAC when alcohol positive: Before=.0449; After=.0529

Odds of head injury type with non-helmet use

	Odds Ratio	Confidence Interval
Any head injury	3.38	(2.42-4.69)
Intracranial injury	1.93	(1.44-2.59)
Skull fracture	3.79	(2.56-5.59)
Open head wound	3.12	(2.23-4.33)

- Alcohol is also a significant predictor of head injury

Head Injury by Rider Helmet Use and BAC Before and After Repeal

	Before (N=369)		After (N=434)	
	BAC ≤ 0.08 (n = 283)	BAC > 0.08 (n = 86)	BAC ≤ 0.08 (n = 332)	BAC > 0.08 (n = 102)
Helmet	94.7%	76.7%	65.6%	51.0%
No Helmet	5.3%	23.3%	34.4%	49.0%

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Next steps

- In-depth examination of head injuries
- Evaluate in- vs. out-of-hospital mortality
  - Prior literature has reported possible shift in fatalities from hospital environment to out-of-hospital with helmet law repeal
- Explore whether those already at high-risk before repeal (i.e. drunk riders) are now population shifting to unhelmeted drunk riders explaining lack of change in mortality

Thank you

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