EVALUATION OF 2005 SOUTH DAKOTA CRASH DATA REPORTED TO MCMIS CRASH FILE

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Reported to the MCMIS Crash File

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16. Abstract

This report is part of a series evaluating the data reported to the Motor Carrier Management Information System (MCMIS) Crash File undertaken by the Center for National Truck and Bus Statistics at the University of Michigan Transportation Research Institute. The earlier studies showed that reporting to the MCMIS Crash File was incomplete. This report examines the factors that are associated with reporting rates for the state of South Dakota.

MCMIS Crash File records were matched to the South Dakota Crash file to determine the nature and extent of underreporting. The South Dakota crash file appears to supply all the information needed to identify cases that qualify for reporting to the MCMIS Crash file. Overall, it appears that South Dakota is reporting 66.4 percent of involvements that should be reported to the MCMIS Crash file.

Reporting rates were related to crash severity, with fatal involvements more likely to be reported than less severe crashes, but this difference was not statistically significant because of the small number of cases. Reporting rates also varied by the type of vehicle and the type of investigation agency (highway patrol, county sheriff, or city police).

Missing data rates are low for most variables, although were 20.1 percent for driver license class and 67.4 percent for road access. Consistency between data as recorded in the South Dakota file and as reported to the MCMIS Crash file was excellent.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1000 L shall be shown in m^3				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
TEMPERATURE (exact degrees)				
^oC	Celsius	1.8C+32	Fahrenheit	^oF
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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1. Introduction

The Motor Carrier Management Information System (MCMIS) Crash file has been developed by the Federal Motor Carrier Safety Administration (FMCSA) to serve as a census file of trucks and buses involved in traffic crashes meeting specific vehicle type and crash severity criteria. FMCSA maintains the MCMIS file to support its mission to reduce crashes, injuries, and fatalities involving large trucks and buses. Accurate data are essential to assess the magnitude and characteristics of motor carrier crashes to design effective safety measures to prevent such crashes. The usefulness of the MCMIS Crash file depends upon individual states transmitting a standard set of data items on all trucks and buses involved in traffic crashes that meet a specific severity threshold.

The present report is part of a series evaluating the completeness and accuracy of the data in the MCMIS Crash file. Previous reports on a number of states showed underreporting due in large part to problems police officers experience in interpreting and applying the reporting criteria. The problems were more severe in large jurisdictions and police departments. Each state also had problems specific to the nature of its system. Some states also had overreporting of cases, often due to technical problems with duplicate records. [See references 3 to 18.] Since the states are responsible for identifying and reporting qualifying crash involvements, improved completeness and accuracy must ultimately reside with the individual states.

In this report, we focus on MCMIS Crash file reporting by South Dakota. In recent years, South Dakota has reported from 220 to 370 involvements annually to the MCMIS Crash file. According to the 2002 Vehicle Inventory and Use Survey, in 2002, South Dakota had over 39,000 trucks registered, ranking 40th among the states and accounting for 0.7 percent of all truck registrations.[1] South Dakota is the 46th largest state by population and generally falls within the lower 15% in terms of the number of annual truck and bus fatal involvements.

The method employed in this study follows that of previous studies:

1. The complete police accident report file (PAR file hereafter) from South Dakota was obtained for the most recent year available, 2005. This file was processed to identify all cases that qualified for reporting to the MCMIS Crash file.

2. All cases in the South Dakota PAR file—those that qualified for reporting to the Crash file as well as those that did not—were matched to the cases actually reported to the MCMIS Crash file from South Dakota.

3. Cases that should have been reported, but were not, were compared with those that were reported to identify the sources of underreporting.

4. Cases that did not qualify but which were reported were examined to identify the extent and nature of overreporting.

Police accident report (PAR) data recorded in South Dakota's statewide files as of December 7, 2006 were used in this analysis. The 2005 PAR file contains the computerized records of 24,248 vehicles involved in 16,307 crashes that occurred in South Dakota.

2. Data Preparation

The South Dakota PAR file and MCMIS Crash file each required some preparation before the South Dakota records in the MCMIS Crash file could be matched to the South Dakota PAR file. In the case of the MCMIS Crash file, the only processing necessary was to extract records reported from South Dakota and to eliminate duplicate records. The South Dakota PAR file required more extensive work to create a comprehensive vehicle-level file from accident, vehicle, and occupant files. The following sections describe the methods used to prepare each file and some of the problems uncovered.

2.1 MCMIS Crash Data File

The 2005 MCMIS Crash file as of August 21, 2006, was used to identify records submitted from South Dakota. For calendar year 2005 there were 343 cases. An analysis file was constructed using all variables in the file. The file was then examined for duplicate records (those involvements where more than one record was submitted for the same vehicle in the same crash; i.e., the report number and sequence number were identical). No such duplicate pairs were found.

In addition, records were examined for identical values for accident date, time, crash county, officer badge number, vehicle license plate number, vehicle identification number, and driver date of birth, even though their case numbers were perhaps different. There should be no records that are identical on all those variables. No such duplicate instances were found.

2.2 South Dakota Police Accident Report File

The South Dakota PAR data for 2005 (dated December 7, 2006) was obtained from the state of South Dakota. The data were contained in a set of three tables in ACCESS format, representing accident, vehicle, and person records. The combined files contain records for 16,307 crashes involving 24,248 vehicles. Data for the PAR file are coded from the State of South Dakota Investigator's Motor Vehicle Traffic Accident Report (DPS-AR-1) completed by police officers.

The PAR file was first examined for duplicate records. A search for records with identical case numbers and vehicle numbers found no instances of duplicates. In addition, inspection of case numbers verified that they were recorded in a consistent format, so there was no reason to suspect duplicate records based on similar, but not identical, case numbers (such as 507332 and 5-7332, for example). Cases were also examined to determine if there were any records that contained identical time, place and vehicle/driver variables, even though their case numbers were different, since two different crashes could not be identical on all variables. To investigate this possibility, records were examined for duplicate occurrences based on the variables for accident date, time, crash county, city, street, vehicle identification number (VIN), vehicle license plate number, and driver's license number. Four duplicate instances were found, representing two unique occurrences of the examined variables.

The duplicate pairs were examined more closely to determine why they occurred. In the first pair, only accident number was different. One explanation could be that a vehicle was involved in two accidents at the same place and virtually at the same time. Once crash events are stabilized, subsequent crashes are reported as new crashes. If a vehicle is reported in a second crash after the first one has stabilized, accident date, location, driver and vehicle information should be identical, but accident time should differ by a short interval. However, in the case of these records, accident hour and minute are identical, suggesting they are in fact duplicate records. Further examination of the records suggested that one record may have been an update to the other in the pair, since a few variables differed between the two cases.

In the second duplicate pair, both accident number and vehicle number were different, but most other variables were the same, including driver last name and birthdate.

The pairs identified above were considered to be duplicates and one member of each pair was excluded. Since there was no variable indicating a date the record was updated or processed, the member of each pair with the most unknown values was excluded, resulting in deletion of two records. The resulting PAR file has 24,246 unique records.

3. Matching Process

The next step involved matching records from the South Dakota PAR file to corresponding records from the MCMIS file. After removing duplicates, there were 343 South Dakota records from the MCMIS file available for matching, and 24,246 records from the South Dakota PAR file. All records from the South Dakota PAR data file were used in the match, even those that were not reportable to the MCMIS Crash file. This allowed the identification of cases in the MCMIS Crash file that did not meet the MCMIS Crash file reporting criteria.

Matching records in the two files requires finding combinations of variables common to the two files that have a high probability of uniquely identifying accidents and specific vehicles within the accidents. Accident Number, which is used to uniquely identify a crash in the South Dakota PAR data, and Report Number in the MCMIS Crash file, are obvious first choices. Indeed, there is a correspondence between the two numbers, and case number was never unrecorded in either file. Accident Number in the South Dakota PAR file is a six-digit numeric value, while in the MCMIS Crash file, Report Number is stored as a 12-character alphanumeric value, a combination of alphabetic characters and numbers. It appears that the report number in the MCMIS Crash file is constructed as follows: The first two columns contain the state abbreviation (SD, in this case), followed by ten digits. Since six of these digits were consistent with the PAR Accident Number, the last six digits of the MCMIS Report Number were used to match the PAR Accident Number variable.

Other variables available for matching at the crash level include crash date, crash time (stored in military time as hour/minute), crash county, city, reporting officer's badge number, and street name. Since city contained the value 'Rural' in 76% of MCMIS cases, it was not used in the match. Officer badge number was unrecorded in 6.9% of PAR cases and 9.9% of the time in MCMIS cases, so it was not used as a match variable. However, where unique values existed, these variables were used to verify cases were accurately matched.

Variables in the MCMIS file that distinguish one vehicle from another within the same crash include vehicle sequence number, vehicle license plate number, driver license number, vehicle identification number (VIN), driver date of birth, and driver last name. Vehicle sequence number did not match PAR Unit Number. However, VIN, driver date of birth, vehicle license number, driver license number and driver last name were all present in the PAR file. Of these variables, those with the lowest unrecorded rates were used in the match.
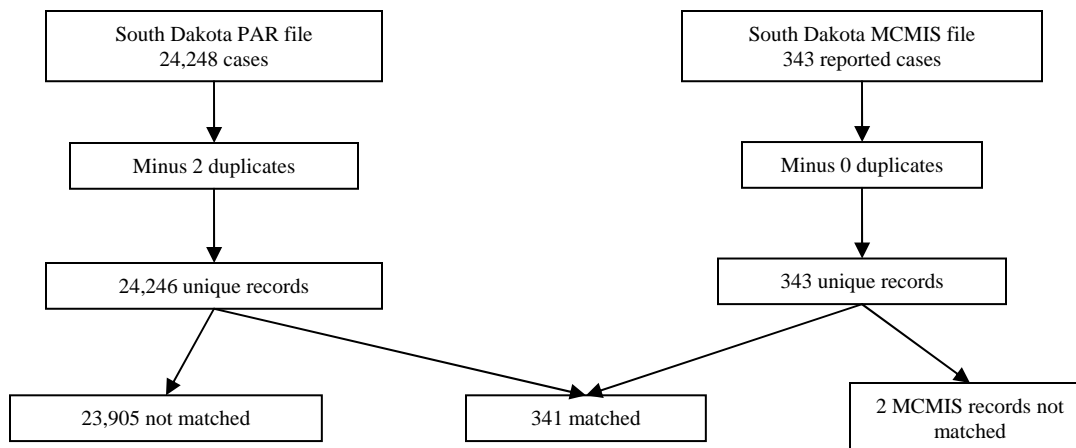
Four separate matches were performed using the available variables. At each step, records in either file with duplicate values on all the match variables were excluded, along with records that were missing values on the match variables. The first match included the variables case number, crash date (month, day), crash hour, crash county, crash street, VIN, vehicle license number, driver license number, and driver last name. The second match step dropped street and vehicle license number, and retained the other variables. The third match step matched on crash date, crash hour, crash county, vehicle license number, and driver last name. The fourth match included variables case number, crash date, and vehicle license number. The third and fourth match steps were hand-verified using all available variables in both files. This process resulted in matching 99.4% of the MCMIS records to the PAR file. (The two MCMIS cases that could not be matched appear to be duplicates of cases that had already been matched to the PAR file.)

See Table 1 for the variables used in each match step along with the number of records matched at each step.

Table 1 Steps in MCMIS/South Dakota PAR File Match, 2005

Step	Matching variables	Cases matched
Match 1	Case number, crash date, crash hour, crash county, crash street, VIN, vehicle license number, driver license number, and driver last name	114
Match 2	Case number, crash date, crash hour, crash county, VIN, driver license number, and driver last name	185
Match 3	Crash date, crash hour, crash county, vehicle license number, and driver last name	21
Match 4	Case number, crash date, vehicle license number	21
Total cases matched		341

Matched records were verified using other variables common to the MCMIS and PAR file as a final check to ensure the match was valid. The above procedure resulted in 341 matches, representing 99.4% of the 343 non-duplicate records reported to MCMIS.

```
┌─────────────────────────┐                    ┌─────────────────────────┐
│   South Dakota PAR file  │                    │  South Dakota MCMIS file │
│      24,248 cases        │                    │    343 reported cases    │
└─────────────────────────┘                    └─────────────────────────┘
             │                                              │
             ▼                                              ▼
┌─────────────────────────┐                    ┌─────────────────────────┐
│    Minus 2 duplicates    │                    │    Minus 0 duplicates    │
└─────────────────────────┘                    └─────────────────────────┘
             │                                              │
             ▼                                              ▼
┌─────────────────────────┐                    ┌─────────────────────────┐
│   24,246 unique records  │                    │   343 unique records     │
└─────────────────────────┘                    └─────────────────────────┘
        │         ╲                            ╱         │
        ▼          ╲                          ╱          ▼
┌──────────────────┐  ╲    ┌──────────────┐  ╱   ┌──────────────────┐
│ 23,905 not matched│      │ 341 matched  │      │ 2 MCMIS records not│
└──────────────────┘      └──────────────┘      │     matched        │
                                                 └──────────────────┘
```

Figure 1 Case Flow in MCMIS/South Dakota Crash File Match

Of the 341 matched cases, 38 are not reportable and 303 are reportable. Twenty-eight of the non-reportable cases did not qualify because they did not meet the crash severity criteria. The remaining 10 cases were not eligible vehicles: One was a light truck and nine were single unit trucks less than 10,000 lbs GVWR.

The method of identifying cases reportable to the MCMIS Crash file is discussed in the next section.

4. Identifying Reportable Cases

The next step in data preparation is to identify records in the South Dakota data that qualified for reporting to the MCMIS Crash file. Records are identified using the information available in the computerized crash files that were sent by South Dakota. To identify reportable records, we use the information that is completed by the officers for all vehicles. The purpose here is to identify all cases that qualified for reporting to the MCMIS Crash file, not just those that were identified as reportable. Some police reports place some of the data elements required for the MCMIS file in a special section on the main crash report or on a supplemental form, with the instruction to the officer to complete that section if he determines that the vehicle and crash meet the MCMIS reporting criteria. But since our goal is to evaluate the completeness of reporting, we attempt to identify all reportable cases, even those an officer may have overlooked. For this purpose, we use the data that is completed for all cases.

The goal of the identification process is to approximate as closely as possible the reporting threshold of the MCMIS file, using the information as collected on the accident report, in South Dakota, Form DPS-AR1. The MCMIS criteria for a reportable crash involving a qualifying vehicle are shown in Table 2.

Table 2 Vehicle and Crash Severity Threshold for MCMIS Crash File

Vehicle	Truck with GVWR over 10,000 or GCWR over 10,000, or Bus with seating for at least nine, including the driver, or Vehicle displaying a hazardous materials placard.
Accident	Fatality, or Injury transported to a medical facility for immediate medical attention, or Vehicle towed due to disabling damage.

The process of identifying reportable records, as set out in Table 2 above, is fairly straightforward in the South Dakota PAR file, because South Dakota crash data includes most of the variables and levels needed to identify reportable cases. South Dakota, like many other states, designates a section of the crash report that officers must complete if any of the involved vehicles meet a specified set of criteria. Instructions on the form state:

> You must Complete boxed area
>
> **IF** the accident involved one or more of the following:
> - a truck having a GCWR of 10,001 or more pounds, OR
> - a vehicle displaying a hazardous materials placard, OR
> - a vehicle designed to transport 9 or more people, including the driver.
>
> **AND**, the accident resulted in one or more of the following:
> - a fatality, OR
> - an injury requiring transportation for immediate medical attention, OR
> - a vehicle was disabled requiring a towaway from the scene

These criteria accurately reflect the MCMIS definition of a qualifying vehicle. For such cases officers are supposed to record the additional MCMIS-required variables displayed in the box on the form. However, for purposes of this study, variables elsewhere on the main form covering *all* vehicles are used to identify eligible vehicles. This, in theory, allows the identification of cases that should have been reported but were not. Data from the crash form supply all the information needed to identify reportable cases, including vehicle type, injury severity, whether an injured person was transported for medical attention, and whether a vehicle was towed with disabling damage. Thus, it appears possible to cleanly and reliably identify MCMIS-reportable cases in the South Dakota crash file.

The South Dakota computerized DPS-AR1 form crash file contains a variable that can be used to identify trucks and buses. VehConfigCode is a 29-level variable containing standard vehicle configuration codes. The vehicle classification system used by South Dakota includes codes that correspond almost exactly with the vehicle configuration variable in the MCMIS Crash file. (See Table 3). Furthermore, many of the code value descriptions contain both the vehicle description and the GVWR or GCWR, allowing MCMIS vehicles to be accurately coded. Accordingly, reportable vehicles were identified as all those assigned one of the body style codes displayed in Table 3. This procedure identified 867 eligible vehicles, representing 3.6% of all 24,246 vehicles in the South Dakota PAR file.

Table 3 Relevant Vehicle Body Style Codes
on South Dakota Accident Report

Cargo van – GVWR 10,001+ lbs
Van/Bus - seats 9-15 inc driver
Van/Bus - seats 16+ inc driver
SUT (2-ax, 6 tire) GVWR 10,001+ lbs
SUT (3 or more axles)
Truck pulling trailer(s) – GCWR 10,001+ lbs
Truck tractor only (bobtail)
Tractor/semi-trailer
Tractor/doubles
Tractor/mobile home (mobile home toter)

Having identified qualifying vehicles, the next step is to identify crashes of sufficient severity to qualify for reporting to the MCMIS Crash file. Qualifying crashes include either a fatality, an injury transported for immediate medical attention, or a vehicle towed from the scene due to disabling damage. Fatal crashes are readily identified. Whether a crash included an injured person transported for medical attention can also be determined.

The South Dakota PAR collects the information needed to identify crashes involving an injury transported for immediate medical attention. For each person involved in a motor vehicle crash, the officer records the severity of the injury (using the usual KABC0 scale) and a code for the source of transport if the person was transported to a medical facility. There are also boxes to write in the name of the facility and the EMS trip number. Accordingly, to identify crashes in which an injured person was transported for medical attention, we took all crashes in which a person was injured and the name of a valid medical facility was entered in the Transported To field. In addition, we took injury cases where the Source of Transport field indicated "EMS" or "Law enforcement," but the Transported To field was blank or "Unk."

The South Dakota crash data includes similar information on vehicles to identify crashes in which a vehicle was towed due to disabling damage. On the police report, the officer records a code for Vehicle Towed? (yes, no, unknown). A value of "yes" should be marked if the vehicle was towed due to disabling damage. Independently, the officer records the Damage Extent to the vehicle. A value of "disabling damage" indicates damage that prevents departure of the vehicle from the scene of the accident in its usual operating manner by daylight after simple repairs.

There were some apparent inconsistencies identified when comparing these fields. For example, there were 39 cases in which a vehicle was not coded towed, but the damage extent was "disabling damage." It was decided that these vehicles with extensive damage would likely have been towed due to that damage. Thus, a vehicle was considered towed due to disabling damage if Damage Extent was "disabling" and Vehicle Towed? was "yes," or Damage Extent was "disabling" and Vehicle Towed? was not "no."

Implementing the eligible vehicle and crash severity filters identified a total of 456 reportable cases in the South Dakota crash data in 2005. There were 456 vehicles—either a truck, bus, or

vehicle transporting hazmat—involved in a crash that included either a fatality, at least one person transported for immediate medical attention, or at least one vehicle towed due to disabling damage.

Table 4 Reportable Records in South Dakota Crash File, 2005

Crash type	Total	%
Fatal	19	4.2
Injury transported for treatment	151	33.1
Vehicle towed due to damage	286	62.7
Total	456	100.0

As Figure 1 above shows, there were 343 records reported to the MCMIS Crash file by South Dakota in 2005. Of these, 341 were matched to the South Dakota file, but 38 did not qualify for reporting, under the method developed to identify reportable cases discussed above.

5. Factors Associated with Reporting

The process discussed in section 4 identified 456 crash involvements in the South Dakota crash report data from 2005 that qualified for reporting to the MCMIS Crash file. There were 343 records that actually were reported to the MCMIS Crash file, of which 341 were matched to the original record in the South Dakota crash file, and two could not be. Of the 341 matched, 303 actually qualified for reporting for an overall reporting rate of 66.4 percent. In other words, 66.4 percent of cases that could be identified as qualifying for reporting to the MCMIS Crash file, actually were reported.

In this section we discuss factors that are associated with the observed reporting rate. Recall that South Dakota, like many other states, uses a separate box that officers must complete if any of the involved vehicles meet a specified set of criteria. The criteria stated in the officer's instruction manual and on the PAR form itself accurately reflect the MCMIS definition of a qualifying vehicle and accident. The box for Commercial Vehicles (CMVs) includes blanks for information that is required to be reported to the MCMIS Crash file, such as carrier identification, gross vehicle weight rating (GVWR), and hazardous materials information; the variable Cargo Body Type at the side of the form is also supposed to be recorded for all cases meeting the criteria. Thus, the officer is responsible for recognizing and filling out this area of the form for all vehicles meeting the MCMIS vehicle and accident type criteria.

To begin with, it is clear that completing the box containing CMV variables appears to be a necessary condition for reporting to the MCMIS Crash file. An index variable was developed that counted the number of data elements in the CMV box that were completed. Generally, either the box was filled out or it was not, there were very few cases in which only one element was entered. Table 5 shows the association between completing the information in the CMV box and reporting the case to the MCMIS Crash file. All but 17 of the cases that were reported to the MCMIS file had CMV variables recorded. And of 153 reportable, but not reported cases, only 3 had the CMV box filled-in.

**Table 5 MCMIS Crash file reporting and
completing the South Dakota box of CMV variables**

CMV variables recorded?	Reported		
	Yes	No, but reportable	No, not reportable
Yes	326	3	96
No	17*	150	23,656

* Includes 2 cases that could not be matched in the
South Dakota PAR file, so they may in fact have CMV
variables recorded.

For practical purposes, then, it appears that cases uploaded through SafetyNet to the MCMIS
Crash file are selected almost exclusively from among those for which the reporting officer
completed the CMV box on the PAR form.

Table 6 shows reporting rates, the number of unreported cases, and the proportion of unreported
cases for each level of the MCMIS crash severity criteria. Traffic crashes that resulted in a
fatality were reported at the highest rate, with 78.9% of such crash involvements reported. The
two less-severe levels of crash severity were reported at lower rates. Injury/transported
involvements were reported at a 64.9 percent rate, while 66.4 percent of the towed/damage
involvements were reported. The most severe crash involvements are more likely to be reported
than less severe, though there are not enough cases for the difference to be statistically
significant. Almost two-thirds of the unreported cases are accounted for by towaway crashes.

Table 6 Reporting Rate by MCMIS Crash Severity, South Dakota 2005

MCMIS Crash Type	Reportable	Reporting rate	Unreported	% of total unreported
Fatal	19	78.9	4	2.6
Injury/transported	151	64.9	53	34.6
Towed due to damage	286	66.4	96	62.7
Total	456	66.4	153	100.0

In Table 7 crash severity is measured by the most severe injury in the crash, using the KABC0
scale. In this scale, incapacitating ("A" injuries) injuries are classified as severe, injuries that are
evident but not incapacitating ("B") are called moderate, and complaint of pain ("C") is the least
severe injury. Note that the trend is not linear, that is, A injuries are reported at a lower rate than
any of the less severe crashes. South Dakota has relatively few cases, so differences of this
magnitude in one year of data are not statistically significant. Thus it is unknown if this
difference is "real," though in our judgment the overall trend that less severe crashes are less
likely to be recognized as reportable is probably true.

Table 7 Reporting Rate by PAR Calculated Crash Severity, South Dakota 2005

Police-reported Crash Severity	Reportable	Reporting rate	Unreported	% of total unreported
Fatal injury	19	78.9	4	2.6
Severe injury	63	57.1	27	17.6
Moderate injury	90	76.7	21	13.7
Complaint of pain	58	62.1	22	14.4
No injury	225	64.9	79	51.6
NA	1	100.0	0	0.0
Total	456	66.4	153	100.0

Reporting also varied by the type of vehicle. Table 8 provides detail about vehicle type from the variable that classifies vehicles by the PAR configuration variable. Generally, larger trucks are more likely to be reported than smaller trucks and trucks are more likely to be reported than buses. Both tractor-semitrailer and tractor-double combinations are reported at rates higher than the overall rate, 83.4% and 78.6% respectively. In contrast, 2-axle SUTs are reported at a 51.1% rate, and cargo vans are only reported 10.0% of the time. Although smaller buses were reported at a slightly higher rate than larger buses, that difference is meaningless. The average reporting rate for buses was only 26.2%.

Table 8 Reporting Rate by Police-Reported Vehicle Configuration, South Dakota 2005

Vehicle configuration	Reportable	Reporting Rate	Unreported	% of total unreported
Cargo van - GVWR>10K	10	10.0	9	5.9
Van/Bus - seats 9-15	21	28.6	15	9.8
Van/Bus-seats 16+	21	23.8	16	10.5
SUT (2-axle, 6 tire)	47	51.1	23	15.0
SUT (3 or more axles)	49	55.1	22	14.4
Truck pulling trailer(s)	70	61.4	27	17.6
Truck-tractor only	10	70.0	3	2.0
Tractor/semitrailer	211	83.4	35	22.9
Tractor/doubles	14	78.6	3	2.0
Tractor/mobile home (toter)	3	100.0	0	0.0
Total	456	66.4	153	100.0

Reporting rates also vary by the type of investigating agency. There are three primary levels of investigating agencies identified in the South Dakota crash file: Highway patrol, county sheriff, and city police. Table 9 shows that the reporting rate is highest for crashes covered by the highway patrol, followed by county sheriffs and then city police departments. All the differences in the table are statistically significant, including the difference between the rates for county

sheriffs and city police. The several enforcement agencies all have different types of responsibilities and training, and these differences are likely reflected in the reporting rates.

Table 9 Reporting Rate by Investigating Agency, South Dakota 2005

Investigating agency	Reportable	Reporting rate	Unreported	% of total unreported
Highway patrol	233	77.3	53	34.6
County Sheriff	120	61.7	46	30.1
City Police	103	47.6	54	35.3
Total	456	66.4	153	100.0

Two other factors were checked: License state of the vehicle and the base state of the carrier. These factors were considered based on the idea that officer's might more readily recognize a vehicle in interstate commerce as falling within the scope of the reporting, while in-state vehicles might be more often overlooked. Reporting rates by registration state provide some support for this notion. Vehicles with South Dakota licenses were less likely to be reported than out of state vehicles. Only 60.4 percent of CMVs in reportable crashes were in fact reported, compared with 76.0 percent of CMVs licensed elsewhere. (See Table 10.)

Table 10 Reporting Rate by Vehicle License State, South Dakota 2005

License plate state	Reportable	Reporting Rate	Unreported	% of total unreported
South Dakota	260	60.4	103	67.3
Other jurisdiction	192	76.0	46	30.1
Unknown	4	0.0	4	2.6
Total	456	66.4	153	100.0

On the other hand, carrier base state showed no such association. Table 11 illustrates that virtually all reportable cases for which the carrier's state was recorded were reported, while only 4.5 percent of cases with no carrier state recorded were reported. The state of carrier is entered in the CMV box on the DPS-AR1, and it has been previously shown that entering information in that box is key to a case being reported. Thus, it appears that out-of-state vehicles are more likely to have their information entered in the CMV box, but once the CMV box has been completed, virtually all reportable cases are reported.

Table 11 Reporting Rate by Carrier Base State, South Dakota 2005

Carrier state	Reportable	Reporting Rate	Unreported	% of total unreported
South Dakota	150	99.3	1	0.7
Other jurisdiction	149	98.7	2	1.3
Unknown	157	4.5	150	98.0
Total	456	66.4	153	100.0

Finally, we considered if some fraction of the underreporting was due to purely administrative factors, such as the time necessary to identify reportable cases, prepare them for submission through the SafetyNet system and then upload the cases. The submission requirement includes a 90 day grace period, and though we used the 2005 South Dakota file that was prepared in December of 2006, there still may be evidence of some time lag in reporting. Table 12 tabulates reporting rates by month, and does not provide any evidence of a time lag in reporting. Instead, it appears that the lowest rates of reporting occurred in the span between May and August. Rates were higher for crashes occurring from January to April, and then again from September to December. This may be related to some other activity that is given a higher priority than MCMIS crash reporting.

Table 12 Reporting Rate by Crash Month, South Dakota 2005

Month	Reportable	Reporting Rate	Unreported	% of total unreported
January	48	75.0	12	7.8
February	32	78.1	7	4.6
March	29	69.0	9	5.9
April	26	65.4	9	5.9
May	26	53.8	12	7.8
June	47	57.4	20	13.1
July	35	51.4	17	11.1
August	32	59.4	13	8.5
September	35	71.4	10	6.5
October	54	66.7	18	11.8
November	44	70.5	13	8.5
December	48	72.9	13	8.5
Total	456	66.4	153	100.0

6. Data Quality of Reported Cases

In this section, we consider the quality of data reported to the MCMIS crash file. Two aspects of data quality are examined. The first is the amount of missing data. Missing data rates are critical

to the usefulness of a data file because records with missing data cannot contribute to an analysis. The second aspect of data quality considered here is the consistency of coding between records as they appear in the South Dakota Crash file and in the MCMIS Crash file. Inconsistencies can indicate errors in translating information recorded on the crash report to the values in the MCMIS Crash file.

Table 13 shows missing data rates for selected variables in the MCMIS Crash file. Missing data rates are generally quite low, with a handful of exceptions. On most fundamental, structural variables, such as date, time, number of fatalities and number of injuries, missing data rates are either zero or extremely low. Missing data rates for some other variables are higher. Driver license class is missing for 20.1% of cases, even though it is collected on the DPS-AR1 Form and available in the South Dakota crash data. Road Access is a derived data element, and is unrecorded 67.4% of the time. DOT number is not recorded for 7.6 percent of cases where the vehicle was recorded as in interstate commerce. Three of the four event variables are missing for 50.7 to 91.8 percent of cases, though this is not necessarily an indication of a problem, since most crashes consist of a single harmful event.

Table 13 Missing Data Rates for Selected MCMIS Crash File Variables, South Dakota 2005

Variable	Percent unrecorded	Variable	Percent unrecorded
Report number	0.0	Fatal injuries	0.0
Accident year	0.0	Non-fatal injuries	0.0
Accident month	0.0	Interstate	4.7
Accident day	0.0	Light	0.0
Accident hour	0.3	Event one	0.0
Accident minute	0.3	Event two	50.7
County	0.0	Event three	74.3
Body type	2.3	Event four	91.8
Configuration	0.0	Number of vehicles	0.0
GVWR class	3.8	Road access	67.4
DOT number*	7.6	Road surface	0.0
Carrier state	0.0	Road trafficway	0.0
Citation issued	0.3	Towaway	0.0
Driver date of birth	0.3	Truck or bus	0.0
Driver license number	2.3	Vehicle license number	3.5

Variable	Percent unrecorded	Variable	Percent unrecorded
Driver license state	2.3	Vehicle license state	0.0
Driver license class	20.1	VIN	0.3
Driver license valid	0.3	Weather	0.0

* Including only cases where the carrier is coded interstate.

Hazardous materials variable	Percent unrecorded
Hazardous materials placard	5.8
Percentages of hazmat placarded vehicles only:	
Hazardous cargo release	0.0
Hazardous materials class (1-digit)	100.0
Hazardous materials class (4-digit)	100.0
Hazardous materials name	0.0

There were five vehicles recorded as displaying a hazmat placard. In the table above, missing data rates on hazmat variable includes only vehicles with a hazmat placard. Both the 1-digit and 4-digit hazardous materials class variables are unrecorded for all of the placarded vehicles.

We also compared the values of variables in the MCMIS Crash file with the values of comparable variables in the South Dakota crash file. The purpose of this comparison is to identify any errors in translating variables from the values in the state crash file to the values required for Safetynet. South Dakota has adopted in many instances the same code levels for certain variables as are used in the MCMIS Crash file.

Generally, consistency between the values recorded in the Crash file and in the South Dakota data was very good. On the important configuration variable, the consistency between coding in the two files is near-perfect, undoubtedly in part because South Dakota uses the same code levels as the MCMIS Crash file. There was one case identified as a tractor-semitrailer in the South Dakota crash file, and as a truck pulling a trailer in the MCMIS file. There were no other differences between the files.

There were minor inconsistencies among some of the other variables examined. Code values for the weather variable are somewhat different between the two files, requiring a decision of how to translate the PAR code to a MCMIS code. The only difference between the two files was in the cases coded as "cloudy" in the South Dakota data. Three were mapped to the MCMIS "no adverse conditions" code while 67 were translated as "other." "No adverse conditions" might be more appropriate. On road surface condition, there was one case coded "snow" in the South Dakota data that was recorded as "dry" in the MCMIS file. The case may have been corrected in one file, but not the other. All other values were consistent. The variables Light Condition, Cargo Body, License Plate State, Driver License State and Hazardous Materials Release were coded identically between the two files.

Vehicle events are recorded on the first page of the DPS-AR1, but these variables were not included in the data supplied by South Dakota, only first harmful event and most harmful event. Accordingly, it was not possible to evaluate the consistency of reporting. However, based on the variables that could be compared, it is likely very high.

7. Summary and Discussion

The results of evaluating the 2005 South Dakota crash file show that about two-thirds of cases that meet the MCMIS Crash file reporting criteria are actually reported. Overall, 456 cases met the MCMIS Crash file threshold as either a truck, bus, or light vehicle carrying hazmat, involved in a crash that included a fatality, an injury transported for immediate medical attention, or a vehicle towed due to disabling damage.

Reporting rates varied across all the elements of the reporting criteria. Fatal involvements were more likely to be reported than less serious crashes. Almost 80 percent of fatal involvements were reported, compared with about 65 percent of injury/transported and 66 percent of towed/disabled involvements. The differences in the rates by crash severity were not statistically significant, because there were only 19 fatal involvements, but they are significant in a practical sense. Rates also varied by the size of the vehicle and the type of the vehicle involved. Large vehicles such as tractor-semitrailers—the characteristic "big truck"—were more likely to be identified as reportable than smaller trucks, and trucks as a whole were more likely to be reported than buses. These differences were statistically significant.

There were also differences in reporting rates by the type of agency reporting and whether a vehicle was obviously from out of state, as indicated by its license state. Members of the highway patrol were more likely to identify reportable cases than cases covered by county sheriffs, and sheriffs more likely than city police. In addition, out of state vehicles were more likely to be recognized as meeting the MCMIS Crash file criteria than in-state.

The factors that are associated with reporting rates clearly point to the pivotal requirement that the reporting officer must recognize the vehicle and crash as meeting the requirements. The South Dakota accident reporting form, DPS-AR1, includes a box that spells out the Crash file criteria, though it does not specifically identify them as such. The officer is instructed to fill in the box, which includes various fields covering the carrier. The box was completed for virtually all the cases that were reported. Only 15 of the reported cases did not have any information in the CMV box on the form. As the system is currently structured in South Dakota, the officer in the field recognizing a crash as reportable and completing the report are the essential first steps.

Thus, if the reporting officer completes the CMV box on the police report, the case may be reported. And if he does not, the case is very likely to be missed. Differences in reporting rates by the type of agency may point to differences in training and focus, which might provide one avenue to improving the overall rate. However, it can be noted that all the information needed to identify cases that meet the MCMIS reporting criteria can be gathered from other variables that are recorded on the police report, in fact, in variables that are recorded for all cases. Accordingly, an alternative methodology might be developed that utilizes the strengths of the South Dakota form to move closer to full reporting.

8. References

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Appendix A Selection Algorithm to Identify Reportable Records

Selection algorithm used in selecting vehicles that meet MCMIS vehicle type criteria:

Variable name	Definition
vehconfig	Vehicle configuration code
hazrel	Hazardous materials release code
valid_hazdesc	Valid hazardous materials placard description

```
Vehicle type (veh_type) definition

 1='truck'
 2='bus'
 3='hazmat'
 8='other';

 if vehconfig in (5,17,18,19,20,21,22,23,24) then veh_type=1;
 else if vehconfig in (6,7) then veh_type=2;
 else if (hazrel=1) or (valid_hazdesc = 1) then veh_type=3;
 else veh_type=8;
```

Selection algorithm used in selecting injured/transported cases:

Variable name	Definition
injstatus	Injury status code
trans_source	Transport source code
goodhosp	Valid hospital name

```
Injured/transported (injtrans) definition

      1 = injured and transported for immediate medical attention
      0 = not injured/transported

if injstatus in (2,3,4) and (trans_source in (1,2) and transto in (' ','UNK')
then injtrans=1;
else if injstatus in (2,3,4) and goodhosp=1 then injtrans=1;
else injtrans=0;
```

Selection algorithm used in selecting tow/disabled vehicles:

Variable name	Definition
vehtowed	Vehicle towed code
damage_ext	Damage extent code

```
Towed with disabling damage (vehtowdis) definition
      1 = towed with disabling damage
      0 = not towed/disabled

if (damage_ext=3 and vehtowed=1) or (damage_ext=3 and vehtowed ne 2) then
vehtowdis=1;
else vehtowdis=0;
```

Appendix B South Dakota Investigator's Motor Vehicle Traffic Accident Report

**STATE OF SOUTH DAKOTA INVESTIGATOR'S
MOTOR VEHICLE TRAFFIC ACCIDENT REPORT**

Agency Use

Please Type or Print   Submission: ☐ Original ☐ Amended   Sheet   of

LOCATION

Date of Accident (MM/DD/YY) | Time of Accident (HHMM) | County | City Accident Occurred in or Indicate Rural

Road, Street or Highway Accident Occurred | At its Intersection With

☐ Miles & Tenths ☐ Feet   N ☐ S ☐ E ☐ W ☐ ☐ Of MRM (Milepost)

NOTE: Unless accident occurred within an intersection completely described above, use space below to give the location from a junction or intersecting street.

(1st) ☐ Miles & Tenths ☐ Feet   N ☐ S ☐ E ☐ W ☐   ☐ Junction

(2nd) ☐ Miles & Tenths ☐ Feet   N ☐ S ☐ E ☐ W ☐   Of ☐ Intersecting Street }

UNIT 1

Full Name (Last, First, Middle) | Address | City | State | Zip

Date of Birth | Phone No | Driver's License Number | Citation Charge? ☐ Yes ☐ No ☐ Pending ☐ Unknown
1.   2.

DL State | DL Class | DL Status: ☐ Normal, within restrictions ☐ No license required | Violation: ☐ Beyond restrictions ☐ Revoked ☐ No license ☐ Expired license ☐ Under suspension ☐ No license endorsement for this vehicle type ☐ Unknown

Owner's Name (Last, First, Middle) ☐ Check if Same as Driver | Address | City | State | Zip

VIN # | Insurance Co Name | Insurance Policy # | Eff Date | Exp Date

Model Yr | Make | Model | License Plate # | State | Year | Damage Amount Veh and Contents $

Total Occupants | Speed Limit | Est Travel Speed | Speed – How Estimated: ☐ Officer Estimate ☐ Occupant Statement ☐ No Estimate ☐ Driver Statement ☐ Witness Statement

Hit and Run? ☐ Yes ☐ No ☐ Unknown | Damage Extent: ☐ None - No Damage ☐ Functional Damage ☐ Unknown ☐ Minor Damage ☐ Disabling Damage | Vehicle Towed? ☐ Yes ☐ No ☐ Unknown | Emergency Vehicle Use? ☐ Yes ☐ No ☐ Unknown

Trailer License Plate # Attached to Power Unit: | State | Year | Trailer License Plate # Attached to Trailer Unit: | State | Year

You must Complete boxed area → | IF the accident involved one or more of the following:
• a truck having a GCWR of 10,001 or more pounds; OR
• a vehicle displaying a hazardous material placard; OR
• a vehicle designed to transport 9 or more people, including driver | AND, the accident resulted in one or more of the following:
• a fatality; OR
• an injury requiring transportation for immediate medical attention; OR
• a vehicle was disabled requiring a tow away from the scene

Accident involved vehicle - Purpose? ☐ Commercial Interstate ☐ Commercial Intrastate ☐ Government ☐ Personal

Carrier Name | Address | City | State | Zip

US DOT # | GVWR | GCWR | Placard # or Name | Hazardous Material Released? ☐ Yes ☐ No ☐ Unknown

UNIT 2

Full Name (Last, First, Middle) | Address | City | State | Zip

Date of Birth | Phone No | Driver's License Number | Citation Charge? ☐ Yes ☐ No ☐ Pending ☐ Unknown
1.   2.

DL State | DL Class | DL Status: ☐ Normal, within restrictions ☐ No license required | Violation: ☐ Beyond restriction ☐ Revoked ☐ No license ☐ Expired license ☐ Under suspension ☐ No license endorsement for this vehicle type ☐ Unknown

Owner's Name (Last, First, Middle) ☐ Check if Same as Driver | Address | City | State | Zip

VIN # | Insurance Co Name | Insurance Policy # | Eff Date | Exp Date

Model Yr | Make | Model | License Plate # | State | Year | Damage Amount Veh and Contents $

Total Occupants | Speed Limit | Est Travel Speed | Speed – How Estimated: ☐ Officer Estimate ☐ Occupant Statement ☐ No Estimate ☐ Driver Statement ☐ Witness Statement

Hit and Run? ☐ Yes ☐ No ☐ Unknown | Damage Extent: ☐ None - No Damage ☐ Functional Damage ☐ Unknown ☐ Minor Damage ☐ Disabling Damage | Vehicle Towed? ☐ Yes ☐ No ☐ Unknown | Emergency Vehicle Use? ☐ Yes ☐ No ☐ Unknown

Trailer License Plate # Attached to Power Unit: | State | Year | Trailer License Plate # Attached to Trailer Unit: | State | Year

You must complete boxed area for Unit 2, if the criteria is met shown above in Unit 1

Accident Involved Vehicle - Purpose? ☐ Commercial Interstate ☐ Commercial Intrastate ☐ Government ☐ Personal

Carrier Name | Address | City | State | Zip

US DOT # | GVWR | GCWR | Placard # or Name | Hazardous Material Released? ☐ Yes ☐ No ☐ Unknown

Work Zone Related? ☐ Yes ☐ No ☐ Unknown | Workers Present? ☐ NA ☐ Yes ☐ No ☐ Unknown | School Bus Related? ☐ No ☐ Indirectly Involved ☐ Directly Involved ☐ Unknown

Object(s) Damaged (Property other than vehicles and contents)

Owner's Name (Last, First, Middle) | Estimate of Damage $

Address | City | State | Zip

	Unit 1	Unit 2	Sequence of Events
First Event			
Second Event			
Third Event			
Fourth Event			
Most Harmful Event by Vehicle (use codes 0, 7-66 only)			
First Harmful Event of Accident (use codes 7-66 only)			

Form DPS-AR1 12/11/03 Mail to : Office of Accident Records, 118 W. Capitol Ave, Pierre, SD 57501

Seating Position

Operator		
1	2	3
4	5	6
7	8	9
10	11	12

13 – Front row other
14 – Second row other
15 – Third row other
16 – Fourth row other
17 – Motorcycle passenger
18 – Pedalcycle passenger
19 – Bus passenger
20 – Trailing unit

21 – On vehicle exterior (non-trailing unit)
22 – Unenclosed cargo area
23 – Enclosed cargo area
24 – Sleeper section of cab (truck)
25 – Seating Position "1" NOT Operator
96 – Not applicable (Pedestrian)
97 – Other
99 – Unknown

Column headers (rotated): Unit No. | Unit Type | Sex | Seating Position | Injury Status | Ejection | Source of Transport | Air Bag Deployed | Safety Equipment

PERSONS INJURED

| | UNIT 1 | Transported to: | EMS Trip # |
| | UNIT 2 | Transported to: | EMS Trip # |

1. Name:		Date of Birth
Address:		Transported to:	EMS Trip #
2. Name:		Date of Birth
Address:		Transported to:	EMS Trip #
3. Name:		Date of Birth
Address:		Transported to:	EMS Trip #
4. Name:		Date of Birth
Address:		Transported to:	EMS Trip #

Left margin (rotated): Manner of Collision (A) | Location of First Harmful Event (B) | Roadway Surface Condition (C) | Relation to Junction (D) | Light Condition (E) | Weather Conditions (F)

Right margin (rotated): Non-Motorist Action (G) | Non-Motorist Contrib. Circumstance (H) | Non-Motorist Location (I) | Roadway Alignment/Grade (J) | Roadway Surface Type (K) | Trafficway Description (L)

DIAGRAM

ACCIDENT DIAGRAM
Indicate North

NARRATIVE

ACCIDENT NARRATIVE: Describe What Happened

| Witness (Last, First, Middle) | Phone No | Address | City | State | Zip |

| Officer Filing Report & ID No. | | Date Notified | Time Notified | Date Arrived | Time Arrived |

| Agency Name | Agency Type |
| | ☐ Highway Patrol ☐ Sheriff Department ☐ City Police ☐ BIA ☐ Tribal Police ☐ Other |

| Officer Approving Report | Date Approved | Red Tag #: Unit 1 | Agency Use |

| Investigation made at scene? ☐ Yes ☐ No | Photos Taken? ☐ Yes ☐ No ☐ Unknown | Unit 2 | |