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**Minnesota MNCrash Design and Training
Research Development**

Final Report

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- Clara City Police Department
- Clearwater County Sheriff's Office
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- Slayton Police Department
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LIST OF ABBREVIATIONS

DPS OTS: Department of Public Safety Office of Traffic Safety

M: Mean

MMUCC 5: Model Minimum Uniform Crash Criteria, Fifth Edition

MNCrash: Minnesota Crash Reporting System

MnDPS: Minnesota Department of Public Safety

SD: Standard Deviation

EXECUTIVE SUMMARY

The purpose of the research activities completed in this report focused on improving data accuracy and data completeness in the MNCrash report through a series of usability tests, design recommendations, and training opportunities. First, usability testing was conducted on the existing MNCrash interface system to document errors, frustration, or confusion points that could be addressed through iterative design or training. Next, recommendations were made for the redesign of the MNCrash user interface to improve efficiency, reduce error, and increase user satisfaction. To follow, an injury severity decision aid prototype was developed through an interactive design process and then evaluated to determine whether the prototype could increase accuracy in crash reporting when determining injury severity level. And finally, complementary training was developed to improve officer knowledge of best practices for data entry and to address knowledge gaps to increase accuracy and completeness in crash reporting.

A commonly documented issue in police crash reporting is that of reporting accuracy and data completion. As a result, the crash data used in safety analyses often contain erroneous or missing information (Imprialou & Quddus, 2019). One approach to reducing the number of errors in crash reporting may be through good design. Careful design is one that prevents a problem from occurring in the first place (Nielsen, 2005). For this reason, the researchers sought to identify existing issues through a series of usability tests within the MNCrash system, provide recommendations for improvement, and determine whether any remaining issues could be improved through supplemental training.

The purpose of these research activities was to address usability issues through user testing and iterative design to improve the MNCrash system to help Minnesota remain a leader in crash data collection. A series of usability tests with MNCrash users was conducted to document common errors, frustrations, or confusion points that could be improved through iterative design or training. Findings revealed that missing data errors in the crash report were often a result of a failure to input known information into fields or misunderstandings about what information was needed for specific fields.

For this reason, the researchers provided design recommendations to improve data accuracy and completion. The design recommendations were made to reduce errors, increase efficiency, reduce frustration, and improve user satisfaction. Furthermore, the improvements to the system were made to reach a wider audience of users and experience levels. The implemented changes were tested to determine whether any final changes were necessary. The outcome of the research resulted in the implementation of the majority of the recommended design changes to increase efficiency, reduce frustration, and improve overall data accuracy and completion within the MNCrash report.

Similarly, crash reporting errors may be a result of the misclassification of injury severity, whereby injuries are either overestimated or underestimated by law enforcement officers. Various levels of non-fatal injuries (e.g., suspected serious injury, possible injury) are often misclassified (Farmer, 2003). Thus, the researchers sought to develop an interactive and visual injury severity decision aid tool that is user-friendly and useful for determining the level of injury severity in the crash report. Initial prototypes were developed to allow officers to click areas of a body diagram to select from a reduced list of injuries, each

leading to the MMUCC 5 defined injury severity level. User-centered evaluations reveal a final injury severity decision aid prototype that received high user satisfaction.

Following the iterative design process, an experimental study was conducted to test the injury severity decision aid efficacy through an online survey. The goal was to determine whether the injury severity decision aid prototype had measurable effects in increasing injury severity reporting accuracy and could improve officer reporting confidence. In total, 386 participants from 115 agencies across Minnesota completed the study. Officers were asked to review six crash scenarios and rate the level of injury using the experimental injury severity decision aid or a standard information list, their confidence in each decision, and demographic information. They were also asked to provide feedback on the experimental decision aid prototype.

There was a significant main effect of using a decision aid on accuracy, $F(1, 320) = 5.86, p < .05$, suggesting that the use of a decision aid resulted in greater accuracy than not using a decision aid. Participants also made slightly more accurate decisions using the experimental decision aid ($M = 2.22, SD = .71$) compared to the standard information list ($M = 2.10, SD = .86$). There was a significant main effect for the injury severity level on confidence levels $F(5, 630) = 4.30, p < .05$. There was a significant interaction between injury type and aid used on confidence, $F(5, 630) = 2.54, p < .05$. The experimental decision aid showed higher confidence scores for injury severity scenarios A2 and C2, while the standard decision aid showed higher confidence scores for injury severity scenarios A1, B1, and B2. Participants indicated a strong/positive likelihood that they would use this tool if implemented in the MNCrash report ($M = 3.57, SD = 1.19$).

Qualitative feedback suggested that the decision aid was easy to use, visually appealing, and provided clear explanations of injury levels. The findings suggest that the decision aid may be a useful tool for increasing injury severity reporting accuracy, particularly for injuries commonly misreported in crash reports (i.e., Suspected Serious Injury, Possible Injury). The outcome of the study was that the injury severity decision aid prototype received high-level support for the use of the tool and produced good usability and user satisfaction.

Although the primary focus of the research activities aimed to reduce errors through user-centered design, there was also a need to give officers a better understanding of the necessity for more accurate and complete data within the crash report. As a result, the final research activity focused on the development of a MNCrash training that was designed and driven by user-centered evaluation. The goal was to develop a training that would serve as a supplemental training tool for law enforcement officers to improve data reporting and accuracy in the MNCrash report. Initial topic areas were identified by observing weaknesses in the officer training (i.e., errors, reported confusion, or frustration) and through expert contributions (i.e., DPS OTS staff and law enforcement trainers). Initial topic areas were segmented into brief training modules and quizzes. The training was created in Rise360, an online e-learning platform.

Effective e-learning systems should include sophisticated and advanced functions, yet their interface should hide their complexity, providing an easy and flexible interaction suited to catch the user's

interest (Ardito et al., 2004). As such, several design changes were made throughout the testing process to improve the quality of the content as well as the usability of the training. Usability testing and iterative design processes were conducted with seven law enforcement participants and eight crash reporting experts to evaluate whether the researchers had correctly understood user requirements and properly incorporated them into the training. The final design included a welcome module (i.e., general instructions, expectations, and resources), eight core modules with eight quizzes, and a concluding module to reinforce key points.

Overall, there were minimal frustrations and concerns reported while using the MNCrash training. Participants reported the training was extremely easy to use, very helpful, and would be applicable to law enforcement officers of all experience levels (i.e., novice to senior officers) as well as for those who do not enter a lot of crash reports. The mean System Usability Score (SUS) was 91.5 ($SD = 4.87$), suggesting high user satisfaction. The outcome of the research resulted in a comprehensive MNCrash training that produced good usability and user satisfaction from users and expert reviews. The training was recommended for implementation.

CHAPTER 1: INTRODUCTION

The analysis of highway-crash data has long been used as a basis for influencing highway and vehicle designs, as well as directing and implementing a variety of regulatory policies aimed at improving safety (Mannering & Bhat, 2014). However, the crash data used in safety analyses often contain erroneous or missing information (Imprialou & Quddus, 2019). Consequently, the reporting bias in police-reported crash data can mislead public road safety policy measures (Abay, 2015). Errors in recording crash data may be due to factors responsible for the occurrence of a crash (e.g., the environment, driver characteristics). Therefore, it is extremely important to motivate personnel responsible for crash data collection to record all information as correctly as possible (Ahmed, Sadullah, & Yahya, 2019).

The path toward quality data is through that of quality design. Careful design is one that prevents a problem from occurring in the first place (Nielsen, 2005). Even though users will always make some mistakes when using software, it is possible to reduce overall errors by designing with the user's experience in mind (Laubheimer, 2015). For this reason, the purpose of the research activities is to address usability issues through user-testing and iterative design to improve the MNCrash system to help Minnesota remain a leader in crash data collection. The first research activities focus on identifying areas of improvement in the MNCrash user interface through a series of usability tests conducted with MNCrash users to document common errors, frustrations, and confusion points to be improved through iterative design and training. The identified issues are then evaluated based on priority and design recommendations are developed based on criteria to improve data accuracy and crash report completion. The majority of the recommended design changes are implemented to increase efficiency, reduce frustration, and improve the overall data accuracy and data completion within the MNCrash user interface.

Similarly, crash reporting errors occur due to the misclassification of injury severity by law enforcement officers. Various levels of nonfatal injuries are often misclassified and under certain crash circumstances, errors are more frequent (Farmer, 2003). Police injury coding may be misclassified such that injuries are either overestimated (e.g., coding an injury as incapacitating when it was only a minor injury) or missed by police altogether (Sherman et al., 1976; Popkin et al., 1991). For example, crashes with less severe injuries are less likely to appear in crash databases, as they are simply not recorded by police (Schlögl & Stütz, 2019). Improving the accuracy of crash severity ratings on crash records is of vital importance to state transportation agencies (Burdett, Li, Bill, & Noyce, 2015).

Thus, the next research activity focuses on the development of an interactive injury severity decision aid tool that is user-friendly and useful for determining the level of injury severity in the crash report. User-centered design is based on the active involvement of users to improve the understanding of the user and task requirements and is widely considered the key to product usefulness and usability (Mao, Vredenburg, Smith, & Carey, 2005). Initial prototypes are then developed to allow officers to click areas of a body diagram to select from a reduced list of injuries, each leading to the MMUCC 5 defined injury severity level. User-centered evaluations reveal a final injury severity decision aid prototype that received high user satisfaction. Following the iterative design process, an experimental study examines

whether the prototype has measurable effects in increasing injury severity reporting accuracy and officer confidence. The findings from the experimental study reveal that the decision aid increased accuracy in injury severity reporting and is particularly useful for increasing accuracy in injury levels commonly misclassified by law enforcement officers.

Although many usability issues can be addressed through re-design and iterative testing, there were certain identified issues that required more extensive training and expansion to better improve the quality of data within the crash report. Therefore, an electronic training tool was developed to address knowledge gaps and serve as a training tool to better inform officers on the importance and usefulness of the crash report being accurate and detailed. Employee training has become an effective way to enhance organizational productivity (Wan, Compeau, & Haggerty, 2012) and has been effective in changing employee behavior and positively influencing organizational outcomes (DeRouin, Fritzsche, & Salas, 2005). As an organizational training medium, e-learning can be a powerful and effective training tool that offers learners accessibility and control over their learning as well as the opportunity to receive information in various formats (DeRouin, Fritzsche, & Salas, 2005). Additionally, through the use of e-learning organizations can deliver training consistently to all employees, update content when necessary and reduce travel costs outside of facilities (Burgess & Russell, 2003).

A mock-up of a MNCrash training was developed on Rise360, an e-learning platform. Iterative design and usability testing were conducted on the MNCrash training with law enforcement officers and crash reporting experts. The final design consisted of an introductory module, eight core training modules with eight quizzes, and a concluding module. Overall, the training produced good usability and user satisfaction. The training was recommended for implementation.

CHAPTER 2: MNCRASH USABILITY AND TRAINING OPPORTUNITIES

2.1 INTRODUCTION

This chapter summarizes the investigation of the MNCrash user interface to identify areas within the user interface that needed improvement. A series of usability tests with MNCrash users was conducted to document common errors, frustrations, or confusion points that could be improved through iterative design or training. The outcome of these activities was expected to help determine areas for immediate improvements to the crash report interface or to indicate areas that should be re-designed and tested to ensure the intended outcome is achieved.

The usability test included two main crash scenarios and allowed users to input the data into the interface of their choosing (i.e., form or wizard). The findings of the usability test predominantly included problems relating to detail and efficiency. Overall, the crash report took users 5 to 20 minutes to complete, generally dependent on the users' familiarity with the report. Recommendations were based on the research team's qualitative comparative analyses of the form and narrative information, detailed in Chapters 2 and 3, as well as feedback from interviews with multiple state employees that regularly read and analyze crash reports. Many suggestions to the report were relatively simple and implementable, while others required structural changes to internal policy or connectivity to other systems/databases. These recommendations detail means of improving the input of data at the form level through alterations to the reporting system's interface.

2.2 USABILITY TESTING

2.2.1 Participants

A recruitment goal for this test was to include law enforcement agencies that were not included or under-represented in past usability testing during the initial crash report interface design.

A total of six law enforcement officers were recruited from four separate law enforcement agencies: Metro Transit Police Department, Coon Rapids Police Department, Minnesota State Patrol, and Saint Paul Police Department (see Table 2.1). Inclement weather caused the scheduled flight to Detroit Lakes to be canceled and ultimately the usability testing session was canceled. The research team did collect some feedback over the phone from MNCrash users from Detroit Lakes Police Department to include any pressing thoughts or frustrations in the findings. The participants in this study varied in rank and years of experience in crash reporting (see Table 2.2 and Table 2.3).

Table 2.1 Recruited agencies

Agencies	N
Metro Transit Police Department	2
Coon Rapids Police Department	2
Saint Paul Police Department	1
Minnesota State Patrol	1
Detroit Lakes Police Department	1
TOTAL	7

Note: Number of usability testing participants (N) by agency

Table 2.2 Law Enforcement Rank

Rank	N
Patrol Officer	4
K-9 Officer	1
State Trooper	1
TOTAL	6

Table 2.3 Reporting years of experience

Crash Reporting Experience	N
0-5	2
6-10	7
11+	2
Average	8.5

2.2.1.1 Materials

The usability testing utilized both the wizard and form-based MNCrash interfaces on officers' computers/laptops. Audio and video recordings were kept for note-taking purposes. Participants were provided with two mock-crash scenarios (see Appendix A) which served as scripts and general outlines that guided them through the interface, while they explored the elements and discussed their specific needs and requirements under different contexts.

2.2.2 Method

Law enforcement participants met with researchers at their home stations and in one case, a participant met the research team on the University of Minnesota-Twin Cities Campus. Law enforcement participants spent approximately 30 minutes with each scenario. Sessions lasted approximately 70 minutes in total. Participants were provided a brief background of the purpose of their feedback/input and the goal of the research. Next, participants were asked to enter information about a 2-unit intersection crash that resulted in one of the vehicles running off the road (see Appendix A). The second crash participants entered information regarding a single unit with a passenger that ran off the road resulting in a fatality (see Appendix A). For both scenarios, some information was purposefully vague or

left out to allow the participants to use intersections and roads that were familiar to them, ensuring that the information being asked for was accessible and natural to their typical processes. Participants were asked to review the crash details before beginning and were allowed to review the document for their reference but could also ask researchers questions regarding the crash.

Participants were encouraged to “think aloud” as they navigated through the interface, noting the features which might seem confusing, what they liked or disliked, etc., and were prompted by researchers to clarify any ambiguities. Typically, the report took 20 to 40 minutes to complete. The testing was followed by some overall interview questions regarding their typical completion time for entering a report and any other impressions of the interface.

2.3 RESULTS

2.3.1 Overall Preference

Within this test sample, there was a preference for the wizard interface over the form interface. Approximately 60% (i.e., 4 of 6 users) preferred or commonly used the wizard over the form. One user had recently switched use to the wizard, Metro Transit exclusively uses the wizards, and although it appears to be policy to use the form within Minnesota State Patrol, the trooper tested used the wizard. Although, it is worth noting that some officers could not see a pronounced difference between the form and wizard. Moreover, similar problems existed in both models.

Participants reported that a typical crash report takes approximately 10 minutes to complete. Two officers reported 5-10 minutes, as the fastest reporting, and one officer reported 15-20 minutes, as the slowest reporting indicated. Notably, the duration measured in the early testing of the MNCrash prototype was approximately 15 minutes.

2.3.2 Summary of Issues Raised

There were multiple aspects of the interface that were deemed problematic or confusing by participants. The compilation of issues raised have been discussed in detail in Appendix B. The following list contains significant issues that warrant attention and is by no means exhaustive. In general, the main sections brought to the researchers’ attention were:

- After selecting that alcohol was not suspected, officers still had to fill out whether or not tests were administered
- Estimating monetary damage is too variable and often leads officers to guess conservatively in order to avoid filling out other reports
- The options for *Location Relative to Trafficway* are not clear enough to know the differences between them
- Being unaware of hyperlinks embedded in text throughout the interface
- The use of 5-minute increments drop-down bars for time pertaining to the crash and EMS is contradictory to wanting more precise timelines

- Organizational and expectation issues for providing some information that may be based on assumptions or less than provable observations

2.3.2.1 Alcohol Not Suspected

When officers indicate that alcohol was not suspected, they are still prompted with the question of whether or not tests were administered (see Figure 2.1). Many officers found this frustrating and redundant. This is a complicated issue because some police departments (e.g., Metro Transit Police Department) are required to test for alcohol for crashes that result in major injuries or fatalities, even if alcohol is not suspected.

Figure 2.1 Screenshot of Alcohol/Drug Suspicion sequence of questions when alcohol is not suspected

Possible actions:

1. Autofill *Alcohol Test* to “Test Not Given” when *Suspect Alcohol* is “No”, which will still allow officers to indicate alternative answers in rare circumstances that a test is still administered.
2. Create an administrative function that would allow law enforcement agencies to opt-out of the feature as it exists now, so that when no alcohol is suspected, they are not prompted with more questions (i.e., the question is skipped and the answer is defaulted to Test Not Given”).
3. Get rid of the question completely. Only ask whether alcohol was tested for.

2.3.2.2 Damage Amount

When officers are asked to estimate private and public property damage, many participants stated that they would guess lower amounts to avoid filling out the MNCrash report, which, in some instances, would take longer than the in-house report. Some participants even described entering “unknown” as a typical default answer because of how hard it is to estimate damage costs.

Possible actions:

- a. Create a decision aid to assist officers in determining damage amount and subsequently selecting damage severity
- b. Offer training to better educate officers on damage estimation techniques and ultimately the importance of crash reporting to help avoid “side-stepping” the report

2.3.2.3 Location Relative to Trafficway

Many participants expressed their confusion regarding the options given for *Location Relative to Trafficway*. Specifically, the differences between “on roadside” and “outside of trafficway” seem too closely related to discern easily (see Figure 2.2). For the option “non-trafficway”, there is also confusion about what falls under this category. Having so many options closely related can make it more difficult

to choose the correct one. This concern highlighted a noticed issue with officers being unaware of embedded help boxes within text hyperlinks. Several officers noted that they did not know that the blue text on dropdown menu labels were hyperlinks containing additional information about the question at hand. Notably, the current design of the hyperlinks included blue text, but not an underline, which is a typical design affordance to support users' expectations for hyperlink presence and reduced the need for learning or cognitive load (Still & Dark, 2013).

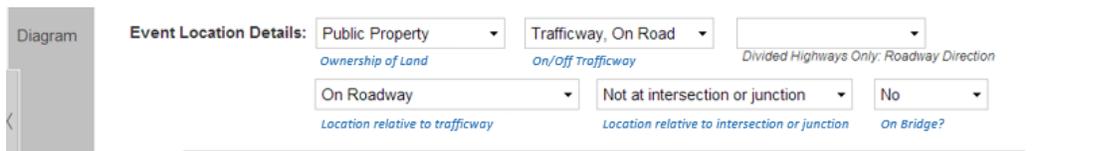
The image shows a screenshot of a web form titled "Event Location Details". It contains several dropdown menus with blue text labels below them. The first row has three dropdowns: "Public Property" (with label "Ownership of Land"), "Trafficway, On Road" (with label "On/Off Trafficway"), and an empty dropdown (with label "Divided Highways Only: Roadway Direction"). The second row has three dropdowns: "On Roadway" (with label "Location relative to trafficway"), "Not at intersection or junction" (with label "Location relative to intersection or junction"), and "No" (with label "On Bridge?").

Figure 2.2 Screenshot of trafficway questions sequence

Possible actions:

- a. Inside the descriptors, pictures could be added to clarify any questions about the definitions
- b. Change hyperlink appearance to include a blue underline to match user expectancies for hyperlink presence
- c. Add hyperlink educational information to future training materials

2.3.2.4 Timestamp

When filling out the crash time, EMS call time, arrival at the scene of the crash, and arrival at the hospital, the dropdown menu options are in 5-minute intervals and no minute-by-minute options are presented. It is possible to enter a specific time not offered in the dropdown menu; however, if the user presses "enter" or "return" on the keyboard the entry is rounded to the nearest menu option. The specific time entry is only maintained if the user clicks out of the entry field, rather than pressing "enter". Not all users know this "trick", and the rounding default may not be even noticed by some users. Overall, this creates a problem for collecting accurate time information about crashes, particularly for fatal crashes where time arrival is critical for our understanding of crash survivability.

Possible actions:

- a. Fix rounding function when users press "enter" after manually typing in time into the field
- b. Remove dropdown menu and allow only manual time entry

2.3.2.5 Expectations for Data Accuracy and Completeness

An important and consistent topic raised by officers was related to their uncertainty and discomfort in entering information of which they cannot verify. This uncertainty and discomfort were often cited when discussing variables such as speed, distraction, and seat belt use. Moreover, some officers seemed to be under the impression that there were multiple "catch points" in the later process if the information was left blank, listed as "unknown", or was incorrect. Some officers felt that any "important" information would be followed-up by someone else or would be superseded by a crash investigation.

2.3.2.6 Speed

Participants reported that estimating speeding or travel speed is difficult to do when not witnessing the crash. Multiple participants mentioned that they almost always put down “not speeding” or “unknown” because they do not feel like they can definitively say if it occurred or not. It was a general feeling that if they did not fill out important speed information accurately, then Minnesota State Patrol or reconstruction will.

Possible actions:

- a. Use words to express that this is supposed to be an educated guess
- b. Include training on downstream data capture and how reconstruction information does not update the state crash report

2.3.2.7 Injury

An important observation was found related to problems with capturing injuries not requiring emergency transportation. Some officers reported that injury reporting might be low because some officers/agencies have to fill out a separate, internal report if there is an injury. This biases officers to omit minor to moderate injuries from the report and only record injured people that were taken from the scene by ambulance. If there is a possible injury or one that does not require an ambulance, it is also unlikely to be included in the injury count.

Possible actions:

- a. Address organizational concerns within agencies and determine if reporting redundancies can be supported through data output of the MNCrash report
- b. Educate users of the importance of crash reporting and the value of documenting even minor injuries

2.3.2.8 MnFILL Functions

When license information auto-fills through the MnFILL function, officers expressed frustration with being required to re-enter the phone number and sex of the person. Officers would like this to autofill like how the other information does. There is also some information officers have to put in manually that the system already has and should autofill.

Possible actions:

- a. Conduct in-house testing of MnFILL function with live data to ensure all features are working as intended
- b. Expand autofill capabilities to more fields within the person information fields

CHAPTER 3: MNCRASH REDESIGN

This chapter summarizes the iterative redesign and usability testing of the MNCrash interface system. Based on the previously identified issues within the MNCrash system, the researchers evaluated the issues based on priority and provided design recommendations to improve data accuracy and crash report completion. The researchers then tested the implemented changes to determine whether any final changes were necessary. The outcome of the research resulted in the implementation of the majority of the recommended design changes to increase efficiency, reduce frustration, and improve overall data accuracy and completion within the MNCrash report.

A commonly documented issue in police crash reporting is the issue of reporting accuracy and data completion. The types of errors made in crash reports may be those that do not require high levels of expertise to assess correctly, such as reporting driver age (Shinar, Treat, & McDonald, 1993). Other frequently misreported attributes include factors such as crash location, time, and severity (Imprialou & Quddus, 2019). Police reports are an important source of information on motor vehicle crashes, and although the data from these reports are useful for evaluating time trends in overall crash rates, they lack the precision necessary for more specific research (Farmer, 2003). Consequently, poor quality crash data can hinder or damage safety analysis and affect the evaluation and development of successful road safety interventions (Imprialou & Quddus, 2019). Therefore, there is a need for improved design of accident report forms (Shinar, Treat, & McDonald, 1993).

The ultimate goal of usability is meeting the needs of users' satisfaction (Nielsen, 1993). The goal of the research was to identify areas in need of improvement in the existing MNCrash system, evaluate the issues in terms of priority to provide recommended design changes to prevent error, reduce frustration and improve user satisfaction. Usable designs do not come from good intentions, but only through a usability process of testing and refinement (Grose, Jean-Pierre, Miller, & Goff, 1999).

To complement the interface design recommendations, the research team created a series of recommendations for training topic areas to improve officer knowledge of best practices for data entry and narrative composition. Most commonly observed errors were addressed in three infographics created for easy and impactful distribution to officers to not only help to educate them on tips and tricks for easy and accurate crash reporting, but also to dispel many myths or inaccurate understandings about crash data and its uses.

3.1.1 Identified Improvement Areas

In the previous chapter, the researchers conducted a detailed series of usability tests on the existing MNCrash user interface in order to identify areas in need of improvement. The testing included two crash scenarios that allowed users (i.e. police officers) to input the data into the form they chose (i.e. form/wizard). The report took users 5 to 20 minutes to complete, which implied a significant improvement over the original interface while still allowing room for improvement.

Therefore, several proposed changes to the current MNCrash interface were developed based on the feedback from previous usability tasks. The purpose was to identify specific problems, rank their criticality and importance for resolution, and to develop specific recommendations for addressing the concerns.

3.1.2 Criteria for Recommendation Priorities

The following criteria were used for determining priority for recommendations: 1) error reduction, 2) efficiency/time to complete, 3) ease of implementation, and 4) user satisfaction.

The first two criteria were important for the overall purpose of the crash reporting system, particularly the first criteria of error reduction. The first two criteria (i.e. error reduction and efficiency/time to complete) were assigned a higher weight when ordering. Recommendations were weighted as follows: Error reduction * 1.5, Efficiency * 1, Easy to Implement * 0.5, User Satisfaction * 0.5. Table 3.1 provides a sample of the design recommendations, problems, and criteria for the recommended changes suggested for MNCrash.

Table 3.1 Example of recommendations, problems and criteria for the recommended changes

Recommendation	Level/ Category	Problem	Reduce Error	Efficiency	Easy to Implement	User Satisfaction
Autofill "Alcohol test" to "Test Not Given" when "Suspect Alcohol" is "No".	Person Level	Redundancy		✓	✓	✓
For descriptors of options in "Location Relative to Trafficway", (1) add pictures to clarify, and (2) add underlines to hyperlinks	Crash Level	Officers confused about these options, and do not recognize hyperlinks	✓	✓		

The proposed changes for improvements addressed concerns raised by multiple officers during usability testing. A total of 62 usability problems were identified with recommendations classified in terms of priority, from greatest to smallest. The majority of issues were identified at the Unit Level (52%), followed by the Person Level (24%), Crash Level (17%), at multiple levels (5%), and in the fatality report (2%). The priority guidance was created to help MnDPS determine which changes should be made more immediately based on the criteria of the recommendation, implemented at a later date or disregarded due to their low priority nature, see Figure 3.1.

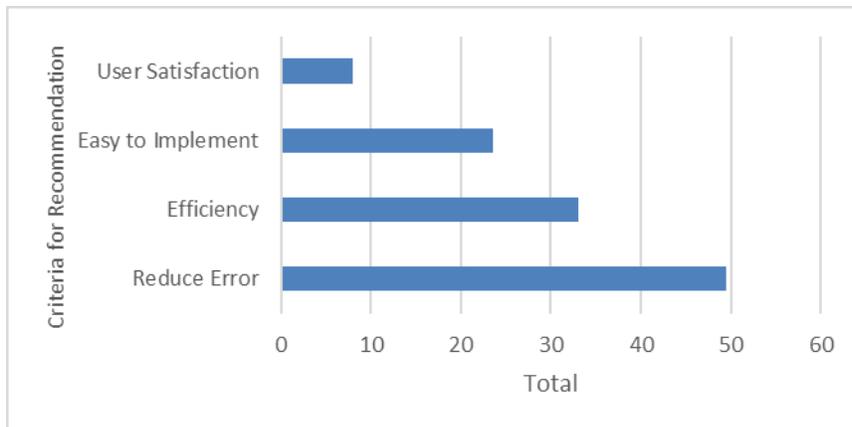


Figure 3.1 Frequencies of recommendation criteria for identified issues

3.2 TESTING AND ITERATIVE DESIGN

Iterative development of user interfaces involves steady refinement of the design based on user testing and other evaluation methods (Nielsen, 1993). The researchers integrated the results from usability testing conducted with seven law enforcement officers into detailed recommendations for improvements in the MNCrash system. The recommendations included screenshots, mock-ups, and specifications for improvements. Additionally, the proposed benefits for design recommendations were included in each addressed issue. Human factors design principles were applied to design recommendations based on previously identified recommendation criteria of error reduction, efficiency, ease of implantation and user satisfaction. Four problematic components of the crash report interface or process are highlighted below, each with corresponding human factors design recommendations. A comprehensive list of the suggested design recommendations submitted to MnDPS is listed in Appendix C.

3.2.1 Confusion with Initial Contact Point and All Damaged Areas

The MNCrash system included a new data entry query related to initial point of contact, in alignment with MMUCC 4th edition. This novel data query has a similar appearance to another updated multi-select widget for *All Damaged Areas* that was updated from the previous singular request of *Damage Location*. There were several problems related to confusion with the *Initial Point of Contact* and *All Damaged Areas* attributes at the unit level. The criteria for the following recommendations were based on error reduction, efficiency, and user satisfaction.

Officers expressed frustration with the *Initial Point of Contact* widget restricting their selection to one area when roll-over crashes typically involve an entire side of vehicle damaged; however, the first harmful event involving non-collisions (e.g., roll-over) should be selected in the side selection “non-collision”. This business rule is not well known and not supported through the design. The recommended modification to the interface should support this situation. This recommendation

included reordering the selection list with non-collision being listed first as well as the inclusion of additional information in the pop-up, see Figure 3.2.

Additionally, officers expressed frustration at the feeling of redundancy of completing both widgets and expressed desire to combine them. However, the feasibility of combining them may be problematic because the initial point of contact for the most harmful event may or may not involve damage to the vehicle. Instead, adding a more distinguishing text and features may help reinforce the different features of the two widgets and data entry fields. To address this need, recommendations included the addition of a label to the top of the pop-up to differentiate the *Initial Point of Contact* pop-up from the *All Damaged Areas* pop-up by labeling them using blue and red text, respectively. The current selection of the buttons on both widgets resulted in a blue appearance. It was recommended that the *All Damaged Areas* buttons give a red appearance when selected to both correspond with the text differentiation and help distinguish selecting initial contact (i.e., coded in blue) and damage (i.e., coded in red), see Figure 3.2 and Figure 3.3. Additionally, it was recommended to add an additional attribute of *Cargo Loss* to support the MMUCC 5th Edition Guidelines and to add a backend attribute of “Vehicle Not at Scene” for the *Hit and Run* vehicle attribute selected as “no information known about vehicle”. The benefits of implementing these recommended changes include improved accuracy of data entry for non-collision events, and reduced user frustration and uncertainty.

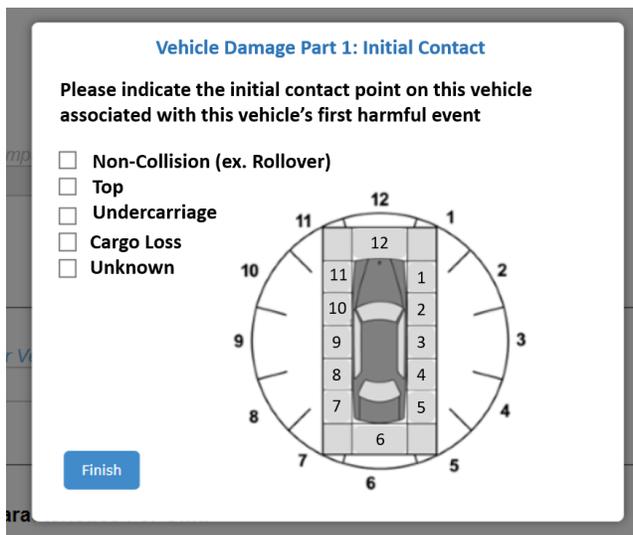


Figure 3.2 Modified screenshot of pop up widget for initial contact point with recommended changes

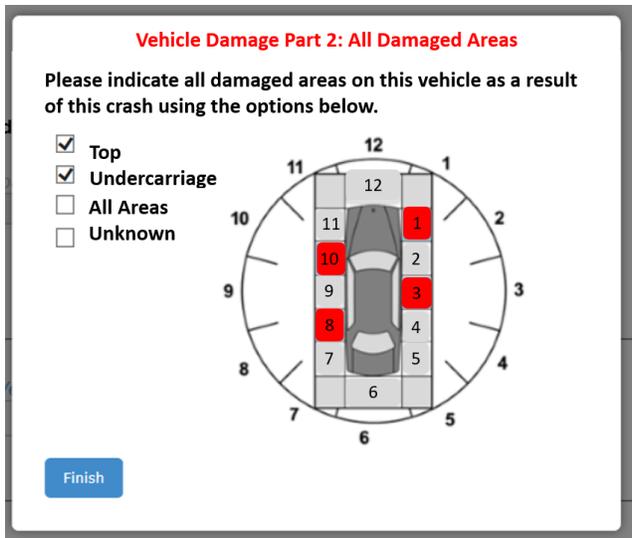


Figure 3.3 Screenshot of pop up widget for all damaged areas with recommended changes

3.2.2 Confusing Terms in Manner of Collision

Two problems were identified related to the Manner of Collision attribute at the Unit Level. First, the usability testing revealed that the familiarity of terms used in *Manner of Collision* is inconsistent for officers. Officers reported that there was no option for a “front to side” collision; however, this stemmed from a misunderstanding that the collision they are describing would be classified as “Angle”. This highlights a common human factors design issue in that a system should speak the users’ language, with words, phrases, and concepts familiar to the user (Nielsen, 2005). Although the “Angle” attribute was the appropriate selection for such a crash, this term does not match the language of other attributes (e.g., rear to side, rear to rear). Therefore, it was recommended that (ex. Front to Side) be added to “Angle” in the attributes list, see Figure 3.4. The benefits of these changes include improved accuracy of data entry and reduced user frustration.

Second, user testing also revealed that there was a general need for better visualization of the manner of collision categories. A modified version of MMUCC 5th edition figures for *Manner of Collision* was recommended to be added to the pop-up in the hyperlink to support officers’ decision making for this attribute, see Figure 3.5. The criteria for recommendation included error reduction and ease of implementation.

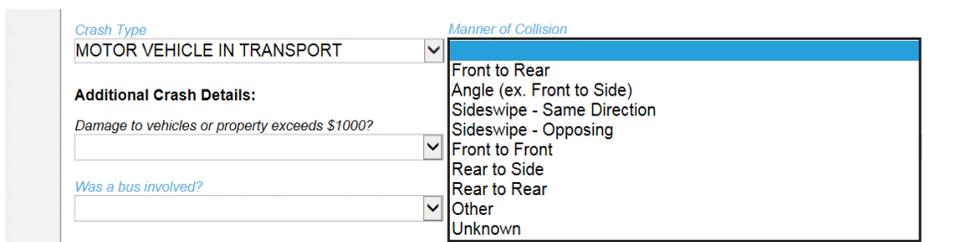


Figure 3.4 Screenshot of manner of collision drop down menu list of attribute with recommended changes

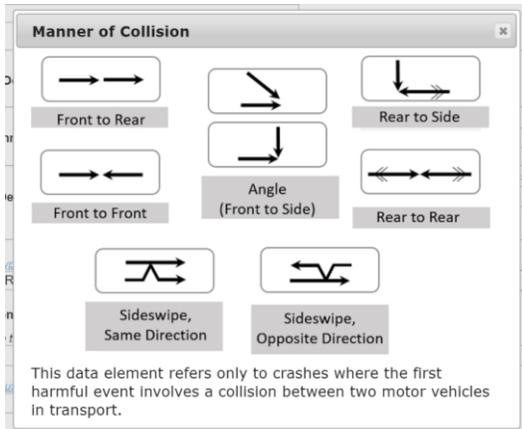


Figure 3.5 Screenshot of enhanced manner of collision pop-up information

3.2.3 Injury Severity Uncertainty

Officers expressed great uncertainty in their ability to correctly assess injured persons injury level and in the injury category definitions. The current hyperlink pop-up is wordy, cluttered, and difficult to read. There is no support for officers trying to determine if the question relates to the condition at the scene of the crash or final condition (e.g., dies at the hospital). Recommendations included an update to the information contained in the pop-up to be better organized and remove superfluous wording, along with adding a mention for which injury state officers should select (see Figure 3.6).

Additionally, it was recommended that the *Injury Severity* hyperlink be underlined and to include the HumanFIRST injury severity decision aid (see Chapter 4 and Appendix E for more details) with a green “Calculate injury” button following *Injury Severity*, Figure 3.7. The criterion for these recommendations were based on error reduction, efficiency, ease of implementation and user satisfaction. The benefits include increased data accuracy as well as decreased officer uncertainty or confusion when reporting injury severity.

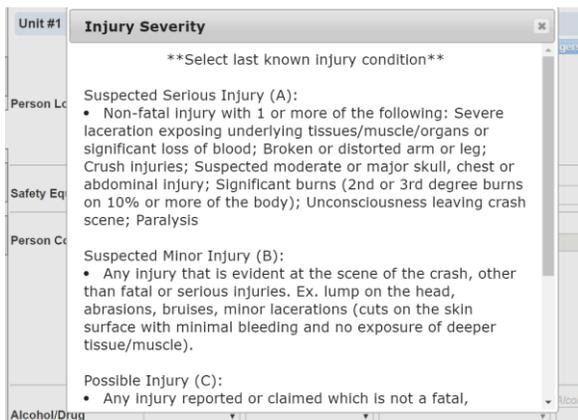


Figure 3.6 Screenshot of implemented enhancements to injury severity hyperlink pop-up

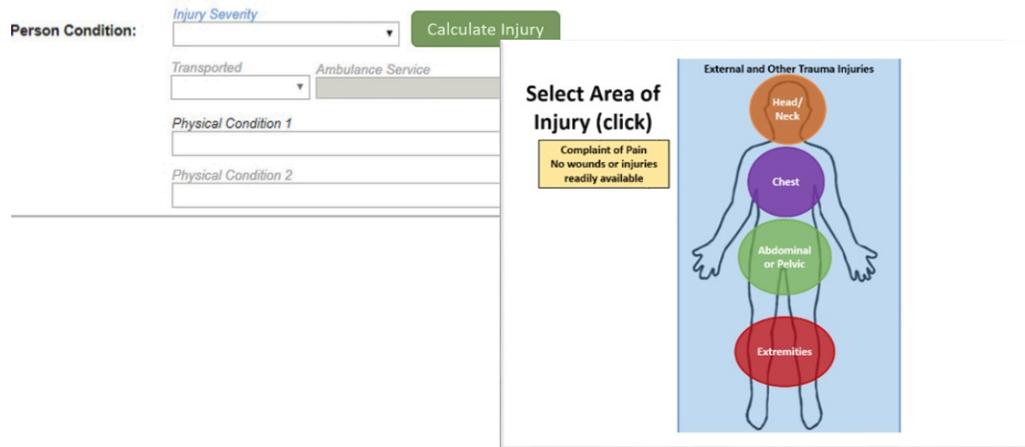


Figure 3.7 Modified screenshot of injury severity field with “Calculate Injury” button and fields moved down and first image screen of Injury Severity Tool

3.2.4 Mapping Limitations

Multiple frustrations were reported from officers regarding their use of the mapping function. Notably, this feature of the MNCrash system was one of the last to be developed in the original build of the system and did not receive user testing prior to the system release. An early frustration reported was that the map re-centered after location selection pop-up boxes were closed, making it difficult for the user to remember which map location they had just clicked. A recommendation was made to remove the re-center function after pop-up boxes are closed to ensure users can efficiently explore the map to find their desired location. The recommendation benefits improving efficiency/time to complete and improving user satisfaction.

Additionally, the mapping function within MNCrash allows officers the flexibility to indicate if the crash location is not available in the map (e.g. the road is too new to be presented) and manually enter the location of the crash. However, this system workaround does not allow the coordinates of the crash to be approximated to the level of detail that is desired. As a solution, the interface of the mapping function required a redesign to allow users to indicate whether the crash did not occur on the roadway or if the map is out of date, provide an approximate location on the map, then manually enter the location in the form fields. The multiple locations of the selectable features were assessed via heuristic evaluation by the research team and it was concluded that the design did not coincide with general principles of grouping heuristics or support typical visual search strategies, see Figure 3.8.

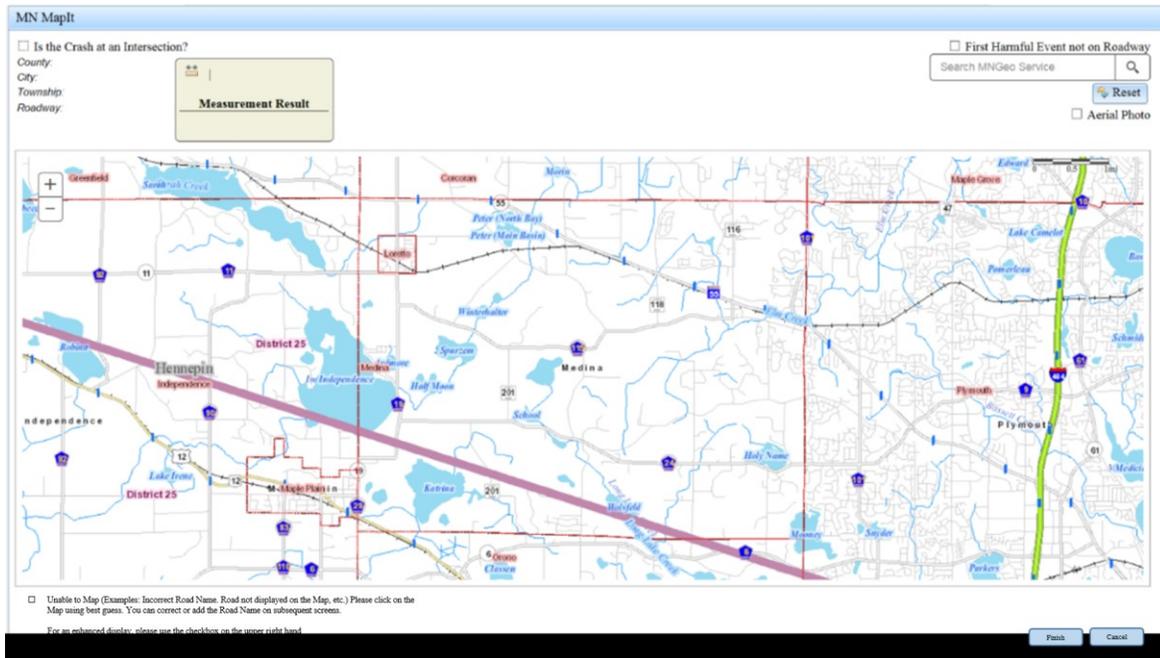


Figure 3.8 Screenshot of mapping interface altered by MnDPS to allow enhanced functions when user is unable to map location

A recommendation was made to shift checkboxes into a single grouping at the top of a page with a “Mapping Considerations” header to encourage users to consider and select special circumstances as appropriate for each crash. Additionally, the recommendation included removing superfluous language in the instructions for instances where the user is unable to map, see Figure 3.9. These recommendations will support error reduction, efficiency/time to complete, ease of implementation, and user satisfaction.



Figure 3.9 Screenshot of map feature with reordered selection boxes and reduced text instructions

3.3 SUMMARY OF RECOMMENDATIONS AND IMPLEMENTATION STATUS

The research team detailed the MNCrash design improvements that were made to DPS OTS staff and their implementation status. Approximately 23 recommendations were implemented into the test environment or active environment, three recommendations were tabled for further review by the Crash Data Users Group, and one was not able to be implemented due to compatibility issues with the Minnesota Bureau of Criminal Apprehension systems. The injury decision aid required a more extensive build and implementation and is slated for future implementation. See Table 3.2 for a summary of recommendations and the status of implementation.

Table 3.2 Overview of Recommended Changes and Status of Implemented

Recommendation	Level/Category	Status
Bug: Date errors at Crash Level highlight time entry in red, not date entry	Crash Level	Implemented
Autofill <i>Alcohol Test</i> to "Test Not Given" when <i>Suspect Alcohol?</i> is "No".	Person Level	Implemented
Autofill <i>Drug Test</i> to "Test Not Given" when <i>Suspect Drugs?</i> is "No".	Person Level	Implemented
For descriptors of options in Location Relative to Trafficway, (1) add pictures to clarify, and (2) add underlines to hyperlinks	Crash Level	Implemented
Clearly define the business rules regarding Location Relative to Trafficway in hyperlink.	Crash Level	Implemented
Above the entry for Unit Travel Speed, put "This should be an educated guess, you do not need to definitively know the answer or match future reconstruction reports"	Fatality report	Implemented
Provide additional information for non-collision harmful event crashes	Unit Level	Implemented
Make the initial contact diagram darker and higher contrast and remove italics	Unit Level	Implemented
Make the initial point of contact look more distinct from all damaged areas	Unit Level	Implemented
Add a "front to side" after "Angle" in Manner of Collision	Unit Level	Implemented
Add image to hyperlink pop-up	Unit Level	Implemented
Roadway System should be in order of most common to least	Crash Level	Implemented
Improve information regarding Yellow Tag # since officers are confused if this pertains to non-state patrol officers	Crash Level	Implemented
Include clear definition of license violations, because this is a common issue	Crash Level	Implemented
Add the definition into the question "How many passengers were in the vehicle", specifically: Not including the driver.	Person Level	Implemented
Modify injury severity hyperlink pop-up to be more clear and more easily readable	Person Level	Implemented
Put "no clear contributing factors" first on the drop down list (Recommendation modified by OTS)	Person Level	Implemented
If "clear" is put for the first weather condition (weather 1), then the second weather condition should autofill "NA"	Crash Level	Implemented
Change "road sign" to "sign" so that it is easier to search for	Unit Level	Implemented
Specify towing information (no towing, towing for disabling damage, etc.). Disabling damage implies damage to the motor vehicle that is sufficient to require the motor vehicle to be towed or carried from the scene.	Unit Level	Implemented
Include "Gillig" in the bus models	Unit Level	Implemented
Default fire to "not on fire"	Unit Level	Implemented
Reorder mapping feature select boxes and reduce text of instructions	Crash Level	Implemented
Implement injury decision aid (Based on findings and recommendations of Injury Severity Decision Aid study)	Person Level	Plans for Future Implementation
Include the option "fail to drive with due care"	Person Level	Future Review
Do not prompt for plate number when it is a bus	Unit Level	Future Review
Clarify bus passenger requirements for only those injured in accident	Unit Level	Future Review
Include "X" in the crash report as it appears on the ID for sex.	Person Level	Unable to Implement

3.3.1 Recommendations Removed Due to Feasibility or MMUCC Guidelines

Several recommendations were either removed due to the feasibility of implementation or because they did not adhere to the MMUCC guidelines. Three recommendations at the MNCrash Unit Level were removed. These recommendations included a feature that would auto-populate the car model into the diagram while also increasing the amount and diversity of car diagrams, placing numbers on the corners of the car diagrams, and changing the first initial point of contact to be colored red and the secondary points to be colored blue. Additionally, it was recommended that the italics be removed and “all damaged areas” be underlined. Due to the lack of feasibility and adherence to MMUCC guidelines, these recommendations were removed for any further consideration.

3.3.2 Recommendations for Future Testing

Several issues were identified as being either already resolved or in need of future testing. A few issues were related to the MnFILL system. Specifically, it was recommended that when license information is automatically filled through MnFILL, the phone number and sex should also autofill. Additionally, it was suggested that MnFILL should ignore the commas when auto-filling names. Other issues were related to copying information from other sections in the crash report. Specifically, officers reported they would have issues with the “copy from owner” button stating that it only filled out half of the information in the crash report, and should be more complete. Further, it was recommended that the “Copy Unit 1” button over the top of the roadway characteristics attribute should be better differentiated from the sequence of events attributes. Lastly, officers requested that Minnesota be the first state on the drop-down menu on the crash level.

The purpose of the research was to evaluate the existing MNCrash interface system and identify areas of weakness to improve the overall usability of the MNCrash report system. The recommended design changes were made to improve data accuracy, decrease user frustration and confusion, improve efficiency, and increase user satisfaction. The outcome resulted in the implementation of a majority of the recommendations that would improve the usability of the MNCrash report.

The research team was limited in the ability to implement certain changes due to existing MMUCC 5 guidelines or compatibility of the MNCrash system. Follow up testing should be completed to evaluate the usability of the recommended changes and to determine whether there are additional issues to be addressed. Additionally, issues that were unable to be implemented due to mandates or regulations should be reexamined and evaluated by experts at a future date.

3.4 TRAINING RECOMMENDATIONS

3.4.1 Common Crash Report Form Errors

A companion study of the MNCrash system by Morris, Libby, Peterson, Ryan, and Sheppard (2020) analyzed data collected through the Minnesota Crash Report legacy system in 2015 and the MNCrash system in 2016. This data audit included a mixed-methods approach to examine how crash data quality

may have improved through the implementation of the MNCrash system in 2016. One analysis examined the data's completeness and accuracy through a comparative analysis of the form field data and information disclosed by officers in the crash report's narrative in 2015 and 2016. Overall, the comparative analysis revealed a reduction in mismatching accounts between the form field data and information in the narrative in 2016 compared to 2015. This analysis also helped to highlight new or persistent data entry errors with the MNCrash system and opportunities to reduce them in the future.

Throughout the comparative analysis, there were several consistent errors or patterns that were observed within the form data entry by officers. Many of these led to increases in both missing and mismatching information relative to the narrative the officers composed at the end of the crash report. Some of these errors may be due in part to human factors design issues that could be improved upon. However, others, based on conversations with our interviewees across the state, seem to be due to officers either not fully understanding the importance of listing all factors or simply not having been properly trained in what certain fields are referencing and the need for accuracy when filling out specific fields.

While the focus of this work is to reduce errors through user-centered design, this work has also identified a need to give officers a better understanding of the necessity for more accurate and complete data. As with any interface, there is always room for iterative design improvement, however, as shown in Figure 3.1 **Error! Reference source not found.**, many of the form errors identified by Morris et al (2020) were not specifically associated with new information added to the new MNCrash report system. Table 3.3 shows the number and percent of matching and mismatching form data relative to information provided in the narrative for form items that were present in both the new and old reporting system as well as for new form items that were added to the new MNCrash system. Similarly, Table 3.4 shows the number and percent of present and missing form data for form items that were present in both the new and old reporting system as well as for new form items that were added to the new MNCrash system.

Table 3.3 Comparison of the Mismatching Data for New and Existing Form Items

	Matching	Mismatching	Total
Existing Form Items	4,296 (83.9%)	819 (16.1%)	5,115
New Form Items	3,007 (86.9%)	454 (13.1%)	3,461

Table 3.4 Comparison of the Missing Data for New and Existing Form Items

	Present	Missing	Total
Existing Form Items	5,115 (92.8%)	397 (7.2%)	5,512
New Form Items	3,461 (98.3%)	60 (1.7%)	3,521

While the new MNCrash report system included nearly twice as many possible form items that officers could potentially fill out per crash report, form items that were present in both report systems accounted for 64% of the mismatching data. Additionally, 87% of the missing data for both the severe injury and fatal injury crash reports that were examined in a previous qualitative analysis were present in both report systems. This indicates that much of the inaccurate and missing form data is not due to

the new items in the crash reporting system, but rather due to existing issues with officers either misunderstanding what is needed for specific fields or simply not being exhaustive or complete in their data entry.

Officers failing to input all relevant crash information into the form was the most common observation regarding missing data as over half of the missing data for both years involved form items that had multiple entry fields, e.g., Sequence of Events or Contributing Factors. Considering that officers often left several of these fields blank, even though their narratives provided more information, suggests that further training may be useful to express the need and usefulness of more complete crash data within the form fields, especially for such significant information.

Other errors of omission were observed during usability testing during the design of the MNCrash system and following its release. One of the most common omission errors was related to passengers. Officers often stated frustration in the work required to document passengers on buses, especially for non-injured passengers. It is important to note that the current interface requests officers to list total passengers on buses, but only queries detailed information on injured bus passengers. Nonetheless, this idea tends to be a powerful bias for officers and impacts underreporting of non-injured passengers in all motor vehicles. Officers described failing to document passenger names, ages, positions, or seat belt use at the scene of the crash and then opting to omit them from the crash report altogether. Design changes have been suggested to help improve officer reporting of critical information of passengers (i.e., excluding personal identifying information). Training, however, is needed to communicate the importance of capturing safety information of passengers even when they have no injuries, are safely buckled, etc. and reminding them to note such information at the scene of the crash and document it later.

Some early observed errors due to lack of training documented during the crash report design project were addressed in the interface through the inclusion of hyperlinks that include common definitions or business rules of which users often were unaware. The utilization of these hyperlinks, however, appears to be limited with users often reporting they had never clicked on a hyperlink or knew they were embedded throughout the report. Raising the awareness of hyperlinks may serve to alleviate some common errors addressed by the information within them. This may also require some design solutions to improve the affordances of the hyperlinks making them appear “clickable”.

3.4.2 Crash report narrative composition

For the purpose of the comparative analysis of the qualitative crash data, the research team compared the information entered into the crash report form with the information transcribed by the reporting officer in the narrative section of the report. The information and order of information that officers elected to put into the narrative section of the reports varied drastically from report to report. From an analyst standpoint, this often made the reading and interpretation of what happened with each specific crash a difficult task. In order to provide a clearer and more comprehensive story of what happened for each crash, the research team interviewed a myriad of state employees who regularly read through and analyzed crash reports along with their narratives to gather information and better understand what

transpired for each event. This process consisted of researchers conducting a semi-structured, open-ended interview with several different state employees from around Minnesota including crash analysts, state patrol officers, state administration program coordinators, traffic engineers, and a principal engineer.

The purpose of the interviews was to identify what information each person wanted to identify when reading through the crash reports, specifically focusing on the narrative portion of the report. The research team then asked each interviewee to provide the overall order of information from the crash that would make the most sense to them when reading the narrative. Based on these interviews, the research team developed guidelines, seen in Table 3.5, for what information was most critical when composing a narrative as well as an ideal sequence of information regarding the crash.

Table 3.5 Recommendations for Composing Crash Report Narratives

Sequence	Information	Instructions
1	Vehicle Information	First state the vehicle(s) direction, position, and roadway/intersection location.
2	Sequence of Events	Sequentially state ALL events that led up to and following the crash for the vehicle(s) including the manner of collision if more than one motor vehicle was involved
3	Crash Location	Describe where on the roadway the crash occurred as well as where the final resting point of the vehicle(s)
4	Driver(s) Factors	List any Contributing Factors to the crash including driver physical condition if pertinent
5	Roadway Factors	Briefly describe the roadway conditions as well as the weather and if it may have played a role in the crash
6	Occupant Information	Without using personal descriptors, list if any occupants were ticketed, injured or killed
7	Form Clarification	Be sure to elaborate on any instances from the crash report form where the officer selected 'Other' or 'Unknown.'

There was consistent agreement among all employees regarding what they looked for when reading crash report narratives. They wanted to know where the vehicle was prior to the crash, what it was doing that led up to the crash, what factors contributed to the crash, and what happened after the crash. There was also a fair amount of consensus among the interviewees regarding information they regularly saw within narratives that they felt was unnecessary, typically because it was explicitly redundant with information within the form and offered nothing new or expounded upon what specifically occurred regarding the crash.

There was also general agreement within the interviews that the primary reasons for inconsistent narrative composition among officers were that: 1) many officers do not realize that the crash reports help inform so many state agencies regarding policies, enforcement, and road design changes; 2) many officers believe the only purpose of the crash report and, specifically, the narratives are for insurance purposes only; 3) there is little to no formal training on composing a narrative, and if there is, it differs between agencies and municipalities; and, 4) officers are reluctant to provide too much information regarding Contributing Factors for fear of being incorrect or being later involved in traffic court cases.

Finally, officers limiting the use of the “all caps” function could improve the legibility of narratives. UPPERCASE print in multiword text, such as the narrative, is harder to read than lowercase or mixed-case print, which provides a more distinctive shape of the entire word (Sanders & McCormick, 1998; Wickens, Lee, Liu, & Gordon Becker, 2004). Switching practices or even departmental policies to prohibit the use of uppercase narratives will not only help others read the document to better understand the circumstances and outcomes of the crash but will also aid officers in reading their own document to spot errors and omissions of the text.

The combined observations of errors, omissions, and inaccurate beliefs about the crash report were used to create three infographics to distribute to officers (see Figure 3.10 or Appendix D for large versions). These infographics contain tips, tricks, and myths to improve officers’ skills, knowledge, and understanding of crash reporting to improve data accuracy and completeness. The two infographics, along with the narrative instructions, will be user tested to ensure that the content and language used achieves the intended goal.



Figure 3.10 Infographics for training officers

3.5 DISCUSSION

Overall, officers were positive in their interactions with the interfaces. The self-reported duration to complete the MNCrash report provided encouraging information that the speed of data entry has exceeded early expectations in the design of the interface. The user support for the wizard interface was surprising and adds difficulty in any future decisions that the state must make about the number of interfaces they must maintain. However, the sample size was small and may have been biased by the inclusion of the Metro Transit Police Department. Nonetheless, the findings reinforce the decision to support users by offering two options that encourage officers to select the interface that best fits their technology preferences and needs.

The areas identified for improvement indicate promise to easily address some of the frustrations or confusion points for officers across multiple areas of the MNCrash interface. These changes are expected to improve data accuracy, data completion, and user satisfaction. Some other areas identified will require more extensive changes to the report or will involve addressing cultural or organizational issues that will require more time and coordination to resolve. Officers may need to be better informed on the importance and usefulness of the crash report being accurate and detailed, specifically relating to the composition of more concise and precise narratives, as well as being more detailed with form data for Sequence of Event and Contributing Factors. Obtaining more accurate crash data from the reporting officers should not only involve education on areas of weakness within the form and narrative but also incorporate more buy-in from officers on the importance of data completeness and accuracy to analysts, engineers, legislators, and other law enforcement personnel.

CHAPTER 4: INJURY SEVERITY DECISION AID

This chapter summarizes the iterative usability design and testing process of a novel injury severity decision aid prototype. The design was driven and refined by user-centered evaluations throughout the iteration process. The goal of the study was to determine if an injury severity decision aid tool would be useful and increase accuracy in injury severity reporting for law enforcement officers. The work aimed to iteratively design a prototype based on user needs, expectations, and feedback. Following the iterative design and testing process, an experimental design was conducted to determine whether the experimental decision aid had measurable effects in increasing injury severity reporting accuracy, as well as in improving officer confidence while reporting. The outcome of the study was that the injury severity decision aid prototype received high-level support for the use of the tool and produced good usability and user satisfaction. The results from the experimental study indicated that the use of a decision aid resulted in greater accuracy in injury severity reporting, particularly for suspected serious injuries and possible injuries.

4.1.1 Background

Quality data on motor vehicle crashes is essential to improving highway safety at all levels of government. The data is used to identify issues, determine highway safety messages and strategic communication campaigns, optimize the location of selective law enforcement, inform decision-makers of needed highway safety legislation, and evaluate the impact of highway safety countermeasures (NHTSA, 2017). Injury severity assessments by law enforcement officers when initiating a crash report, particularly that of incapacitating injury (i.e. injury severity level A), are one of the bases for estimating crash cost, and, in turn, for allocating safety funds by the state transportation agencies (Burdett, Li, Bill, & Noyce, 2015).

According to the Fifth Edition of the Model Minimum Uniform Crash Criteria (MMUCC 5), the severity of the crash is based on the most severe injury to any person involved in the crash. One issue with injury severity level reporting is that injury severity levels tend to be either underestimated or overestimated by law enforcement officers. There may be different factors that lead to the misclassification of injuries, such as the age and gender of the victim, the road environment, the number of vehicles involved in the accident, the time of day, the blood-alcohol test results, and the type of accident (Couto, Amorim, & Ferreira, 2016). Similarly, other attributes such as travel speed, restraint device usage, and whether the driver was at fault influence injury severity decisions (Dissanayake & Lu, 2002). Errors in injury severity reporting may be a result from obvious injuries that appear worse than they are, or from injuries that are not evident (Compton, 2005). For instance, Burdett, Li, Bill and Noyce (2015) analysis of crash data noted the most common injuries inaccurately documented in crash reports were bone injuries, lacerations, abrasions, and contusions.

Police reporting probability increases with increasing injury severity. The higher the severity, the more likely the people involved, as well as police, would feel the casualty was serious and should be reported (Amoros, Martin, & Laumon, 2006). Police reports overestimate the injury severity, and factors such as

age and the position of the victim determine the likelihood of police injury misclassification (Tsui, So, Sze, Wong, & Leung, 2009). In one study, older drivers not in good physical condition were more likely to have been reported as having more severe injuries (Dissanayake & Lu, 2002). On the other hand, traffic accident data may also suffer from underreporting effects, especially for lower injury severities (Yamamoto, Hashiji, & Shankar, 2008). Similarly, when comparing police databases to hospital databases, police databases showed severe underreporting of crash victims, with the amount of underreporting increasing for lower injury severity levels (Kamaluddin, Rahman, & Varhelyi, 2019; Janstrup, Kaplan, Hels, Lauristen, & Prato, 2016). Furthermore, underreporting was more likely for the motorcyclists, cyclists, males, young people and injuries occurring in remote and inner regional areas (Watson, Watson, & Vallmuur, 2015).

4.2 METHOD

4.2.1 Injury Severity Decision Aid Prototype Development

Content for the injury severity decision aid was based on current injury status and injury area information listed in MMUCC 5. The development of the content for the decision aid focused on three of the five injury status attributes most commonly misclassified in crash reports: 1) suspected serious injury (i.e. injury A), 2) suspected minor injury (i.e. injury B), and 3) possible injury (i.e. injury C). Injury area attributes were grouped into six categories and were labeled on a generic body diagram. The categories included: 1) Head/Neck, which contained head, face, and neck injuries, 2) Chest, which contained thorax and spine injuries, 3) Abdomen/Pelvis, which contained abdominal and pelvic injuries, 4) Extremities, which contained upper and lower extremity injuries, and 6) No wounds or injuries readily available, which account for injuries that were unobservable or claimed by the person. An external and other injuries category was also created to classify injuries that occurred on other areas of the body that were not specific to one of the previously mentioned categories such as burns, bruises and crush injuries.

A user-centered design approach was taken to build an injury severity decision aid tool that would be useful and usable when determining injury severity in crash reports. Initial decision aid prototypes were developed using Microsoft PowerPoint based on the generated content. The prototypes were designed using a generic body diagram and included information about the types of injuries observed in each area of the body (e.g., abdominal, head) and the level of injury associated with the given observable injury (i.e. Suspected Serious Injury, Suspected Minor Injury, and Possible Injury). Additionally, the flow of information through the injury severity decision aid, the design features appearance (e.g., interactivity, color), allocation of tasks between user and the system, and how the system should behave were modified to optimize usability. Initially, two interactive injury severity decision aid prototypes were developed (i.e. Prototype 1 and Prototype 2), see

Figure 4.1. Multiple design attempts were created throughout the iterative process. Prototype 1 and Prototype 2 were identical except for the appearance of the Home Screen.

The participant was presented with the prototype home screen. On the home screen, the participant was directed to click on the area of injury on a picture of a body. Once an area of injury was selected, the participant was presented with a list of possible observable injuries and was asked to select the injury that best describes the situation. After selecting the observable injury, the participant was provided with the appropriate injury severity level (Injury A, Injury B, or Injury C) to report in the MNCrash report.



Figure 4.1 Screenshot of prototypes used in trial one

4.2.2 Participants

A concerted effort was made to sample users from state, county, and city law enforcement agencies to represent a diverse sample of data users and perspectives. Seven law enforcement officers were recruited from Granite Falls Police Department, Yellow Medicine Sheriff’s Department, Minnesota State Patrol, and St. Louis Park Police Department (see Table 4.1) The participants in this study varied in rank and years of experience working in law enforcement (see Table 4.2 and Table 4.3).

Table 4.1 Recruited agencies

Agencies	N
Granite Falls Police Department	1
Yellow Medicine Sheriff’s Department	1
State Patrol Headquarters	3
St. Louis Park Police Department	2
TOTAL	7

Table 4.2 Law enforcement rank

Rank	N
Trooper	3
Officer	3
Deputy	1
TOTAL	7

Table 4.3 Years of experience

Years of Experience	N
0-5	4
10-15	2
Over 15	1
TOTAL	7

4.2.3 Procedure

Law enforcement participants met with researchers at their home stations. Law enforcement participants spent approximately 20 minutes examining the injury severity decision aids. Participants were provided a brief background of the state of the prototypes and were asked about their current decision strategy for determining injury severity. Next, participants were asked to navigate through the injury severity prototype at their own pace.

Participants were encouraged to “think aloud” as they navigated through the decision aid, noting the features which might seem confusing, what they liked, or disliked, etc., and were prompted by researchers to clarify any ambiguities. Researchers kept detailed notes while the participant interacted with the decision aid. Once the trial was completed, participants were asked to provide any suggestions for improvement and to indicate the likelihood that they would use this prototype. In the first trial, participants were asked to indicate which of the two interfaces best represented an interface they would like to see in the final version and to state the reasoning for their answer.

4.3 RESULTS

4.3.1 Current Decision Approach

Law enforcement officers reported using the following methods to determine injury severity, including the presence/absence of an ambulance, consulting with paramedics or following up at the hospital, assessing the damage to the vehicle, or asking the victim themselves. Most participants reported that they were skeptical of the victim complaints of pain or injury or were reluctant to code the injury severity because they did not know how extensive the injury was or because the paramedics took over the crash scene. One officer even reported that what he thinks about the level of injury severity does not matter. Table 4.4 displays the current decision approach by injury level.

Table 4.4 Current reported injury severity decision approach by level of injury

Injury Level	Officers' Described Decision Approach
Injury A	All “messed” up Serious or severe injuries Assaults Not responding Cannot move on their own Presence of blood
Injury B	Broken bones Still able to communicate Minor injuries but went to hospital
Injury C	Only uses this option because it covers all categories Bloody nose No ambulance present No transport to hospital but complaint of pain Stomach hurting Transported to hospital

4.3.2 Overall Design Changes

Qualitative factors identified during usability testing were integrated into subsequent design and development of a prototype tool to improve the injury severity decision making process. Several changes were made to the overall design throughout the iteration process. The researchers sought to make improvements to the decision aid to make it understandable to a broad range of experience levels by evaluating issues related to the design, content, and user engagement. First, the labeling of both extremities (i.e. arm and leg) was removed due to redundancy. Only the leg was labeled with Extremities. The home screen was changed so that when any area of injury was selected (e.g., head), the rest of the areas of injury would be “grayed out” such that they were still visible to law enforcement participants. These grayed out areas remained clickable to law enforcement participants to provide the option to select a different area of injury (e.g., chest). Additionally, a home button was added to the PowerPoint to provide users with an option to return to the home screen to start from the beginning of the decision aid. The coloring of the Chest section was changed from gray to purple to accommodate changes to the home screen and subscreen returns.

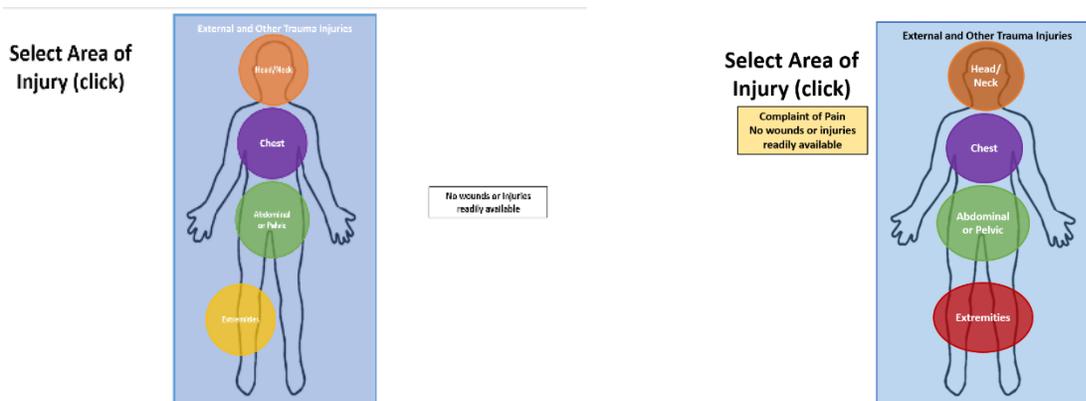


Figure 4.2 Screenshot of prototype iteration and final design

4.3.3 Addition of injuries/terminology, order of injuries by severity

Injuries were added to one or more of the areas of injury. In trial two, minor lacerations (cuts on skin surface with minimal bleeding and no exposure to deeper muscle tissue) were added to all categories. In trial three, complaint of pain or injury was included in all categories to account for miscellaneous reported victim injuries (e.g., neck pain, whiplash, stomach pain, and headache). Injuries were also ordered by severity, ranging from worst to minor (i.e. A to C). Table 4.5 displays a summary of changes made to the areas of injury across all trials.

Table 4.5 Summary of changes made to areas of injury for all trials

	Original	Trial Additions and Changes	Final Version
Head	<ol style="list-style-type: none"> 1. Unconsciousness when taken from the crash scene 2. Lump on head 3. Momentary loss of consciousness 	<ol style="list-style-type: none"> 1. Unconsciousness when taken from the crash scene 2. Severe laceration resulting in exposure of underlying tissues/muscle/organs or significant loss of blood 3. Lump on head 4. Momentary loss of consciousness 5. Minor laceration (cut on skin surface with minimal bleeding and no exposure of deeper muscle tissue or bone) 6. Suspected skull injury other than bruises or minor lacerations 	<ol style="list-style-type: none"> 1. Unconsciousness when taken from the crash scene (breathing but not awake when talking) 2. Severe laceration resulting in exposure of underlying tissues/muscle/organs or significant loss of blood 3. Suspected skull injury other than bruises or minor lacerations 4. Confused or acts irrational or unusual 5. Bulging eyes or veins popping in neck 6. Lump on head 7. Minor laceration (cut on skin surface with minimal bleeding and no exposure of deeper muscle tissue or bone) 8. Momentary loss of consciousness 9. Claim of injury
Chest	<ol style="list-style-type: none"> 1. Severe laceration resulting in exposure of underlying tissues/muscle/organs or significant loss of blood 2. Suspected skull, chest or abdominal injury other than bruises or minor lacerations 	<ol style="list-style-type: none"> 1. Severe laceration resulting in exposure of underlying tissues/muscle/organs or significant loss of blood 2. Suspected chest injury other than bruises or minor lacerations 3. Minor laceration (cut on skin surface with minimal bleeding and no exposure of the deeper muscle tissue) 	<ol style="list-style-type: none"> 1. Severe laceration resulting in exposure of underlying tissues/muscle/organs or significant loss of blood 2. Suspected chest injury other than bruises or minor lacerations 3. Bruising, swelling, bleeding, or deformities of chest 4. Minor laceration (cut on skin surface with minimal bleeding and no exposure of the deeper muscle tissue) 5. Claim of injury
Abdominal or Pelvic	<ol style="list-style-type: none"> 1. Suspected skull, chest or abdominal injury other than bruises or minor lacerations, 2. Severe laceration resulting in exposure of underlying tissues/muscle/organs or significant loss of blood 	<ol style="list-style-type: none"> 1. Suspected abdominal injury other than bruises or minor lacerations 2. Severe laceration resulting in exposure of underlying tissues/muscle/organs or significant loss of blood 3. Minor lacerations (cuts on skin surface with minimal bleeding and no exposure of deeper muscle tissue) 	<ol style="list-style-type: none"> 1. Suspected abdominal injury other than bruises or minor lacerations 2. Severe laceration resulting in exposure of underlying tissues/muscle/organs or significant loss of blood 3. Bruising, swelling, bleeding, or deformities of abdomen 4. Minor lacerations (cuts on skin surface with minimal bleeding and no exposure of deeper muscle tissue) 5. Claim of injury
Extremities	<ol style="list-style-type: none"> 1. Broken or distorted extremity (arm or leg) 2. Limping 	<ol style="list-style-type: none"> 1. Broken or distorted extremity (arm or leg) 2. Minor lacerations (cuts on skin surface with minimal bleeding and no exposure of deeper muscle tissue) 3. Limping 	<ol style="list-style-type: none"> 1. Broken or distorted extremity (arm or leg) 2. Minor lacerations (cuts on skin surface with minimal bleeding and no exposure of deeper muscle tissue) 3. Limping 4. Claim of injury
External and Other Trauma Injuries	<ol style="list-style-type: none"> 1. Paralysis 2. Significant burns (second and third degree burns over 10% or more of body) 3. Minor lacerations (cuts on skin surface with minimal bleeding and no exposure of deeper muscle tissue) 4. Bruises 5. Abrasion 6. Claim of injury 7. Complaint of pain or nausea 	<ol style="list-style-type: none"> 1. Crush Injuries 2. Paralysis 3. Significant burns (second and third degree burns over 10% or more of body) 4. Minor lacerations (cuts on skin surface with minimal bleeding and no exposure of deeper muscle tissues) 5. Bruises 6. Abrasion 7. Claim of injury 8. Complaint of pain or nausea 	<ol style="list-style-type: none"> 1. Unconscious when taken from the crash scene (breathing but not awake when talking) 2. Crush injuries 3. Paralysis 4. Significant Burns (second and third degree burns over 10% or more of the body) 5. Minor lacerations (cuts on skin surface with minimal bleeding and no exposure of deeper muscle tissues) 6. Bruises 7. Abrasion 8. Momentary loss of consciousness 9. Claim of injury 10. Complaint of pain or nausea

4.3.4 Overall Preference and Likelihood of Use

In trial one, participants were asked to choose which interface (i.e. Prototype 1 and Prototype 2) would best represent the actual future injury decision aid. There was overwhelming support for the use of Prototype 2 from the participants. Overall, there were minimal frustrations and concerns reported while using the decision aid. All participants suggested that the injury severity decision aid be embedded into the MNCrash report (i.e., as a pop-up tool) and said that if embedded, they would be very likely to use this tool. Participants reported the decision aid was extremely easy to use and very helpful. Furthermore, participants noted that this tool would be highly useful for a variety of experience levels of law enforcement (e.g., use for current law enforcement officers to learn to code correctly, useful for new officers). Some participants indicated that they would consider changing their current methods used to code injury severity levels after using this decision aid. Prototype 2 was selected for advancing iterative design with users.

4.4 INJURY SEVERITY DECISION AID STUDY

Integrating the injury severity decision aid into the state's crash report requires some research evidence that using the aid results in greater reliability and validity and/or reduced frustration or improved confidence for law enforcement officers as they make their determination of injury. The dissemination of the findings may help improve crash injury data collection nationwide. Therefore, the purpose of the study was to determine if an injury severity decision aid tool would be useful in increasing the accuracy of injury severity reporting for law enforcement officers. The injury severity decision aid prototype designed in the previous study was used to rate the injury severity levels commonly documented in the MNCrash report (i.e. suspected serious injury, suspected minor injury, or possible injury). The outcome of the study will result in the validation of a new decision aid tool to improve crash reporting accuracy for law enforcement officers.

4.5 METHOD

4.5.1 Participants

In total, 386 participants completed the survey. The majority of participants were sergeant/patrol sergeant (24.8%), trooper (16.5%), patrol officers/patrol (14.7%), police officers/officers (13.3%), and deputy (9.7%). Participants had an average of 13.79 ($SD = 8.25$) years of experience in law enforcement and reported an average of 13.02 ($SD = 8.02$) years of experience in crash reporting. Participants reported documenting crashes in the MNCrash system daily (4%), weekly (20.6%), monthly (47.5%), yearly (9.8%), and almost never (14%).

4.5.2 Materials

4.5.2.1 Experimental Decision Aid

The experimental decision aid was developed by the researchers that allows officers to click on a generic body diagram to quickly narrow down to an observable injury type and discover an appropriate injury severity level. The experimental decision aid prototype was constructed using JustinMind prototyping software.

4.5.2.2 Experimental Decision Aid Features

The decision aid tool was designed to allow users smooth, user-friendly navigation through the screens during the injury severity determination process. The users were presented with a modified interactive MNCrash injury severity screen in which they were able to click a “calculate injury” button to begin the injury severity determination process. Users were then prompted to click on the observed injured area of a generic body image. Once the injured area was selected, users were presented with a list of observable injuries. Once users selected the description that best matches that observable injury, they were provided the appropriate injury severity level. Users were then prompted to submit the injury status by clicking on a “Submit Injury Status” button. Once the button was clicked, users were presented with the MNCrash interface screen with the completed injury severity attribute. See Figure 4.3.

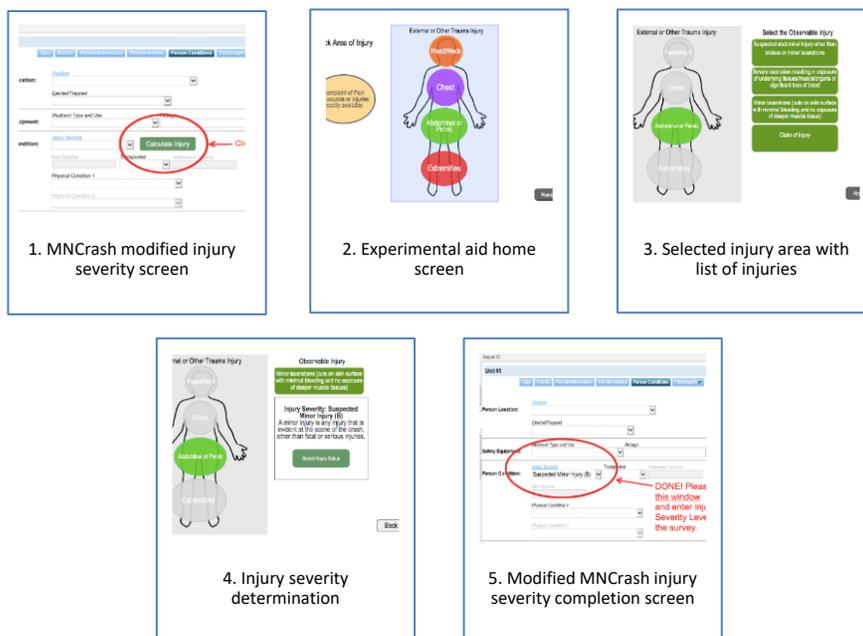


Figure 4.3 Screenshots of experimental decision aid injury decision process

4.5.2.3 Standard Decision Aid

The standard decision aid provided a single image of a standardized list of injuries provided by the Model Minimum Uniform Crash Criterion (MMUCC) created by the US DOT National Highway Traffic Safety Administration. The format of the text information was presented in an identical image of what is within the MNCrash interface's hyperlink pop-up for injury severity. See Figure 4.4.

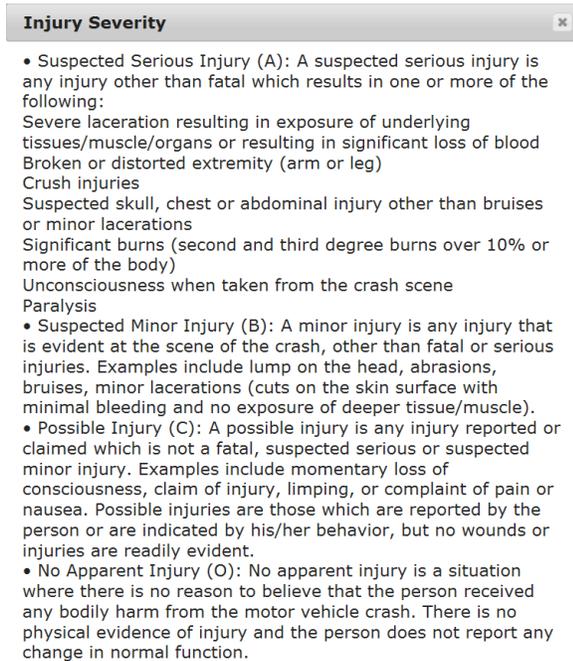


Figure 4.4 Standard decision aid

4.5.2.4 Injury Severity Scenarios

Six sample scenarios for various injury levels, including two scenarios for suspected serious injury (A), two scenarios for suspected minor injury (B), and two scenarios for possible injury (C) were constructed by the researchers. Each scenario contained an image of a damaged vehicle, a description of an injured person, and a hyperlink to one of the two decision aids. Table 4.6 provides details of each injury severity scenario. The injury severity scenarios were validated by crash reporting experts to ensure that the described injuries matched their assigned categories and that the assigned injury severity level determined by officers could be properly coded for accuracy.

Table 4.6 Injury severity scenarios, descriptions and images

Injury Severity Level	Description	Image
Suspected Serious Injury (Scenario A1)	A middle-aged male driver had to be freed by a rescuer at the scene of the crash because his legs were pinned in the vehicle. He was wearing a seat belt. The vehicle was towed. The driver reported intense pain, was unable to bear any weight on his left leg and could not walk on his own. The driver refused to be checked by EMS because his wife was on scene to transport him to the hospital.	
Suspected Serious Injury (Scenario A2)	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 (Scenario B1)	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.	
Suspected Minor Injury (Scenario B2)	A 30-year-old male driver had a bloody nose and cuts on his face from shattered glass from a broken windshield. The driver was wearing a seat belt and declined ambulance transport to the hospital. He left the scene of the crash on his own accord.	
Possible Injury (Scenario C1)	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.	
Possible Injury (Scenario C2)	An elderly female pedestrian was struck by a motorist. After the crash, she is having trouble walking unassisted but had no broken bones or visible cuts. The pedestrian threw up at the scene.	

4.5.2.5 Decision Confidence

After rating the injury level of each scenario, participants were asked to rate their confidence in injury severity level decisions, with a response set ranging from 1 = not confident at all to 5 = very confident.

4.5.2.6 Other Demographic Information

Officers were asked to state how often they opened the provided hyperlink in the six scenarios and to provide feedback about the usability of the experimental decision aid. Officers also completed basic demographic information in which they provided their rank, years of experience in crash reporting and current frequency in crash reporting.

4.5.3 Procedure

Law enforcement officers across the state of Minnesota were asked to make a series of injury severity determinations in an online survey. The survey link was distributed to law enforcement agencies and through online agency partners. The survey was hosted online through the University of Minnesota Qualtrics. Officers were presented with instructions to review six crash injury scenarios in which they would be provided an image of a damaged vehicle, a description of an injured person, and an aid to assist them in selecting the appropriate injury severity. Each decision aid was presented through a hyperlink in which officers were asked to click to open following each crash injury scenario description and image. They were randomly assigned to one of four test groups in which they would either receive the standard information aid first followed by the experimental decision aid or vice versa. They would either evaluate Set A injury scenarios first followed by the Set B injury scenarios or vice versa. The three injury severity scenarios in each set were randomized for each participant. After rating the injury severity level for each scenario, participants completed confidence measures and other demographic information.

4.6 RESULTS

Injury severity responses were scored to determine how often officers selected the correct injury severity for each of the scenarios.

4.6.1 Use of Decision Aids

Fifty-one (15.8%) participants reported clicking on the links and used both the experimental and standard decision aids and 55 (17%) reported clicking on some of the links and used both the experimental and standard decision aids. While, 48 (14.9%) participants clicked on some of the links and only saw the standard decision aid and 58 (18%) participants clicked on some of the links and only saw the experimental decision aid. Additionally, 111 (34.4%) participants clicked on none of the links and did not use either of the decision aids, see Figure 4.5.

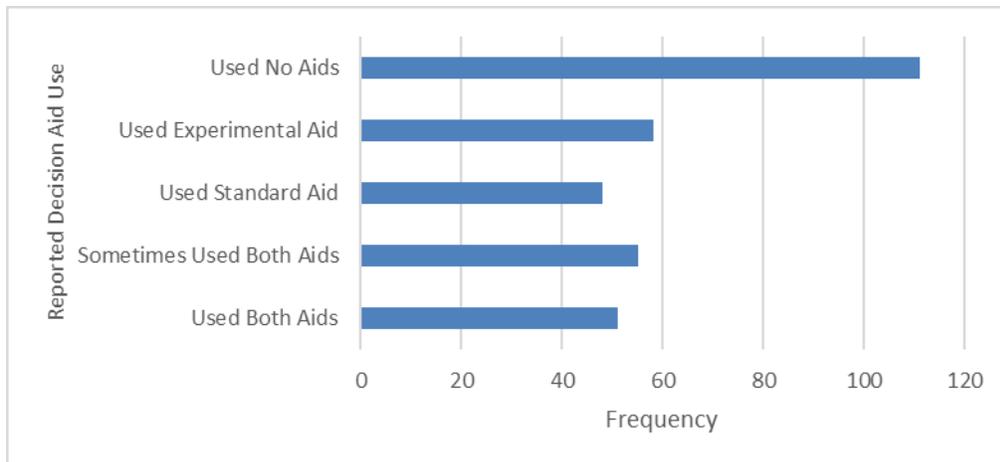


Figure 4.5 Participant frequencies of reported decision aid use throughout the study

4.6.2 Decision Aid Use, Type of Aid, and Accuracy

A Factorial ANOVA was conducted to examine participant decision aid use and the type of decision aid (standard or experimental) on accuracy. There was a significant main effect of using the decision aids on accuracy, $F(1, 320) = 5.86, p < .05$. There was no main effect for the type of decision aid (standard or experimental) used on accuracy. However, participants made slightly more accurate decisions using the experimental decision aid ($M = 2.22, SD = .71$) compared to the standard decision aid ($M = 2.10, SD = .86$). There was a marginally significant interaction between using the decision aids and the type of decision aid used on accuracy, $F(1, 321) = 3.103, p = .079$. See Figure 4.6. This suggests that if participants were to use a decision aid to rate injury severity levels, the use of the experimental decision aid may lead to more accurate decisions compared to using the standard decision aid.

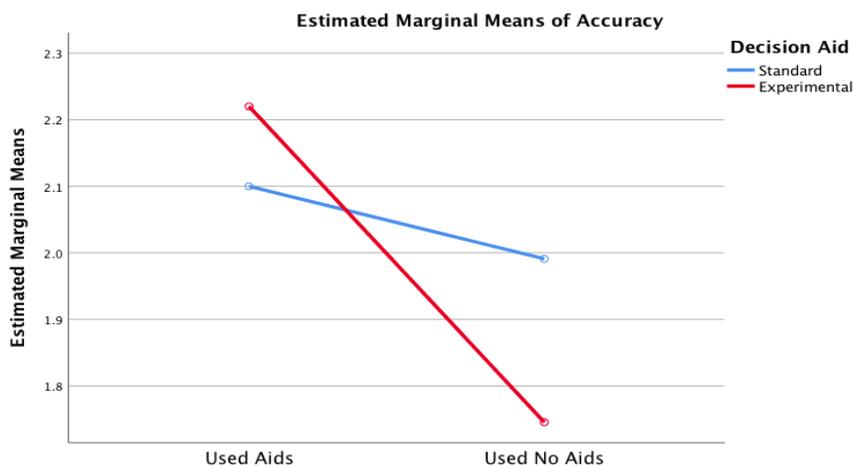


Figure 4.6 Interaction of decision aid type and use of aid on accuracy

4.6.3 Type of Aid, Accuracy, Condition, and Use of Aid

A four-way log linear analysis produced a final model that retained all effects. The likelihood ratio of this model was $\chi^2(0) = 0, p = 1$. This indicated that there was a highest-order interaction (Aid Type x Accuracy X Condition X Use of Aid), $\chi^2(3) = 14.35, p < .05$.

There was a significant association between using a decision aid and accuracy, $\chi^2(1) = 4.15, p < .05$. Odds ratios indicated that the odds of making a correct decision was 2.51 times higher using either decision aid compared to 1.89 for using no decision aid. There was a significant association between using the experimental decision aid and accurate decisions, $\chi^2(1) = 7.50, p < .05$. Odds ratios indicated that the odds of making a correct decision was 2.85 times higher when using the experimental decision aid, but only 1.65 when not using the experimental decision aid. There was not a significant association between using the standard decision aid and making a correct decision.

Therefore, the analysis suggests a fundamental difference between the use of either decision aid (i.e. standard or experimental) and no use of a decision aid. The use of a decision aid increases accuracy in rating injury severity levels compared to not using a decision aid. Furthermore, it appears that the use of the experimental decision results in a higher likelihood of making a correct decision compared to using the standard decision aid. See Figure 4.7.

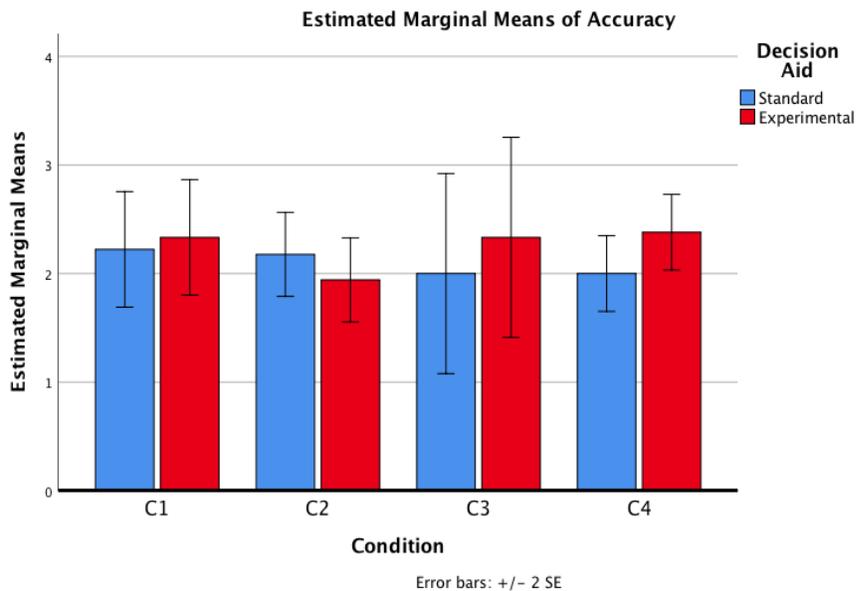


Figure 4.7 Bar graph of accuracy by decision aid and condition

4.6.4 Accuracy by Decision Aid Type

Frequencies were calculated for accuracy using the experimental and standard decision aids by each injury level scenario, see Table 4.7. Overall, the experimental aid resulted in greater accuracy for the majority of injury scenarios compared to the standard aid.

Table 4.7 Percentages of accurate decisions by injury scenarios with standard and experimental decision aids

Injury Severity	Decision Aid	
	Standard	Experimental
Injury A1	41.7	42.1
Injury A2	82.1	83.3
Injury B1	83.3	86.6
Injury B2	91.7	89.5
Injury C1	71.1	91.7
Injury C2	51.3	58.3

4.6.5 Confidence and Correct Decisions

An independent samples t-test was done to compare confidence scores for those who made correct or incorrect decisions. There was a significant difference in confidence scores for participants who made correct decisions, $t(1921) = 9.72, p < .05$. Participants who made correct decisions were more confident ($M = 4.15, SD = .81$) compared to those who made incorrect decisions ($M = 3.75, SD = .92$).

4.6.6 Injury Severity Level, Decision Aid, and Confidence

A factorial ANOVA was conducted to examine the differences in the injury severity level and the type of aid used on confidence. There was a significant main effect for the injury severity level on confidence levels $F(5, 630) = 4.30, p < .05$. There was not a significant main effect for aid on confidence. There was a significant interaction between injury type and aid used on confidence, $F(5, 630) = 2.54, p < .05$. The experimental decision aid showed higher confidence scores for injury severity scenarios A2 and C2 while the standard decision aid showed higher confidence scores for injury severity scenarios A1, B1, and B2. The experimental and standard decision aids showed similar confidence scores for injury C1. See Table 4.8.

Table 4.8 Means and standard deviations of confidence scores for injury severity levels for standard and experimental decision aid

Injury	Standard Aid		Experimental Aid	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
A1	4.06	.76	3.60	.91
A2	4.04	.85	4.22	.83
B1	4.31	.82	4.07	.89
B2	4.41	.71	4.18	.79
C1	4.11	.83	4.13	.83
C2	3.70	.95	4.00	.87

4.6.7 Likelihood of Experimental Decision Aid Use

Participants were asked to indicate how likely they would use the Experimental Decision Aid tool if it were made available in the MNCrash Report, with a response set ranging from 1 = not likely at all to 5 =

very likely. Participants indicated a strong/positive likelihood that they would use this tool if implemented in the MNCrash report ($M = 3.57, SD = 1.19$).

4.6.8 Qualitative Feedback for Experimental Decision Aid

Qualitative feedback was coded for participants' self-reported likes and dislikes about using the experimental decision aid. Overall, there were more reported likes ($N = 179$) than dislikes ($N = 39$) for the experimental decision aid.

4.6.8.1 Experimental Decision Aid Likes

The most frequently reported likes for the experimental decision aid were that the experimental decision aid was easy to use, provided clear explanations of injury levels, was visually appealing, and helped increase the accuracy in decision-making. See Table 4.9 for a summary of reported likes about the experimental decision aid.

Table 4.9 Summary of likes for the experimental decision aid

Likes ($N = 179$)	Example Feedback		Frequency, n (%)
Easy to use	<ul style="list-style-type: none"> Made it easy. Easy reference. 	<ul style="list-style-type: none"> Very easy to use and understand. 	44 (25)
Clear Explanations of injury level	<ul style="list-style-type: none"> Helps to clarify how to list the injuries. Clear breakdowns for various symptoms. Gives me more specific injury categories to choose from. 	<ul style="list-style-type: none"> Very helpful in narrowing down exactly what injuries should be labeled as. 	39 (22)
Visually appealing	<ul style="list-style-type: none"> Better visual. [I liked] the ability to view certain areas of the body. 	<ul style="list-style-type: none"> Visual area of body helps in the decision process. Well laid out. Looks nice. 	17 (9)
Increased accuracy in decision making	<ul style="list-style-type: none"> Easily determine what category injuries would be. Eliminates guesswork. 	<ul style="list-style-type: none"> Allows for more accurate documentation. More consistent reporting. 	15 (8)
Helpful	<ul style="list-style-type: none"> Helped guide the user. Helped determine most injuries. 	<ul style="list-style-type: none"> Better determine the extent of injury while specifying the area of the body the injury is located. 	15 (8)
Ease of decision making	<ul style="list-style-type: none"> Made it easier to determine the severity of the injury, makes the decision for you. 	<ul style="list-style-type: none"> Easier to figure out what to put in the box of the crash report. 	12 (7)
Simple	<ul style="list-style-type: none"> Simplifies the decision. 	<ul style="list-style-type: none"> Simple to use. 	12 (7)
Detailed	<ul style="list-style-type: none"> More specific. More options. 	<ul style="list-style-type: none"> More detail. 	11 (6)
Objective	<ul style="list-style-type: none"> Takes out the guess work. 	<ul style="list-style-type: none"> It is less subjective. It leaves less to interpretation. 	7 (4)
Informative	<ul style="list-style-type: none"> In-depth. 	<ul style="list-style-type: none"> Informative. 	4 (2)
Useful	<ul style="list-style-type: none"> User friendly. 	<ul style="list-style-type: none"> Good tool, especially for new troopers/officers. 	3 (2)

4.6.8.2 Experimental Decision Aid Dislikes

Although there were fewer reported dislikes ($N = 39$) about the experimental decision aid, the most frequently mentioned dislikes about the experimental decision aid were that the decision aid was not exhaustive of all injury options, too time consuming, and the click-rate was too high. See Table 4.10 for a summary of reported dislikes about the experimental decision aid.

Table 4.10 Summary of dislikes for the experimental decision aid

Dislikes ($N = 39$)	Example Feedback	Frequency, n (%)
Not exhaustive of all injury options	<ul style="list-style-type: none">• Does not have all the options you could pick from.• Not enough options for types of injuries.	13 (33)
Time consuming	<ul style="list-style-type: none">• It takes slightly longer than just guessing the severity level. Takes more time.• It took longer than rough estimates.• Another step in already lengthy process.	12 (31)
Too much clicking	<ul style="list-style-type: none">• Too much clicking through injury types.• Multiple screens to get through. Additional clicking.	5 (13)
Inability to select multiple injuries	<ul style="list-style-type: none">• Could be more than one area of the body that is injured.• Can only use the most severe injury, cannot aggregate combination of injuries.	4 (10)
Too much information	<ul style="list-style-type: none">• Too many options.• Too much information.• Too much information to go through.	3 (8)
Complicated	<ul style="list-style-type: none">• Too complicated.	2 (5)

4.7 DISCUSSION

The purpose of the injury severity decision aid study was to develop a decision aid tool that would be useful and increase crash reporting accuracy for law enforcement officers. The outcome of the current study resulted in the development of a novel tool that may be useful for increasing accuracy of injury severity reporting of injury types commonly reported in the MNCrash system.

Several design changes were made to the overall design throughout the iteration process to improve user experience and the likelihood of use. There was strong support for the use of the tool. The user-centered design of the tool was found easy to use, helpful in determining the level of injury severity, and was visually appealing. Importantly, participants reported they would be likely to use this tool if it were made available. The findings from the current study are similar to that of research that suggested decision aids have the potential to decrease conflict related to feeling uninformed, and can lead to increased user knowledge and engagement in decision making (Hess et al., 2012; Mathers et al., 2012; Stacey et al., 2017; Meinick et al., 2017).

Police coding of injury severity is too inexact for many research applications. Police officers usually correctly identify drivers as either killed or uninjured, but the various levels of nonfatal injury are often misclassified (Farmer, 2003). The findings from the experimental study suggest that providing law enforcement officers with a decision aid tool to determine injury severity level results in greater

accuracy compared to not using a decision aid tool. Specifically, using the experimental decision aid resulted in higher accuracy compared to using the standard information list that officers are currently provided within the crash report system. Further, the experimental decision aid appeared to be particularly useful for increased accuracy when reporting suspected severe injuries (i.e. injury A) and possible injuries (i.e. Injury C). These findings suggest that the implementation of a decision aid may be particularly useful in decreasing misclassification of certain injury levels commonly documented in the crash report.

Interestingly, the experimental decision aid resulted in increased confidence when used to determine the possible injury scenario (C2). Decision aids have the potential to strengthen the user experience of self-efficacy and control (Grim, Rosenberg, Svedberg, & Schön, 2017).

As previous research has suggested that certain driver characteristics and crash and uncertain crash circumstances may be prone to more errors in crash reporting (Farmer, 2003), the implementation of an objective tool to determine injury severity that increases officer confidence may ultimately lead to increased injury severity reporting accuracy.

4.8 LIMITATIONS

Although the purpose of the study was to use the decision aids to determine injury severity levels, a large number of participants reported they did not use the decision aid during the study. The lack of decision aid use during the study greatly reduced the sample size.

Additionally, the experimental decision aid may require further iteration to consider additional injuries not listed in the current study (i.e. whiplash) and should be evaluated by experts. It is also important to consider other factors that would reduce user frustration (e.g., number of clicks, inability to select multiple injuries) to encourage greater use of the decision aid.

Lastly, although the injury scenarios were evaluated by crash reporting experts, further validation of these scenarios is necessary to determine the reliability of the experimental decision aid. Specifically, an examination of the reliability of the tool should be focused on more ambiguous crash scenarios that may be difficult to interpret.

4.9 FUTURE DIRECTIONS

A follow-up study should be conducted with law enforcement officers to increase the power of the current findings and to further examine the sensitivity of the experimental decision aid across multiple injury severity levels. Future research should consider testing the injury severity decision aid with participants in other states to increase the generalizability and statistical power of the tool. Furthermore, it would be important to examine the reliability and sensitivity of the tool with more ambiguous crash scenarios typically subject to misclassification.

CHAPTER 5: MNCRASH TRAINING

This chapter summarizes the development of an electronic learning training tool designed and driven by user-centered evaluation to improve MNCrash data accuracy and to serve as a training for law enforcement officers when entering crash data into the MNCrash system.

Prior to developing the MNCrash training, initial topic areas were identified through observed weaknesses in the officer's training (i.e. errors, reported confusion or frustration) and through expert contributions (i.e. DPS OTS staff and law enforcement trainers). Topic ideas were segmented into brief training modules and quizzes to be included in the MNCrash training. Next, usability testing and iterative design processes were conducted on a mock-up design of the MNCrash training with law enforcement participants as well as crash reporting experts to evaluate whether the researchers had correctly understood user requirements and properly incorporated them into the training.

Several changes were made throughout the testing process to improve the design and content of the training. The outcome of the research indicated that the MNCrash training produced good usability and user satisfaction from users (i.e. law enforcement participants) and crash data report experts. The final MNCrash training design was recommended for implementation.

5.1 BACKGROUND

The use of e-learning tools has become increasingly widespread and therefore has become a popular learning approach utilized by many organizations (Jia et al., 2011). However, designing an effective training tool requires careful consideration of the quality of content and elements of design. During training design, training developers should focus on training objectives, factors external to the training program (e.g., individual and organizational characteristics and resources), the selection of instructional strategies and methods, and specification of program content (Salas, Wilson, Priest, & Guthrie, 2006).

For e-learning environments, usability is a necessary condition for effective online learning. As such, ensuring usability and enhancement of user experience should be one of the main goals of e-learning developers (Vesin, Mangaroska, & Giannakos, 2018). Usable systems are easy to learn, efficient to use, easy to remember, not error-prone, and satisfactory in use (Nielsen, 1993). Effective e-learning systems should include sophisticated and advanced functions, yet their interface should hide their complexity, providing an easy and flexible interaction suited to catch the user's interest (Ardito, Marsico, Lanzilotti, Levaldi, Roselli, Rossano, & Tersigni, 2004).

Importantly, the design features of the e-learning system may influence the efficacy of the training and knowledge retention. There are several design elements that have been shown to potentially improve the effectiveness of e-learning (DeRouin, Fritzsche, & Salas, 2005). For example, including self-directed learning activities has been shown to be beneficial to learner knowledge acquisition and skill development during online training (Wan, Compeau, & Haggerty, 2012). Similarly, providing feedback to the learner in a constructive and timely manner is important to the success of a training program as it

allows the learner to know how they did during a training and what improvements are needed (Cannon-Bowers & Salas, 1997). Lastly, an additional key factor in determining organizational learning effectiveness is the user satisfaction. User satisfaction increases when the system is easy to use and is user friendly (Navimipour & Zareie, 2015). Therefore, it is important to consider the role of design, content, and usability of the e-learning training to optimize both user engagement and knowledge retention.

5.2 IDENTIFIED TOPIC AREAS

Prior to developing the online training module, it was important to identify any observed weaknesses in the officer's training as evidenced by errors, reported confusion and frustrations, or through expert contributions (i.e., DPS OTS staff and law enforcement trainers). The researchers reviewed MNCrash user testing results, identified knowledge areas in the past hierarchical task analysis created in the crash report usability and design project and met with DPS OTS staff to outline and prioritize areas for training.

The content for the MNCrash Online training was based on previous training tools for the legacy system for existing processes and protocols and prioritized MMUCC Guideline: Model Minimum Uniform Crash Criteria, Fifth Edition (MMUCC 5) variables, MNCrash features, and best practices for complete reports. Initial topic areas were segmented into training modules and accompanying quizzes. Table 5.1 presents a brief overview of the initial topic areas and content.

Table 5.1. Overview of initial topic areas and content

Identified Topic Area	Overview of Topic Content
Why is crash reporting important	<ul style="list-style-type: none"> Why crash reporting is important How crash reporting and data is used Tips and tricks for reporting crash data Debunking myths about crash reporting and data
Distraction/Inattention	<ul style="list-style-type: none"> Understanding the distinction between distraction and inattention Examples of distraction and inattention while driving
Initial point of contact/all damaged areas	<ul style="list-style-type: none"> Understanding manner of collision Defining Subfield 1, Subfield 2, and Subfield 3 attributes
Sequence of Events	<ul style="list-style-type: none"> Understanding reporting the sequence of events How to report sequence of events
Passengers	<ul style="list-style-type: none"> Completing passenger information in the crash report Reporting passenger information for commercial vehicles and school buses
Contributing Factors	<ul style="list-style-type: none"> Understanding the types of contributing circumstances of crash Non-motorist actions, roadway environment, driver actions, and vehicle elements
How to choose the right unit type	<ul style="list-style-type: none"> Describe and define various unit types including motorist and non-motorist for crash reporting Commercial vehicles
Hit and run	<ul style="list-style-type: none"> Defining hit and runs and crash reporting Importance of reporting hit and run data
Work zones	<ul style="list-style-type: none"> Understanding work zones and types of work zones Importance and reporting of work zone crashes and work zone-related crashes

The topic areas were expanded to identify information that should be conveyed to MNCrash users in an online training course. Candidate quiz questions were also developed as a way to assess law

enforcement knowledge on the course content. The initial quiz questions consisted primarily of multiple-choice and true/false response formats. Each quiz question included additional feedback and information for users. The initial training information and quiz questions were refined or expanded where needed. The content was user tested to ensure the information was accurate, up-to-date with the latest MMUCC 5 guidelines, and understandable to users.

5.3 TRAINING DEVELOPMENT

A mock-up of the MNCrash training was designed on Rise360, an online platform for developing e-learning courses. The functionality of the MNCrash online training was designed with the intention of improving user knowledge and experience by considering what features would be appropriate for the design of the course, such as the layout of the interface (e.g., text, diagrams, navigation) as well as the content aesthetics (e.g., color, 'look and feel'). The initially identified training topic areas and quizzes were converted to eight training modules and eight quizzes to make up the content of the MNCrash training. The user was guided through the modules sequentially, although they were free to repeat modules from previously covered material. The training also included frequent interactive knowledge checks to reinforce key teaching points and to reference materials on crash reporting. The total time to complete the MNCrash training and quizzes was estimated to take one hour.

5.3.1 Training Module Topics and Quizzes

The modules developed for the training addressed the following topic areas: 1) Why is crash reporting important, 2) work zones, 3) how to choose the right unit type, 4) initial point of contact/all damaged areas, 5) sequence of events, 6) contributing factors, 7) distraction and inattention, and 8) passengers. The training was self-paced and relied on simple graphics with easy to follow navigation controls (e.g. users clicked the *continue* button to advance the training). Each of the eight training modules contained a series of informational areas, graphics, and interactive components that were designed to keep users engaged. For example, in the first module users reviewed crash reporting information through a series of interactive card-flip tasks and clicked through various information tabs. Each module also contained several knowledge checks, which were designed to test user knowledge and understanding of content. The knowledge checks were presented using various response formats including card sorting, multiple-choice, matching, and true/false.

Additionally, eight module quizzes were developed to correspond with the module topics. The quizzes were interactive and used to reinforce key teaching points as well as to reference materials related to crash reporting. The quiz question formats included multiple-choice, true/false, multiple response, and matching. After the user completed a learning module (e.g., Why is crash reporting important?), they were directed to complete a short quiz related to the content learned in the previous module (e.g., Why is crash reporting important? Quiz).

Why do we need to fill out state crash reports?

DATA SAVES LIVES

MINNESOTA STATUTE 169.09

Minnesota Statute 169.09 requires crash reports on all traffic crashes causing death, injury, or \$1,000 or more in property damage.

While crash reports might feel like unnecessary paperwork, they are completed in order to obtain information that helps to reduce traffic crashes, fatalities, and injuries.

The data collected on crash reports is the first and most important source of information for designing safer roads and vehicles, as well as legislation and programs to bring about changes in human behavior to improve traffic safety.

An officer should make their best judgment call on all of the following except:

- Whether or not alcohol was suspected
- Speeding
- Use of seatbelts
- Driver's license information

SUBMIT

Question

04/05

Minnesota Statute 169.09 requires crash reports on all traffic crash scenarios except:

- Single-unit, run-off-road crash with no injuries, but over \$1,000 in damage
- Parking lot crash between two vehicles with damage greater than \$1,000
- A vehicle rear-ending a parked vehicle
- All of the above

Figure 5.1. Screenshots of initial module content

5.4 METHOD

5.4.1 User Testing and Iterative Design

After the initial MNCrash training was created, user testing and iterative design processes were conducted to determine whether the researchers had correctly understood user requirements and properly incorporated them into the training. Iterative development of user interfaces involves steady design refinement based on user testing and other evaluation methods (Nielsen, 1993). Researchers conducted usability testing using a “think aloud” approach. In iterative design, testing methods such as thinking aloud, provide sufficient insight into the problems to suggest specific changes to the interface (Nielsen, 1992). The testing was conducted with a sample of individuals considered the primary users of the system (i.e. law enforcement participants). The recommended solutions to usability problems were incorporated into the online training during the iterative design process.

5.4.2 Participants

In total, seven law enforcement officers were recruited from Granite Falls Police Department, State Patrol Headquarters, and St. Louis Park Police Department (see Table 5.2). The participants in this study varied in rank and years of experience working in law enforcement (see Table 5.3 and Table 5.4).

Table 5.2 Recruited agencies

Agencies	N
Granite Falls Police Department	1
Yellow Medicine Sheriff's Department	1
State Patrol Headquarters	3
St. Louis Park Police Department	2
TOTAL	7

Table 5.3 Law enforcement rank

Rank	N
Trooper	3
Officer	3
Deputy	1
TOTAL	7

Table 5.4 Years of experience in law enforcement

Years of Experience	N
0-5	4
10-15	2
Over 15	1
TOTAL	7

5.4.3 Materials

5.4.3.1 System Usability Survey (SUS)

The System Usability Scale (SUS) includes 10 items that asked participants to describe their experience using the MNCrash Training Module, ranging from 1 = *strongly disagree* to 5 = *strongly agree*. Sample items include, "I found the system to be unnecessarily complex" and "I felt very confident using the system." A SUS score above 68 would be considered above average.

5.4.4 Procedure

Law enforcement participants met with researchers at their home stations. The order of the modules was counterbalanced across participants. Law enforcement participants spent approximately 10 minutes examining four modules and five-question quizzes. Sessions lasted approximately 40 minutes in total. Participants were provided with a brief background of the state of the module and were asked about their current experiences with the MNCrash system. Next, participants were asked to navigate through the MNCrash training at their own pace.

Participants were encouraged to “think aloud” as they navigated through the online training module, noting the features which might seem confusing, they liked, or disliked, etc., and were prompted by researchers to clarify any ambiguities. Researchers kept detailed notes while the participant interacted with the training module. Once the trial was completed, participants were provided the System Usability Scale (SUS) and rated the training’s usability. Participants were also asked to provide any suggestions for improvement and to indicate the likelihood that they would use this online training.

5.5 RESULTS

5.5.1 Overall Preference and Likelihood of Use

Overall, there were minimal frustrations and concerns reported while using the MNCrash training. Participants reported the training was extremely easy to use, very helpful, and would be applicable to law enforcement officers of all experience levels (i.e. novice to senior officers) and for those who do not enter a lot of crash reports.

Results from qualitative interviews with participants suggested that MNCrash training user experience was generally a successful and positive experience. The feedback received from officers suggested a strong need for user testing as many officers felt their training on the MNCrash report was limited and did not provide foundational knowledge about the definitions or rules of many of the data elements within the crash report. Most law enforcement participants suggested there should be a “how to use MNCrash report” section added into the MNCrash Training. For example, the MNCrash Training would include a section with sample crash scenes and instructions for how to enter the crash data into the MNCrash system. This would allow law enforcement participants to practice interacting and entering data into the MNCrash report to ensure accurate data entry.

5.5.2 System Usability Survey (SUS)

Five participants completed the SUS for the MNCrash Training Module. The mean score was 91.5 ($SD = 4.87$), suggesting high user satisfaction.

5.6 EXPERT REVIEW

A final design iteration and validation review was conducted on the MNCrash training course. Specific content and design elements were modified based on the input from law enforcement users. The training module with the integrated iterations and changes was then reviewed by crash reporting and data experts. Experts reviewed the training modules of the e-learning program for quality and accuracy using Articulate’s Review360, which allows users to review the MNCrash training online and add comments. In total, eight experts completed reviews for the MNCrash Online Training. Reviewers were recruited from the Minnesota Department of Public Safety Office of Traffic Safety, Minnesota State Patrol, Saint Paul Police Department, and Minnesota Department of Transportation. The feedback received from the expert reviewers was assessed by the research team and organized into actionable items and general feedback in terms of satisfaction or frustration.

5.6.1 General Reviewer Feedback and Overall Preference

Overall, there were minimal frustrations and concerns reported while reviewing the MNCrash Training module. Participants reported that the online training was easy to follow and information was presented in a simple, clear, and visually interesting manner. The MNCrash online training was perceived as valuable and useful for improving the crash reporting process.

5.7 ITERATIVE DESIGN AND MNCRASH TRAINING CHANGES

Iterative development of user interfaces involves steady design refinement based on user testing and other evaluation methods (Nielsen, 1993). Several changes were made to the overall design throughout the iteration process. The researchers sought to make improvements to the training to make it understandable to a broad range of experience levels and evaluated issues related to design, content, and user engagement. Design changes were made to module content, knowledge checks, and quizzes to improve information delivery, navigation control, and overall layout. Users and experts provided suggested revisions related to the quality and accuracy of the MNCrash training. Table 5.5 presents a summary of changes for each module and quiz throughout the iterative design process.

Table 5.5 Summary of iterative design changes to training modules and quizzes

Module/Quiz	Initial Content Changes	Final Content Changes
Why is crash reporting important?	<ul style="list-style-type: none"> Crash report statistics were updated from 2016 to 2017 crash and homicide statistics rates in Minnesota and the United States. Suicide rate statistics were removed to increase salience of crash rate statistics. 	<ul style="list-style-type: none"> Crash report statistics were updated to 2018 crash and homicide statistics rate for Minnesota and the United States. Who is most affected? statistics updated Included ANSI D16 definition of a motor vehicle traffic crash and 8 qualifications of traffic crash. Updated statistics on human behavior changes for seat belt use and alcohol-related deaths in module and Quiz question #3.
Work Zones and Quiz	<ul style="list-style-type: none"> Work Zone Crashes and Work Zone-Related Crashes sections segmented Instructions were added for the dropdown list of types of work zone crashes. 	<ul style="list-style-type: none"> Work Zone Crash definition and work zone examples updated. MMUCC 5Diagram of a Work Zone Area added to Work Zone Related Crashes Modified Quiz question #5 Work Zone Quiz terminology updated from ‘accident’ to ‘crash.’
How to Choose the Right Unit Type	<ul style="list-style-type: none"> A card sort knowledge check was added to aid in distinguishing between motorist and non-motorists. The unit type clickable dropdown list was changed to a scrolling list for easier navigation. Instructions were added for participants. 	<ul style="list-style-type: none"> Updated commercial vehicle definition to MMUCC 5 and ANSI D-16 guidelines sec 2.2.7.3. guidelines. Added Knowledge Check on commercial vehicles Added “wheelchair” to personal conveyance type, added snowplow removing ice to working vehicles.
Important Vehicle Data Elements	<ul style="list-style-type: none"> Manner of collision was reformatted so that the content fit within the user computer screen. Knowledge Check instructions were modified to be more easily understood. 	<ul style="list-style-type: none"> Initial Point of Contact/All Damaged Areas was renamed with the title “Important Vehicle Data Elements” and additional content on motor vehicle data elements, direction of travel and pre-crash maneuver. Removed image of the vehicle with a NY license plate. Added images of manner of collision and associated crash diagrams from MMUCC 5. Updated labels for Subfield 1: Initial Point of Contract, Subfield 2: Location of Damaged Area(s) and Subfield 3: Resulting Extent of Damage
Sequence of Events	<ul style="list-style-type: none"> Sequence of events sample scenarios were changed from paragraph format to an interactive, clickable format in sequential order. Reformatted general layout to reduce confusion. 	<ul style="list-style-type: none"> Revision to layout of sequence of events examples Added section to describe “storytelling with data’ to highlight the importance sequence of events
Contributing Factors	<ul style="list-style-type: none"> Instructions were added to the contributing factors car diagram to increase user experience. Plus signs were changed to numbers for easier navigation and user interaction. 	<ul style="list-style-type: none"> Road circumstances and non-motorist actions lists reformatted to clickable checkboxes. Question 5 quiz terminology updated from “causes a car accident” to “causes a car crash”.
Distraction and Inattention	<ul style="list-style-type: none"> The two constructs of inattention and distraction were defined to be understood as two distinct constructs. Addition of interactive card sort for the distraction and inattention constructs 	<ul style="list-style-type: none"> Addition of content to include the importance of the distinction between distraction and inattention
Passengers	<ul style="list-style-type: none"> School bus crash statistics were added to show that this type of crash is a rare occurrence. Instructions were added for how to use certain interactive features (e.g., special use cases click-to-flip). 	<ul style="list-style-type: none"> School Bus Crashes statistics and knowledge check were updated 603 crashes in 2018 and 489 of them were property damage only.

5.7.1 Information Changes

Several information changes were made throughout the design process to improve the quality of the training content and to reduce user frustration or confusion. Statistics were modified to ensure they were up to date with the most recent crash statistics. For instance, the 2016 crash report statistics were updated to 2018 crash report statistics. Additionally, modifications were made to terminology and vocabulary to ensure they were appropriate for learning (e.g., ‘accident’ was replaced with ‘crash’).

Information changes were made based on feedback provided by the expert reviewers to create a more comprehensive training and to address additional knowledge gaps. For example, additional information was added to include the definition and major characteristics of a motor vehicle crash to the *Why is crash reporting important?* module. Additional information was added to address the direction of travel and pre-crash maneuvers in the *Motor Vehicle Data Elements* module. Abstract concepts (i.e. inattention versus distraction) were clarified with concrete, specific examples and content was added to highlight the importance of understanding abstract concepts.

5.7.1.1 Knowledge Checks

Knowledge checks were incorporated throughout the training to reinforce user knowledge and to better prepare users for subsequent module quizzes, labeled as “knowledge check” to help users differentiate the knowledge checks from other content within the modules. Answer feedback was added to each knowledge check to provide an explanation as to why the selected answer was either correct or incorrect.

5.7.1.2 Module Quizzes

Each module quiz was changed to include a total of five questions. Quiz question grammar was edited, and the question wording was modified so that it would be easily understood by a wider audience of law enforcement participants. Feedback was added to each quiz question for both correct and incorrect answers so that the user consistently received information about why the answer was correct or incorrect.

Knowledge Check:

How many school buses in Minnesota were involved in crashes in 2018?

5,000

1,020

9,999

603



Correct

There were only 603 school buses in Minnesota involved in crashes in 2018. 489 of them were property damage only meaning they would only require a simple headcount of any passengers on board.

Direction of Travel

The direction of travel is the direction of a motor vehicle's travel on the roadway before the crash. This is not a compass direction, but a direction consistent with the designated direction of the road. Code the direction the vehicle was going just before they enter the intersection. Includes the following attribute values:

- Not on roadway
- Northbound
- Eastbound
- Southbound
- Westbound
- Unknown

Why does this matter? It is important to indicate direction the motor vehicle was traveling before the crash for evaluation purposes. It is also important for intersection analysis and future roadway considerations.



Defining a Motor Vehicle Traffic Crash

In MNCrash, a traffic crash is equivalent to the ANSI D16.1 definition of a motor vehicle crash. The ANSI D16.1, American National Standard: Manual on Classification of Motor Vehicle Traffic Crashes defines a **motor vehicle traffic crash** as a motor vehicle crash which is also a traffic crash.

Figure 5.2 Screenshots of training information changes

5.7.2 Navigational Changes

Several navigational changes were made throughout the iteration process to provide better navigational control throughout the MNCrash training and to help users recognize the functionality of different types of buttons (e.g., click to flip, use the mouse to drag and drop). Instructions were added to the interactive and clickable features of the modules to provide users instructions for how to interact with each feature. For example, to complete a card sort activity, users were given the following instructions: *“Use the mouse to drag each example card into the correct category.”* Other navigation tools were implemented such as the addition of “continue” buttons to segment each section and “up next” to inform the users what would be coming next in the training (e.g., a module quiz). Additionally, continue buttons were “locked” to prevent users from skipping slides and to increase user learning and engagement.

The factors that may have contributed to a crash are divided into 3 sections. Click on each tab to learn more.

ROADWAY ENVIRONMENT	MOTOR VEHICLE	PERSON
----------------------------	---------------	--------

Apparent environmental or roadway conditions which may have contributed to the crash.



 Click each tab to review all content above before moving on.

Up Next: Passengers Quiz

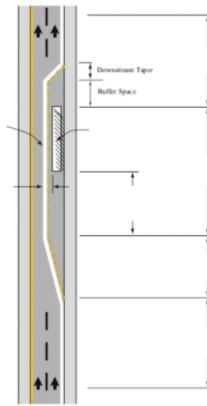
CONTINUE

Figure 5.3 Screenshot of example navigational changes

5.7.3 General Layout Changes

Several general layout changes were made throughout the MNCrash training. Each module was resized so that the viewed content fit on one page and the user did not have to scroll down to read the remaining portion of the sections of the module. Other example layout changes included adding supplemental MMUCC 5 diagrams for reference (e.g., Diagram of a Work zone, Manner of Collision, and Associated Crash Diagrams) and transforming standard information lists into interactive lists (i.e. clickable checkboxes) to increase participation. Additionally, several design and aesthetic changes were added to enhance the overall 'look and feel' of the training. For example, multimedia changes were made to enhance the visual appeal and increase the user experience (e.g., pie charts were added to Who is most affected? statistics). Font sizes were scaled appropriately to emphasize the importance of the content being presented (e.g., font size for important definitions were increased). Lastly, an effort was made to balance the content presented within each module through the use of text, images, lists, and interactive features.

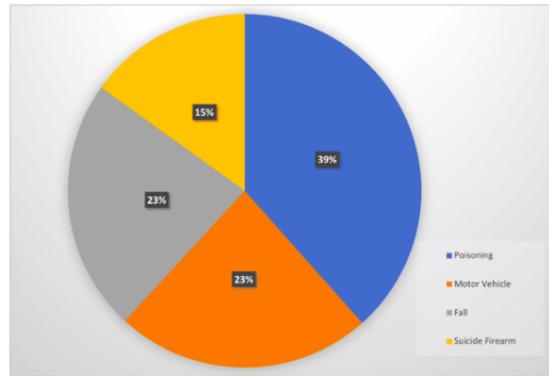
Figure 6: Diagram of a Work Zone Area



Work Zone Related Crashes. A work zone related crash is a crash that occurs in or related to a construction, maintenance, or utility work zone, whether or not workers were actually present at the time of the crash. Work zone related crashes may also include those involving motor vehicles slowed or stopped because of the work zone, even if the first harmful event occurred before the first warning sign.

Who is most affected?

Motor vehicle traffic crashes are one of the top four leading causes of unintentional injury deaths along with unintentional poisoning, falls, and suicide by firearm.



Leading Causes of Unintentional Injury Deaths

Figure 5.4 Screenshots of sample layout changes

5.7.4 Addition of Welcome and Concluding Modules

Two additional modules were added to the MNCrash training at the beginning and end of the training. The first module was a welcome module to introduce users to the purpose of the training and to provide general instructions for how to use the training. A concluding module was added to summarize the course content and to provide closure for completing the training.

5.7.4.1 Welcome Module

A “Welcome to your MNCrash Training” module was created to provide general instructions, expectations, and additional resources for users prior to beginning the core training modules. The user was first presented with information about the importance of their role in improving safety as well as an overview of why crash reporting matters. Next, participants were provided a step-by-step, interactive presentation of how to navigate the MNCrash training (e.g., Step 1: Review the content, Step 2: Take the

knowledge checks). Lastly, participants were thanked for their participation and were primed with what they would gain by completing the training.

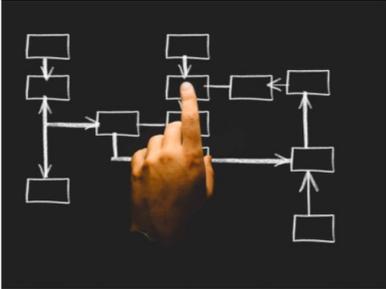
Welcome



You have an important role in helping to improve the safety of our roadways and the health of our communities. Crash reporting is critical in helping to document, tabulate, and analyze the circumstances and contributing factors of crashes on our roadways.

Step 1

Review the content



The content of this training has been created to help improve your areas of knowledge in some of the more challenging or complex components of crash reporting.

Summary



Once you complete this training, you should leave with a greater appreciation for your important role in roadway safety, a deeper understanding of many of the sections within the MNCrash report, and greater confidence in your ability to accurately convey the critical details of each and every crash.

Figure 5.5 Screenshots of example content in Welcome to your MNCrash Training module

5.7.4.2 Concluding Module

A concluding module titled “Summary, Tips and Tricks for Crash Reporting” was added to reinforce key learning points throughout the MNCrash training. First, users reviewed brief interactive summaries of each of the eight core modules and several knowledge checks. Next, users reviewed tips and tricks for documenting future crash reports. Example tips included using mix-case letters in the narrative instead of uppercase and encouraging users to not hold back information when documenting a report. Sample tricks included items such as encouraging users to use hyperlinks to reduce uncertainty and the use of keystrokes (i.e. tab) to improve navigation and efficiency. Participants then reviewed crash reporting

narrative tips to improve the completion and accuracy of the narrative report section within the MNCrash report. Lastly, users viewed a course completion message congratulating them of their course completion. Users were thanked for being an important partner in roadway safety and reminded of the importance of their role in crash reporting.

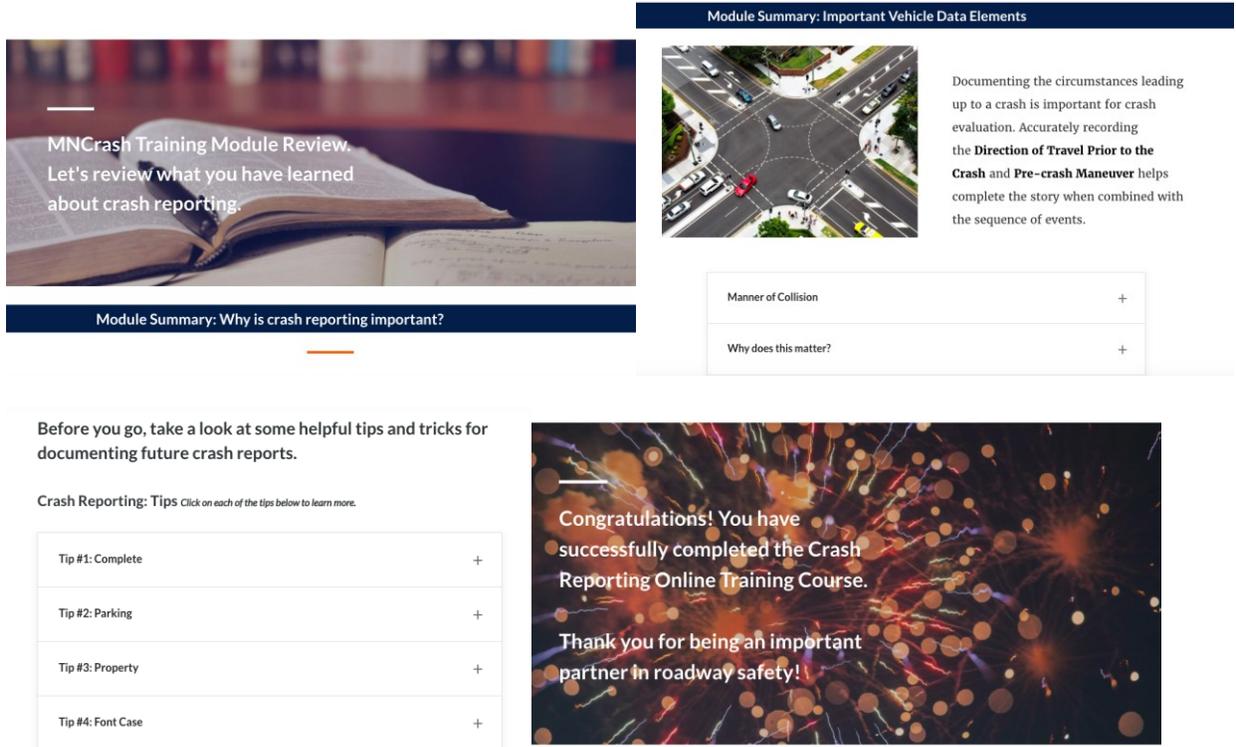


Figure 5.6 Screenshots of sample content included in Summary, Tips and Tricks for Crash Reporting module

5.8 DISCUSSION

The purpose of the research was to develop an electronic training that would improve data accuracy and serve as a training for law enforcement officers when entering crash data into the MNCrash system. The recommended solutions to usability problems were incorporated into the MNCrash training throughout the iterative design process to create a final comprehensive training course for users. Any system designed for people to use should be easy to learn (and remember), useful, and be easy and pleasant to use (Gould & Lewis, 1985).

The final training design consisted of an introductory module, eight core modules with eight quizzes, and a concluding module. Changes were made to enhance user experience and satisfaction by modifying the information, navigation features, and the general layout throughout the design process. Multiple phases of user testing and iteration resulted in a final design that resulted in good usability and user satisfaction for both end-users (i.e. law enforcement participants) and expert reviewers (i.e. trainers, DPS OTS staff).

The primary purpose of the MNCrash training was to design a training that would serve as a supplemental tool within an officer’s training environment. In addition, the training can be used by law

enforcement officers with various crash reporting experience levels (i.e. novice to expert) as either a novel or refresher training, and can be used with any amount of computer literacy. Ultimately, the training was designed to improve data accuracy and address user knowledge gaps when entering crash data into the MNCrash system. It was recommended that the MNCrash training be considered as an option for implementation. See Appendix F for the finalized version.

5.9 LIMITATIONS

The sample used to conduct testing consisted of law enforcement participants whom had been in their positions for at least four years. It is important to evaluate the efficacy of the training with newer officers (i.e. those with less than one year of experience) to determine whether additional modules would be useful for addressing knowledge gaps in crash reporting. Additionally, some of the content in the current training is based on current MMUCC 5 guidelines and recent statistics (i.e. 2018 traffic crash deaths) which need to be regularly updated as new guidelines and statistics are released.

5.10 FUTURE DIRECTIONS

Future research should consider additional module topic areas that would be effective at increasing data accuracy and overall crash reporting, such as including “practice” crash scenarios to simulate completing a crash report. A successful training program includes practice opportunities provided to trainees during training (Salas, Wilson, Priest, & Guthrie, 2006). Furthermore, it would be important to look at measurable differences in the transfer of knowledge and the long-term effects of the training on crash reporting practices using an experimental design with a control group. Previous research has suggested there may be certain factors associated with higher learning performance such as the learner’s motivation and computer self-efficacy skills (Lim, Lee, & Nam, 2007). Additionally, further user testing should be conducted to determine the compatibility of the system on various devices, such as smartphones or tablets. Lastly, it would be important to consider implementing the MNCrash training into onboarding training for new officers as well as conducting follow-up evaluations to determine the benefits to the training, particularly for new law enforcement officers.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

The goal of the research activities was to improve the data accuracy and data completeness in the MNCrash interface system by conducting a series of usability tests, design recommendations, and training opportunities. A commonly documented issue in police crash reporting relates to reporting accuracy and data completion. Therefore, crash reporting forms should be improved (Ahmed, Sadullah, & Yahya, 2019). One approach to reduce the amount of errors in crash reporting may be through good design. As such, this study uses a user-centered design approach to address existing issues within the MNCrash interface system. A careful design is one that prevents a problem from occurring in the first place (Nielsen, 2005).

For this reason, a series of usability testing with the existing MNCrash interface was conducted to document errors, frustrations, or confusion points that could be addressed through iterative design and training. Many observed problems were related to detail and efficiency issues, such that errors were a result of failing to input information into the crash report or misunderstandings about what information was needed for specific fields within the crash report. Design recommendations were developed and user-tested to improve efficiency, reduce errors, and increase user satisfaction. The outcome resulted in the implementation of the majority of the recommended design changes to improve data accuracy and data completeness.

Another commonly documented issue within crash reporting is the misclassification of injury severity, such that police officers correctly identify drivers as either killed or uninjured, but the various levels of nonfatal injury are often misclassified (Farmer, 2003). Therefore, an injury severity decision aid prototype was designed and driven by user-centered evaluations to improve injury severity reporting accuracy and officer confidence. The feedback on the decision aid suggested that it was easy to use, provided clear explanations of injury levels, and was visually appealing. Further, findings from the experimental study revealed that the decision aid was useful for increasing the accuracy in determining injury severity levels. Moreover, it was found that the decision aid was particularly useful for increasing the accuracy of injuries commonly misreported in the crash report (i.e., suspected series injury, possible injury).

The primary focus of the research activities was to improve data accuracy and completeness on the MNCrash interface through user-centered design. However, it was important to provide officers with a better understanding of the necessity for more accurate and complete data within the crash report. Therefore, a complementary training was designed through user-centered evaluation. Employee training has become an effective way to enhance organizational productivity (Wan, Comeau, & Haggerty, 2012). Throughout the iterative design process, several design changes were made to improve the quality of the content and the overall usability of the training. Overall, the training was found to be extremely easy to use, very helpful, and would be applicable to law enforcement officers of all experience levels (i.e., novice to senior officers) as well as for those who do not enter a lot of crash reports. The outcome resulted in a comprehensive MNCrash training that produced good usability and user satisfaction from users and expert reviews.

6.1 LIMITATIONS AND FUTURE DIRECTIONS

The research activities completed in this report were not without limitations. First, while the sample sizes in the MNCrash design and usability testing were consistent with usability testing standard standards (Wickens, Lee, Liu, & Gordon, 2004), they may not be fully representative all MNCrash

interface users at agencies that were not sampled in this study. Therefore, it would be important to do further testing with additional participants to determine the usability of the changes, such as with newer officers (i.e., those with less than one year of experience) and various levels of computer self-efficacy. Nonetheless, the findings from the current research activities are expected to improve data accuracy, data completion, and user satisfaction. Some other areas identified will require more extensive changes to the report or will involve addressing cultural or organizational issues that will require more time and coordination to resolve.

Follow-up testing should be completed to evaluate the usability of the recommended changes and to determine whether there are additional issues to be addressed. Additionally, issues that were unable to be implemented due to mandates or regulations should be reexamined and evaluated by experts at a future date. Obtaining more accurate crash data from reporting officers should not only involve education on areas of weakness but also incorporate more buy-in from officers on the importance of data completeness and accuracy to analysts, engineers, legislators, and other law enforcement personnel.

In addition, the sample size was limited in the injury severity decision aid study due to a lack of reported decision aid use, and the sample consisted of only Minnesota law enforcement officers. A larger and more representative sample size should be included in a future study to increase the study's power and further validate the injury severity decision aid prototype. To examine the strength and reliability of the decision aid, it would also be important to test the decision aid with more ambiguous crash scenarios that might be difficult to interpret. Similarly, the crash scenarios used in the study were evaluated by crash reporting experts. However, it would be useful to evaluate these scenarios with other experts, such as medical professionals, to strengthen content validity.

Finally, the MNCrash training module topics covered were not exhaustive in terms of all areas in need of improvement. Moreover, some of the existing content contained statistics and information that needed to be routinely updated (e.g., crash statistics, MMUCC guidelines) as new standards and statistics were released. Future research should consider additional module topic areas that would be useful for increasing data accuracy and data completeness in crash reporting. In addition, future research should consider implementing the training with new law enforcement officers to determine the usefulness of the training as it relates to data completeness and accuracy within the crash report.

Taken together, the research activities highlight the importance of taking a user-centered design approach to reducing error and improving overall quality of data. As such, the path toward quality data could be through that of quality user-centered design. Taking a user-centered design approach should be considered a standard toward achieving high-quality data and data completeness.

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APPENDIX A
USABILITY TESTING SCENARIOS

SCENARIO A: 2 UNIT INTERSECTION CRASH + RAN OFF ROAD

A 2-unit collision occurred on Nov 19th at 11:30am and originated at the intersection of <insert here a familiar intersection in your city>. **Vehicle 1** was traveling North the N/S roadway when she made a left turn on a green arrow and hit **Vehicle 2**. **Vehicle 2** was travelling South on the N/S roadway and made a right on red light. **Vehicle 2** did not come to a complete stop before entering the intersection and getting hit by **Vehicle 1**. Driver of **Vehicle 2** did not realize the left turn lane consisted of 2 lanes. After being hit, driver of **Vehicle 2** overcorrected and ran right off the road hitting a street sign and coming to a stop on the sidewalk.

Road was dry and weather was fair and sunny.

All traffic control signals were present and working.

You have the following information for...

Vehicle 1:

1. <Insert any dummy data for a generic passenger vehicle for Vehicle 1>
2. Vehicle 1 has damage to the right side front bumper
3. Driver:
 - a) Driver license: M220683067118
 - b) Name: MOSES, PHOEBE
 - c) DOB: 2/14/1939
 - d) Address: 1000 University Ave SE, Minneapolis Hennepin County 55414
 - e) Wore a LAS belt at time of crash
 - f) Not injured

Vehicle 2:

4. <Insert any dummy data for a generic passenger vehicle for Vehicle 2>
5. Vehicle 2 has damage to driver side door, front bumper, and undercarriage
6. Driver:
 - g) Driver license: B600119107167
 - h) Name: BARROW, CLYDE
 - i) DOB: 4/3/1975
 - j) Address: 1015 SE 8th St, Minneapolis Hennepin County 55414
 - k) Wore a LAS belt at time of crash
 - l) Possible back injury and not taken to the hospital

SCENARIO B: SINGLE UNIT RAN OFF ROAD

A single vehicle crash occurred on Nov 19th at 10am on <insert any familiar east/west highway in your area>. Driver of **Vehicle 1**, travelling eastbound the highway lost control navigating a bend to the right in the road, crossed the centerline, went off the road, and rolled once before coming to a rest right side up. The driver of Vehicle 1 was suspected to have been going upwards of 80mph in a 55mph. The scent of alcohol was on the driver, and his BAC was .23 at the hospital where he was transported for major injuries and later died at hospital. The passenger of **Vehicle 1** could not remember what happened just before the crash, but thinks the driver may have looked away from the roadway briefly.

Road conditions were icy. No street lights illuminating road.

You have the following information on **Vehicle 1:**

1. <Insert generic pickup truck dummy data for Vehicle 1>

2. Driver:
 - a) Driver license: R100603020977
 - b) Name: RAPP, MITCH
 - c) DOB: 08/11/1965
 - d) Address: 200 Arch St, St Paul, MN 55130 Ramsey County
 - e) Was not belted at time of crash and ejected through windshield
 - f) Transported to Regions Hospital with major injuries and died at the hospital
3. Passenger:
 - a. No injuries

APPENDIX B
USABILITY TEST DETAILED FINDINGS

DETAILED LIST OF ISSUES RAISED IN USABILITY TESTING

Category (Crash Level)	Problem/Issue	Proposed solution
State	Searching for Minnesota is cumbersome.	Make Minnesota the first on the drop down menu.
Weather	It is redundant to put "clear" in weather 1 and weather 2.	If "clear" is put for the first weather condition, then the second weather condition should autofill NA.
Road System	Officers struggle to know who owns the roads.	Road systems should be in order of most common to least.
Distance From Intersection	Judging distance from intersection is difficult to gauge.	
Location Relative to Trafficway	On/Off trafficway has some business rules with location relative to trafficway that are not intuitive, and they get an error frequently that they have to go back and change.	Clearly define the rules around business with location relative to trafficway.
	The differences between on roadside and outside of trafficway are unclear.	Provide diagrams in descriptions to answer any questions about definitions.
	It is unclear what constitutes as a "non-trafficway" and what does not and why.	In the definition of non-trafficway, include a list of types of non-trafficways.
Hyperlinks	Some hyperlink information is unclear or inaccurate.	Go through the hyperlink content, making sure that it is clear and factual.
Total Number of Lanes	Not all officers know if this includes all the lanes or just the number of lanes in one direction.	Include the definition of number of lanes in the question i.e. How many lanes of traffic (going both directions) were there?
Map	The zoom feature in the map is finicky and does not consistently allow for a close enough zoom.	
	Mapping parking lots can come up as an error.	
	The keywords in easy street draw are not familiar, so searching for items is difficult.	Use more common words for ease of searching.
Bus/Work zone/Bridge	It is cumbersome to have to fill out common infrequent questions.	Group infrequent questions together so they can be filled out faster.
City	The report auto-fills the same city every time when starting the report.	
Yellow tags	The officers find it cumbersome to always have to fill this out when it has no relevance. However, state patrol needs this to submit public property damage.	Remove the "Yellow Tags" question from the report for all except state patrol.

Category (Unit Level)	Problem/Issue	Proposed solution
Sequence of events	Searching for events is inefficient.	Change "road sign" to "sign" so that it is easier to search for; additionally, making the list of events in order of frequency instead of alphabetical would make things faster to complete.
Most Harmful Event	Having to fill out the most harmful event when there is only one event is redundant.	Auto-populate the most harmful event when there is only one event.
Damage & Damage Diagram	When the report is printed out, it is too hard to see the damage diagram.	Make the diagram darker and higher contrast.
	It is too hard to differentiate the damage areas.	Make the first initial point of contact red then secondary points of contact blue. In addition to this, remove italics and underline "all damaged areas".
	There are no clear numbers on the damage diagram to indicate damage to a corner of the car.	Put numbers specifically to the corner so that it is very clear what number on the diagram includes the corner.
	The widget button is gray until activated, so it is easy to miss.	Keep the button always up instead of having the pop-in feature.
	The damage diagram is limited on the car model options.	Auto-populate the car model into the diagram, while also increasing the amount and diversity of car diagrams.
	Initial point of contact for a roll is usually the whole side.	Create an option for a roll that would allow the officer to pick multiple points for initial point of contact.
VIN	Out of state commercial VIN's are hard to find or do not work in the system, then it does not let officers submit the crash report.	
Buses	There is no "Gillig" bus model.	Include "Gillig" in the bus models.
	Buses do not have plates, so when prompted for the bus plate number, officers have to make something up.	Do not prompt for plate number when it is a bus.
	Writing down all the bus passengers' info in a bus accident is cumbersome.	Do not require bus passenger info unless injured in accident.
	Bus inspection numbers can be hard to find, and there is no "unknown" box to check for this.	Add a box for "unknown inspection number"
Roadway Characteristics	"Copy Unit 1" is too far to the left.	Move "Copy Unit 1" over the top of roadway characteristics to better differentiate from sequence of events.
Insurance	Having to fill out insurance when already giving out a citation for no insurance is redundant.	When putting in that they are giving a citation for no insurance, autofill the insurance box to none.
	Takes a long time to put in insurance policy numbers when they are very long.	

	Some insurance policies are from smaller companies so they are too short and then are not accepted.	Do not have a minimum for the insurance policy numbers.
Endorsements	Endorsements are already in the system, but officers have to fill them in anyways.	Autofill endorsements.
Hazmat Placard	Autofill is unreliable when filling out hazmat information.	Make this autofill more consistent.
	There is no hazmat option for lube tech trucks.	Add hazmat lube tech option.
MnFILL	License plates do not autofill even though the information is already in the system.	Autofill license plates.
	"Copy from owner" button only fills out half the information.	
	Vehicle information regarding color, year, and model should autofill.	Use the existing information in the system to autofill this.
Towing	Officers are inquisitive as to why they have to fill out towing information.	Explain to officers why this information is pertinent, possibly in a hyperlink.
	Officers do not know if towing includes private or impound tows.	Specify this information in a towing hyperlink.
Fire	Fires rarely happen to cars so always having to fill out "not on fire" is cumbersome.	Default fire to "not on fire" and if there is a fire, the officers ensure that it would be notable enough to remember to change.
Type of Car	There is no "Kia" option.	Add "Kia" to the type of cars.
Manner of Collision	There is no option for "front to side" collision.	Add a "front to side" manner of collision, since this is a popular type of crash.
	When choosing "other" there is no way to explain what type of collision it was.	Add a text box when picking "other" so the officer can explain the collision.
Pulling Unit	When selecting "pulling unit", there is no way to show on the damage diagram if damage was done to the pulling unit.	After selecting that a vehicle has a pulling unit, this should autofill into the damage diagram so that officers can accurately display where damage happened.

Category (Person Level)	Problem/Issue	Proposed solution
ID/License	When using instruction license without an adult, is the permit valid but beyond restriction?	Include clear definition of license violations, because this is a common issue.
	Gender "X" in the crash report is missing.	Include "X" in the crash report as it appears on the ID.
MnFILL	When license info autofills, officers expressed frustration with having to reenter the phone number and sex of the person.	Officers would like this to autofill like the other information does. There is also some information officers have to manually put in that the system already has and should autofill.
	MnFILL information is not consistently accurate.	Implement thorough internal checks on MnFILL information.
	MnFILL will sometimes autofill names with commas after the last name.	Have the system ignore commas concerning people's names.
Address Correct?	The "address correct" question pops up frequently, and they have no way to verify this but by asking them.	Some officers feel it is the responsibility of the person to make sure their address is up to date.
Passenger	Add passenger button is redundant because this was already stated in a previous question.	Delete the add passenger button.
	Passenger info is seldom taken on scene, so officers end up deleting passengers because they cannot fill out the information.	Add an "unknown" button for information about the passenger, so officers can still include what they do know.
	There is confusion about whether or not the driver counts as a passenger.	Add the definition into the question i.e. How many passengers were in the vehicle (not including the driver)?
Restraint System Used	There are limited options for buses.	Include options like "LAS not present and not used".
Contributing Factors	There is no option for "fail to drive with due care".	Include the option "fail to drive with due care".
	"No clear contributing factor" should be first on the drop down list.	Put "no clear contributing factors" first on the drop down list to make it faster to select.
	Inattentive and distraction should be distinct.	Make "inattentive" a separate contributing factor.
	There should be choices for admitted distracted driving and suspected distracted driving.	Create an option for admitting distraction and suspecting distraction.
	The option "swerved due to slippery surface" is too specific for general swerving that is not due to road conditions.	Put in an option for "swerving, general".
Speed	When choosing "too fast for conditions" it does not auto-populate speed.	Auto-populate speed when picking "too fast for conditions".
Citation	Citation should link to e-charging for efficiency.	Link e-charging to the crash report.
	Violation does not make sense in terms of a fatality violation.	Change "fatality violation" into "What citation was issued?"
Injury	It is unknown on how to report that someone was alive at the scene of the crash and died later because picking fatality and injury results in an error.	Specify in the hyperlinks which one to choose for a scenario where someone is alive at the crash and then dies at the hospital.
	Serious injuries is too all encompassing.	Include more specific definitions and examples for injury determinations
	Letters from the dropdown menu are unnecessary.	Remove the letters from dropdown menu.

APPENDIX C
SUMMARY OF DESIGN RECOMMENDATIONS

DETAILED LIST OF Design Recommendations

Issue	Design Recommendation	Further Details	Benefit
Alcohol and Drug Testing Selection Criteria	Autofill <i>Alcohol Test</i> to “Test Not Given” when <i>Suspect Alcohol?</i> is selected as “No”.	Default selecting “Test Not Given” when “No” is selected for both alcohol and drug testing will alleviate a step and frustration for users. In the instances when no alcohol or drugs are suspected, but a test is administered (e.g., Metro Transit PD policy) the option to change the test selection will still be possible. There is a risk of “default bias” where users will be unlikely to change any selection that is made through default processes that is believed to be low. Keystroke Level Model (KLM) estimates (i.e. estimated duration of mouse pointing, clicking, thinking for each step) that this modification would reduce task duration by 7.6 seconds.	Reduction in mental workload and user frustration.
	Autofill <i>Drug Test</i> attribute to “Test Not Given” when <i>Suspected Drugs?</i> Is selected as “No”.		
Under-utilized Hyperlinks and Trafficway Fields	All blue text labels containing hyperlinks should be underlined.	Officers reported being confused about the options related to this attribute as well as what does and does not constitute as a non-trafficway and the business rules with the location relative to the trafficway are not intuitive. Additionally, user testing indicated officers were often not aware of the features or functionality of embedded pop up information contained in blue text hyperlink data entry labels. This may be due to the fact that the links are only denoted through blue text, but are not underlined. This design violates usability guidelines that state that an underlined black or preferably blue text maximizes the perceived affordance of the “clickability” of the text (Nielsen, 2004).	Improved accuracy of data entry through increased reference to information embedded throughout the crash report.
	Image of the trafficway be updated from the MMUCC 5 th edition.		
	Duplicate the image used in <i>Location Relative to Trafficway</i> hyperlink pop-up be used in <i>On/Off Trafficway</i> hyperlink pop-up.		
Uncertainty for Speed Data Accuracy Requirements	Change the label text to state: “ <i>What is your best estimate for the unit’s travel speed?</i> ” and underline the blue text labels containing the hyperlink.	Officers reported uneasiness about entering unit travel speed in the Fatality section. They were unaware that they should be giving a best estimate, that they may contradict future reconstruction reports, and did not know reconstruction reports would not correct or populate crash reports.	Improved accuracy, decreased confusion, and increased data entry. Improved use of hyperlinks in crash reporting.
	Modify hyperlink pop-up to state: “This should be an educated guess, you do not need to definitively know the answer or match future reconstruction reports.”		
	<i>Roadway System</i> attribute should be in order of most common to least common roadways.		Increased accuracy, reduced user

Search Selection Difficulty for Roadway System	“Other road” should be moved to the bottom of the most frequent list or the bottom of the entire list.	Officers reported frustration in selecting correct roadway system for the crash location and requested assistance in selecting best option through an ordering of most to least frequent road system types involved in crashes.	frustration, and reduced search time.
Yellow Tag Confusion	Improve information regarding <i>Yellow Tag #</i> by indicating who is expected to complete the field as well as where the tags and information can be found.	The <i>Yellow Tag #</i> data entry field implies that the question only applies to MN State Patrol. Officers were confused if this attribute pertains to non-state patrol officers. DPS OTS informed the research team that based on MnDOT discussions, that Yellow Tags apply to all officers and that the tag number should relate to the Local Case Number. DPS intends to give users an option to copy the Local Case Number to the Yellow Tag # entry field.	Reduced user frustration and reduced confusion.
Need for Violations/Criterion Clarification	Update section to be MMUCC 5 compliant allowing for State Violation Code to be entered.	Officers reported uncertainty regarding which citations should be included when selecting <i>Citation Issued?</i> They reported that issuing citations for driver’s license violations are common, but their applicability to crash reporting is uncertain.	Increased data quality regarding citations involved in traffic crashes and decreased officer uncertainty about citation inclusion.
	Remove drop down menu from Violations section and add open entry field labeled <i>Minnesota Offense Code (MOC)</i> .		
	Add a check box for “No Violation”		
	Add hyperlink on the <i>Minnesota Offense Code (MOC)</i> with an information pop-up box containing: “Enter 5 digit alphanumeric MOC code to document any citations issued.”		
Passenger Count Clarification	Add in a definition and hyperlink (i.e. blue, underlined text), to the <i>Passenger Count</i> label stating: “Passenger count should include all occupants of motor vehicle <u>NOT including the driver.</u> ”	Officers were uncertain if they should include drivers in the passenger count. The number of reported passengers may be inflated if this error results in the inclusion of drivers in the passenger count.	Increased data accuracy and decreased officer uncertainty or confusion about what does and does not constitute as a passenger.
Insufficient Options for	Include “Driver Inattentive” to <i>Contributing Factors</i> to support drivers who are not properly paying attention, but have no evidence of explicit distraction.	Officers were uncertain about how they could include inattentive driving into crash reports and how they could report suspected distraction as opposed to confirmed or observed distraction. Past analyses found officers often included distraction in contributing factors but then selected “Unknown” for type of distracted driving. Additionally, inattentive driving	Increased data capture and accuracy and decreased officer

Distracted Driving	Add "Suspected distraction" as an attribute to <i>Distracted Driving?</i>	is distinctly different from distracted driving and should not be included as a subcategory of it. Users should not have to wonder whether different words, situations or actions mean the same thing (Nielsen, 2005).	uncertainty or confusion.
Organization of Contributing Factors Drop Down	Move "No Clear Contributing Action" to the first position of the Contributing Factors drop down.	The contributing factors drop down is inconsistent in ordering, with "No Clear Contributing Action" listed second and out of alphabetical order. Officers reported that this attribute is the most commonly selected when crash reporting.	Increased efficiency and decreased officer frustration.
	Add "Fail to drive with due care" as an option.	The request to add "Fail to drive with due care" should be examined by analysts and/or CDUG before implementation as it is not consistent with MMUCC 5 terminology.	
Gender Selection Limitations	Add "X" as an attribute option to <i>Sex</i> .	This issue relates to the gender selection choices available in the current MNCrash drop-down menu. Minnesota driver's licenses now include "X" as an option for <i>Sex</i> . However, there is no option in the crash report and forcing officers to select "Unknown" is frustrating which leads to inaccurate data capture.	Increased data accuracy and reduced officer uncertainty and confusion.
Weather 1 and Weather 2	If "clear" is selected for the <i>Weather 1</i> attribute, then the second weather condition (i.e. <i>Weather 2</i>) should autofill to "NA".	Officers reported that it is redundant to manually enter both <i>Weather 1</i> and <i>Weather 2</i> attributes if the first option is selected as clear. The MMUCC 5 notes that if <i>Clear</i> weather condition is selected as weather 1, then a second occurrence of this element should not be selected.	Increased efficiency and decreased officer frustration.
Sequence of Events Search Difficulty	Change <i>Roadway sign or sign structure</i> to "sign" in the sequence of events.	Officers felt that searching for specific events in this attribute is inefficient. Specifically, officers reported searching for the "road sign" attribute is inefficient. However, the information is not listed by MMUCC 5 and should be reviewed by CDUG and analysts before implementation.	Increased efficiency, data capture and accuracy, and decreased officer frustration.
Total # of Lanes in Roadway Clarification	Add further definition to <i>Total # of Lanes</i> attribute to clarify what data should be entered.	Some of the officers did not know whether the <i>Total # of Lanes</i> included all lanes or just the number of lanes in one direction. Therefore, clarification was needed for officers when reporting this attribute. It was also important to guide future trafficway design and traffic control.	Increased data accuracy and decreased officer uncertainty or confusion.
Towing Description Clarification	Include a blue, underlined hyperlink with specific towing information for each option (e.g., no towing, towing due to disabling damage, etc.).	The towing description clarification is confusing for officers. Officers were confused about whether towing includes private or impound. Therefore, specific towing information is needed for each of the towing attributes to provide clarification when entering towing data. Additionally, MMUCC 5 specifies that there are situations where the driver may engage in a private company without law enforcement assistance, in which case the officer should code as retained by driver (i.e. not towed).	Added accuracy in data reporting and decreased officer uncertainty or confusion.

Bus Plate Errors and Bus Model Limitations	When <i>intercity bus</i> is selected as the motor vehicle, do not prompt for license plate information.	Officers state that there should be no prompt for license plate number when the vehicle is a bus because buses do not have license plates. However, the Minnesota Department of Public Safety states that standard bus license plates are issued to buses other than intercity buses.	Error reduction, increased efficiency, and accuracy in data reporting.
	Include option for "Gillig" in make information for the motor vehicle attribute.	Officers have reported that there is no "Gillig" in the bus model option. MMUCC 5 states that the reporting motor vehicle make is important for evaluation, research, and crash comparison processes.	
	Add a note to Passengers section when Vehicle Type: School Bus, Transit Bus, Motor coach, or Other Bus is selected stating: Note: Document <i>Injured</i> passengers of crash-involved buses. Non-injured passengers should be included in the overall passenger count under "Units: Type" but are not required to be documented here."	Officers appear to be confused that they are not required to document all passenger of buses who were not injured. The report only presents entry fields for injured passengers (not all passengers when Vehicle Type: School Bus, Transit Bus, Motor coach, or Other Bus is selected, but this process is "under the hood" so it may not be clear what the report has done or requires.	
Vehicle Fire Default	Default <i>Vehicle on Fire</i> attribute to "No"	Officers would like the vehicle on fire attribute to default to "no" because fires rarely happen to vehicles. The 2018 Department of Public Safety Minnesota Motor Vehicle Crash Facts reported that fires/explosions occurred in 40 (.0005%) of 79,215 crashes reported, once (.0009%) out of 1,004 motorcycle crashes, and 6 (.0013%) of all 4,623 truck crashes in 2018. These statistics suggest an extremely low occurrence of fires.	Increased efficiency and decreased officer frustration.

APPENDIX D
TRAINING INFOGRAPHICS

CRASH REPORTING

Tips, Tricks, & Myths



COMPLETE

Don't hold back information! Describing the ENTIRE sequence of events leading up to the crash in data format is critical to understanding how crashes tend to occur across the state!

PARKING

Parking lot crashes are not reportable crashes for the state of Minnesota. If you wish to use MNCrash to document them, be sure to select parking lot in "location relative to trafficway"



PROPERTY

Documenting public or private property is an important part of crash reporting, but privately owned or publicly owned vehicles do not qualify as property in this sense.

HYPERLINKS

Click on blue text throughout the report. They will open boxes that contain useful definitions and business rules that may reduce uncertainty for what you are being asked



SHORT CUTS

Use short cuts such as "Same as Owner", "Same as Unit 1" and MnFILL to help the report auto-populate information for you

KEYSTROKES

Save time by using keystrokes instead of your mouse. You can navigate most of the report through the use of the Tab, arrows, and Enter keys

Tab



CRASH REPORTING

Tips, Tricks, & Myths



MYTH # 1

Crash reports are just for insurance companies

FACT

Crash reports have the power to save lives!



Crash reports are used to determine laws, infrastructure changes, vehicle recalls, and many other things far more influential than providing information to insurance companies!

MYTH # 2

Important details will be figured out by the reconstruction team

CRIME SCENE

It is important to provide as much information as you can, even your best guess. You are the state's only chance to learn about what happened at the crash to try to prevent them in the future!

FACT

Reconstruction reports never add information to a state crash report!



MYTH # 3

Crash report details need evidence



FACT

Crash reports should provide your best guess



The state's crash report is inadmissible in court for the explicit reason that crash data supports safety first and isn't hindered by the burden of proof!

CRASH REPORTING

Narrative Tips

1

VEHICLE INFO

First state the vehicle(s) direction, position, and roadway/intersection location.

2

SEQUENCE OF EVENTS

Sequentially state ALL events that led up to and following the crash for the vehicle(s) including the manner of collision if more than one motor vehicle was involved

3

CRASH LOCATION

Describe where on the roadway the crash occurred as well as where the final resting point of the vehicle(s)

4

DRIVER(S) FACTORS

List any contributing factors to the crash including driver physical condition if pertinent

5

ROADWAY FACTORS

Briefly describe the roadway conditions as well as the weather if it may have played a role in the crash

6

OCCUPANT INFORMATION

Without using personal descriptors, list if any occupants were ticketed, injured or killed

7

FORM CLARIFICATION

Be sure to elaborate on any instances from the crash report form where the officer selected 'Other' or 'Unknown.'

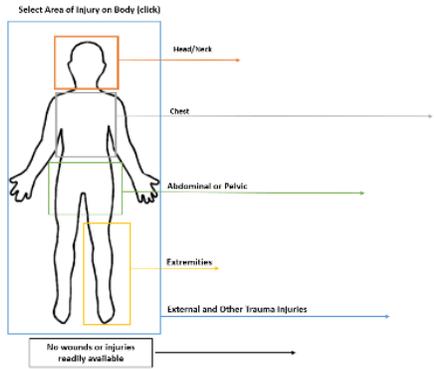
Tip: Use mix-case letters, not UPPERCASE!

APPENDIX E
INJURY SEVERITY DECISION AID

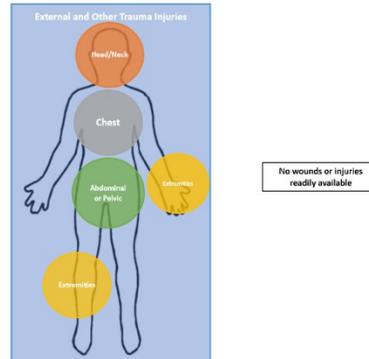
Home screen options for Injury Severity Decision Aid Prototype 1 and Prototype 2.

Prototype 1 (Trial 1)

Prototype 2 (Trial 1)



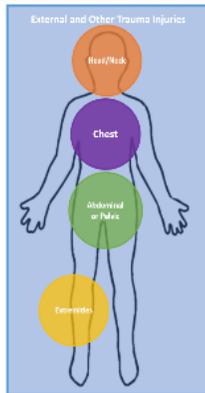
Select Area of Injury (click)



Prototype 2 (Trial 2)

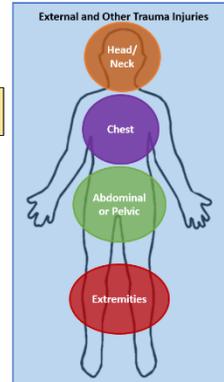
Prototype 2 (Final Design)

Select Area of Injury (click)



Select Area of Injury (click)

Complaint of Pain
No wounds or injuries readily available



Structure of Decision Aid

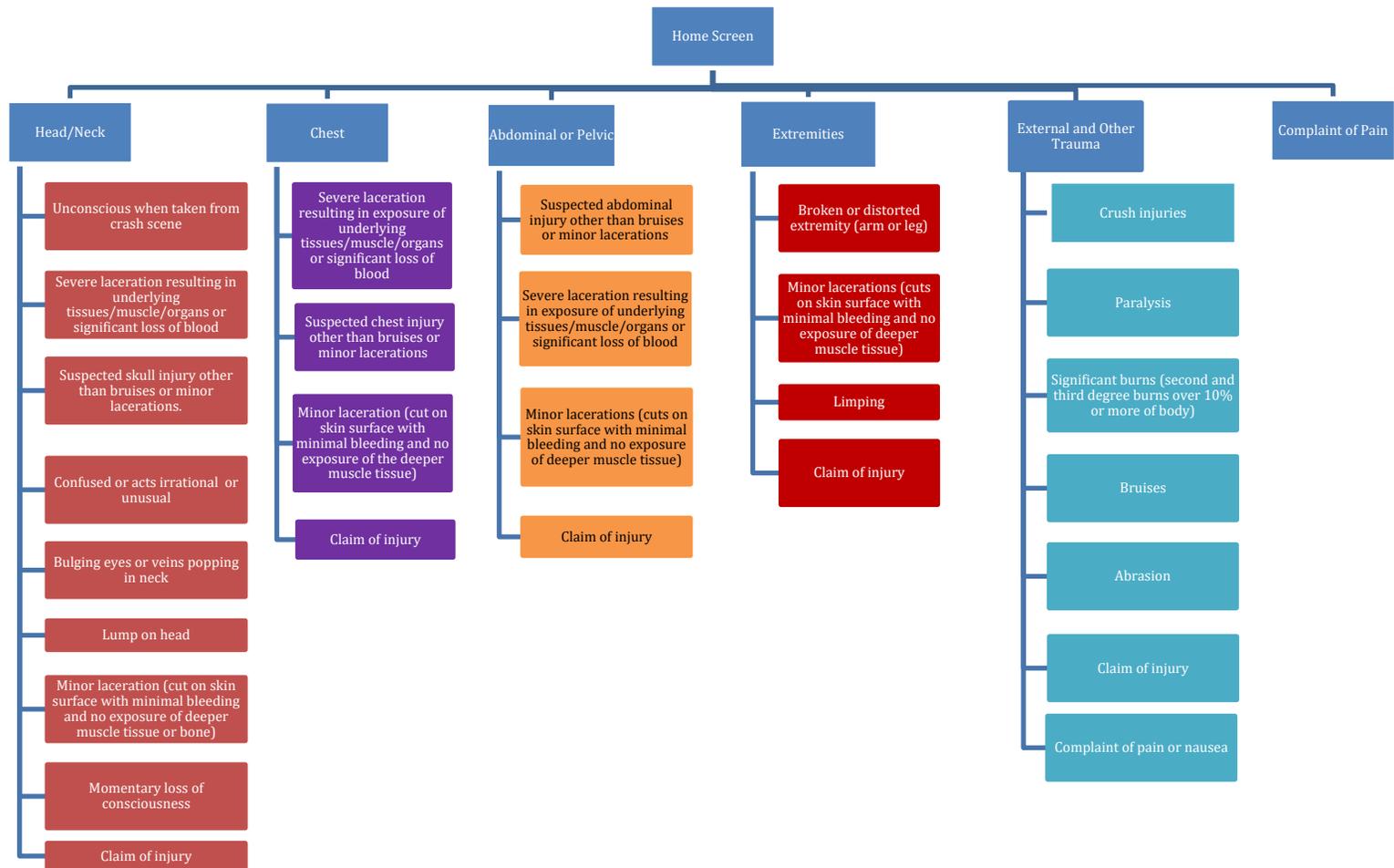


Figure A. Home screen

Click Area of Injury

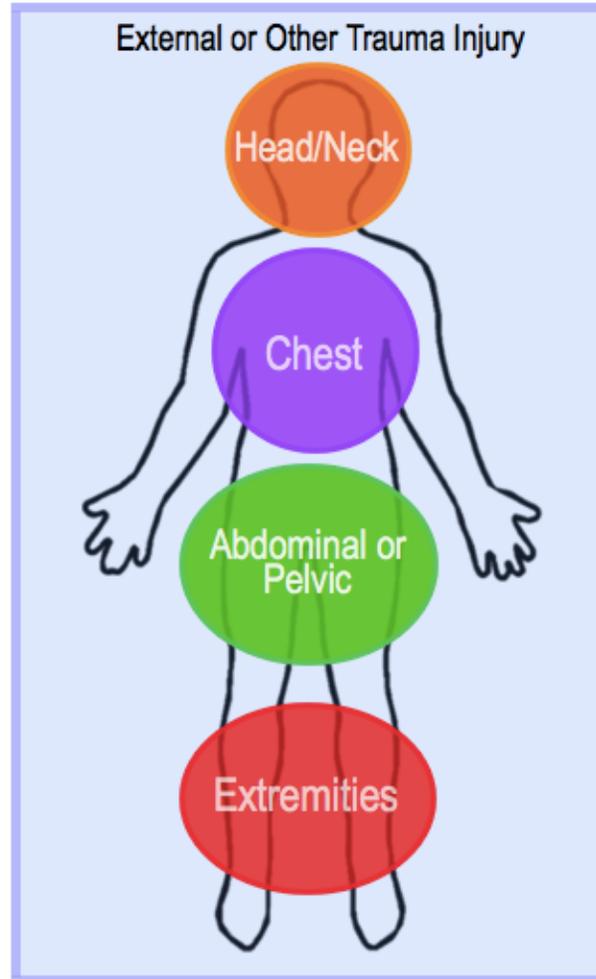


Figure A-1. Head/Neck Home Screen

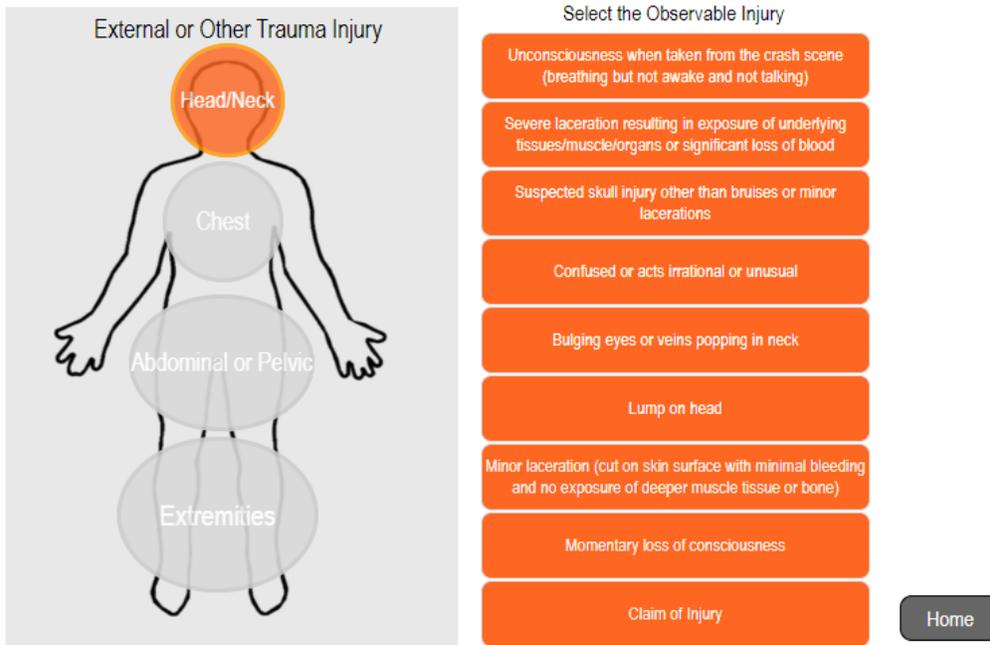


Figure A-1.1. Unconscious when taken from the crash scene

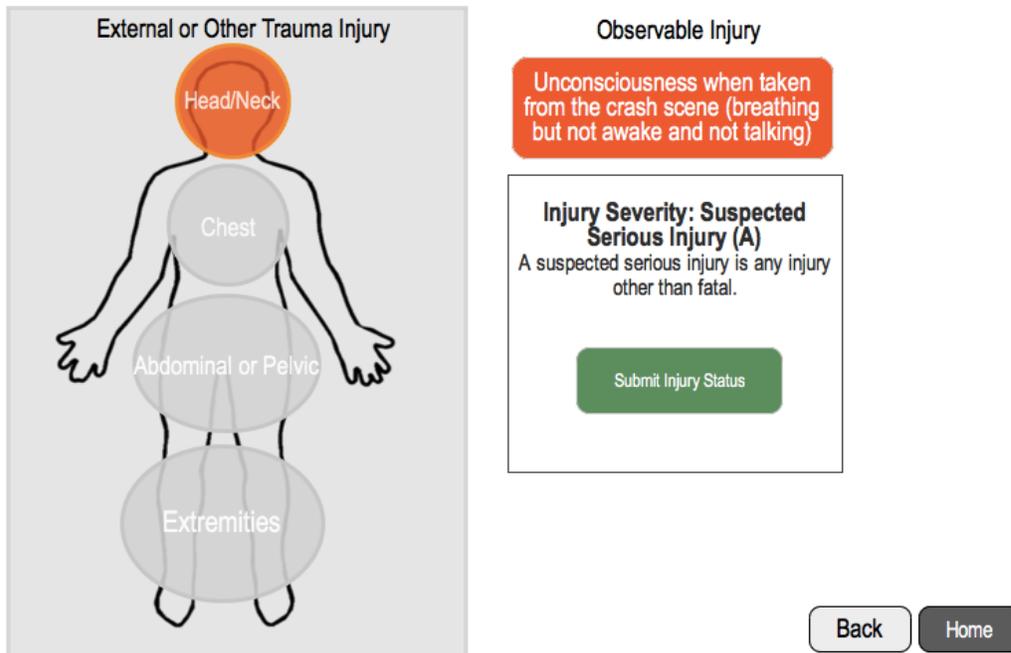
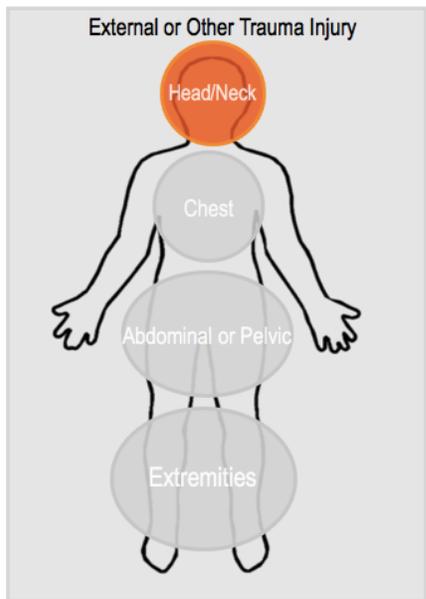


Figure A-1.2. Severe laceration resulting in exposure of underlying tissues/muscles/organs or significant loss of blood



External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

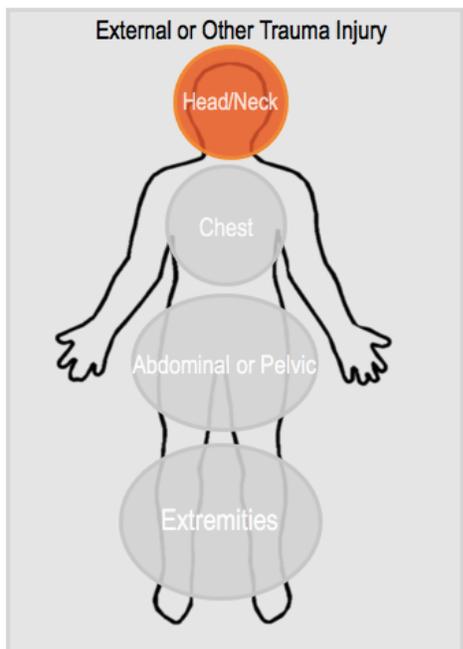
Severe laceration resulting in exposure of underlying tissues/muscle/organs or significant loss of blood

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

Submit Injury Status

Back Home

Figure A-1.3. Suspected skull injury other than bruises or minor lacerations



External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

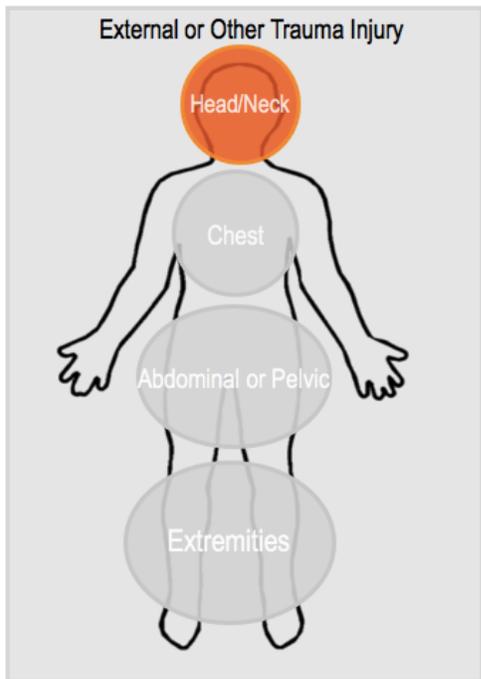
Suspected skull injury other than bruises or minor lacerations

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

Submit Injury Status

Back Home

Figure A-1.4 Confused or acts irrational or unusual



External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

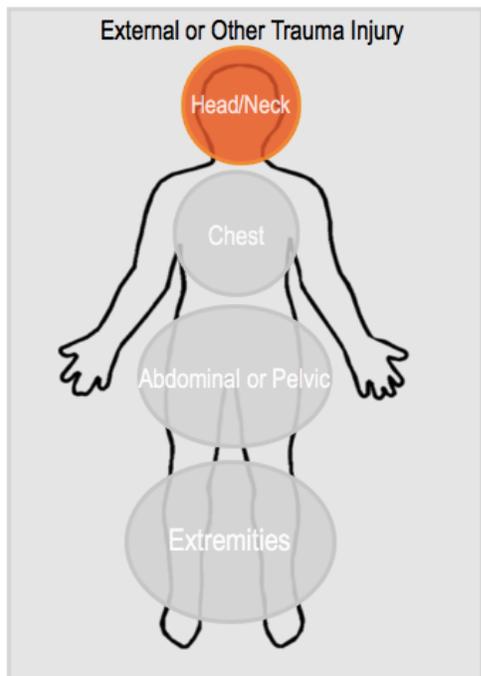
Confused or acts irrational or unusual

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

Submit Injury Status

Back Home

Figure A-1.5 Bulging eyes or veins popping in neck



External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

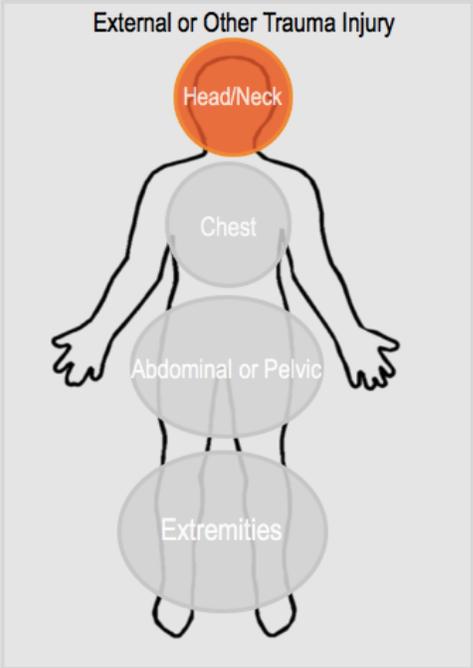
Bulging eyes or veins popping in neck

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

Submit Injury Status

Back Home

Figure A-1.6 Lump on head



External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

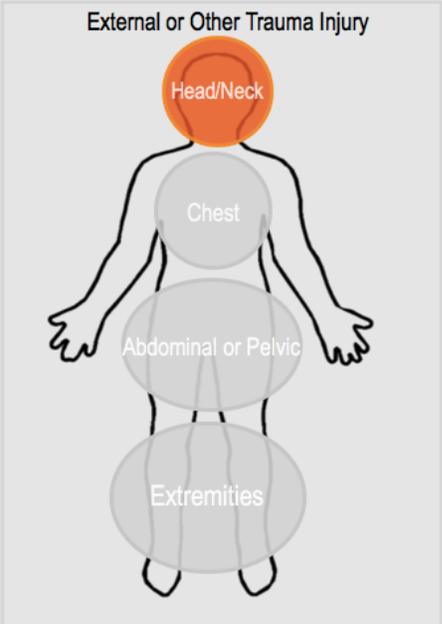
Lump on head

Injury Severity: 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.

Submit Injury Status

Back Home

Figure A-1.7. Minor laceration (cut on skin surface with minimal bleeding and no exposure of deeper muscle tissue/bone)



External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

Minor laceration (cut on skin surface with minimal bleeding and no exposure of deeper muscle tissue or bone)

Injury Severity: 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.

Submit Injury Status

Back Home

Figure A-1.8. Momentary loss of consciousness

External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

Momentary loss of consciousness

Injury Severity: Possible Injury (C)
A possible injury is any injury reported or claimed which is not fatal, suspected serious, or suspected minor injury.

Submit Injury Status

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Figure A-1.9. Claim of Injury

External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

Claim of injury

Injury Severity: Possible Injury (C)
A possible injury is any injury reported or claimed which is not fatal, suspected serious, or suspected minor injury.

Submit Injury Status

Back Home

Figure A-2. Chest Home Screen

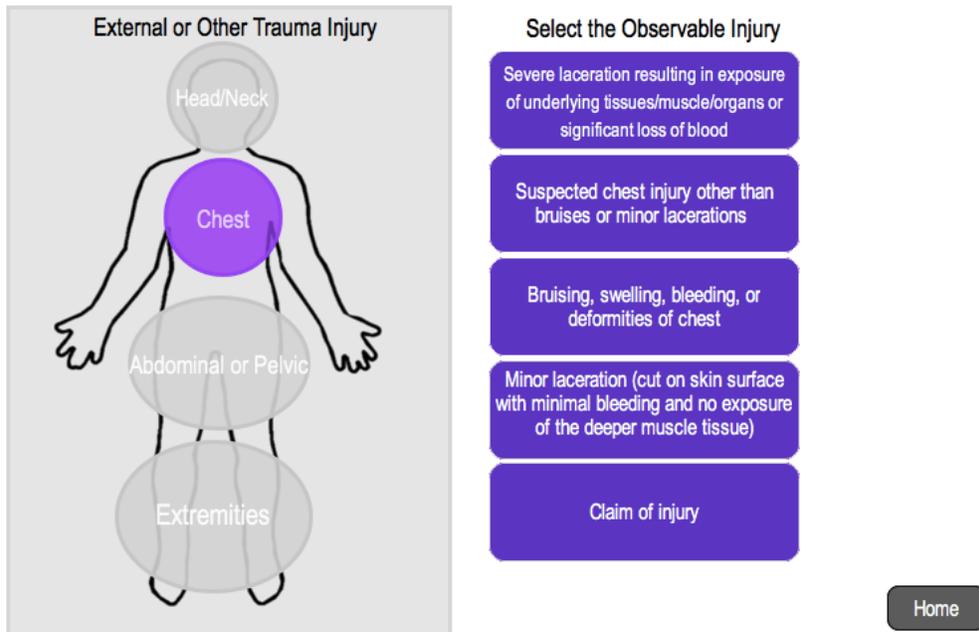


Figure A-2.1. Severe laceration resulting in exposure of underlying tissues/muscles/organs or significant loss of blood

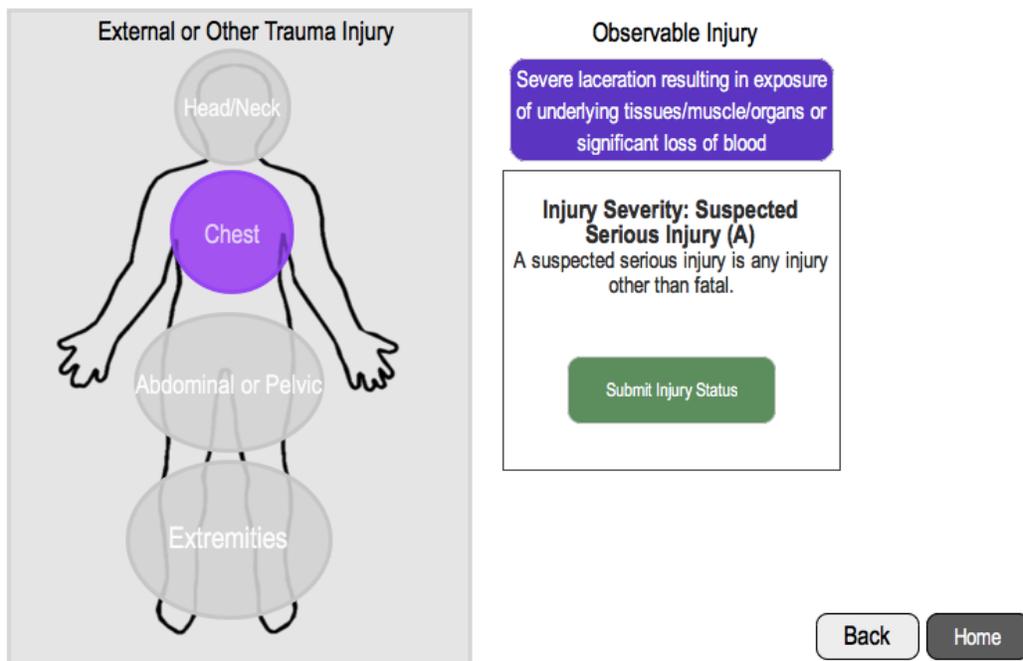
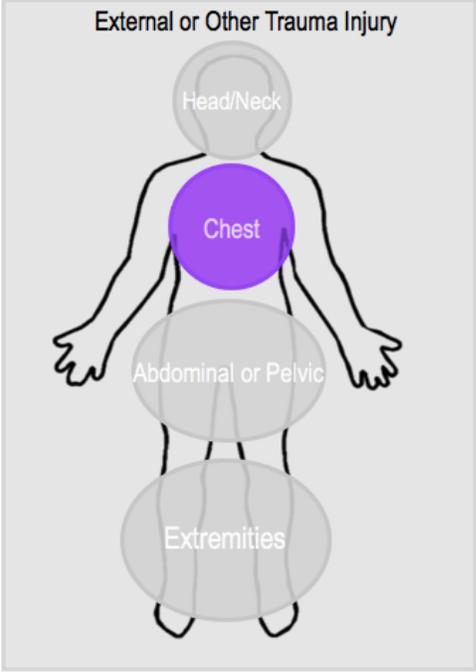


Figure A-2.2. Suspected chest injury other than bruises or minor lacerations

External or Other Trauma Injury



Observable Injury

Suspected chest injury other than bruises or minor lacerations

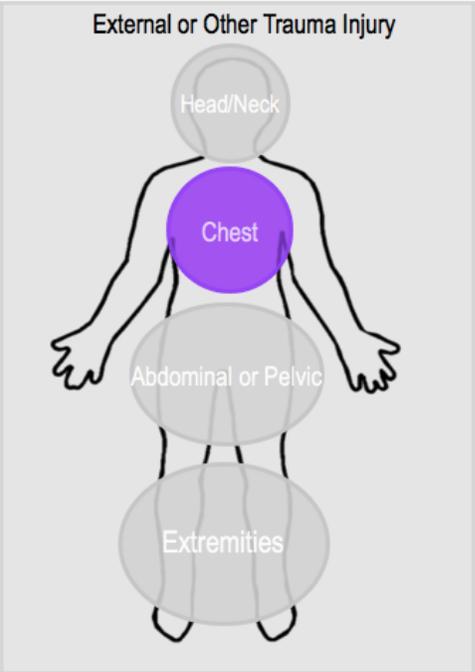
Injury Severity: Suspected Serious Injury (A)
A suspected serious injury is any injury other than fatal.

Submit Injury Status

Back Home

Figure A-2.3. Bruising, swelling, bleeding, or deformities of chest

External or Other Trauma Injury



Observable Injury

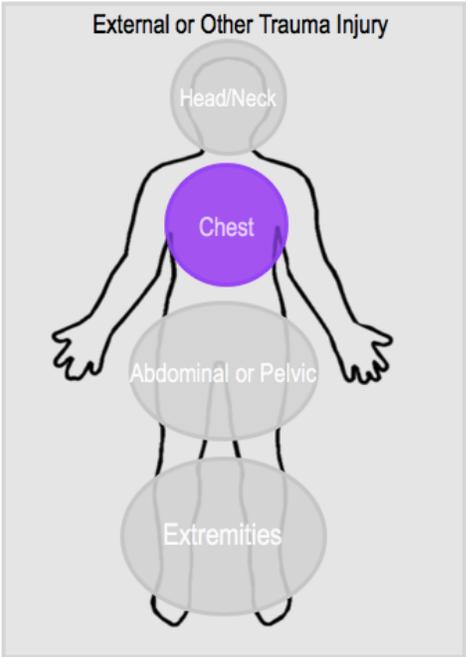
Bruising, swelling, bleeding, or deformities of chest

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

Submit Injury Status

Back Home

Figure A-2.4. Minor lacerations (cut on skin surface with minimal bleeding and no exposure to deeper muscle tissue)



External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

Minor laceration (cut on skin surface with minimal bleeding and no exposure of the deeper muscle tissue)

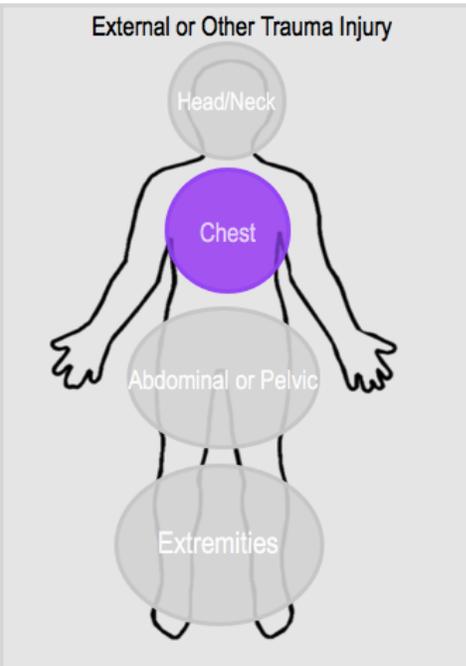
Injury Severity: Suspected Minor Injury (B)

A minor injury is any injury that is evident at the scene of the crash, other than fatal or serious injuries.

Submit Injury Status

Back Home

Figure A-2.5. Claim of injury



External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

Claim of injury

Injury Severity: Possible Injury (C)

A possible injury is any injury reported or claimed which is not fatal, suspected serious, or suspected minor injury.

Submit Injury Status

Back Home

Figure A-3. Abdominal or Pelvic Home Screen

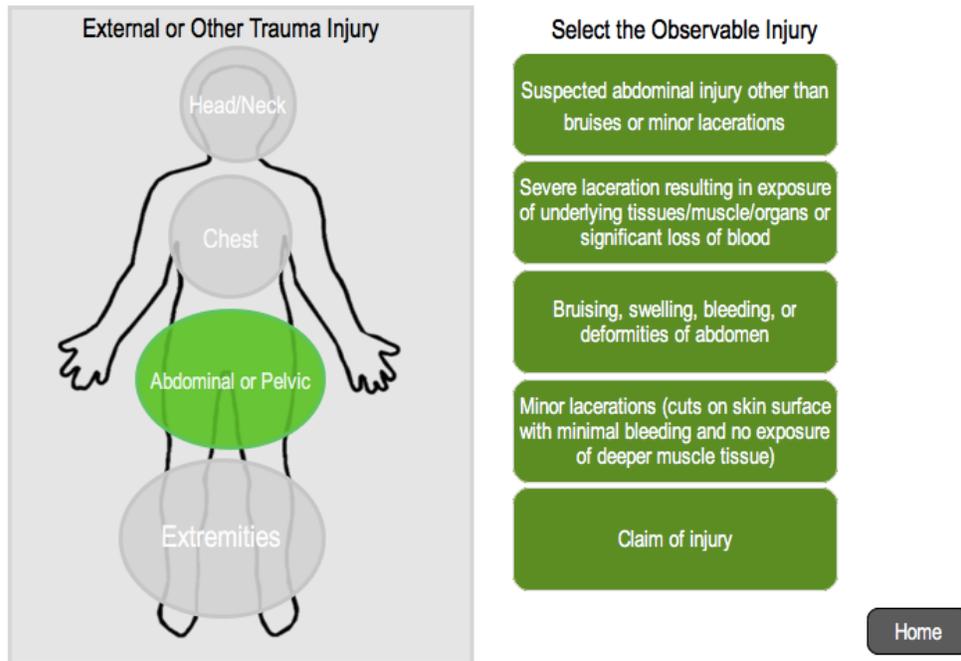


Figure A-3.1. Suspected abdominal injury other than bruises or minor lacerations

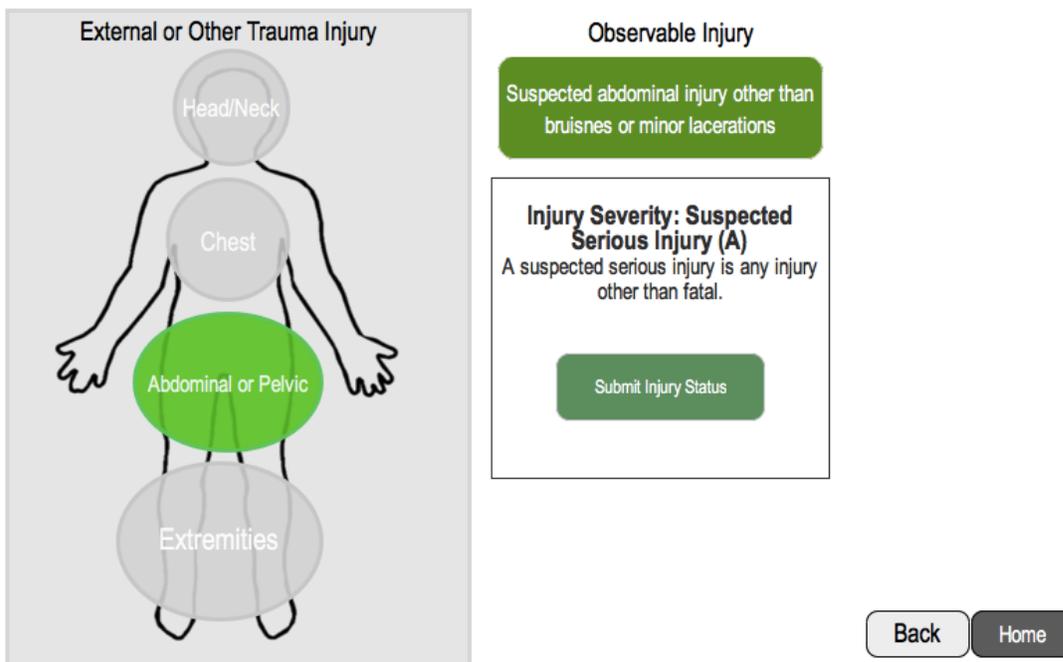
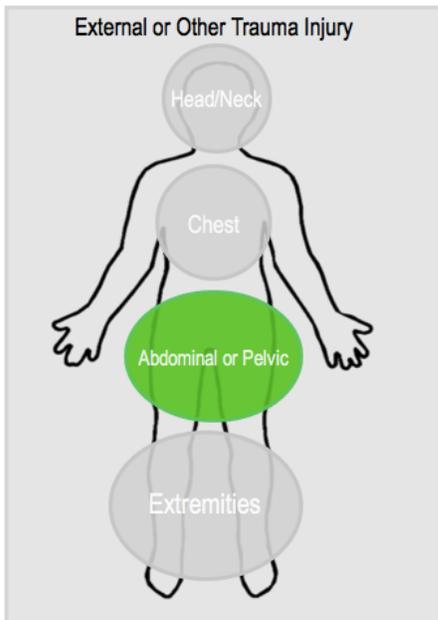


Figure A-3.2. Severe laceration resulting in exposure of underlying tissues/muscle/organs or significant loss of blood



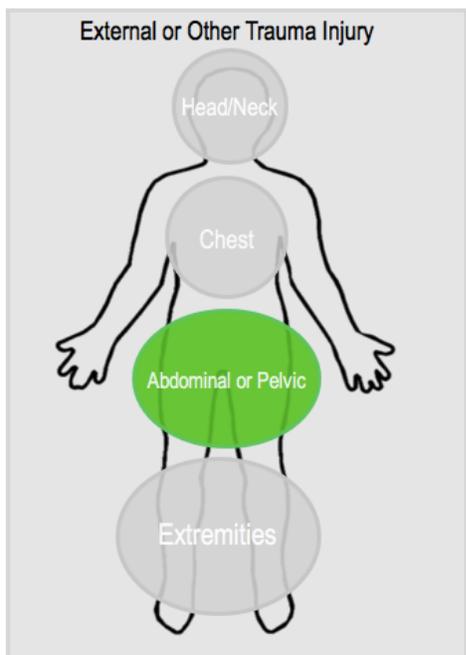
Observable Injury
Severe laceration resulting in exposure of underlying tissues/muscles/organs or significant loss of blood

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

Submit Injury Status

Back Home

Figure A-3.3. Bruising, swelling, bleeding, or deformities of abdomen



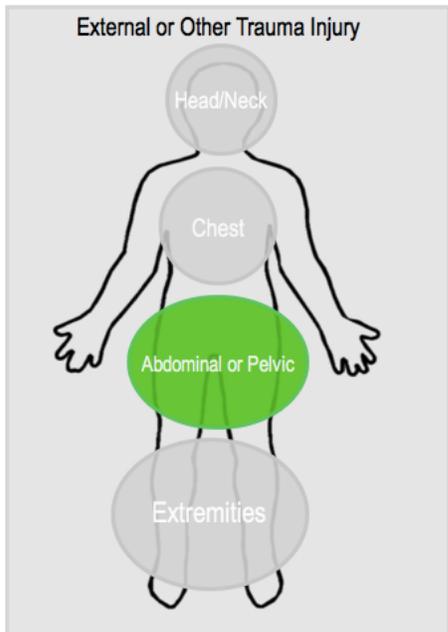
Observable Injury
Bruising, swelling, bleeding, or deformities of abdomen

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

Submit Injury Status

Back Home

Figure A-3.4. Minor lacerations (cuts on skin surface with minimal bleeding and no exposure of deeper muscle tissue)



External or Other Trauma Injury

Observable Injury

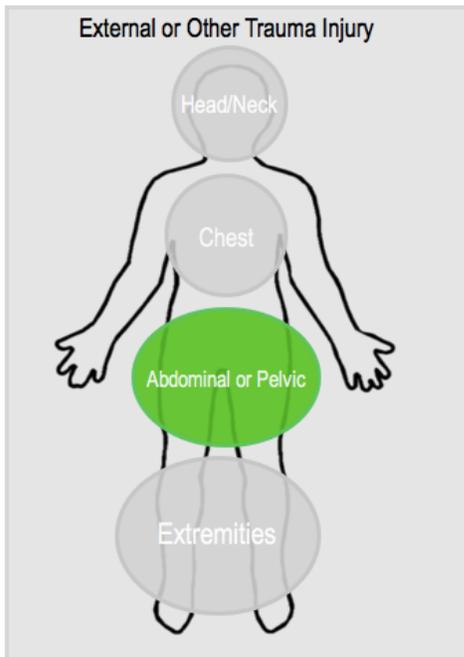
Minor lacerations (cuts on skin surface with minimal bleeding and no exposure of deeper muscle tissues)

Injury Severity: 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.

Submit Injury Status

Back Home

Figure A-3.5. Claim of injury



External or Other Trauma Injury

Observable Injury

Claim of injury

Injury Severity: Possible Injury (C)
A possible injury is any injury reported or claimed which is not fatal, suspected serious, or suspected minor injury.

Submit Injury Status

Back Home

Figure A-4. Extremities Home Screen

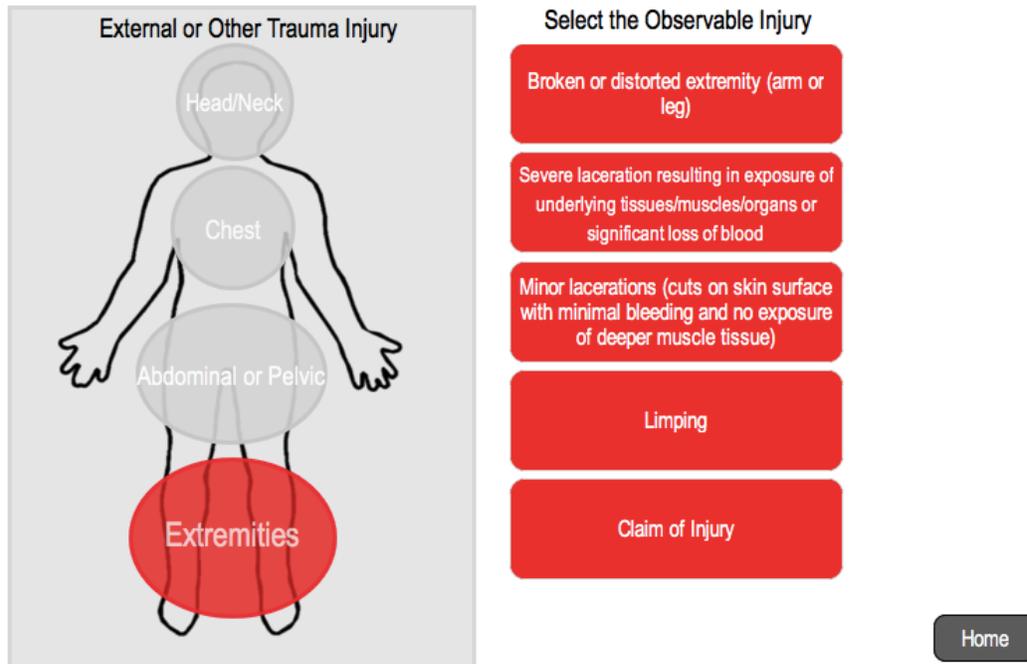


Figure A-4.5. Broken or distorted extremity (arm or leg)

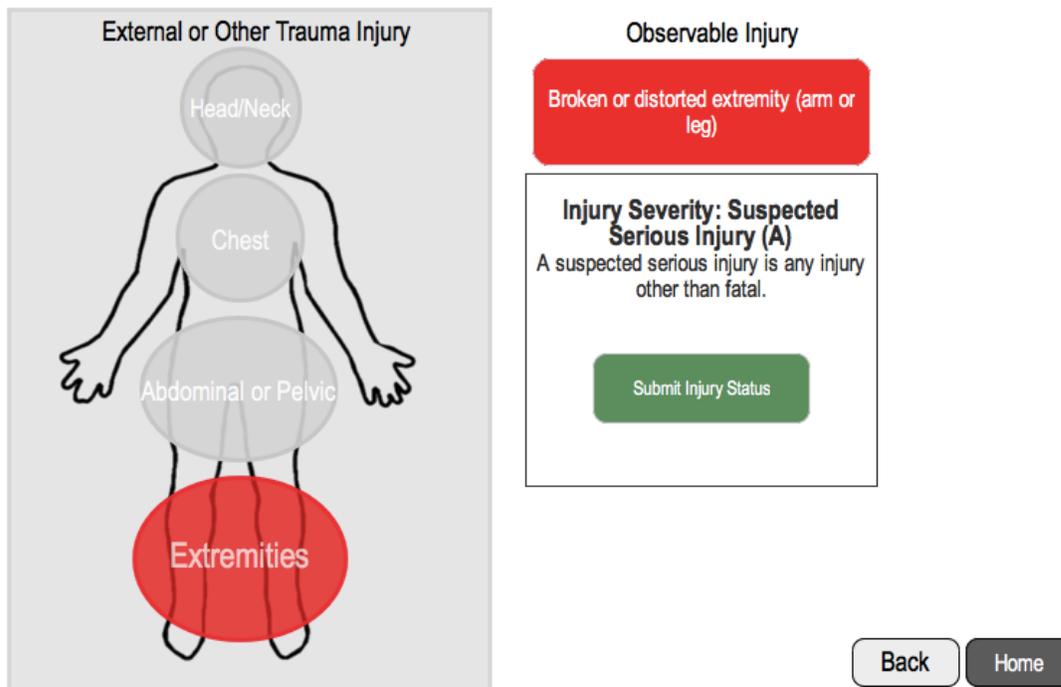
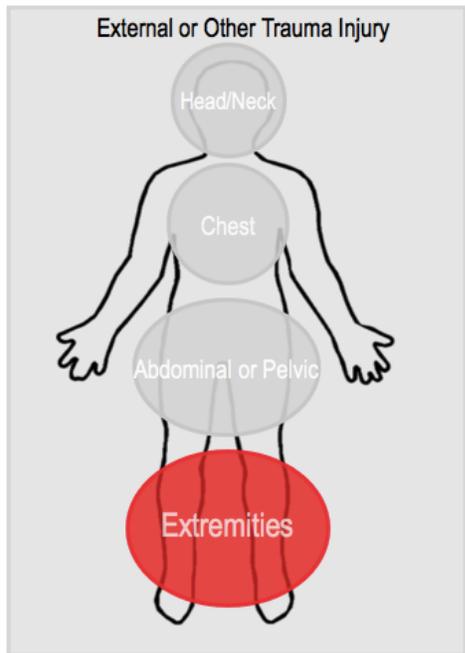


Figure A-4.6. Severe lacerations resulting in exposure of underlying tissues/muscles/organs or significant loss of blood



External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

Severe laceration resulting in exposure of underlying tissues/muscle/organs of significant loss of blood

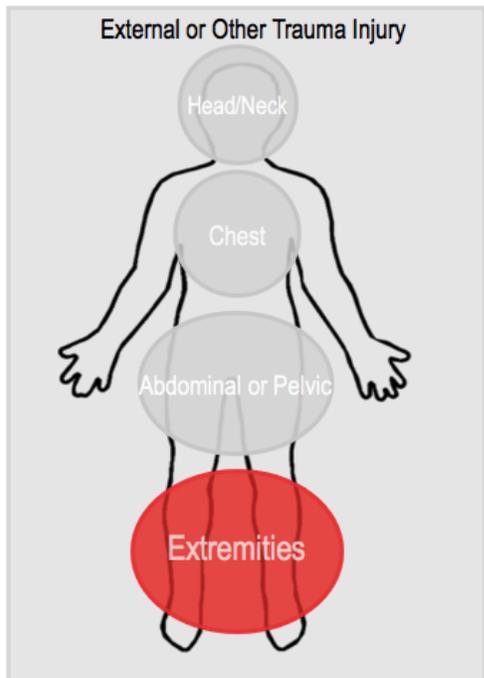
Injury Severity: Suspected Serious Injury (A)

A suspected serious injury is any injury other than fatal.

Submit Injury Status

Back Home

Figure A-4.7. Minor lacerations (cuts on skin surface with minimal bleeding and no exposure of deeper muscle tissue)



External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

Minor lacerations (cuts on skin surface with minimal bleeding and no exposure of deeper muscle tissue)

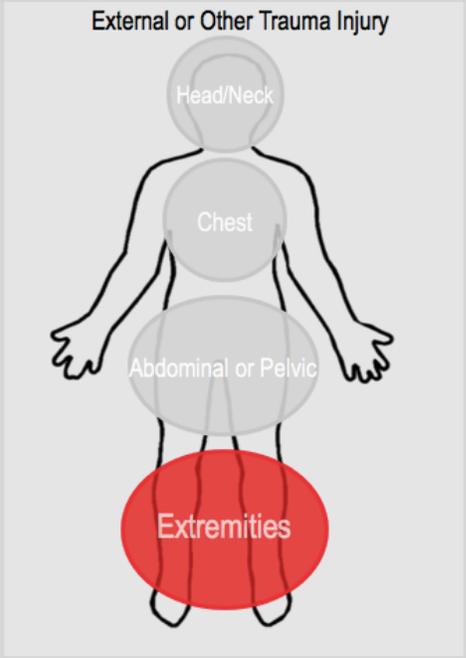
Injury Severity: Suspected Minor Injury (B)

A minor injury is any injury that is evident at the scene of the crash, other than fatal or serious injuries.

Submit Injury Status

Back Home

Figure A-4.8. Limping



External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

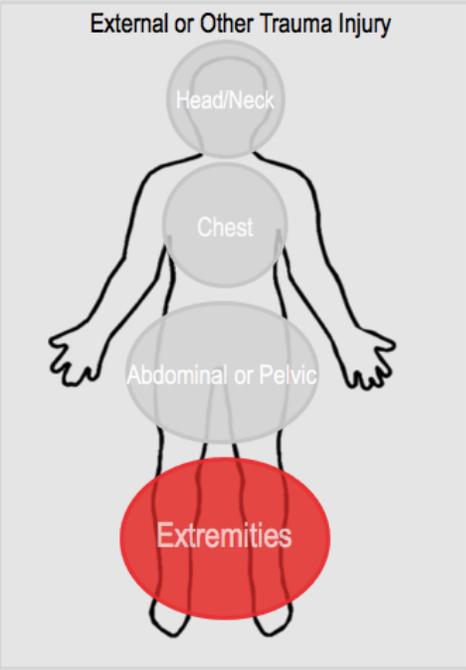
Limping

Injury Severity: Possible Injury (C)
A possible injury is any injury reported or claimed which is not fatal, suspected serious, or suspected minor injury.

Submit Injury Status

Back Home

Figure A-4.9. Claim of injury



External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

Claim of injury

Injury Severity: Possible Injury (C)
A possible injury is any injury reported or claimed which is not fatal, suspected serious, or suspected minor injury.

Submit Injury Status

Back Home

Figure A-5. External and Other Trauma Injuries Home Screen

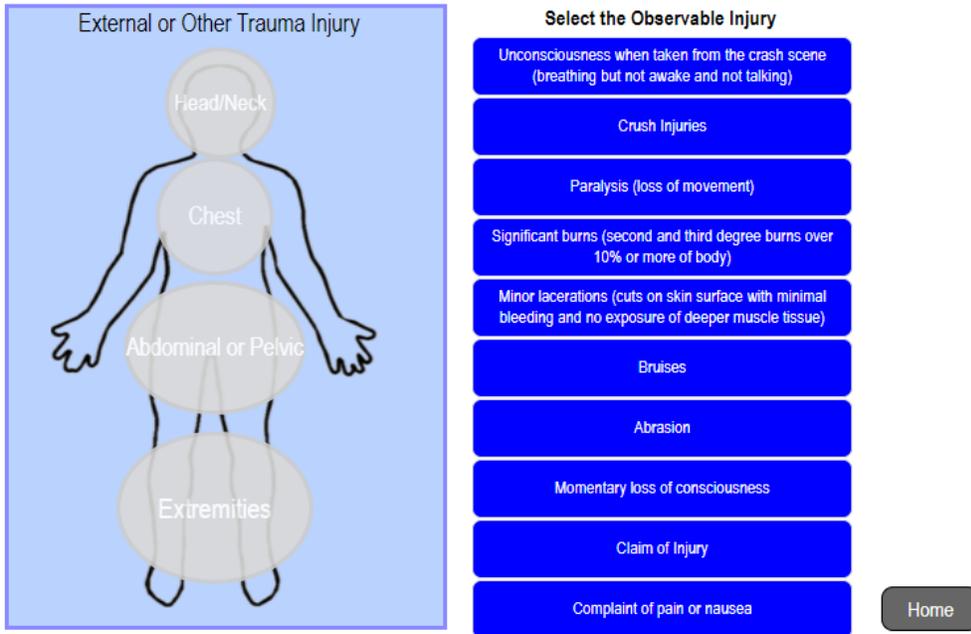


Figure A-5.1. Unconsciousness when taken from crash scene

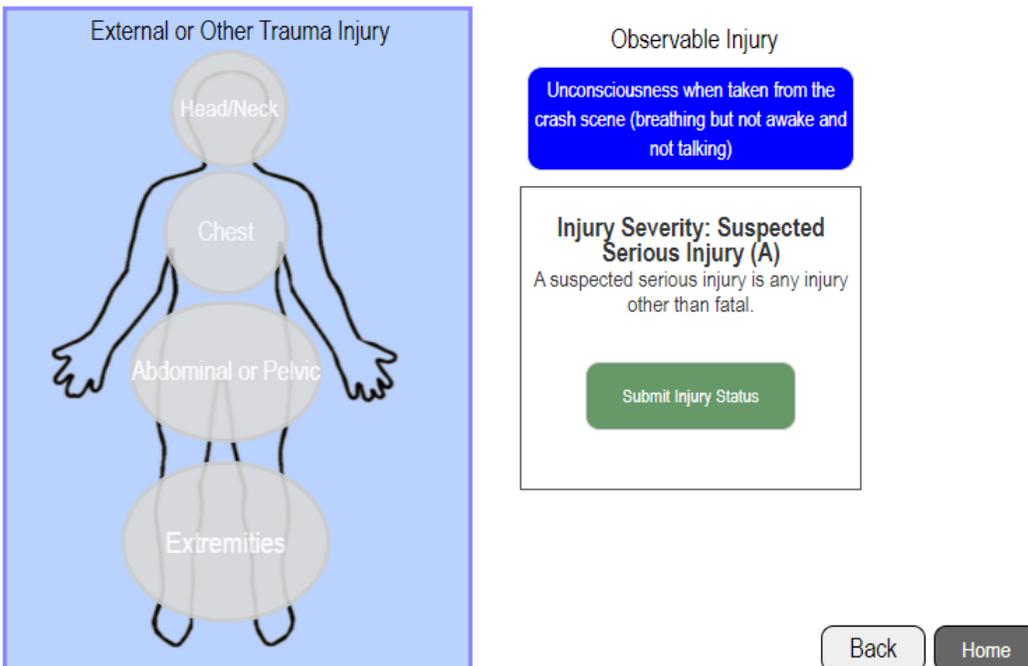
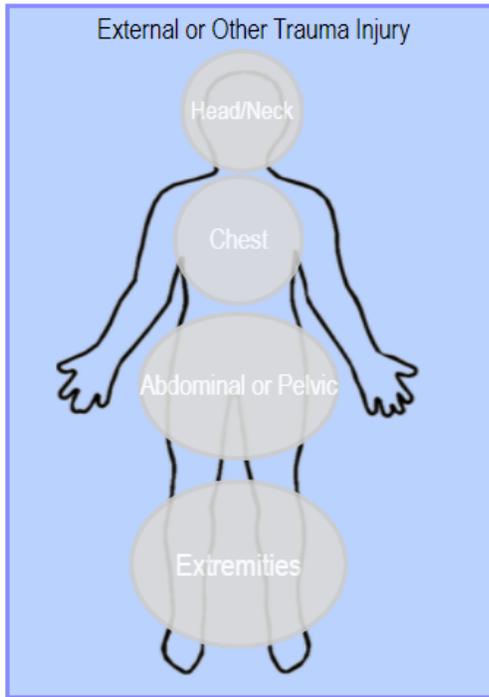


Figure A-5.2. Crush injuries



Observable Injury

Crush Injuries

Injury Severity: Suspected Serious Injury (A)

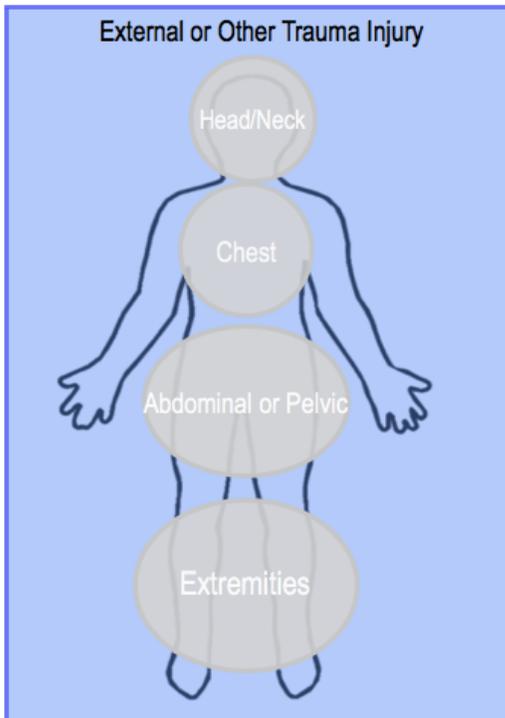
A suspected serious injury is any injury other than fatal.

Submit Injury Status

Back

Home

Figure A-5.3. Paralysis (loss of movement)



Observable Injury

Paralysis (loss of movement)

Injury Severity: Suspected Serious Injury (A)

A suspected serious injury is any injury other than fatal.

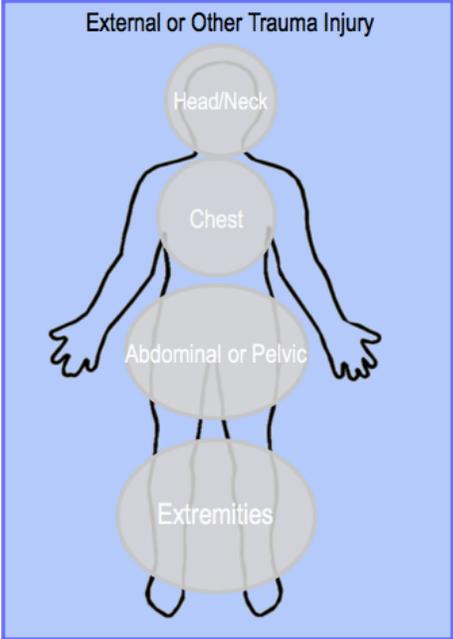
Submit Injury Status

Back

Home

Figure A-5.4. Significant burns (second or third degree burns over 10 percent or more of the body)

External or Other Trauma Injury



Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

Significant burns (second and third degree burns over 10% or more of body)

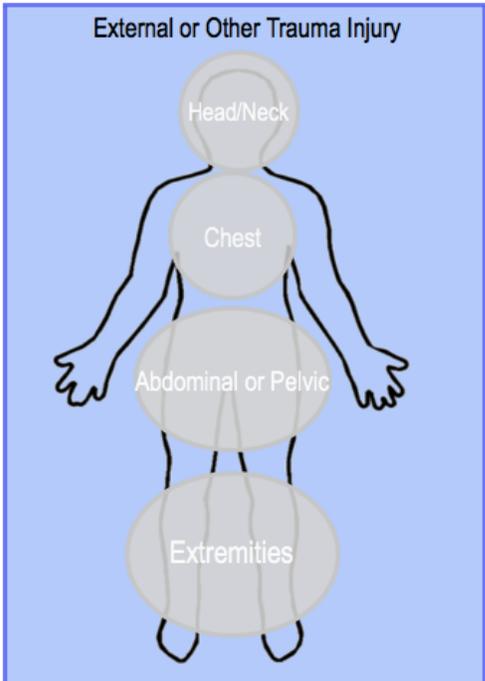
Injury Severity: Suspected Serious Injury (A)
A suspected serious injury is any injury other than fatal.

Submit Injury Status

Back Home

Figure A-5.5. Minor lacerations (cuts on skin surface with minimal bleeding and no exposure of deeper muscle tissue)

External or Other Trauma Injury



Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

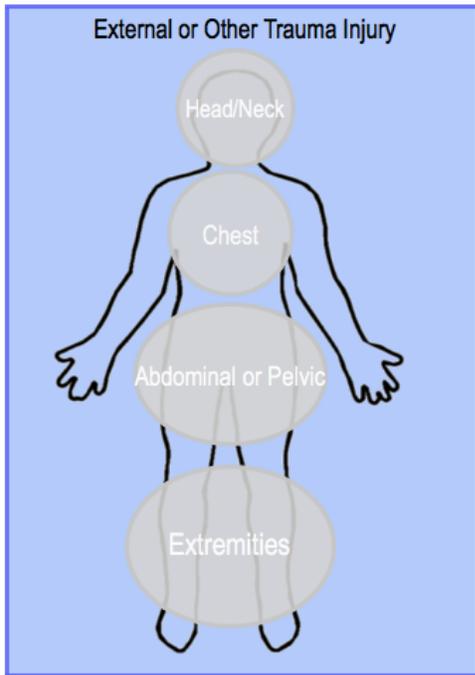
Minor lacerations (cuts on skin surface with minimal bleeding and no exposure of deeper muscle tissue)

Injury Severity: 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.

Submit Injury Status

Back Home

Figure A-5.6. Bruises



Observable Injury

Bruises

**Injury Severity: Suspected
Minor Injury (B)**

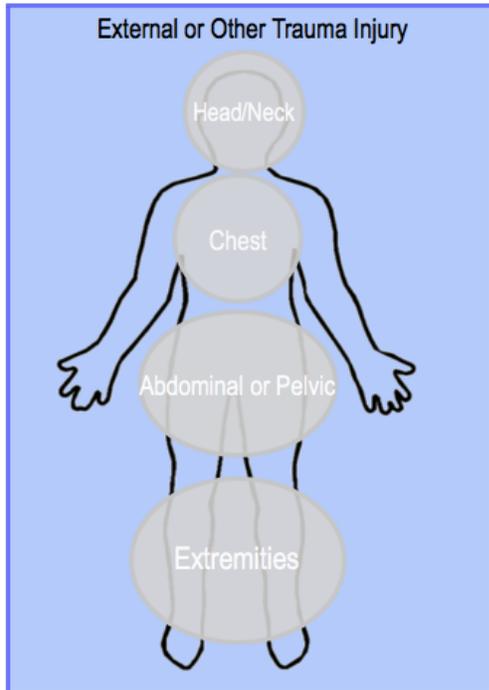
A minor injury is any injury that is evident at the scene of the crash, other than fatal or serious injuries.

Submit Injury Status

Back

Home

Figure A-5.7. Abrasion



Observable Injury

Abrasion

**Injury Severity: 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.

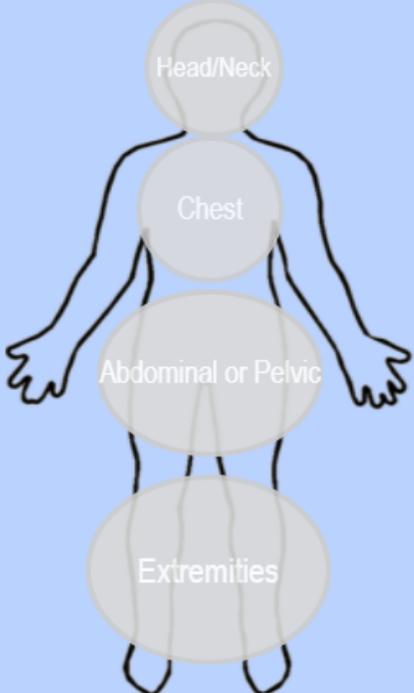
Submit Injury Status

Back

Home

Figure A-5.8. Momentary loss of consciousness

External or Other Trauma Injury



Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

Momentary loss of consciousness

Injury Severity: Possible Injury (C)

A possible injury is any injury reported or claimed which is not fatal, suspected serious, or suspected minor injury.

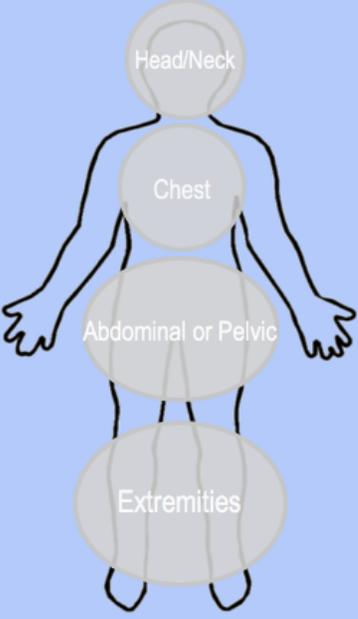
Submit Injury Status

Back

Home

Figure A-5.9. Claim of injury

External or Other Trauma Injury



Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

Claim of Injury

Injury Severity: Possible Injury (C)

A possible injury is any injury reported or claimed which is not fatal, suspected serious, or suspected minor injury.

Submit Injury Status

Back

Home

Figure A-5.10. Complaint of pain or nausea

External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Observable Injury

Complaint of pain or nausea

Injury Severity: Possible Injury (C)
A possible injury is any injury reported or claimed which is not fatal, suspected serious, or suspected minor injury.

Submit Injury Status

Back Home

Figure A-6. Complaint of Pain Screen

External or Other Trauma Injury

Head/Neck

Chest

Abdominal or Pelvic

Extremities

Complaint of Pain
No wounds or injuries readily available

Injury Severity: Possible Injury (C)
A possible injury is any injury reported or claimed which is not fatal, suspected serious, or suspected minor injury.

Submit Injury Status

Home

Figure A-A. Injury Status Suspected Serious Injury

Report ID:

Unit #1

Type Events Person Information Person Actions **Person Conditions** Passengers ✓

Crash

Units

Narrative

Diagram

Person Location: *Position*
Ejected/Trapped

Safety Equipment: *Restraint Type and Use* *Airbags*

Person Condition: *Injury Severity* *Transported* *Ambulance Service*

Run Number

Physical Condition 1

Physical Condition 2

DONE! Please close this window and enter Injury Severity Level A into the survey.

Figure A-B. Injury Status Suspected Minor Injury

Report ID:

Unit #1

Type Events Person Information Person Actions **Person Conditions** Passengers ✓

Crash

Units

Narrative

Diagram

Person Location: *Position*

Ejected/Trapped

Safety Equipment: *Restraint Type and Use* *Airbags*

Person Condition: *Injury Severity* **Suspected Minor Injury (B)** *Transported* *Ambulance Service*

Run Number

Physical Condition 1

Physical Condition 2

DONE! Please close this window and enter Injury Severity Level B into the survey.

Figure A-C. Injury Status Possible Injury

Report ID:

Unit #1

Type Events Person Information Person Actions **Person Conditions** Passengers ✓

Crash

Units

Narrative

Diagram

Person Location: *Position*

Ejected/Trapped

Safety Equipment: *Restraint Type and Use* *Airbags*

Person Condition: *Injury Severity* *Transported* *Ambulance Service*

Run Number

Physical Condition 1

Physical Condition 2

DONE! Please close this window and enter Injury Severity Level C into the survey.

APPENDIX F
MNCRASH TRAINING MODULE

Welcome to your MNCrash Training Module

Welcome



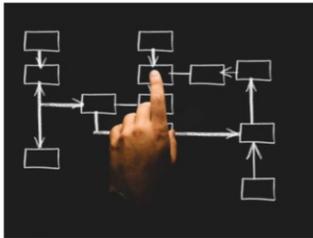
You have an important role in helping to improve the safety of our roadways and the health of our communities. Crash reporting is critical in helping to document, tabulate, and analyze the circumstances and contributing factors of crashes on our roadways.

In fact, crash reporting is the ultimate tool we have to carry us forward in our mission to reduce serious and fatal crashes, keeping our Minnesota families together.

[START >](#)

Step 1

Review the content



The content of this training has been created to help improve your areas of knowledge in some of the more challenging or complex components of crash reporting.

This training is useful for those who are just getting started in crash reporting and for those who have decades of experience under their belt. The federal guidelines for crash reporting are always evolving, meaning the Minnesota crash report must also evolve.

Click your way through the interactive content to gain a deeper understanding of how to accurately communicate what you see and hear at the scene of a crash.

Step 2

Take the knowledge checks

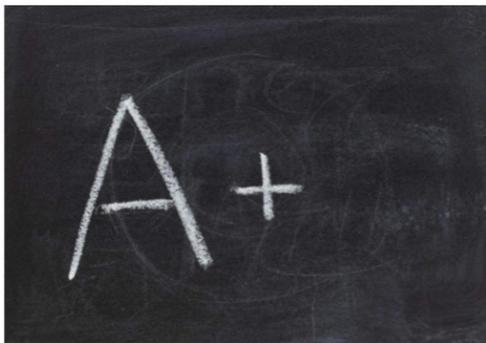


There will be knowledge checks throughout each of the nine modules in this training, each module focused on a different topic area of the crash report. Take the knowledge checks to be sure you have captured the important aspects of the training content.

1 2 3 4 ✓

Step 3

Take the quizzes



At the end of each module, you will be quizzed on your knowledge. You must earn an 80% or better on each quiz to pass each module. You may retake quizzes, if necessary. You should be able to complete the entire training in about 1 hour or you can break up the training over multiple sessions.

1 2 3 4 ✓

Step 4

Follow up



The guidelines for crash reporting are set by the Minnesota Department of Public Safety and are driven by national standards including the Model Minimum Uniform Crash Criterion (can be viewed through this link: [MMUCC](#)) and American National Standard (can be viewed through this link: [ANSI](#)). You'll find similar hyperlinks embedded throughout the MNCrash report to guide you on definitions or rules for various aspects of the report.

1 2 3 4 ✓

Summary



Once you complete this training, you should leave with a greater appreciation for your important role in roadway safety, a deeper understanding of many of the sections within the MNCrash report, and greater confidence in your ability to accurately convey the critical details of each and every crash.

Thank you for being an essential partner in road safety!

Scroll down and click Continue to begin the course.

START AGAIN



1 2 3 4 ✓

Up Next: Why is Crash Reporting Important

CONTINUE

Why is crash reporting important? Module

Lesson 2 of 18

Why is crash reporting important?

NM Nichole Morris



Why is crash reporting important?

Crash reporting is one of the greatest tools we have to address serious and fatal crashes. As a law enforcement officer at the scene of the crash, you have the capability to pass on invaluable details to help us prevent such an event from happening in the future.

This lesson will help you realize what an important player you are in our mission to reduce traffic-related deaths on our roads to zero.

CONTINUE



Defining a Motor Vehicle Traffic Crash

In MNCRASH, a traffic crash is equivalent to the ANSI D16.1 definition of a motor vehicle crash. The ANSI D16.1, American National Standard: Manual on Classification of Motor Vehicle Traffic Crashes defines a **motor vehicle traffic crash** as a motor vehicle crash which is also a traffic crash.

CONTINUE

8 Primary Motor Vehicle Traffic Crash Qualifications

- 1 The incident includes one or more occurrences of injury or damage.
- 2 There was at least one occurrence of injury or damage which was **not** a direct result of a cataclysm (i.e. a large scale and violent event such as a tornado) nor was the first harmful event produced by the discharge of a firearm.
- 3 The incident involved one or more motor vehicles.
- 4 Of the motor vehicles involved, at least one motor vehicle was in-transport.
- 5 The incident was an unstabilized situation. An unstabilized situation is a set of events not under human control.
- 6 The unstabilized situation originated on a traffic way or the injury or damage occurred on a trafficway.
- 7 If the incident involved a railway train in transport, the motor vehicle in transport became involved prior to any injury or damage involving the train.
- 8 It is true that neither an aircraft in transport nor a watercraft in transport was involved in the incident.

CONTINUE

Why do we need to fill out state crash reports?

DATA SAVES LIVES

MINNESOTA STATUTE 169.09

Minnesota Statute 169.09 requires crash reports on all traffic crashes causing death, injury, or \$1,000 or more in property damage.

While crash reports might feel like unnecessary paperwork, they are completed in order to obtain information that helps to reduce traffic crashes, fatalities, and injuries.

The data collected on crash reports is the first and most important source of information for designing safer roads and vehicles, as well as legislation and programs to bring about changes in human behavior to improve traffic safety. Furthermore, this data helps with safety programming and funding opportunities.



Why do we need to fill out state crash reports?

DATA SAVES LIVES

MINNESOTA STATUTE 169.09

All written reports required shall be for the use of the Commissioner of Public Safety and other appropriate agencies for crash analysis purposes. Crash reports and data contained in the reports shall not be discoverable under any provision of law or rule of court. No report shall be used as evidence in any trial, civil or criminal, arising out of a crash. This language is designed to give officers freedom to report their opinions and conclusions. Thus, as an example, if your investigation leads you to believe that alcohol contributed to a crash, or that a driver had been drinking or that a passenger was not wearing a seat belt, then report that belief (or opinion) in the spaces provided. This report reflects your best judgment, not findings of fact in a court of law. In the worst-case scenario, you can always file an amended report at a later date.

CONTINUE

How have crash reports improved safety so far?

Crash reports have led to past roadway safety improvements including safer vehicles, safer roads, and human behavior changes.

Review the many improvements that have happened due to the detailed crash reports of the past.

Safer Vehicles

- Padded dashboards
- Crumple zones that absorb energy in collisions and protect people in the passenger compartment
- Seat belts and airbags

Safer Roads

- Divided highways that separate the flow of traffic, reducing the risk of the most dangerous type of crashes (head-on collisions)
- Breakaway signposts
- Rumble strips

Human Behavior Changes

- Alcohol-related deaths in Minnesota decreased from about 500 per year in the late 1970s to 120 per year in the 2010s.
- Seat belt use increase from 20% in 1986 to 92% in 2018.

CONTINUE

Knowledge Check: Crash reporting is a source of information for all of the following **except:**

- Safer roads and vehicles
- Designing legislation
- To be used as evidence in a court of law**
- Creating programs to improve human behavior and traffic safety

Path Toward Zero

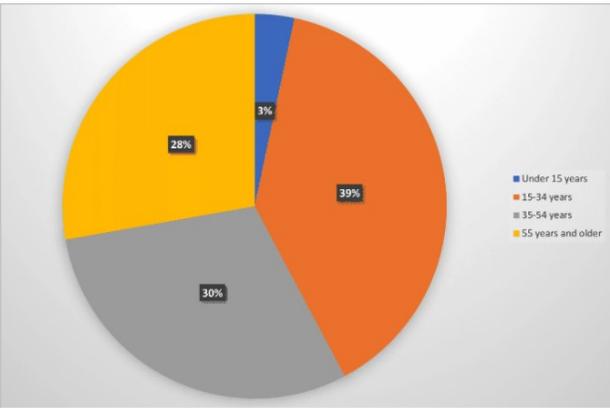
Despite dramatic progress, traffic crashes continue to be a major cause of avoidable death and injury. There have been more than 3.1 million traffic deaths in the US in the last 100 years. *Click below to read death statistics for Minnesota and the US.*

Minnesota Deaths: 2018	+
United States Deaths: 2018	+

 Click the '+' signs to review all content above before moving on.

<p>Minnesota Deaths: 2018</p> <ul style="list-style-type: none"> • 104 homicides • 381 traffic deaths 	-
<p>United States Deaths: 2018</p> <ul style="list-style-type: none"> • 16,214 homicides • 36,560 traffic deaths 	-

CONTINUE



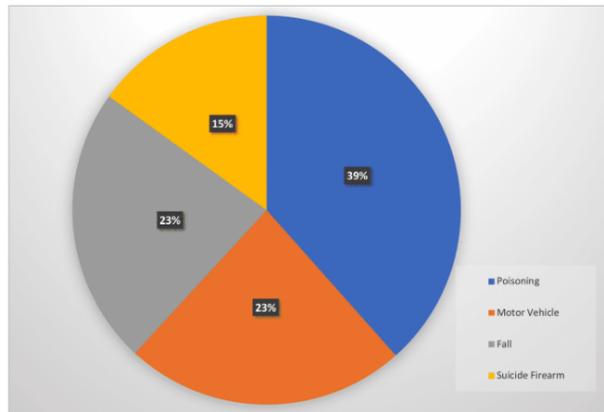
Percentages of Traffic Crash Deaths by Age Group

Who is most affected?

Traffic crashes account for about half the deaths from all crashes and claim mostly younger and middle-aged persons as victims.

Who is most affected?

Motor vehicle traffic crashes are one of the top four leading causes of unintentional injury deaths along with unintentional poisoning, falls, and suicide by firearm.



Leading Causes of Unintentional Injury Deaths

CONTINUE

Knowledge Check: An officer should make their best judgment call on all of the following except:

- Whether or not alcohol was suspected
- Speeding
- Use of seatbelts
- Driver's license information**

Knowledge check: Minnesota Statute 169.09 requires crash reports on all traffic crash scenarios except:

- A car leaves the roadway and crashes into a private garage causing \$1,200 in property damage
- Two bicyclists on a roadway collide**
- A bus crash that leaves 1 injured
- A woman walking on the sidewalk is killed by a car running into her

Crash Report Myths

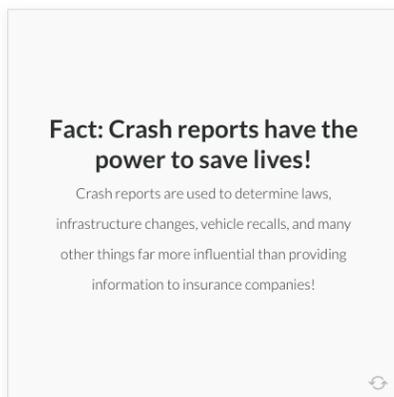
There are three persistent myths in crash reporting. *Click through the cards to dispel them.*



 Click through the cards to review all content above before moving on.

Crash Report Myths

There are three persistent myths in crash reporting. *Click through the cards to dispel them.*



 Click through the cards to review all content above before moving on.

Crash Report Myths

There are three persistent myths in crash reporting. *Click through the cards to dispel them.*



 Click through the cards to review all content above before moving on.

Crash Report Myths

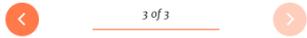
There are three persistent myths in crash reporting. *Click through the cards to dispel them.*



 Click through the cards to review all content above before moving on.

Crash Report Myths

There are three persistent myths in crash reporting. *Click through the cards to dispel them.*



 Click through the cards to review all content above before moving on.

Crash Report Myths

There are three persistent myths in crash reporting. *Click through the cards to dispel them.*



CONTINUE

Up Next: Why is Crash Reporting Important Quiz

CONTINUE

Quiz: Why is crash reporting important?

1. True or False: Crash reports are not discoverable under provision of law or rule of court.
 - ✓ **True**
 - False
2. The state gathers data from which of the following to learn about crashes:
 - Reconstruction reports
 - ✓ **Law enforcement officer's crash reports**
 - Citizen's reports from the drivers involved in crashes
 - All of the above
3. Use the mouse to drag and match the appropriate number of lives lost to the causes of death for each of the causes of life lost in Minnesota (2018)

104 Homicides

381 Traffic Deaths

Correct Answer: 104 Homicides and 383 Traffic Deaths

4. Minnesota Statute 169.09 requires crash reports on all traffic crashes **except:**
 - Single-unit, run-off-road crash with no injuries, but over \$1,000 in damage
 - ✓ **Parking lot crash between two vehicles with damage greater than \$1,000**
 - A vehicle rear-ending a parked vehicle
 - All of the above
5. True or False: In circumstances of fatal car crashes, reconstruction personnel or state patrol will fill in the crash report with more detail. Therefore, it is better to leave more things blank than to make an educated guess
 - True
 - ✓ **False**

Work Zones Module



What is a work zone?

A **work zone** is an area of a trafficway where construction, maintenance, or utility work activities are identified by warning signs/signals/indicators, including those on transport devices (e.g., signs, flashing lights, channelizing devices, barriers, pavement markings, flagmen, warning signs, and arrow boards mounted on the vehicles in a mobile maintenance activity) that mark the beginning and end of a construction, maintenance or utility work activity.

A work zone extends from the first warning sign, signal or flashing lights to the END ROAD WORK sign or the last traffic control device pertinent for that work activity.

Work zones also include roadway sections where there is ongoing, moving (mobile) work activity such as lane line painting or roadside mowing only if the beginning of the ongoing, moving (mobile) work activity is designated by warning signs or signals.

 Work zones do NOT need to be active (e.g., with people working in it) for it to be a work zone.

CONTINUE

Types of Work Zones

- Lane Closure
- Lane Shift/Crossover
- Work on Shoulder or Median
- Intermittent or Moving Work Zone. A work zone designating temporary activity that may move or shift frequently.
- Other Type of Work Zone



CONTINUE

Knowledge Check: True or false. Work zones need to be an active work zone (workers present) in order for it to be considered a work zone.

- True
- False



Defining a Work Zone Crash

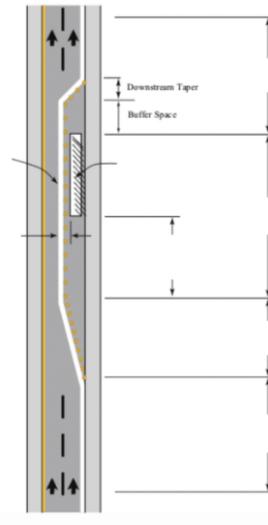
A **work zone crash** is a traffic crash in which the first harmful event occurs within the boundaries of a work zone or on an approach to or exit from a work zone, resulting from an activity, behavior or control related to the movement of the traffic units through the work zone.

A work zone crash includes collision and non-collision crashes occurring a) within the signs or markings indicating a work zone, b) on approach to the work zone, or c) exiting from or adjacent to work zones that are related to the work zone.

A crash that occurs as a result of traffic congestion in an area prior to the first work zone warning signs should still be coded as a work zone crash, even if the first harmful event occurred before the first warning sign.

CONTINUE

Figure 6: Diagram of a Work Zone Area

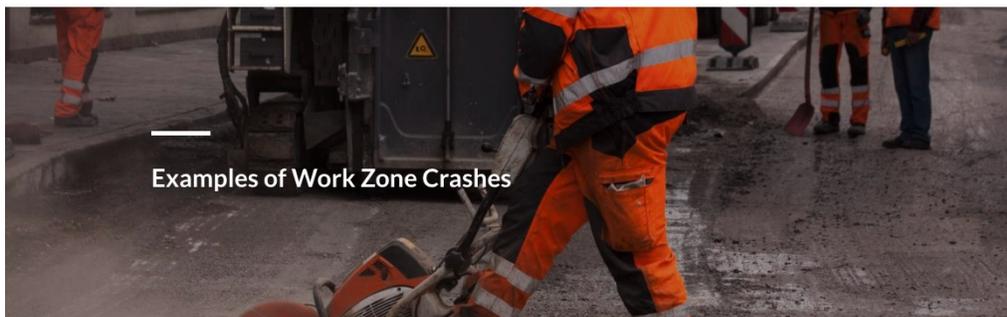


Work Zone Related Crashes. A work zone related crash is a crash that occurs in or related to a construction, maintenance, or utility work zone, whether or not workers were actually present at the time of the crash. Work zone related crashes may also include those involving motor vehicles slowed or stopped because of the work zone, even if the first harmful event occurred before the first warning sign.

CONTINUE

Knowledge Check: A work zone crash is

- A crash in which the first harmful event occurs within the boundaries of a work zone
- A crash in which occur son an approach to or exit from a work zone
- A result from an activity, behavior or control related to the movement of the traffic units through the work zone
- Occurs as a result of traffic congestion in an area prior to the first work zone warning signs
- All of the above**



Click on each example below to learn about the types of work zone crashes.

Vehicle loses control	+
Striking road worker	+
Striking working vehicle	+
Rear-end crash in cue	+
Crash at end of road work	+
Pedestrian crash	+



Click the '+' signs to review all content above before moving on.

Vehicle loses control	—
An automobile on the roadway loses control within a work zone due to a shift or reduction in the travel lanes and crashes into another vehicle in the work zone.	
Striking road worker	—
A van in an open travel lane strikes a highway worker in the work zone	
Striking working vehicle	—
A highway construction vehicle working on the edge of the roadway is struck by a motor vehicle in transport in a construction zone	
Rear-end crash in cue	—
A rear end collision crash occurs before the signs or markings indicating a work zone due to vehicles slowing or stopped on the roadway because of the work zone activity	

Crash at end of road work

A pickup in transport loses control in an open travel lane within a work zone due to a shift or reduction in the travel lanes and crashes into another vehicle which exited the work zone

Pedestrian crash

A tractor-trailer approaching an intersection where the other roadway has a work zone strikes a pedestrian outside the work zone because of lack of visibility caused by the work zone equipment

CONTINUE



Why does understanding work zones matter?

It is important to assess the impact on traffic safety of various types of on-highway work activity, to evaluate Traffic Control Plans used at work zones, and to make adjustments to Traffic Control Plans for the safety of workers and the traveling public. This data element needs to be collected at the scene because work zones are temporary or moving operations that are not recorded in permanent road inventory files.

CONTINUE

Up Next: Work Zone Quiz

CONTINUE

Quiz: Work Zones

1. True or False: To be considered a crash in a work zone, there must be people working in it at the time of the crash.
 - True
 - False

2. True or False: Construction is happening on a highway causing abnormal congestion that stretches a quart of a mile before the first warning sign indicating construction. A driver does not suspect the congestion and rear-ends the car in front of them. This would not be categorized as a 'work zone related' crash because it happened before the first warning sign.
 - True
 - False**
3. True or False: A work zone crash cannot happen in the actual worksite (e.g., a construction worker is hit by the bucket of an excavator inside the site).
 - True**
 - False
4. Identify the type of work zone. A truck is moving and painting the lines on a 2-way city road with a truck before and after indicating construction. What type of work zone is this?
 - Lane closure
 - Intermittent or Moving**
 - Lane Shift/Crossover
 - Not a work zone
5. All the following are considered work zone crashes **except**:
 - A van in an open travel lane strikes a highway worker in the work zone
 - An automobile on the roadway loses control within a work zone due to a shift or reduction in the travel lanes and crashes into another vehicle in the work zone.
 - A utility worker repairing the electric lines over the trafficway falls from the bucket of a cherry picker**
 - A pickup in transport loses control in an open travel lane with a work zone due to a shift or reduction in the travel lanes and crashes into another vehicle which exited the work zone

How to Choose the Right Unit Type Module

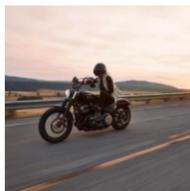
Lesson 6 of 18

How to Choose the Right Unit Type

 Nichole Morris

Unit Type

Each crash report will have at least one unit that is a motor vehicle in transport associated with the crash. Multi-unit crashes will include at least one motor vehicle in transport and could include other motorized or non-motorized units.



CONTINUE

Choosing The Correct Unit

A **Unit** is used as the general term to refer to any vehicle or non-motorist. Each unit type selected will provide you with a catered list of items and will leave out those that don't pertain to your specific crash. So, choosing the correct unit is important. *Review each unit type below to learn more.*

Motor Vehicle in Transport

A motor vehicle is any motorized (mechanically or electrically powered) road vehicle not operated on rails. When applied to motor vehicles, “in-transport” refers to being in motion or on a roadway. Inclusions: motor vehicle in traffic on a highway, driverless motor vehicle in motion, motionless motor vehicle abandoned on a roadway, disabled motor vehicle on a roadway, etc.

Hit-and-Run Vehicle (not present)

Refers to cases where the vehicle or the driver of the vehicle in transport is a contact vehicle in the crash and departs the scene without stopping to render aid or report the crash.

Working Vehicle/Equipment

A vehicle not intended for highway transport being used for Construction, maintenance or utility work related to the trafficway. The “work” may be located within open or closed portions of the trafficway, and the vehicle performing these activities can be within or outside the trafficway. Examples of working vehicles include: snowplow actively removing snow and ice, asphalt/steam roller paving or flattening a roadway, a highway maintenance crew painting lane lines on the road or mowing grass, a street sweeping vehicle, and a utility truck performing maintenance on power lines along the roadway.

Parked/Stalled Vehicle

A parked motor vehicle is a motor vehicle not in-transport, other than a working motor vehicle, that is not in motion and not located on the roadway. In roadway lanes used for travel during some periods and for parking during other periods, a parked motor vehicle should be considered to be in-transport during periods when parking is forbidden. Any stopped motor vehicle where the entirety of the vehicle's primary outline as defined by the four sides of the vehicle (e.g., tires, bumpers, fenders) and load, if any, is not within the roadway is parked.

Pedestrian

A person who is not an occupant of a motor vehicle in transport or a pedalcyclist. Includes a person who is adjacent to the motor vehicle regardless of their actions.

Bicycle

This includes traditional two-wheeled bicycles and electric assist bicycles or e-bikes. A two-wheeled E-bike is defined by fully operational pedals and an electronic motor of less than 750 watts whose maximum speed on a paved level surface, when powered solely by such a motor while ridden by an operator who weighs 170 pounds is less than 20 mph (NCSL, 2016).

Other Cycle (Unicycle, Tricycle, etc.)

Non-motorist using a non-motorized pedal-powered vehicle other than a bicycle, such as a unicycle or adult tricycle.

Moped or Motorized Bicycle

A moped or motorized bicycle possesses two wheels in contact with the ground, a seat or saddle for driver and passenger, a steering handle bar, and a brake horsepower not exceeding 2 HP. Unlike motorcycles, a moped by definition cannot include an enclosure.

Other Personal Conveyance

A personal conveyance is a device, other than a transport device, used by a pedestrian for personal mobility assistance or recreation. These devices can be motorized or human powered, but not propelled by pedaling. Examples include electric scooters (e.g., Bird, Lime, Spin), wheelchairs, and horse and buggy.

Commercial Vehicles



A commercial motor vehicle is any motor vehicle used for the transportation of goods, property, or people in interstate or intrastate commerce. This includes:

- Motor vehicle providing transportation of goods, property, or people for compensation (for-hire)
- Privately-owned motor vehicle providing transportation of privately-owned goods or property in furtherance of business enterprise
- Privately-owned motor vehicle providing passenger transportation in furtherance of a business enterprise

Examples: A trucking company hauling a manufacturing company's goods for a fee, a motorcoach transporting passengers within and between cities and towns.

③ **Commercial Motor Vehicle Exclusions;** Privately owned motor vehicle providing private transportation of personal property or people. Examples: Large family of 10 persons taking a trip in the family's 12-person van, homeowner carrying recyclables to a drop-off point in a personally owned pickup truck greater than 10,000 lbs.

CONTINUE

Knowledge Check. True or False. In a crash report, a trucking company hauling a manufacturing company's goods for a fee would be considered a commercial motor vehicle.

- True**
- False**

Non-motorists

Non-Motorists involved in crashes are an important segment of the population and have been increasing in number and percent of the people involved in crashes. Under-reporting of pedestrians and bicyclists in crashes makes it difficult to analyze the impact of crashes on this portion of the population, and results in missed opportunities to improve safety. The non-motorist section should be completed for every crash-involved person who was NOT the driver of a motor vehicle.



CONTINUE

Non-motorist or Motor Vehicle? Use the mouse to drag each example card into the correct category.

Motor-driven cycles

Non-motorists

Motor Vehicles



Sort all of the cards into the two categories above before moving on.

Recreational Off-Highway Vehicles (ROC)	Other cyclist	Snowmobile	2-Wheeled Motorcycle
Passenger Car	Wheelchair	All-Terrain Vehicle/All-Terrain Cycle (ATV/ATC)	Golf Cart
Personal Conveyance (e.g., Lime scooter, Spin scooter)	Pedestrian	Bicyclist	Occupant of non-motor vehicle transportation device
Horse & Buggy	Moped	Skater	

Knowledge Check: True or False. Non-motorists involved in crashes are an important segment of the population, and have been increasing in number and percent of people involved in crashes.

- True
- False



Hit-and-Runs

A **hit-and-run** refers to cases where the vehicle or the driver of the vehicle in transport is a contact vehicle in the crash, and departs the scene without stopping to render aid or report the crash.

Identifying hit and runs is important for uniformity, quality control, and identification purposes in reported motor vehicle crash statistics.

CONTINUE

Knowledge Check: Categorize the following crash scenario. A driver of the vehicle in transport is involved in the crash and departs from the scene without stopping to render aid or report the crash. What type of crash would this be categorized as?

- Un-reportable crash
- Hit and run**
- Work zone crash
- Two-unit crash

Up Next: How to Choose the Right Unit Type Quiz

CONTINUE

Quiz: How to Choose the Right Unit Type

1. City buses are always classified as commercial vehicles.
 - True
 - False**
2. In a vehicle and non-motorist crash, a biker gets hit by a car on a rural road. Who should be Unit 1 in the crash report?
 - The biker
 - The car**
 - Whoever is more injured
3. A commercial vehicle is all of the following **except**:
 - A truck weighing 5,000 lbs.**
 - A vehicle required to display a hazardous materials placard
 - A vehicle used for transporting more than 15 passengers, including the driver
 - A *chartered* school bus
4. True or False. In the case of a **hit and run**, you must enter information about the driver of the fleeing vehicle.
 - True
 - False**
5. All of the following can be classified as a personal conveyance except:
 - Wheel chair
 - Skateboard
 - Electric scooter (e.g., Lime, Spin, Bird)
 - Golf cart**

Important Vehicle Data Elements Module

Lesson 8 of 18

Important Vehicle Data Elements

NM Nichole Morris



Direction of Travel

The direction of travel is the direction of a motor vehicle's travel on the roadway before the crash. This is not a compass direction, but a direction consistent with the designated direction of the road. Code the direction the vehicle was going just before they enter the intersection. Includes the following attribute values:

- Not on roadway
- Northbound
- Eastbound
- Southbound
- Westbound
- Unknown

Why does this matter? It is important to indicate direction the motor vehicle was traveling before the crash for evaluation purposes. It is also important for intersection analysis and future roadway considerations.

CONTINUE

Pre-Crash Maneuver

- Parked or Entering or Leaving
- Moving Forward
- Wrong Way into Opposing Traffic
- Turning Right
- Turning Left
- Marking a U Turn
- Slowing
- Swerved or Attempt to Avoid Object in Roadway
- Changing Lanes
- Overtaking/Passing
- Leaving Traffic Lane
- Entering Traffic Lane
- Negotiating a Curve
- Backing
- Vehicle Stopped or Stalled in Roadway

Pre-Crash Maneuver Attributes

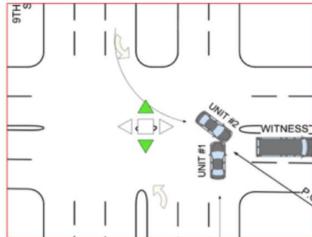
The pre-crash maneuver is the controlled maneuver for this motor vehicle *prior* to the beginning of the sequence of events. Use code other than "Moving Forward" if applicable.

Why does this matter? This is important for crash evaluation, particularly when combined with sequence of events. It is important to clarify this element in the crash report.

CONTINUE

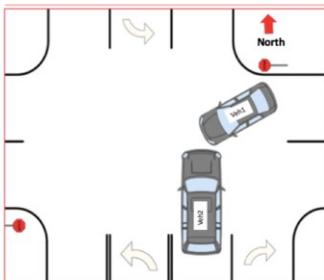
Example of Direction of Travel and Pre-Crash Maneuver

If a southbound vehicle turns left to go Eastbound, code the direction of as **Southbound** and the pre-crash maneuver as **Turning Left**.



CONTINUE

Knowledge Check: What is the direction and pre-crash maneuver for Vehicle 1?



- Southbound and Turning Left
- Westbound and Moving Forward
- Westbound and Turning Left**
- Southbound and Moving Forward



Manner of Collision

The manner of collision is the identification of the manner in which two motor vehicles in transport initially came together without regard to the direction of force. This data element refers only to crashes where the first harmful event involves a collision between two motor vehicles in transport.

Review each of the manner of collision and associated crash diagrams below.



Figure 2: Manner of Collision and Associated Crash Diagrams

Click the right side arrows to review all content above before moving on.

Review each of the manner of collision and associated crash diagrams below.

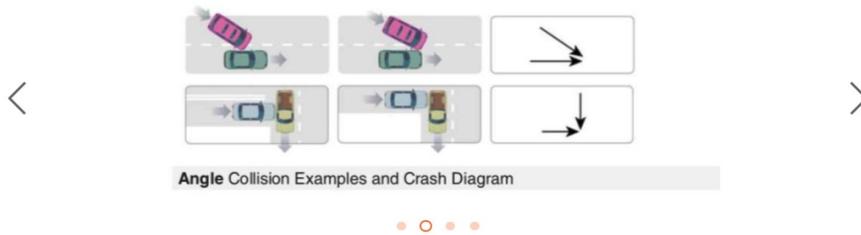


Figure 2: Manner of Collision and Associated Crash Diagrams

Click the right side arrows to review all content above before moving on.

Review each of the manner of collision and associated crash diagrams below.



Sideswipe, Same Direction Collision Example and Crash Diagram



Sideswipe, Opposite Direction Collision Example and Crash Diagram



Figure 2: Manner of Collision and Associated Crash Diagrams



Click the right side arrows to review all content above before moving on.

Review each of the manner of collision and associated crash diagrams below.



Rear to Side Collision Example and Crash Diagram

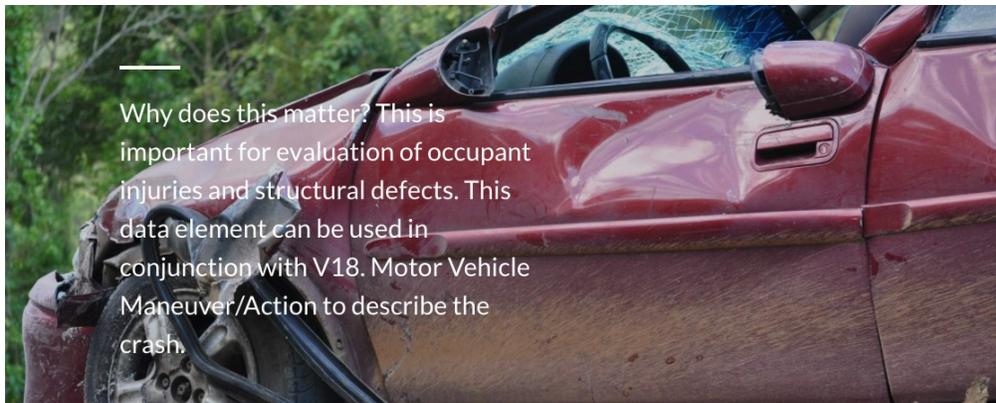


Rear to Rear Collision Example and Crash Diagram



Figure 2: Manner of Collision and Associated Crash Diagrams

CONTINUE



Why does this matter? This is important for evaluation of occupant injuries and structural defects. This data element can be used in conjunction with V18. Motor Vehicle Maneuver/Action to describe the crash.

Click on Each Subfield Below to Learn More.

Subfield 1: Initial Point of Contact	+
Subfield 2: Location of Damaged Area(s)	+
Subfield 3: Resulting Extent of Damage	+

 Click the '+' signs to review all content above before moving on.

Subfield 1: Initial Point of Contact

Subfield 1 of this element is intended to collect the approximate contact point on this vehicle associated with this vehicle's initial harmful event.

- If the initial harmful event does not involve a collision, then code the attribute, Non-Collision (refer to glossary).
- If the initial harmful event for this vehicle involves striking another vehicle, person, or property (a collision event) by virtue of a load/cargo that falls from or is propelled by the vehicle, then code the attribute, Cargo Loss.
- If the vehicle is **not** at the scene for the officer to assess the initial point of contact, location of damaged area(s), or resulting extent of damage, then code the attribute, Vehicle Not at Scene, for all three Subfields.

Subfield 2: Location of Damaged Area(s)

Subfield 2 identifies all areas damaged on the vehicle as a result of this crash.

Subfield 3: Resulting Extent of Damage

Subfield 3 identifies the extent to which the damage identified in Subfield 2 effects the vehicle's operability rather than the cost to repair.

CONTINUE

Knowledge Check: The initial point of contact is important for all of the following reasons except:

- ✓ **To be used in a court of law**
- To better evaluate occupant injuries
- To better improve structural vehicle defects
- To better understand the crash sequence of events

Up Next: Important Vehicle Data Elements Quiz

CONTINUE

Quiz: Important Vehicle Data Elements

1. The initial point of contact is:
 - The most damaged part of the vehicle
 - ✓ **The part of the vehicle's body that is touched in the first harmful event**
 - Everywhere there is damage on the vehicle
 - The part of the vehicle's body that is touched in the last harmful event
2. True or False: In order to know the initial point of contact, there has to be damage done to the vehicle
 - True
 - ✓ **False**
3. *Read the following scenario and determine the initial point of contact.* A driver is going down a road in an area heavy with pedestrians. They do not see a woman coming into the crosswalk. The vehicle swerves to get out of the way but still hits the woman with the front left headlight. The vehicle then hits the curb and crashes head on into a light pole. What is the initial point of contact?
 - The curb, so the tires/undercarriage
 - The light pole, so the front of the car
 - ✓ **The woman, so the front left of the car**
 - None of the above
4. A person is driving down the street when their vehicle is struck by a crate that fell off the bed of a truck. This type of collision is called:
 - ✓ **Cargo loss**
 - Non-collision
 - Initial point of contact
 - Vehicle not at scene

5. True or False: There is no initial point of contact if 'all damaged areas' is selected.
 - True
 - False**
6. True or False: Manner of collision should NOT be recorded for single unit crashes or crashes involving one motor vehicle and a non-motorist
 - True**
 - False
7. What is the direction of travel and pre-crash maneuver for Vehicle 2? (INSERT SCREEN SHOT)
 - Northbound and turning left
 - Westbound and moving straight
 - Northbound and moving straight**
 - Southbound and turning left

Sequence of Events Module

The **sequence of events** are events in a sequence related to the motor vehicle, including **non-harmful events**, **non-collision harmful events** and **collision events**.

Refer to Appendix G: Sequence of Events Examples.

CONTINUE

How to Write a Detailed Sequence of Events in MNCrash Report.

MMUCC recommends up to four events be recorded by the State.

In cases where there might be more than four events, it is recommended that non-harmful events be eliminated first. This is the same for the narrative.

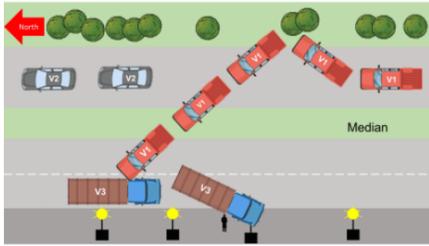
Enter up to four codes to describe events prior to, during, and after the crash for each unit. Enter them in the sequence in which they occurred to the vehicle involved.

CONTINUE

Knowledge Check: The sequence of events includes

- Non-harmful events
- Non-collision harmful events
- Collision events
- All of the above**

Sequence of Events Example #1



Vehicle #1 (V1), a pickup, was traveling northbound Minnesota Route 7 (MN7) following Vehicle #2 (V2), a car. V2 slowed suddenly. Driver #1 (D1) did not notice V2 slowing in time and swerved to the right to avoid striking V2. V1 struck a tree off the right side of the road. V1 veered off the tree and proceeded to cross over the center median grass striking Vehicle #3 (V3) traveling in the right-hand southbound lane injuring the driver of V1.

After being struck by V1, V3 struck the curb on the right-hand side of the road, crossed over the sidewalk, and struck a pedestrian and then a light pole. V2 did not know the crash had occurred and kept on driving.

Sequence of Events Example #1 Continued

Vehicle #1 Sequence of Events	Vehicle #3 Sequence of Events
Ran off Roadway Right	Motor Vehicle in Transport
Tree (standing)	Curb
Cross Median	Pedestrian
Motor Vehicle in Transport	Utility Pole/Light Support

Up Next: Knowledge Check on Sequence of Events Example #1

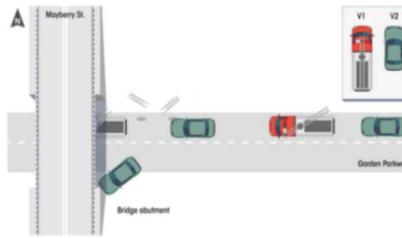
CONTINUE

Knowledge Check: True or False. There would be no sequence of events coded for Vehicle #2 in the Sequence of Events #1 example above.

- True**
- False

Sequence of Events Example #2

Vehicle #1 (V1), a firetruck returning from an emergency, was traveling west on Garden Parkway approaching the Mayberry Street underpass when a malfunction in the hydraulic system of its hook and ladder apparatus caused the ladder to raise and swing to the right of the vehicle. When V1 went under the Mayberry Street overpass the ladder and bucket struck the bottom of the bridge, breaking off the top portion of the ladder. The ladder piece struck the right front quarter panel of Vehicle #2 (V2), which was following directly behind V1. V2 lost control and struck the underpass bridge abutment on the eastbound side of the road.

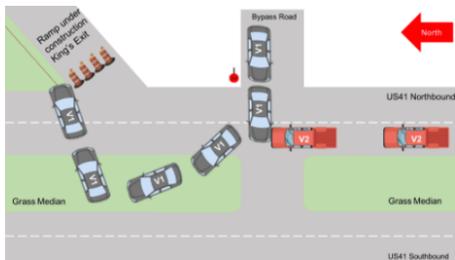


Sequence of Events Example #2 Continued

Vehicle #1 Sequence of Events	Vehicle #3 Sequence of Events
Equipment Failure (blown tire, brake failure, etc.)	Struck by Falling, Shifting Cargo or Anything Set in Motion by Motor Vehicle
Bridge Overhead Structure	Cross Centerline
Cargo/Equipment Loss or Shift	Ran Off Roadway Left
Motor Vehicle in Transport	Bridge Pier or Support

CONTINUE

Sequence of Events Example #3



Driver #1 (D1) was stopped at the stop sign on the south end of the bypass road around the King's Mine Overpass construction. Upon entering US41 with the intention of crossing over the northbound lanes and then turning to the south, D1 failed to see Vehicle #2 (V2) northbound on US41. V2 struck the front driver's side of V1 causing it to spin clockwise.

D1 was either unconscious or disoriented. D1 apparently had her foot on the accelerator and went approximately 1,000 feet to the north in the median and then crossed over northbound US41.

After crossing the northbound lanes, V1 started up the ramp at the King's Mine Interchange which is currently closed for construction. V1 went head-on into the guardrail end terminal on the west side of the ramp.

Sequence of Events Example #3 Continued

Vehicle #1 Sequence of Events	Vehicle #2 Sequence of Events
Motor Vehicle in Transport	Motor Vehicle in Transport
Ran Off Roadway Left	
Ran off Roadway Right	
Guardrail End Terminal	

CONTINUE



Storytelling with data

The sequence of events is your opportunity to tell the story of each crash through data. This helps us better understand the common themes and causes across hundreds and thousands of crashes in Minnesota and nationwide.

Include as many events as you can to serve your role as a storyteller.

Up Next: Sequence of Events Quiz

CONTINUE

Quiz: Sequence of Events

1. True or False: Sequence of events only ever includes the harmful ones.
 - True
 - False**
2. What is the number of events that MMUCC recommends to be recorded by the state in crash reports?
 - One
 - Three
 - Four**
 - Zero
3. A car is driving westbound in the left lane on a 4-lane highway when the driver becomes distracted, veering right off the road and eventually rolling **twice** down a ditch before crashing into a tree and coming to a complete stop. What is the most correct way to record this sequence of events?

- ✓ **Ran off road right, rollover, rollover, tree**
 - Ran off road right, ditch, rollover, tree
 - Cross lanes right, ran off road right, ditch, rollover
 - Ditch, rollover, tree
- 4. True or False: An officer or witness must see the event in order to record it into their report.
 - True
 - ✓ **False**
- 5. True or False: A vehicle that rear-ends a parked vehicle would have “collision with a parked vehicle” as one of its sequence of events. The parked vehicle would also have “collision with a parked vehicle” as one of its sequence of events.
 - True
 - ✓ **False**

Contributing factors Module



The factors that may have contributed to a crash are divided into 3 sections. *Click on each tab to learn more.*

ROADWAY ENVIRONMENT	MOTOR VEHICLE	PERSON
<p>Apparent environmental or roadway conditions which may have contributed to the crash.</p> 		

Click each tab to review all content above before moving on.

The factors that may have contributed to a crash are divided into 3 sections. *Click on each tab to learn more.*

ROADWAY ENVIRONMENT	MOTOR VEHICLE	PERSON
---------------------	----------------------	--------

Pre-existing motor vehicle defects or maintenance conditions that may have contributed to the crash.



 Click each tab to review all content above before moving on.

The factors that may have contributed to a crash are divided into 3 sections. *Click on each tab to learn more.*

ROADWAY ENVIRONMENT	MOTOR VEHICLE	PERSON
---------------------	---------------	---------------

Driver Actions: The actions by the driver that may have contributed to the crash. This data element is based on the judgment of the law enforcement officer investigating the crash and need not match "P15. Violation Codes."

Non-motorist Actions: The actions/circumstances of the non-motorist that may have contributed to the crash. This data element is based on the judgment of the law enforcement officer investigating the crash.



The factors that may have contributed to a crash are divided into 3 sections. *Click on each tab to learn more.*

ROADWAY ENVIRONMENT	MOTOR VEHICLE	PERSON
<p>Driver Actions: The actions by the driver that may have contributed to the crash. This data element is based on the judgment of the law enforcement officer investigating the crash and need not match "P15. Violation Codes."</p> <p>Non-motorist Actions: The actions/circumstances of the non-motorist that may have contributed to the crash. This data element is based on the judgment of the law enforcement officer investigating the crash.</p> 		

Click each card to see the definitions for some specific road circumstances.

<p>Glare</p> <p><small>Click to flip ↻</small></p>	<p>Visual Obstruction</p> <p><small>↻</small></p>	<p>Roadway Surface Condition</p> <p><small>↻</small></p>
<p>A very harsh, bright, dazzling light that impairs vision</p> <p><small>↻</small></p>	<p>An object that blocked the driver's sight, contributing to the crash (e.g., bush, tree)</p> <p><small>↻</small></p>	<p>The road that is wet, icy, snow-covered, slush-covered, etc. that contributed to crash.</p> <p><small>↻</small></p>

Click through the remaining potential road circumstances to help you recognize them in the future.

- Rut, Holes, Bumps
- Worn, Travel-Polished Surface
- Traffic Control Inoperative, Missing or Obscured
- Shoulders (none, low, soft, high)
- Debris
- Obstruction in roadway
- Work Zone (construction/ maintenance/utility)
- Non-Highway Work
- HOV, HOT, MnPass, Carpool or Toll Lane Related
- Congestion back up due to Prior Crash
- Congestion back up due to Non-recurring incident
- Congestion back up due to Other
- Other & Unknown

Knowledge Check: Which item would be listed as a contributing road circumstance?

- Congestion due to a prior crash**
- Distracted driving
- Deer in road
- Defective brakes

Motor Vehicle

Pre-existing motor vehicle defects or maintenance conditions that may have contributed to the crash.



Why are vehicle contributing circumstance important?

Important for determining the significance of pre-existing problems, including equipment and operation, in motor vehicles involved in crashes that could be useful in determining the need for improvements in manufacturing and consumer alerts.

CONTINUE

Click on each number around the image to explore the possible values for documenting motor vehicle issues which may have contributed to the crash.



Lighting Issues < > Headlights Signals Tail lights	Visual Obstructions < > Windows/Windshield Mirrors Wipers
--	---

Towing Issues < > Truck coupling Trailer Hitch Safety Chains	Vehicle Control System Issues < > Steering Power Train Suspension
--	---

Vehicle Maintenance Issues < > Brakes Exhaust System Tires Wheels	Vehicle Exterior Issues < > Vehicle Body Doors
--	---

Other/ Unknown < >

Knowledge check: Which item would be listed as a motor vehicle contributing circumstance?

- Speeding
- Pot hole
- Bald Tires**
- Following too close



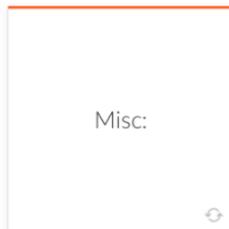
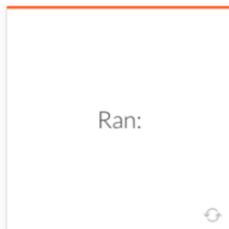
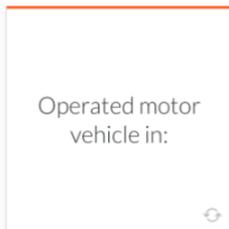
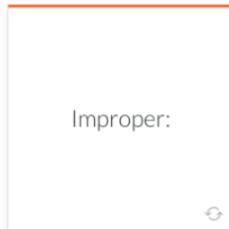
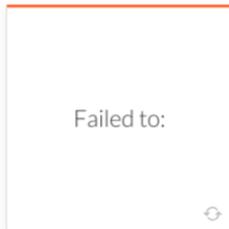
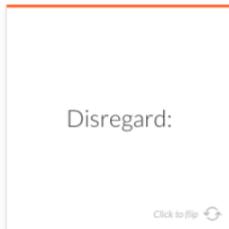
Driver Actions at Time of Crash

The actions by the driver that may have contributed to the crash.

Why are driver actions important?

Important for evaluating the effect that dangerous driver behavior has on crashes.

Click each card to view some common dangerous driver behaviors often associated with crashes.



 Flip each card to review all content above before moving on.

Click each card to view some common dangerous driver behaviors often associated with crashes.

- Other Road Markings - Other Traffic Signs	- Keep in proper lane - Yield the right of way	- Backing - Passing - Turn
- Inattentive, careless, negligent or erratic manner - Reckless or aggressive manner	- Off roadway - Red light - Stop sign	- Followed too closely - Swerved or avoided due to wind, surface, vehicle, objects, non-motorist - Wrong side or way - Other Contributing action - Unknown

CONTINUE

Knowledge check: Which item would be listed as an appropriate selection for **driver action** at time of crash?

- Inoperable signal
- Work zone (construction)
- Ran off roadway**
- Texting while driving

Non-Motorist Contributing Action(s)/Circumstances

The actions/circumstances of the non-motorist that may have contributed to the crash.



Why are contributing actions of the non-motorist important

The development of effective roadway design and operation, education, and enforcement measures to accommodate pedestrians and cyclists and prevent crashes with motor vehicles is enhanced by the collection of the actions and circumstances at the time of the crash.

CONTINUE

Click through the possible contributing actions that may be listed for non-motorists prior to the crash to help you recognize them in the future.

- Dart/Dash
- Disabled Vehicle-Related (working on, pushing, leaving/approaching)
- Entering/Exiting Parking/Standing Vehicle
- Failure to Obey Traffic Signs, Signals, or Officer
- Failure to Yield Right-of-Way
- Improper passing
- Improper turn/merge
- Inattentive (Talking, Eating, etc.)
- In Roadway Improperly (Standing, Lying, Working, Playing)
- Not Visible (Dark Clothing, No Lighting, etc.)
- Wrong-Way Riding or Walking
- Other
- Unknown

Up Next: Contributing Factors Quiz

CONTINUE

Quiz: Contributing factors

1. A non-motorist contributing action is which of the following:
 - ✓ **A biker who fails to obey traffic signals**
 - A driver talking on her cellphone
 - A pedestrian who walks on a crosswalk with the walk signal
 - A car parked illegally on the side of the road
2. An example of **person** contributing factor are all of the following **except**:
 - ✓ **A tire flies off the vehicle while on a highway**
 - Followed another car too closely
 - Over-correcting while texting and driving
 - Swerved due to speeding on icy roads
3. An example of a **roadway environment** contributing factor is which of the following:
 - Driving the wrong direction on a one-way
 - ✓ **Rain causing slippery roads**
 - Disregarding road markings
 - Failing to keep in the proper lane

4. An example of a vehicle contributing factor is which of the following:
 - Ran a red light
 - Changing the radio station
 - Brake failure**
 - Hydroplaning
5. A pedestrian walks across a street with no lighting at night in dark clothing and cause sa car crash. This would fall under which contributing factors category?
 - Person
 - Non-motorist**
 - Roadway Environment
 - Vehicle

Distraction and Inattention Module

Distraction and Inattention

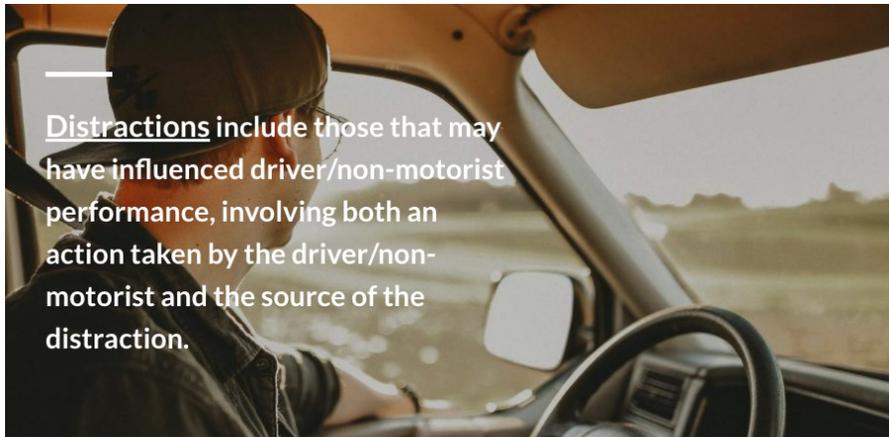
NM Nichole Morris



Why does understanding distraction and inattention matter?

It is important to identify specific driver behavior during a crash and understand and mitigate the effects of these activities. Distraction and inattention are different from one another. It is important to understand these differences as well as the types of distractions and inattention to improve data accuracy in crash reporting.

CONTINUE



Distractions include those that may have influenced driver/non-motorist performance, involving both an action taken by the driver/non-motorist and the source of the distraction.

Types of Distractions. *Click each distraction type to learn more.*

External	+
Other Inside the Vehicle	+
Passenger	+

Types of Distractions. *Click each distraction type to learn more.*

External -

External distractions are driver distractions that occur outside the vehicle. Examples of external distractions include: a crash in the next lane, a crash on the other side of the median, viewing automated highway signs, interesting objects in the sky, a roadside fire, animals outside the vehicle (e.g., birds, deer).

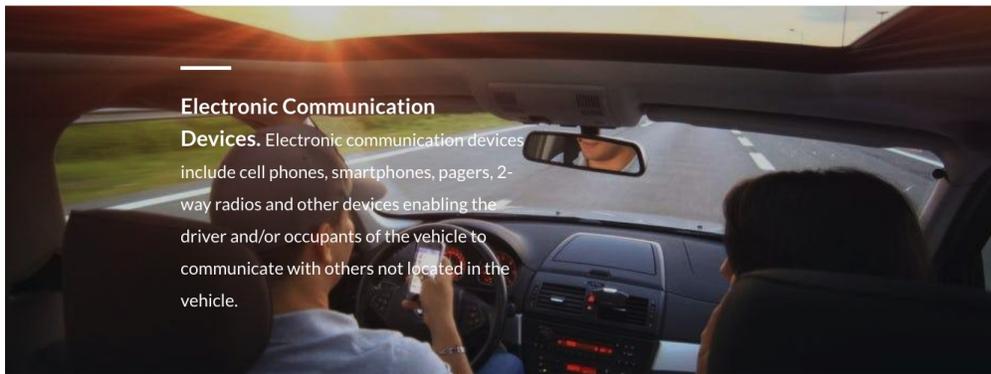
Other Inside the Vehicle -

Other distractions inside the vehicle affecting the driver. This includes actions taken by the driver or distractions within the vehicle. Examples of other distractions inside the vehicle include: eating, drinking, smoking, pets, cell phones, insects, etc.

Passenger

A **passenger** can also be the source of distraction affecting the driver, through conversation or other forms of interaction or interference with mindful driving of the roadway environment

CONTINUE



Electronic Communication

Devices. Electronic communication devices include cell phones, smartphones, pagers, 2-way radios and other devices enabling the driver and/or occupants of the vehicle to communicate with others not located in the vehicle.

Knowledge Check: Which of following are example(s) of distractions? *Check all that apply.*

- Smoking**
- Roadside fire**
- Passengers in the vehicle**
- A wandering mind
- A crash in the next lane**



Types of Inattention. *Click on each inattention type to learn more.*

Inattention Due to Thoughts	+
Inattention Due to Feelings	+

 Click the '+' signs to review all content above before moving on.

Inattention Due to Thoughts —

Examples of inattention due to thoughts include: Daydreaming while driving, a wandering mind (i.e., getting lost in one's thoughts), remembering something on a to-do list, replaying a past conversation with a friend

Inattention Due to Feelings —

Examples of inattention due to feelings include: Feeling angry from an argument with a loved one, feeling happy about starting a new job, feeling upset over a news story heard on the radio

CONTINUE

Distraction or Inattention? Use the mouse to sort the cards into the appropriate piles.

The interface shows a central card with the text "A roadside fire" and a small icon below it. Below the card are two dashed rectangular boxes representing target piles: "Distraction" on the left and "Inattention" on the right.

A roadside fire	Daydreaming about a vacation	Smoking
Wandering mind	Passenger	Replaying a conversation in your head
Lost in thought	A crash across the median	



Electronic Communication

Devices. Electronic communication devices include cell phones, smartphones, pagers, 2-way radios and other devices enabling the driver and/or occupants of the vehicle to communicate with others not located in the vehicle.

How to report electronic communication devices in the crash report:

Attribute values include a two-subfield set that collects Subfield 1, *Action*, and Subfield 2, *Source*. The new two-subfield element aims at collecting a greater number of combinations, without including them in an exhaustive attribute list. *Review the details of each subfield below.*

Subfield 1, Action.

- **Manually operating (texting, dialing, playing game, etc.).** The driver was in the act of manually manipulating an electronic communication device (cell phone, smartphone, hand-held radio, etc.). The type of device manipulation includes dialing, texting and typing.

Subfield 2, Source

- **Talking on a Hand-Held Electronic Device.** The driver was conversing on a hand-held electronic device such as a cell phone.
- **Talking on a Hands-Free Electronic Device.** The driver was conversing using a hands-free electronic Device, such as a Bluetooth equipped headset/earpiece or a vehicle-integrated system.
- **Other Activity, Electronic Device.** The driver was in the act of using an electronic device for some purpose other than communicating, such as operating a navigation device, playing a game, or watching a video.



CONTINUE

Up Next: Distraction and Inattention Quiz

CONTINUE

Quiz: Distraction and Inattention

1. True or False: Drivers can be distracted by things outside of the vehicle
 - ✓ **True**
 - False
2. All of the following would be considered a distraction **except**:
 - A bee inside the car
 - ✓ **Sadness causing inattention**
 - A passenger talking
 - Drinking coffee
3. True or False: Distraction is generally described as things that happen inside the driver's head when there is no distractor present.
 - True
 - ✓ **False**
4. True or False: Distraction and inattention can be used interchangeably/they mean the same thing.
 - True
 - ✓ **False**
5. All of the following are examples of inattention **except**:
 - Daydreaming about vacation

- Solving work problems in your head
- Dozing off
- ✓ **Looking at an accident across the highway**

Passengers Module



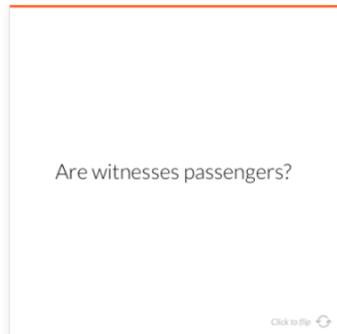
How to Fill Out Passengers on the MNCrash Report

Providing all known information about passengers present in a crash, injured or not, adds critical knowledge about how to keep them safe in future crashes.

Complete the information on both *injured* and *uninjured* passengers since the resulting data is necessary for assessing the safety of vehicles and occupant restraint systems.

CONTINUE

Click on each card below to reveal the answer.



1 of 3



Click through the 3 cards to review all content above before moving on.

Click on each card below to reveal the answer.

No. Do not list passengers as witnesses.



 Click through the 3 cards to review all content above before moving on.

Click on each card below to reveal the answer.

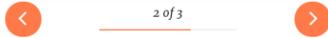
Do I have to list the names of uninjured passengers?



 Click through the 3 cards to review all content above before moving on.

Click on each card below to reveal the answer.

Complete information is best, but for uninjured passengers, listing age, position, and restraint use is critical information. Name is not.



 Click through the 3 cards to review all content above before moving on.

Click on each card below to reveal the answer.

What position should the passengers be coded as?



 Click through the 3 cards to review all content above before moving on.

Click on each card below to reveal the answer.

Enter the passenger's position
prior to the crash.



3 of 3



CONTINUE



While school bus crashes are rare, documenting them is critical!

School Bus Crashes

Documenting passengers on a school bus may seem too time-consuming, but the MNCrash report has simplified this process.

- 1) Document the complete number of passenger present on the bus during the time of the crash.
- 2) Document the number of passengers with any injuries from the crash.
- 3) Only document the details of INJURED passengers, not those uninjured.

① School bus crashes are rare: There were only 603 school buses in Minnesota involved in crashes in 2018. 489 of them were property damage only meaning they would only require a simple headcount of any passengers on board.

CONTINUE

Knowledge Check: How many school buses in Minnesota were involved in crashes in 2018?

- 5,000
- 1,020
- 9,9999
- 603

Special use cases

Passengers may be present on a variety of unit types and the position of passengers is important to document for each. *Click on the cards below to reveal each special use case.*



Special use cases

Passengers may be present on a variety of unit types and the position of passengers is important to document for each. *Click on the cards below to reveal each special use case.*

<p>Motorcycle passengers should be listed as in SECOND SEAT LEFT (for behind driver) or FRONT RIGHT (for sidecar)</p>	<p>If a vehicle has right-side driver control, the driver will be in FRONT RIGHT, and a front left passenger would be coded to FRONT LEFT (DRIVER) position.</p>	<p>Options for passengers riding outside of the cab include: other enclosed cargo area, riding on motor vehicle exterior, etc.</p>
---	--	--

CONTINUE



Remember to ask and make note of passenger restraints at the scene of the crash.

Knowing when proper use of seat-belts and car seats kept passengers safe is equally important to knowing when failure of proper use led to injury.

Knowing the complete data picture helps keep Minnesota's primary seat-belt law in place.

CONTINUE

Knowledge Check: In a property damage only crash, I should collect the following information at the scene of the crash regarding passengers:

- Number of passengers
- Injury severity of passengers

- Restraint use
- Position
- All of the above**
- None of the above since it is only a PDO

Up Next: Passengers Quiz

CONTINUE

Quiz: Passengers

1. True or False: The driver is included in the vehicle passenger count.
 - True
 - False**
2. If a passenger is a witness, how they should they be listed on the report?
 - As a passenger**
 - As a witness
 - Both
 - Neither
3. True or False: Passengers should only be listed if they were injured in the crash.
 - True
 - False**
4. The passenger's position should be listed:
 - In the position they were found after the crash
 - Not at all
 - In the position during the crash
 - In the position they were in prior to the crash**
5. Check all that apply. Motorcycle passengers should:
 - Not be listed
 - Only included if injured
 - Coded as FRONT RIGHT for side car**
 - Coded as SECOND SEAT LEFT for riding on seat behind driver**
 - Coded as backseat

Summary, Tips and Tricks for Crash Reporting Module



CONTINUE

Module Summary: Why is crash reporting important?

Crash reporting is one of the greatest tools we have to address serious and fatal crashes.

Crash reports have led to roadway safety improvements, including safer vehicles, safer roads, and human behavior changes.

CONTINUE

Knowledge check: Why is crash reporting important?

- It's just for insurance companies
- Paperwork is fun
- Crash reporting is one of the greatest tools we have to address series and fatal crashes**

Module Summary: Work Zones



- A work zone crash is a traffic crash in which the first harmful event occurs within the boundaries of a work zone or on an approach to or exit from a work zone, resulting from an activity, behavior, or control related to the movement of the traffic units through the work zone. *Examples include a vehicle losing control, striking a working vehicle, and striking a road worker.*
- It is important to assess the impact of traffic safety on various types of on-highway work activity, to evaluate Traffic Control Plans used at work zones, and to make adjustments for the safety of workers and the traveling public.

CONTINUE

Module Summary: Choosing the Right Unit Type

Click through this list of information on choosing unit types to help you in the future.

- A Unit is the general term to refer to any vehicle or non-motorist. Choosing the right unit type is important for crash reporting.
- Unit types include: Motor Vehicle in Transport, Hit-and-Run Vehicle, Parked/Stalled Vehicle, Working Vehicle/Equipment, Pedestrian, Bicycle, Other Cycle (Unicycle, Tricycle) Other Personal Conveyances
- Non-motorists involved in crashes are an important segment of the population.

CONTINUE

Module Summary: Important Vehicle Data Elements



Documenting the circumstances leading up to a crash is important for crash evaluation. Accurately recording the **Direction of Travel Prior to the Crash** and **Pre-crash Maneuver** helps complete the story when combined with the sequence of events.

Manner of Collision

+

Why does this matter?

+

Subfield 1, Subfield 2, and Subfield 3

+



Complete the content above before moving on.

Manner of Collision

—

The manner of collision is the identification of the manner in which two motor vehicles in transport initially came together without regard to the direction of force. This data element refers only to crashes where the first harmful event involves a collision between two motor vehicles in transport.

Why does this matter?

—

This is important for evaluation of occupant injuries and structural defects

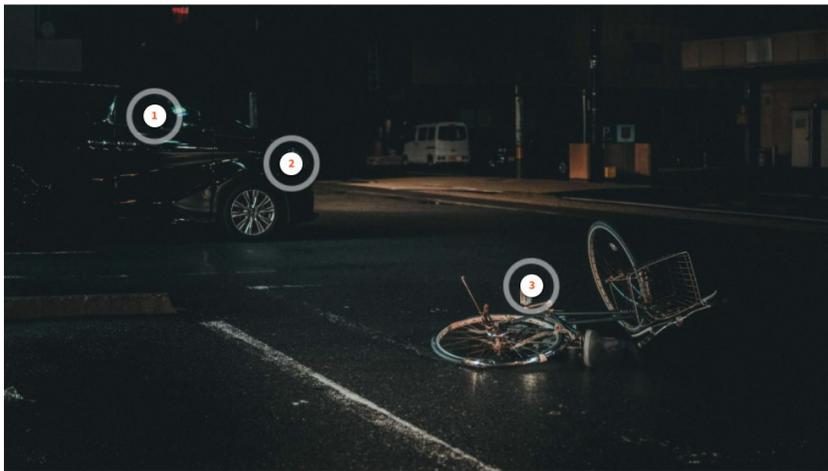


Subfield 1, Subfield 2, and Subfield 3

- Subfield 1: **Initial point of contact** is intended to collect the approximate contact point on this vehicle associated with this vehicle's initial harmful event.
- Subfield 2: **Location of damaged area(s)** identifies all areas damaged on the vehicle as a result of this crash.
- Subfield 3: Resulting **extent (severity) of damage** identifies the extent to which the damage identified in Subfield 2 affects the vehicle's operability rather than the cost to repair.

CONTINUE

Module Summary: Sequence of Events



Complete the content above before moving on.



The sequence of events are events in a sequence related to the motor vehicle, including non-harmful events, non-collision harmful events and collision events.



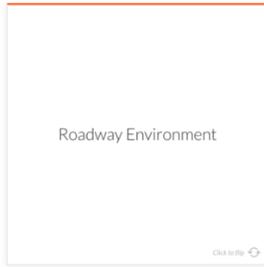
It is important to include as many applicable events as you can to tell a complete story of the crash



In cases where there may be more than four events, it is recommended that non-harmful events be eliminated first.

Factors that may have contributed to the crash.

Factors that may have contributed to the crash.

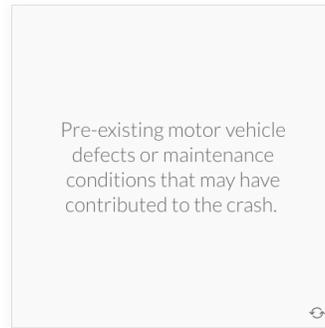
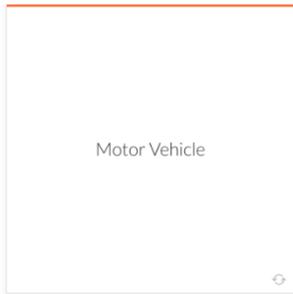


 Click through and flip each of the cards above before moving on.

 Click through and flip each of the cards above before moving on.

Factors that may have contributed to the crash.

Factors that may have contributed to the crash.



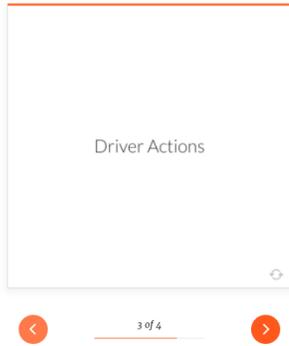
 Click through and flip each of the cards above before moving on.

 Click through and flip each of the cards above before moving on.

Module Summary: Contributing Factors

Factors that may have contributed to the crash.

Driver Actions

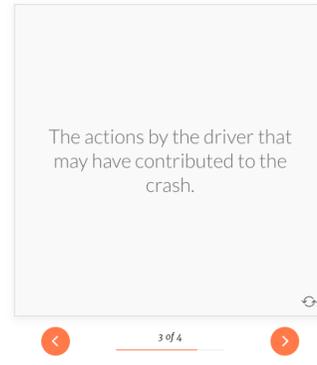


 Click through and flip each of the cards above before moving on.

Module Summary: Contributing Factors

Factors that may have contributed to the crash.

The actions by the driver that may have contributed to the crash.

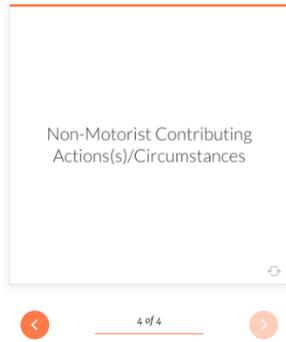


 Click through and flip each of the cards above before moving on.

Module Summary: Contributing Factors

Factors that may have contributed to the crash.

Non-Motorist Contributing Actions(s)/Circumstances

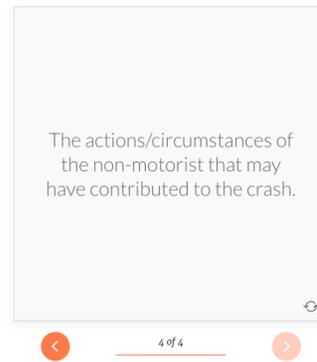


 Click through and flip each of the cards above before moving on.

Module Summary: Contributing Factors

Factors that may have contributed to the crash.

The actions/circumstances of the non-motorist that may have contributed to the crash.



CONTINUE

Module Summary: Passengers



- Providing all known information about passengers present in a crash, injured or not, adds critical knowledge about how to keep them safe in future crashes.
- Complete the information on both injured and uninjured passengers since the resulting data is necessary for assessing the safety of vehicles and occupant restraint systems.

CONTINUE

Module Summary: Distraction and Inattention

DISTRACTION

INATTENTION

Distractions include those that may have influenced the driver/non-motorist performance, involving both an action taken by the driver/non-motorist and the source of distraction.

- Examples include eating, passengers, a crash in the next lane.



Complete the content above before moving on.

Module Summary: Distraction and Inattention

DISTRACTION

INATTENTION

Inattention refers to drivers who improperly pay attention to things on the road that they should. Inattention is generally described as things that happen inside the driver's head when there is no distractor present. Inattention can be caused by thoughts or feelings.

- Examples include a wandering mind and being lost in thought.



CONTINUE

Crash Reporting Myths

MNCRASH MYTH #1

MNCRASH MYTH #2

MNCRASH MYTH #3



MYTH #1
Crash reports are just for insurance companies

FACT
Crash reports have the power to save lives!

Crash reports are used to determine laws, infrastructure changes, vehicle recalls, and many other things far more influential than providing information to insurance companies!



Click tabs to review all content above before moving on.

Crash Reporting Myths

MNCRASH MYTH #1 MNCRASH MYTH #2 MNCRASH MYTH #3

MYTH #2 **CRIME SCENE**

Important details will be figured out by the reconstruction team

It is important to provide as much information as you can, even your best guess. You are the state's only chance to learn about what happened at the crash to try to prevent them in the future!

FACT  **Reconstruction reports never add information to a state crash report!**

 Click tabs to review all content above before moving on.

Crash Reporting Myths

MNCRASH MYTH #1 MNCRASH MYTH #2 MNCRASH MYTH #3

MYTH #3

Crash report details need evidence

FACT  *The state's crash report is inadmissible in court for the explicit reason that crash data supports safety first and isn't hindered by the burden of proof!*

Crash reports should provide your best guess

CONTINUE

Before you go, take a look at some helpful tips and tricks for documenting future crash reports.

Crash Reporting: Tips *Click on each of the tips below to learn more.*

Tip #1: Complete	+
Tip #2: Parking	+
Tip #3: Property	+
Tip #4: Font Case	+

 Click the '+' signs to review all content above before moving on.

Tip #1: Complete



COMPLETE

Don't hold back information! Describing the ENTIRE sequence of events leading up to the crash in data format is critical to understanding how crashes tend to occur across the state!

Tip #2: Parking

PARKING

Parking lot crashes are not reportable crashes for the state of Minnesota. If you wish to use MNCrash to document them, be sure to select parking lot in "location relative to trafficway"



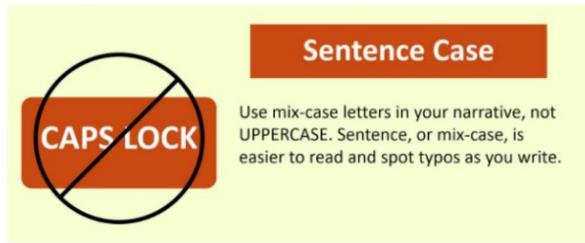
Tip #3: Property



PROPERTY

Documenting public or private property is an important part of crash reporting, but privately owned or publicly owned vehicles do not qualify as property in this sense.

Tip #4: Font Case



The graphic features a light green background. On the left, there is a red rectangular button with the text "CAPS LOCK" in white, which is crossed out by a black circle with a diagonal slash. To the right of this button is a red rectangular button with the text "Sentence Case" in white. Below the "Sentence Case" button, there is a paragraph of text: "Use mix-case letters in your narrative, not UPPERCASE. Sentence, or mix-case, is easier to read and spot typos as you write."

Knowledge Check: If a parked, city-owned vehicle is damaged in a crash, you should list it in the damage to public property section of the crash report.

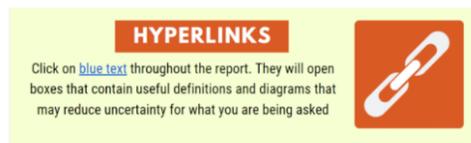
- True
- False**

Crash Reporting: Tricks. Click on each of the tricks below to learn more.

Trick #1: Hyperlinks	+
Trick #2: Short Cuts	+
Trick #3: Key Strokes	+
Trick #4: Mapping	+
Trick #5: Diagram	+

 Click the '+' signs to review all content above before moving on.

Trick #1: Hyperlinks



The graphic has a light green background. On the left, there is a red rectangular button with the text "HYPERLINKS" in white. Below this button is a paragraph of text: "Click on [blue text](#) throughout the report. They will open boxes that contain useful definitions and diagrams that may reduce uncertainty for what you are being asked". To the right of the text is a red square containing a white icon of a paperclip.

Trick #2: Short Cuts



The graphic has a light green background. On the left, there is a red square containing a white "X" icon. To the right of this icon is a red rectangular button with the text "SHORT CUTS" in white. Below the button is a paragraph of text: "Use short cuts such as "Same as Owner", "Same as Unit 1" and MnFILL to help the report auto-populate information for you".

Trick #3: Key Strokes

KEYSTROKES

Save time by using keystrokes instead of your mouse. You can navigate most of the report through the use of the Tab, arrows, and Enter keys

Tab

Trick #4: Mapping

 **MAPPING**

Click on the **Map Location** button to then accurately select the crash location on the map. If you are unable to map the location, then you should *manually enter the location* in the appropriate fields

Trick #5: Diagram

Diagram

Save any useful or common roadway templates you use in EasyStreet Draw to easily paste them into your diagram in the future.



Knowledge Check: True or False. Using keystrokes (tab, arrows, and enter key), as opposed to clicking on the mouse, is more efficient when completing a crash report.

- True
- False

Crash Reporting Narrative Tips

- 1 **Vehicle Info.** First state the vehicle(s) direction, position, and roadway/intersection location
- 2 **Sequence of Events.** Sequentially state ALL events that led up to and following the crash for the vehicle(s) including the manner of collision if more than one motor vehicle was involved.
- 3 **Crash Location.** Describe where on the roadway the crash occurred as well as where the final resting point of the vehicle(s) occurred.
- 4 **Driver Factors.** List any contributing factors to the crash including driver physical condition if pertinent.
- 5 **Roadway Factors.** Briefly describe the roadway conditions as well as the weather if it may have played a role in the crash.
- 6 **Occupant Information.** Without using personal descriptors, list if any occupants were ticketed, injured or killed.
- 7 **Form Clarification.** Be sure to elaborate on any instances from the crash report where the officer selected 'Other' or 'Unknown.'

Do not include personal identifiers (such as a driver's name) in the narrative. Crash reports are most useful when their data can be shared. *Personal identifiers must be removed by hand before partners can see crash reports which uses valuable resources.*

CONTINUE



FINISH