Bayesian Network-based Pedestrian/Bicyclist Behavioral Analysis in Intersection-related Crashes

–Impacts of Age, Gender, Sobriety Heterogeneity

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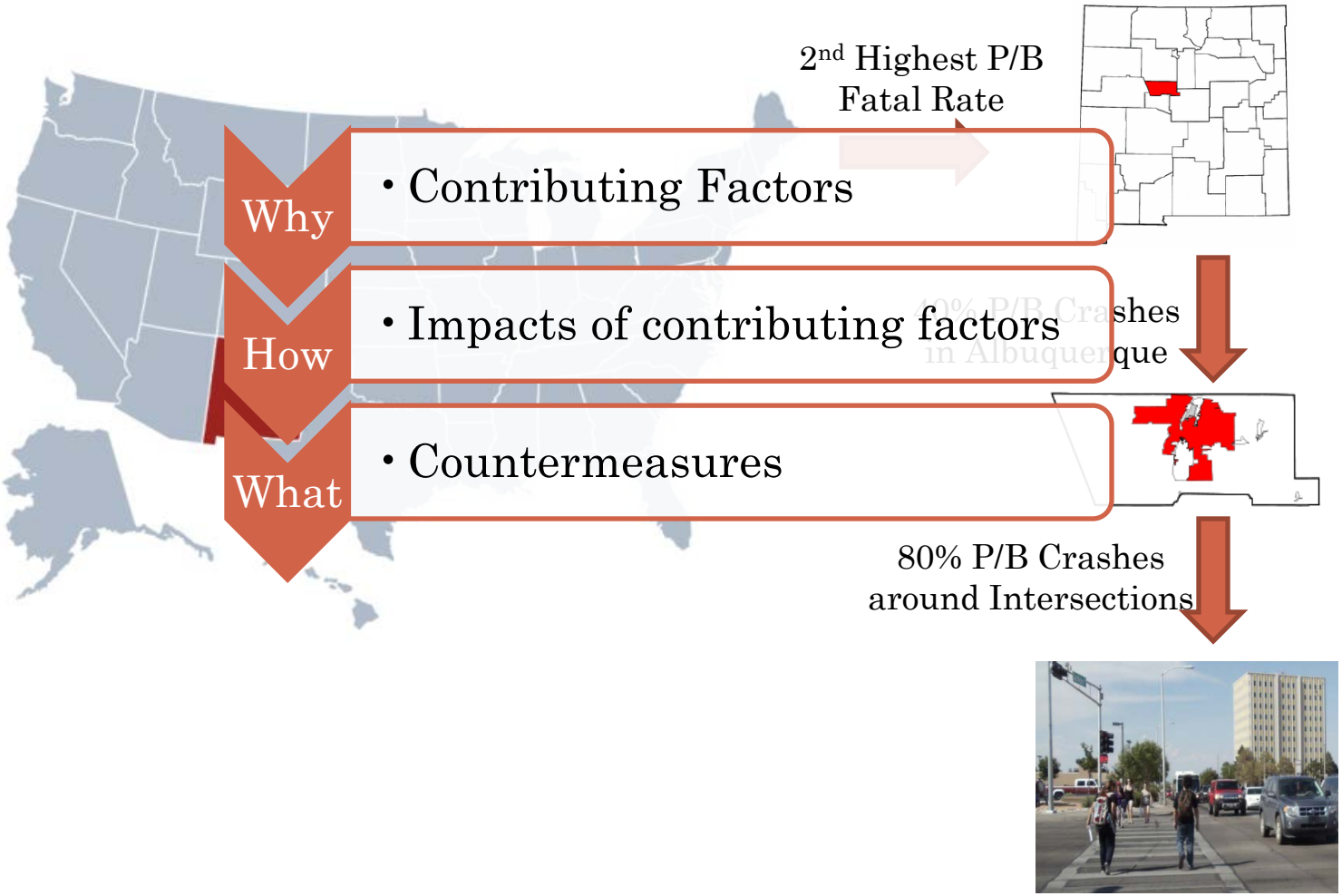
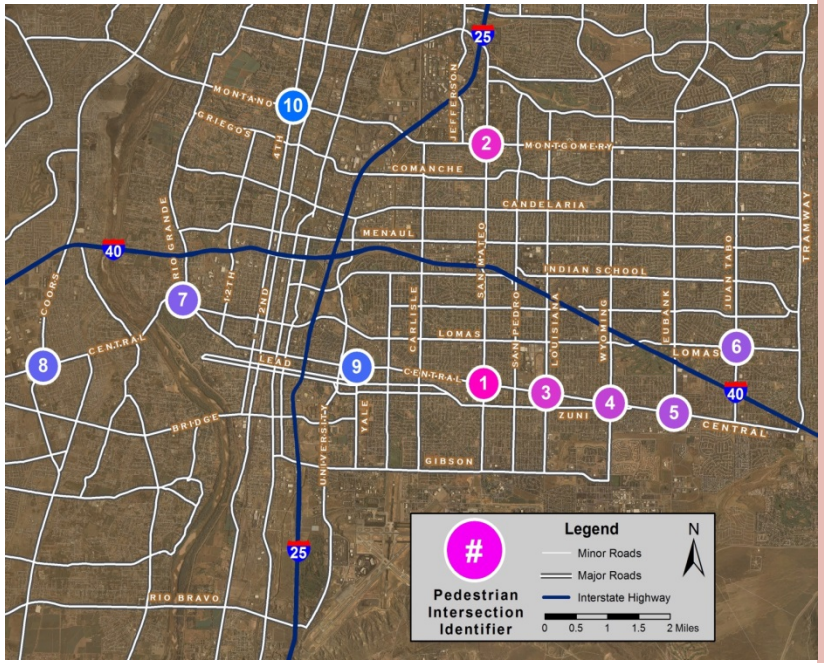
Research Questions

- New Mexico: Pedestrian/Bicyclist-involved Crashes (P/B)



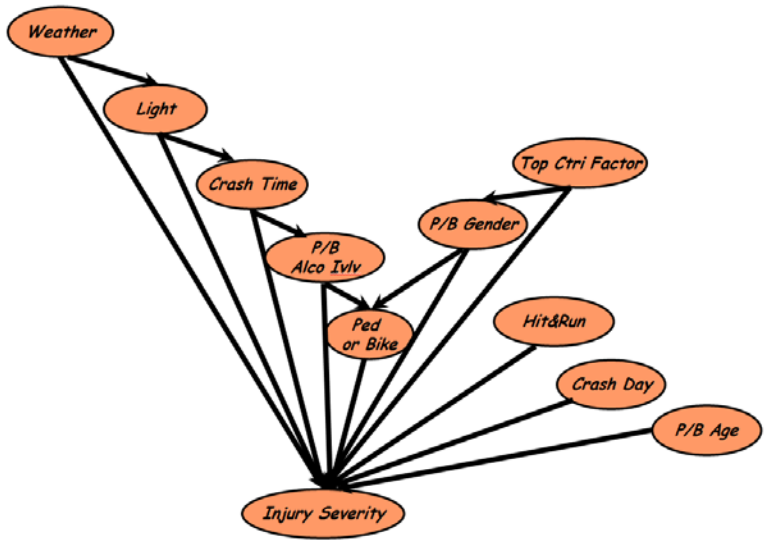
Data Preparation

- 10 intersections with highest P/B crash frequency
- Crash Data:
  - Time period: 2004-2013 (10 years).
  - Total No.: 258 records.
- Basic Information:
  - Intersection layout
  - Land usage
  - P/B facility
- Traffic Data:
  - Total: 1000 hours of video
  - Traffic control
  - Traffic volume (vehicle and P/B volume)
  - P/B information (age, gender)



Methodology

- Injury Severity Analysis
  - Bayesian network: a **probabilistic graphical model** representing **a set of random variables** and **their conditional dependencies** via a directed acyclic graph **(DAG)**
  - Injury Categories: No injury/Injury
  - Variable influence analysis



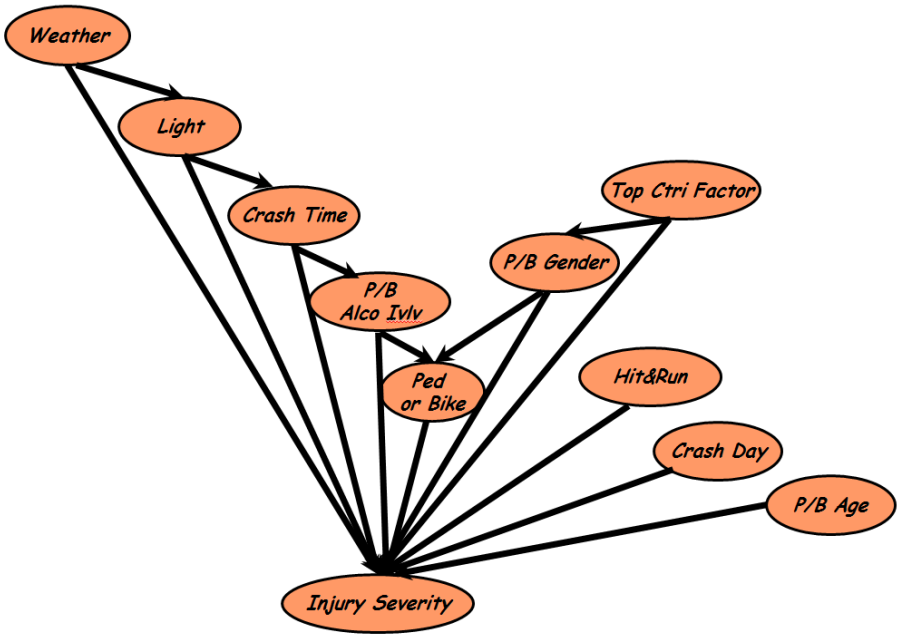
- Intersection Evaluation
  - On field survey
  - P/B facility evaluation
  - Characteristic investigation

Critical Findings

- Injury Severity Analysis
  - Bayesian network prediction performance

	Overall	No Injury	Injury
Prediction Accuracy	69.42%	63.54%	74.55%

- Model Estimation Result



- Variable Influence Result

		No Injury	Injury
	Alcohol/Drug Involvement	-22.0%	20.7%
Crash Time	Morning	35.5%	-25.3%
	Afternoon	15.9%	-12.3%
	Evening	-18.5%	17.0%
	Night	-26.7%	24.9%
Weather	Clear	-33.2%	60.1%
	Adverse(Fog, Rain, Snow, etc.)	49.6%	-37.5%
P/B Age	20 or younger	20.4%	-15.0%
	21-34	14.9%	-11.1%
	35-44	-4.0%	3.2%
	45-54	5.4%	-4.2%
	55-64	2.4%	-1.8%
	65 or older	-35.7%	31.1%

Critical Findings

- Intersection Evaluation
  - Example: Montgomery Blvd @ San Mateo Blvd
  - Intersection Characteristic
    - P/B age under 20: 29.6% and 66.7%
    - Time period: 3-5 pm & 6-8 pm
    - Top factors: pedestrian error
    - Transit stops
  - Countermeasures
    - Safety enforcement and education
    - Encouraging usage of overpass
    - Flashing warning signs
    - Median Barriers
    - Surveillance system

Future Research Needs

- Pedestrian at-fault actions are generally recorded as "Pedestrian error", such as jaywalking, ignoring the signal, etc. More detailed record is needed to evaluate each at-fault action.
- Conduct comprehensive survey to examine P/B safety awareness among students and/or at high P/B volume intersections.
- Incorporate land use data (% for each type) into crash dataset and quantify the influence of land use pattern on injury outcome.

Implications for practice

- Visibility Enhancement Countermeasures (Dawn/Dusk)
  - Flash warning signs
- Signal Timing Improvement
  - Consideration of P/B characteristics (age/gender)
- Median Barrier
  - Encourage of crosswalk usage