

# Technical Notes for the Crash Outcome Data Evaluation System (CODES) Dashboard

## Description of data sources

### Hospital Data

Hospitalization (inpatient) and emergency department (ED) data are extracted from Minnesota Hospital Discharge Data, which is maintained by the Minnesota Hospital Association (MHA). MHA represents Minnesota's hospitals and health systems. Hospitals submit ED and inpatient discharge data to MHA using the standardized universal billing 2004 (UB-04) form. Submitting data to MHA is voluntary, but the hospital discharge data typically represents data from more than 95% of hospitals (with some variation year to year). MHA began data-sharing agreements with several states in 2005. Minnesota residents receiving care from emergency departments and hospitals from the participating border states of North Dakota, South Dakota and Iowa are also included in hospitalization measures. MHA data are periodically revised by the MHA to reflect more complete and accurate discharge information.

### Crash Data

The Minnesota crash records system (MNCrash) provides a single source of statewide crash data for motor vehicle traffic crashes on Minnesota roads. Law enforcement officers report traffic crashes to the Department of Public Safety under Minnesota Statute 169.09, subdivision 8. The data drive enforcement, engineering, and education decisions to help save lives and prevent life-changing injuries.

## Data linkage methods

Hospital and crash data were linked using LinkSolv software from Strategic Matching, Inc. LinkSolv utilizes probabilistic record linkage with imputed links. Probabilistic record linkage can be effective even if the original data sources lack common unique personal identifiers or if identifying fields contain errors and omissions. LinkSolv improves upon earlier implementations of the Fellegi and Sunter theory of probabilistic record linkage. The

software first estimates a Bayesian posterior probability that each possible record pair is a true match given all observed agreements and disagreements of field values. Then the Bayesian posterior probabilities are used either to select a single imputation linked data set with the maximum likelihood estimate matches or to impute multiple complete sets of linked record pairs. Both options include both high and low probability matches. The CODES dashboard uses the maximum likelihood estimate datasets.

## Description of Variables used in the Dashboard

### Geographic units of interest

Variable	Description
State	State where the crash occurred. All occurred in Minnesota.
TZD region	Toward Zero Deaths region where the crash occurred. Regions are based on counties. For more detail: <a href="#">TZD Regions   Minnesota Toward Zero Deaths</a>

### Group by variables

Variable	Description
Sex (M/F)	Sex of the person from crash data
Age grouped by 0-14, 15-19, 20-24, 25-44, 45-64, 65+ yrs	Age of the person from crash data, supplemented with person age from the hospital data when missing in crash data
Year	Year of the crash as recorded in the crash data

# TECHNICAL NOTES FOR CODES DASHBOARD

Variable	Description								
Admission status (hospital inpatient vs. ED-treated only)	<p>Outpatient claims are filtered by MHA using CPT and Revenue codes to limit them to emergency department treatment. Admission status is calculated from the bill type variable (BILLTYPE) in hospital data:</p> <table> <tr> <td>110-119</td><td>Inpatient Stay (Hospitalization)</td></tr> <tr> <td>130-139</td><td>Outpatient Visit</td></tr> <tr> <td>830-839</td><td>Outpatient Visit – Ambulatory Surgery</td></tr> <tr> <td>850-859</td><td>Outpatient Visit – Critical Access Hospital</td></tr> </table>	110-119	Inpatient Stay (Hospitalization)	130-139	Outpatient Visit	830-839	Outpatient Visit – Ambulatory Surgery	850-859	Outpatient Visit – Critical Access Hospital
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“Big 4” crash predictor variables	<p>Four behavioral factors continue to be responsible for most traffic fatalities: speeding, distraction, impaired driving and failure to use a seat belt (Minnesota Crash Facts, 2023). These factors were calculated based on variable definitions specified in the MN Strategic Highway Safety Plan Technical Report 2020-2024 (July 2020).</p>								
Distracted driving	<p>Distraction by any driver in a crash was applied to all people involved in the crash to identify all people in distraction-related crashes.</p> <p>Distraction is calculated as:</p> <p style="padding-left: 40px;">Distractions inside or outside the motor vehicle which may have influenced the driver performance (DistractedDrivingCde) =</p> <p style="padding-left: 40px;">Manually Operating an Electronic Communication Device (texting, typing, dialing) (2); Talking on Hands-Free Electronic Device (3); Talking on Hand-Held Electronic Device (4); Other Activity, Electronic Device (5); Passenger (6); Other Inside the Vehicle (eating, personal hygiene, etc.) (7); Outside the Vehicle (includes unspecified external distractions) (8)</p> <p style="padding-left: 40px;">or</p> <p style="padding-left: 40px;">a Contributing factor (FactorCde1-FactorCde4) = Driver (motorist) Distracted (74)</p>								

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Variable	Description
Speeding	<p>Speeding by any driver in a crash was applied to all people involved in the crash to identify all people in speeding-related crashes.</p> <p>The crash data includes the officer's impression of whether the driver was speeding and includes a posted speed limit variable, but it does not have a variable for the actual speed of the driver.</p> <p>Speeding is calculated as:</p> <p>Indication of whether the investigating officer suspects that the driver involved with the crash was speeding based on verbal or physical evidence and not on speculation alone (ExceedingSpeedLimitInd) = Racing (3); Exceeding Speed Limit (4); Too Fast For Conditions (5)</p> <p>or</p> <p>a Contributing factor (FactorCde1-FactorCde4) = Driver (motorist) Speeding (75)</p>
Alcohol	<p>Suspected or confirmed alcohol use by any driver in a crash was applied to all people involved in the crash to identify all people in alcohol-related driving crashes.</p> <p>Alcohol-related drivers are calculated as:</p> <p>Type of person involved in the crash (persontypeenum) =Driver (1)</p> <p>and</p> <p>Driver suspected by law enforcement to have used alcohol (alcoholsuspectedcde) = Yes (1)</p> <p>or</p> <p>Person's apparent physical condition (physicalconditioncde, physicalcondition2cde) = Has been drinking alcohol (10)</p> <p>or</p> <p>Alcohol test result code (alcoholtestresultcde) = .01 BAC (1) through .70 BAC (70) (max BAC value)</p>

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Variable	Description
Alcohol/Drugs	<p>Suspected or confirmed alcohol or drug use by any driver in a crash was applied to all people involved in the crash to identify all people in alcohol/drug-related driving crashes.</p> <p>Alcohol/drug-related drivers are calculated as:</p> <p>Type of person involved in the crash (persontypeenum) =Driver (1)</p> <p>and</p> <p>Driver suspected by law enforcement to have used alcohol (alcoholsuspectedcde) = Yes (1)</p> <p>or</p> <p>Person's apparent physical condition (physicalconditioncde, physicalcondition2cde) =</p> <p>Has been drinking alcohol (10); Has Been Taking Illicit Drugs (11); Has Been Taking Medications (12)</p> <p>or</p> <p>Alcohol test result code (alcoholtestresultcde) = .01 BAC (1) through .70 BAC (70) (max BAC value)</p> <p>or</p> <p>Observation of person that would lead to drug use suspected = Yes (1)</p> <p>or</p> <p>Results of tests performed to determine presence of drugs (drugsuspectedcde) =</p> <p>Positive (1); Narcotic (5); Depressants (6); Stimulant (7); Hallucinogen (8); Cannabinoid (9); PCP (10)</p>
Not using a seatbelt	<p>Seatbelt use in motor vehicle occupants is calculated for people age 9 and older. The dashboard highlights the people who did not use a seatbelt/car seat, combining not using a seatbelt and not using a car seat. Incomplete seatbelt use (lap belt only or shoulder belt only) is considered nonuse.</p> <p>Not Using a Seatbelt is calculated as:</p>

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Variable	Description
	<p><b>Type of Vehicle</b> (VehicleTypeCde) = Passenger Car (2); Pickup (3); Sport Utility Vehicle; (4); Passenger Van (Seats Installed Behind Driver) (5); Cargo Van 10,000lbs or Less (No Seats Installed Behind Driver) (6); Motor Home/Camper/RV (20); Other Light Trucks (10,000lbs or Less) (48); Medium / Heavy Trucks (More than 10,000lbs) (49)</p> <p>and</p> <p><b>Position of occupant in vehicle</b> (positioncde) =</p> <p>Driver (1); Front Center (2); Front Right (3); Second Seat Left (4); Second Seat Center (5); Second Seat Right (6); Third Seat Left (7); Third Seat Center (8); Third Seat Right (9); Fourth Row Left (11); Fourth Row Middle (12); Fourth Row Right (13); Fifth or Other Row (Bus, 15 Passenger Van, etc.) (14)</p> <p>and</p> <p><b>Age of the person</b> (AgeNbr) = 9 or older</p> <p>and</p> <p><b>Type of safety equipment</b> (SafetyEquipmentUseCde, SafetyEquipmentUse2Cde) = None Used, Motor Vehicle Occupant (5); Lap Belt Only Used (7); Shoulder Belt Only Used (8); None (18)</p>
Not using a car seat	<p>Child restraint use (car seat or booster) in motor vehicle occupants is calculated for children age 8 and under. The dashboard highlights the people who did not use a seatbelt/car seat, combining not using a seatbelt and not using a car seat. Improper child restraint use (including lap/shoulder belt use) is considered nonuse of proper restraint for children age 8 and under.</p> <p>Not Using a Car Seat is calculated as:</p> <p><b>Type of Vehicle</b> (VehicleTypeCde) = Passenger Car (2); Pickup (3); Sport Utility Vehicle; (4); Passenger Van (Seats Installed Behind Driver) (5); Cargo Van 10,000lbs or Less (No Seats Installed Behind Driver) (6); Motor Home/Camper/RV (20); Other Light Trucks (10,000lbs or Less) (48); Medium / Heavy Trucks (More than 10,000lbs) (49)</p>

## TECHNICAL NOTES FOR CODES DASHBOARD

Variable	Description
	<p>and</p> <p><b>Position of occupant in vehicle</b> (positioncde) =</p> <p>Front Center (2); Front Right (3); Second Seat Left (4); Second Seat Center (5); Second Seat Right (6); Third Seat Left (7); Third Seat Center (8); Third Seat Right (9); Fourth Row Left (11); Fourth Row Middle (12); Fourth Row Right (13); Fifth or Other Row (Bus, 15 Passenger Van, etc.) (14)</p> <p>and</p> <p><b>Age of the person</b> (AgeNbr) = 8 or younger</p> <p>and</p> <p><b>Type of safety equipment</b> (SafetyEquipmentUseCde, SafetyEquipmentUse2Cde) = None Used, Motor Vehicle Occupant (5); Lap and Shoulder Belt Used (6); Lap Belt Only Used (7); Shoulder Belt Only Used (8); Child restraint system Not Used (10); Child Restraint System Seat Used Improperly (11);</p> <p>None (18)</p>

### Outcome variables

Variable	Description
Severe Injury	Severe injury is defined as hospital determined Injury Severity Score (ISS) of 15 or higher. The ISS is calculated based on ICD-10-CM diagnosis codes in the hospital data using ICDPIC-R software. Medical professionals have the training and equipment necessary to diagnose injuries and their severity, while law enforcement officers report what they can observe from the scene but are not expected to provide medical diagnoses or detect internal injuries.
Traumatic Brain Injury	<p>Traumatic Brain Injury (TBI) diagnosis (any listed ICD-10-CM diagnosis code):</p> <ul style="list-style-type: none"> <li>G93.1 - anoxic brain damage (when T75.1, T71.1xx, T71.2xx or T71.9 also coded)</li> </ul>

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Variable	Description
	<ul style="list-style-type: none"> <li>▪ S02.0 – fracture of vault of skull</li> <li>▪ S02.1xx - fracture of base of skull</li> <li>▪ S02.91 – unspecified fracture of skull</li> <li>▪ S04.0 (no 5th digit), S04.01 - injury to optic nerve itself</li> <li>▪ S04.02, S04.03, S04.04 Injury of optic chiasm; injury of optic tract and pathways; injuries of visual cortex</li> <li>▪ S06.xxx – Intracranial Injury</li> <li>▪ S07.1 – crushing injury of skull</li> <li>▪ T74.4 - shaken infant syndrome</li> </ul>
TBI Severity	TBI severity using maximum Abbreviated Injury Scale head region score: 1-2 mild, 3-4 moderate, 5-6 severe as proposed by <a href="https://pubmed.ncbi.nlm.nih.gov/27466967/">Traumatic brain injury: It is all about definition (https://pubmed.ncbi.nlm.nih.gov/27466967/)</a> . AIS scores are also calculated based on ICD-10-CM diagnosis codes using ICDPIC-R software.

Minnesota Department of Health  
 Traumatic Brain Injury  
 625 N Robert St  
 PO Box 64975  
 St. Paul, MN 55164-0975  
 651-201-5000  
[health.injuryprevention@state.mn.us](mailto:health.injuryprevention@state.mn.us)  
[www.health.state.mn.us](http://www.health.state.mn.us)

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To obtain this information in a different format, email [health.injuryprevention@state.mn.us](mailto:health.injuryprevention@state.mn.us)