



# HumanFIRST

## Improving Injury Severity Reporting Through User-Centered Design

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# Acknowledgements

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# Identifying Crash Injury Severity is Difficult



Injury severity levels may be underestimated or overestimated by law enforcement officers



Misclassification of injuries can result from: age and gender of the victim, road environment, number of vehicles involved, time of day, blood-alcohol tests, and type of crash *(Couto, Amorim, & Ferreira, 2016)*

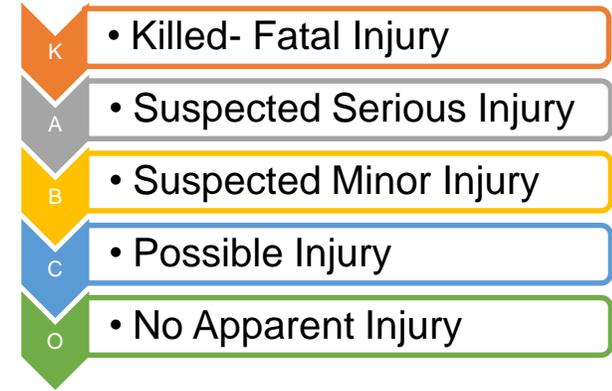


Errors result from obvious injuries that appear worse than they are or from injuries that are not evident *(Compton, 2005)*

# Classifying KABCO Injuries is Error Prone

- MMUCC categorizes injuries within 3 levels:

- A. Suspected Serious Injury
- B. Suspected Minor Injury
- C. Possible Injury

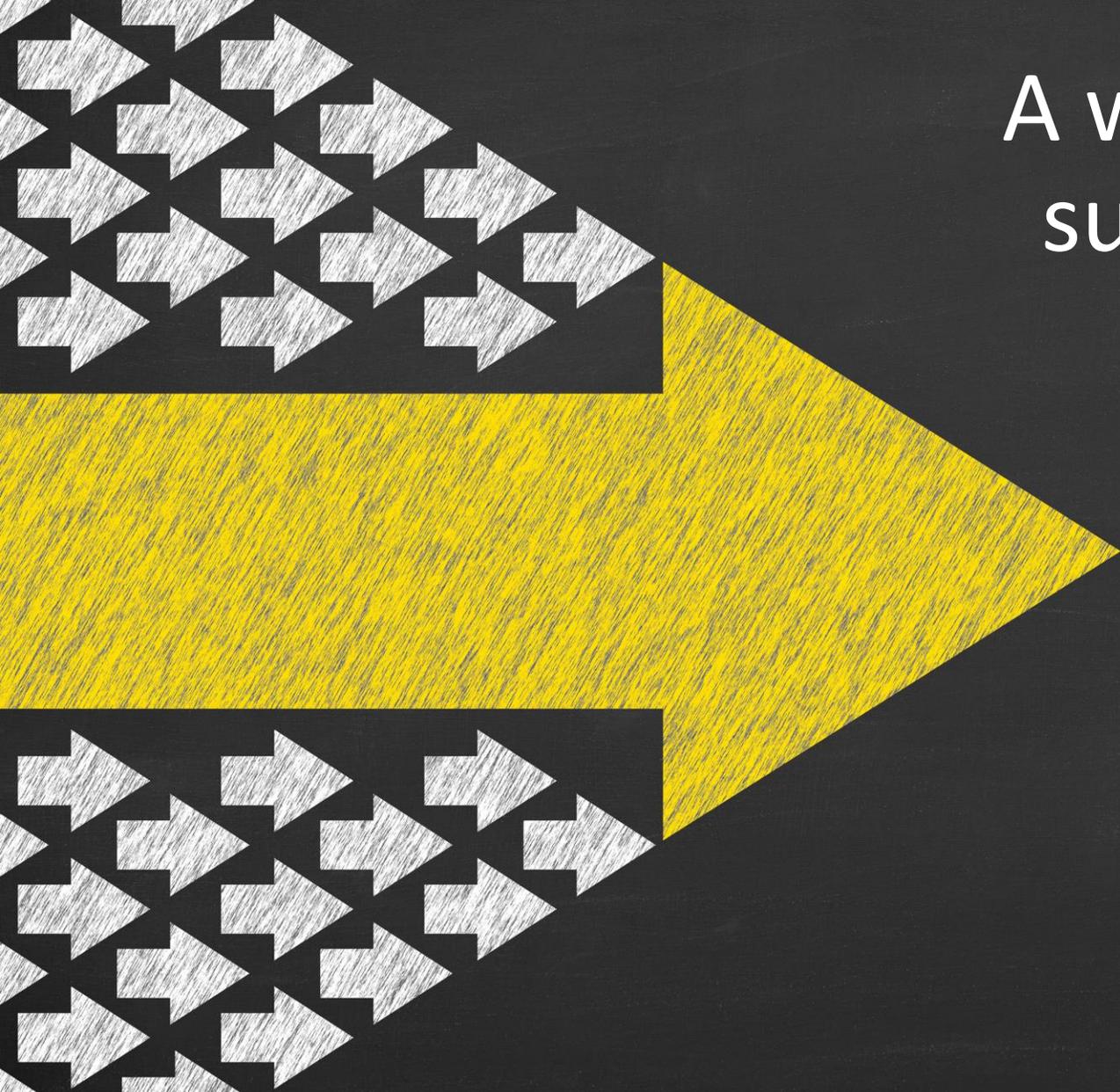


- Selecting based on definition requires officers to:
  - begin with an assumption of level
  - then search for an injury description that matches the observed injuries of the crash victim
- *This process may be inefficient, error-prone, and discourage reference use altogether*

# Decision Aids are Helpful in Many Disciplines



- Decision aids are tools or interventions which facilitate decision-making
  - Common in the healthcare field
- Decision aids have been shown to improve reliability and validity in diagnostic decision making
  - *(Ramnarayan et al., 2003)*



# A well-designed diagnostic support tool should have:

- ✓ Easy retrieval of information
- ✓ High user acceptance/usability/satisfaction
- ✓ Easy navigation
- ✓ Enhanced workflow/reduced cognitive load
- ✓ Easy transfer of information

*Balogh, Miller, & Ball (2015)*

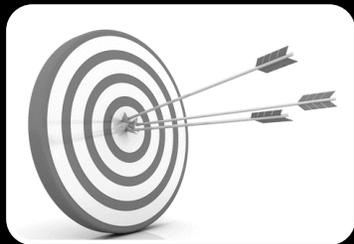
# Creating a Decision Aid with User-Centered Design



Design an injury severity decision aid through an iterative, user-centered development and testing process



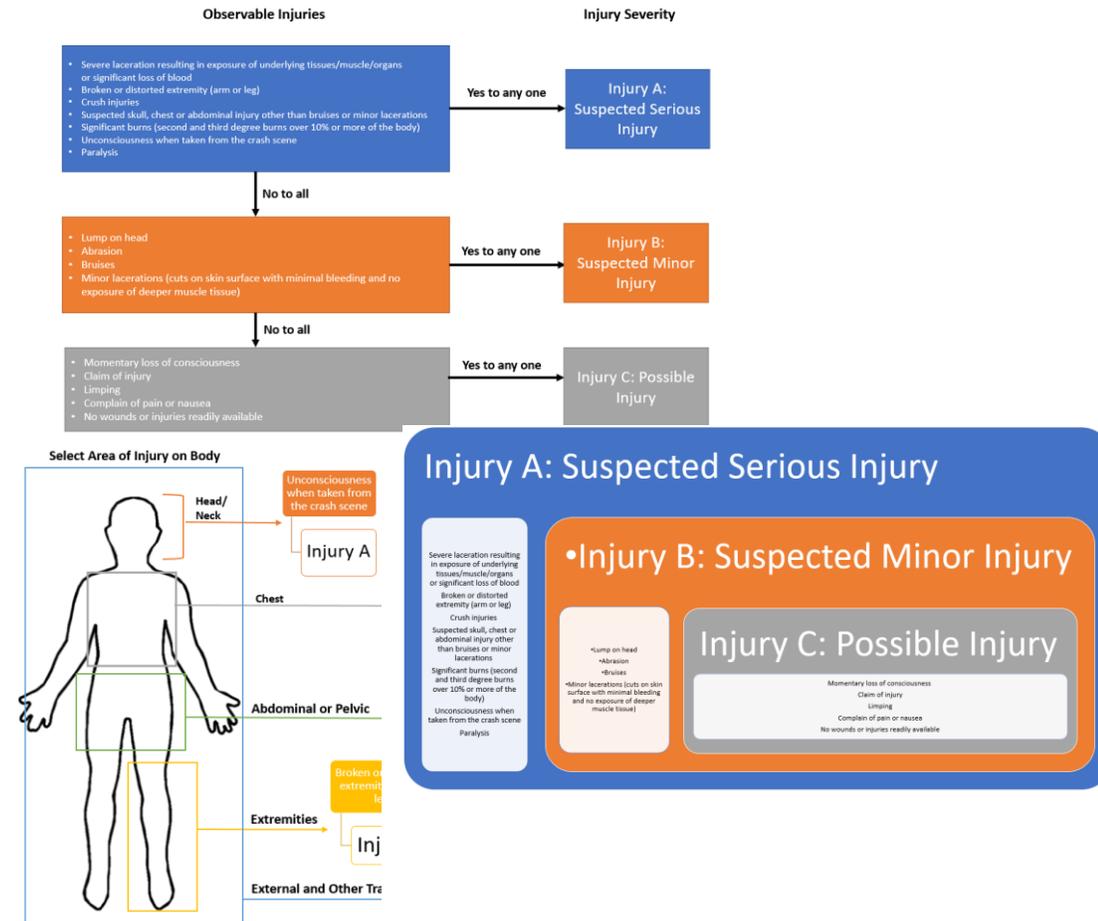
Determine if an injury severity decision aid would have user acceptance among law enforcement officers



Measure possible changes in accuracy and reporting confidence in using the decision aid compared to a standard information list

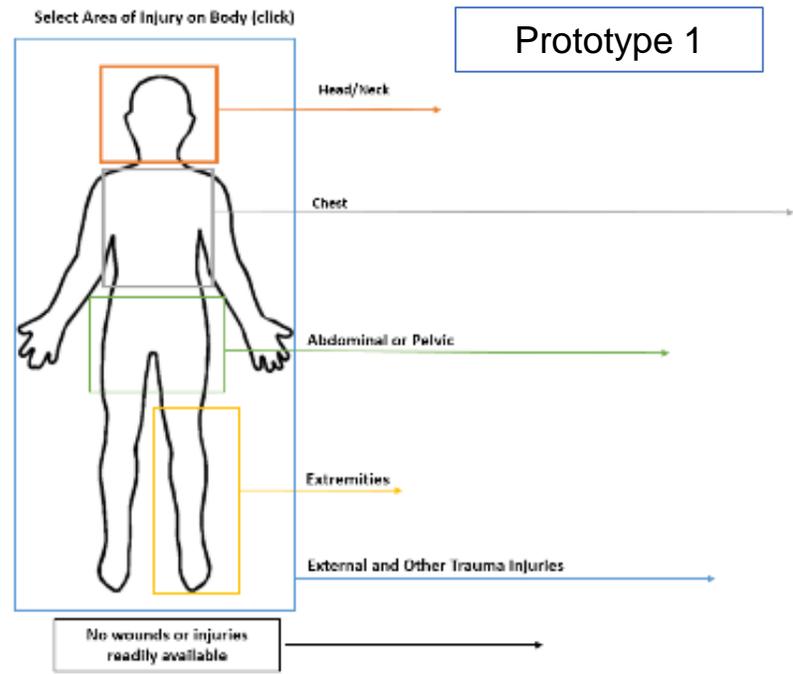
# Creating an Interactive & Visual Tool Design

- Multiple prototypes were considered including flow charts, nested charts, and check lists
- An interactive body diagram was selected as the best candidate which would reduce cognitive workload and improve user satisfaction

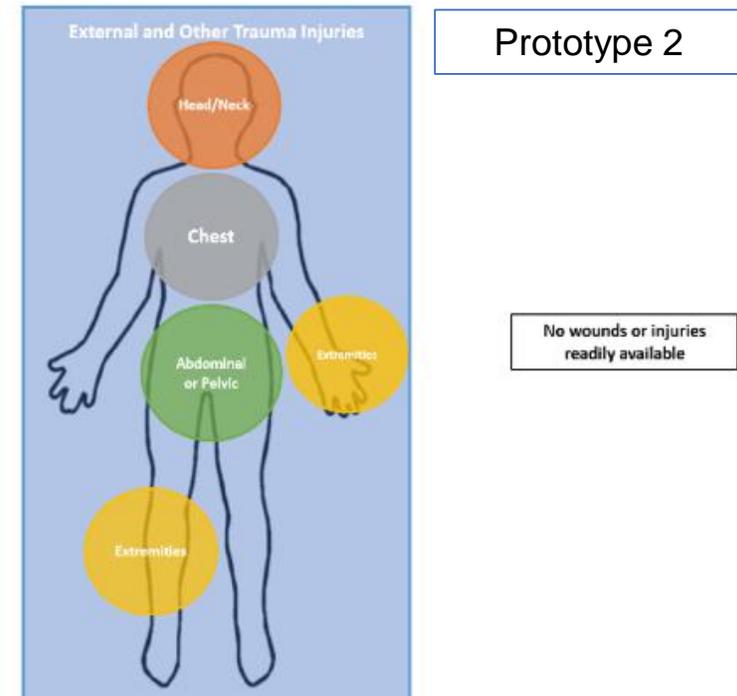


# Initial Prototypes

- Two prototypes were created to allow officers to click areas of a body diagram to select from a reduced list of injuries, each leading to the MMUCC defined injury severity level



Select Area of Injury (click)



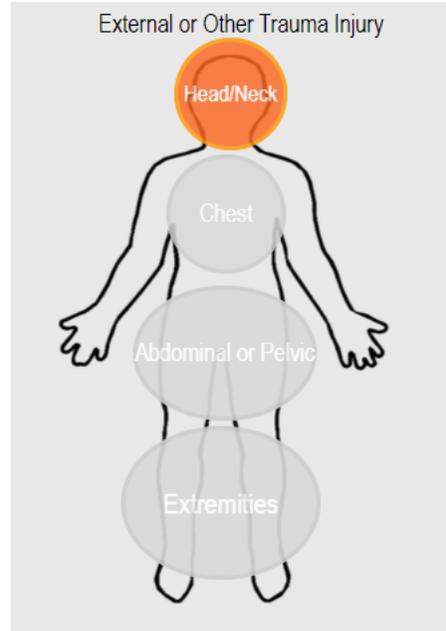
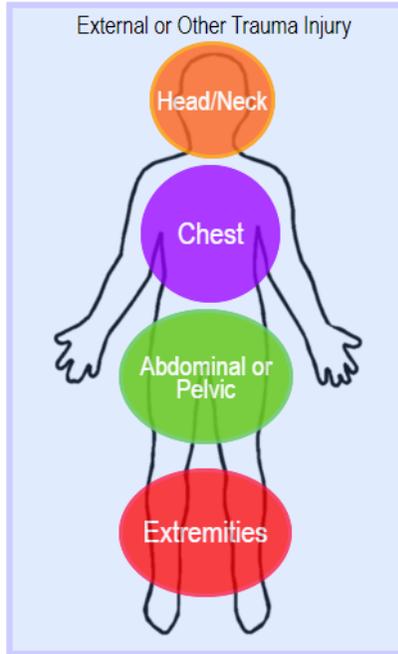
# Usability Testing

- Participants ( $N = 7$ )
  - Agency types: Rural PD, Rural SD, State Patrol, Metro PD with 7 years average experience
- Asked to describe current methods for determining injury level
  - Most reported low confidence in decision making
  - Several reported inaccurate decision heuristics including:
    - A = All “messed” up
    - Injuries are either A or C (never report Bs)
    - Broken bones = B

# Revised Prototype 2

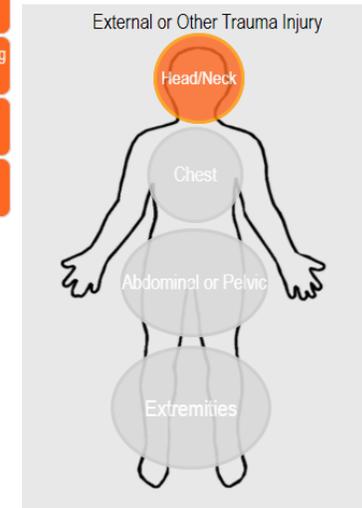
Click Area of Injury

Complaint of Pain  
No wounds or injuries  
readily available



Select the Observable Injury

- Unconsciousness when taken from the crash scene (breathing but not awake and not talking)
- Severe laceration resulting in exposure of underlying tissues/muscle/organs or significant loss of blood
- Suspected skull injury other than bruises or minor lacerations
- Confused or acts irrational or unusual
- Bulging eyes or veins popping in neck
- Lump on head
- Minor laceration (cut on skin surface with minimal bleeding and no exposure of deeper muscle tissue or bone)
- Momentary loss of consciousness
- Claim of Injury



Observable Injury

Suspected skull injury other than bruises or minor lacerations

**Injury Severity: Suspected Serious Injury (A)**  
A suspected serious injury is any injury other than fatal.

Submit Injury Status

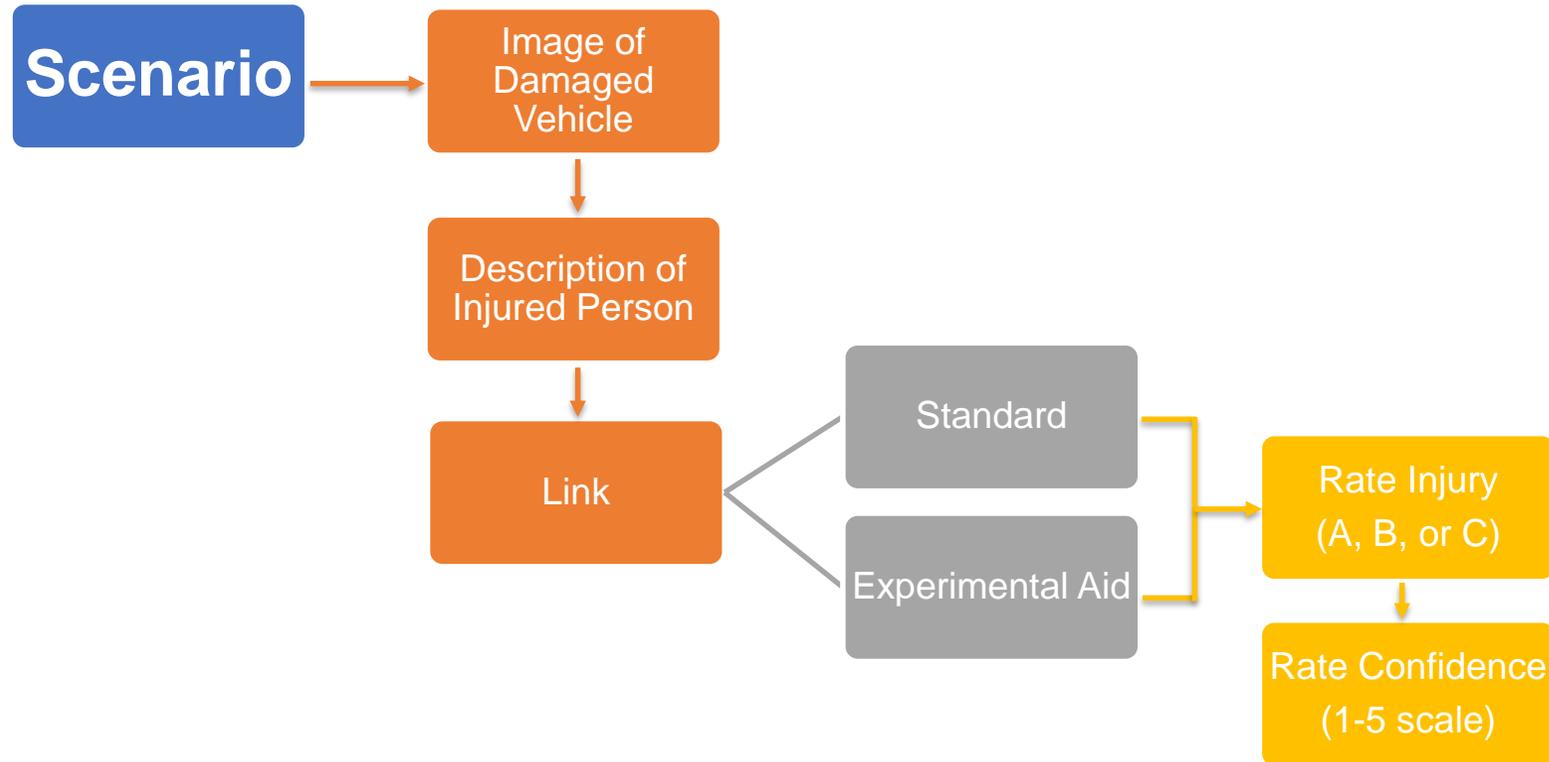
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# Testing Decision Aid Efficacy

- Conducted an online survey to test injury severity accuracy and confidence with the decision aid compared to a standard information list
- Participants: Minnesota Law Enforcement Officers ( $N = 386$ )
  - 115 agencies participated across Minnesota
  - Average crash reporting experience
    - 13.02 years ( $SD = 8.02$ )
  - Majority reported weekly-monthly crash reporting experience

# Injury Severity Decision Aid Study Method



# Injury Severity Scenarios



## Suspected Serious Injury

A middle-aged male driver had no apparent broken bones or cuts but was unresponsive when taken from the scene by an ambulance. The vehicle was drivable.



## Suspected Minor Injury

An 18-year-old female driver had road rash on her arms, legs, and hip from a moped crash. The driver claimed she was on her way to the lake to meet her friends to watch fireworks. The driver was hysterical and left the scene in an ambulance.



## Possible Injury

A male driver in his early 40's had no visible injuries at the scene of the crash. The driver failed to remember the crash and claimed to have "came to" as the officer arrived at the scene. The vehicle was not towed, and no airbags were deployed. Possible suspected alcohol use.

# Standard and Experimental Decision Aids

- Standard Decision Aid

**Injury Severity**

- Suspected Serious Injury (A): A suspected serious injury is any injury other than fatal which results in one or more of the following:  
Severe laceration resulting in exposure of underlying tissues/muscle/organs or resulting in significant loss of blood  
Broken or distorted extremity (arm or leg)  
Crush injuries  
Suspected skull, chest or abdominal injury other than bruises or minor lacerations  
Significant burns (second and third degree burns over 10% or more of the body)  
Unconsciousness when taken from the crash scene  
Paralysis
- Suspected Minor Injury (B): A minor injury is any injury that is evident at the scene of the crash, other than fatal or serious injuries. Examples include lump on the head, abrasions, bruises, minor lacerations (cuts on the skin surface with minimal bleeding and no exposure of deeper tissue/muscle).
- Possible Injury (C): A possible injury is any injury reported or claimed which is not a fatal, suspected serious or suspected minor injury. Examples include momentary loss of consciousness, claim of injury, limping, or complaint of pain or nausea. Possible injuries are those which are reported by the person or are indicated by his/her behavior, but no wounds or injuries are readily evident.
- No Apparent Injury (O): No apparent injury is a situation where there is no reason to believe that the person received any bodily harm from the motor vehicle crash. There is no physical evidence of injury and the person does not report any change in normal function.

- Experimental Decision Aid

Click Area of Injury

External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

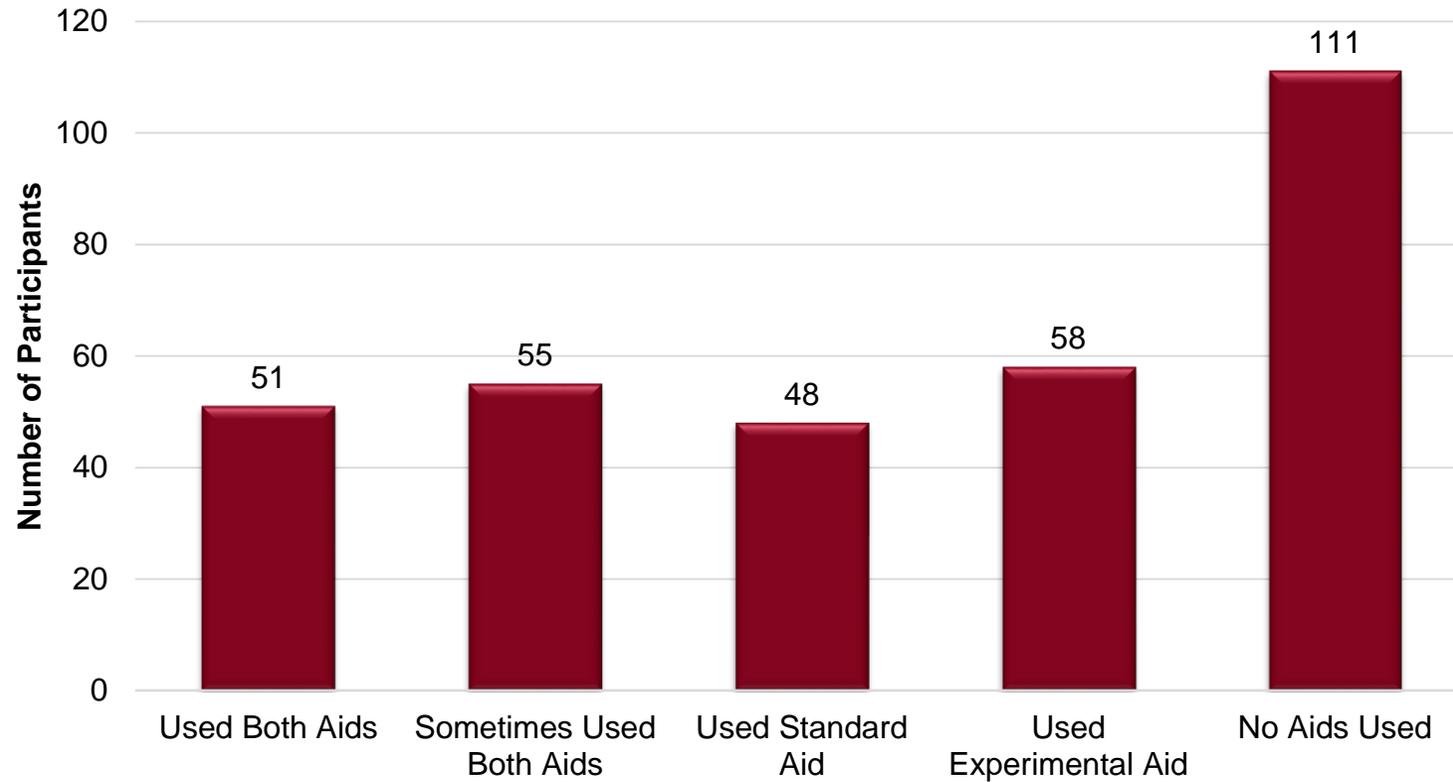
Extremities

Complaint of Pain  
No wounds or injuries  
readily available

Close

# Injury Severity Decision Aid Study Results

- Participant reported use of decision aids to complete survey



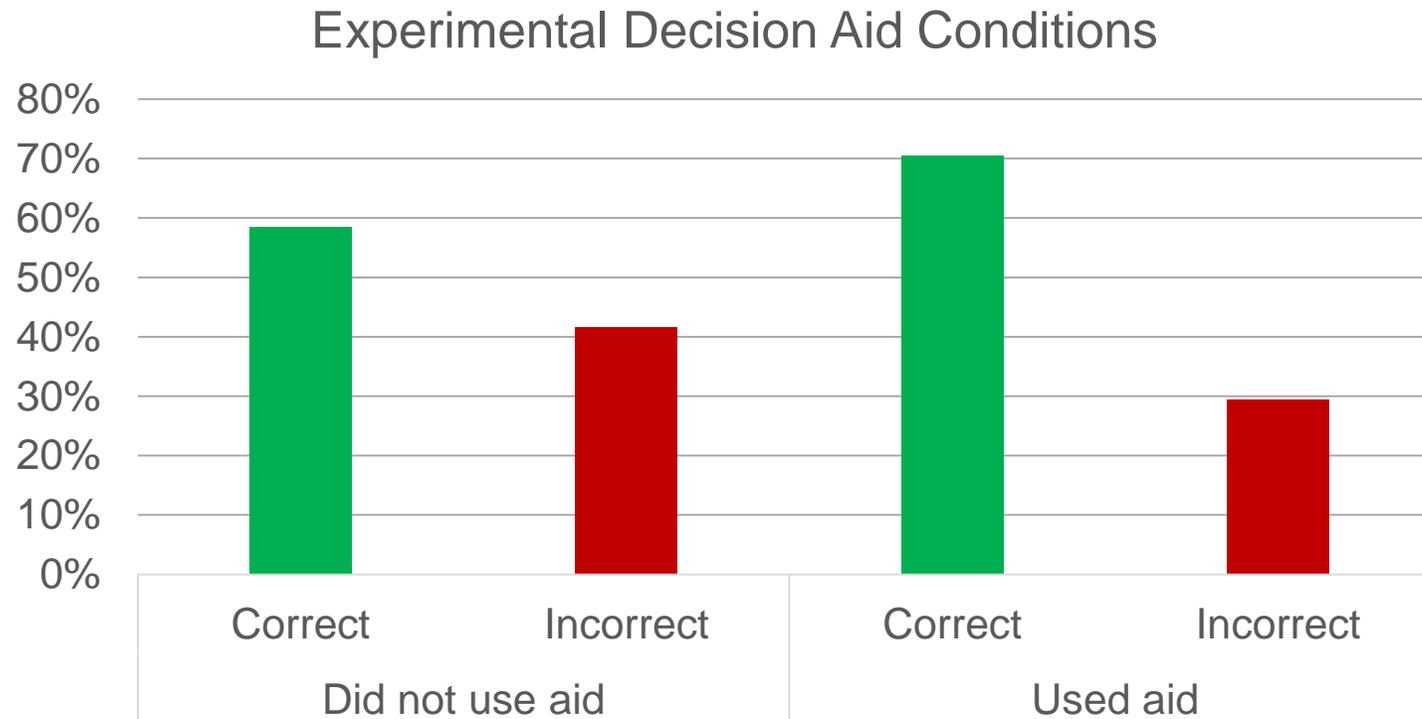
# Injury Severity Decision Aid Study Results

## Accuracy and Confidence by Scenario

	Accuracy		Confidence	
	Standard	Experimental	Standard	Experimental
A-1		✓	✓	
A-2		✓		✓
B-1		✓	✓	
B-2	✓		✓	
C-1		✓		✓
C-2		✓		✓

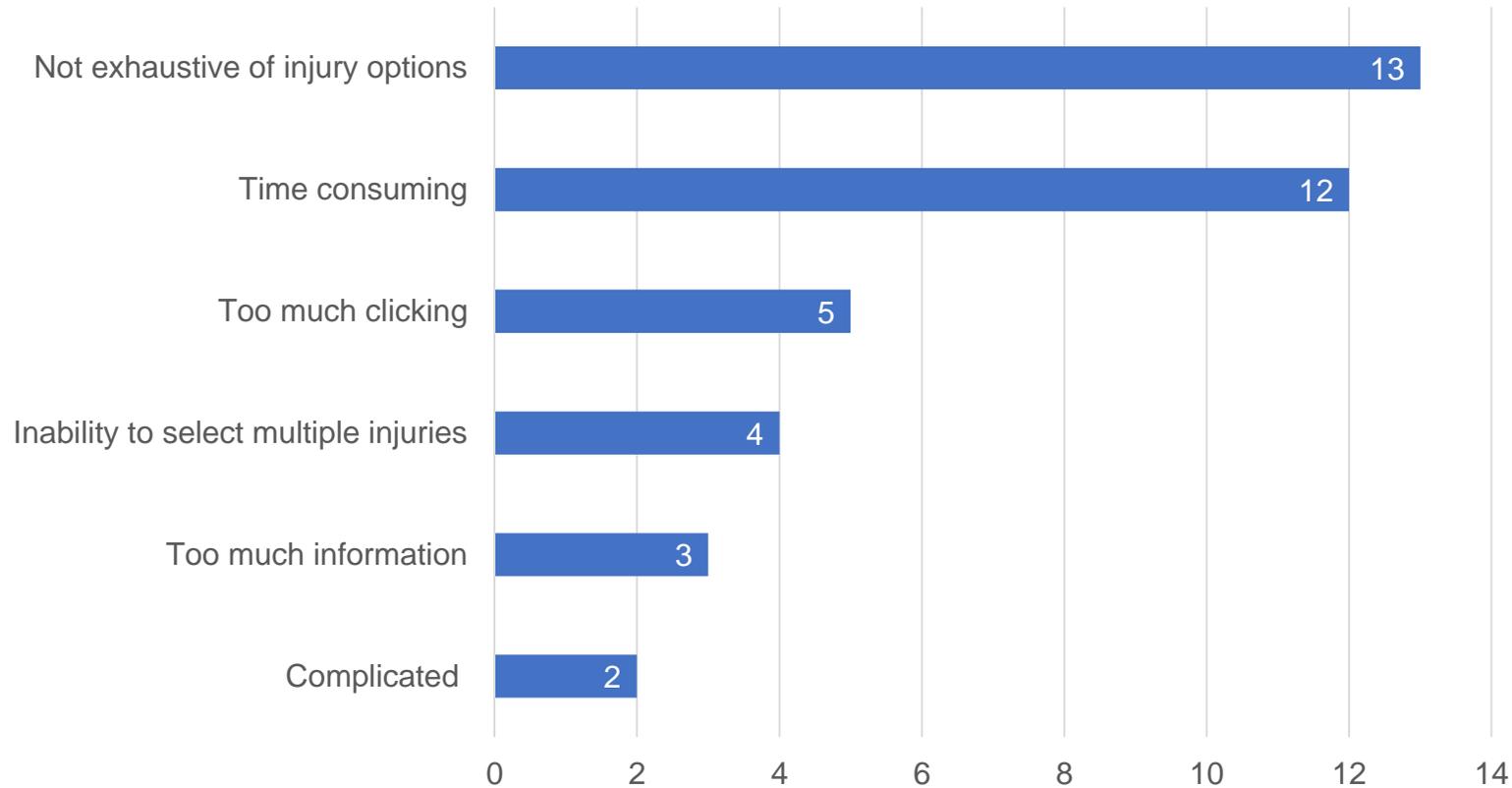
# Injury Severity Decision Aid Study Results

- Chi-square analysis conducted found a no significant relationship between decision aid use and accuracy for the standard aid:  $p = .459$
- Chi-square analysis conducted found a significant relationship between decision aid use and accuracy for the experimental aid:  $\chi^2(1) = 10.21, p < .05$



# Qualitative Feedback for Experimental Decision Aid

- Dislikes about experimental decision aid ( $N = 39$ )



# Strong support for the use of injury severity decision aid tool

- Use of any decision aid tool can increase accuracy in injury severity reporting
- New tool perceived as extremely easy to use and very helpful
  - May increase accuracy when determining injury severity levels compared to standard information list
  - Experimental aid may be particularly useful in reporting certain levels of injury that are typically misreported (i.e., suspected serious injury, possible injury)
- Objective tool to increase officer confidence may ultimately lead to increased injury severity reporting accuracy

# Expanded National Testing

- Conducted testing with  $N = 198$  law enforcement officers
  - $n = 164$  – Louisiana
  - $n = 3$  – South Dakota, North Carolina, West Virginia
  - $n = 31$  – Unknown
- Participants had an average of 15.14 ( $SD = 8.75$ ) years of law enforcement experience
  - Majority documented crashes on a daily (53%) or weekly (21%) basis



# National Study Results

- Law enforcement officers were more likely to make the correct injury severity judgment if they used one of the decision aids
  - $B = .469$  ( $SE = .176$ ),  $p < .01$
- Severe injuries were less likely to be judged accurately
  - A. Suspected Serious Injury – Least accurate
  - B. Suspected Minor Injury – Most accurate
  - C. Possible Injury – Moderately accurate

# Decision Aids Improve Crash Injury Severity Selection

- Accurate injury severity data is a vital tool in improving roadway safety
- Using decision aids can improve accuracy of injury severity information
- The experimental tool created by the HumanFIRST lab offers promise to
  - Improve accuracy
  - Boost confidence
  - Capture additional injury information with ease
- Future work should compare injury data pre- and post-decision aid deployment to validate research findings

# Thank you!

Contact

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