UMTRI-2006-30 AUGUST 2006

EVALUATION OF IOWA CRASH DATA REPORTED TO MCMIS CRASH FILE

DANIEL BLOWER
ANNE MATTESON

UMTRI-2006-30

Evaluation of Iowa Crash Data Reported to the MCMIS Crash File

Daniel Blower
Anne Matteson

The University of Michigan
Transportation Research Institute
Ann Arbor, MI 48109-2150
U.S.A.

August 2006

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTRI-2006-30		

4. Title and Subtitle	5. Report Date
Evaluation of Iowa Crash Data Reported to the MCMIS Crash File	August 2006
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Blower, Daniel, and Matteson, Anne	UMTRI-2006-30

9. Performing Organization Name and Address	10. Work Unit no. (TRAIS)
The University of Michigan Transportation Research Institute 2901 Baxter Road Ann Arbor, Michigan 48109-2150 U.S.A.	052702
	11. Contract or Grant No. DTMC75-06-H-00003

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
U.S. Department of Transportation Federal Motor Carrier Safety Administration 400 Seventh Street, SW Washington, D.C. 20590	Special report
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This report is part of a series of reports 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 Iowa.

MCMIS Crash File records were matched to the Iowa Police Accident Report (PAR) file to determine the nature and extent of underreporting. Overall, it appears that Iowa is reporting 71.6 percent of crash involvements that should be reported to the Crash file.

Reporting rates vary by crash severity and vehicle type. Overall, about 94.1 percent of fatal involvements are reported, compared with 86.4 percent of injury, transported involvements, and 61.4 percent of towed, disabled involvements. Crashes involving large trucks such as tractor-semitrailers or doubles combinations were more likely to be reported than crashes involving single-unit trucks or buses. Crashes covered by the Iowa State Patrol were more likely to be reported than those covered by either county sheriffs or local police departments.

Missing data rates are low for most variables, although rates are elevated for body type, driver condition, roadway access, and roadway surface condition. Hazardous materials variables are also problematic. Inconsistencies for non-missing values between the two files may be explained by corrections applied in one file but not the other.

17. Key Words	18. Distribution Statement
MCMIS, Iowa Crash File, accident statistics, underreporting	Unlimited

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	36	

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)

Table of Contents

Tables

Figures

Evaluation of Iowa Crash Data Reported to the MCMIS Crash File

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 traffic crashes involving trucks and buses. FMCSA maintains the MCMIS file to support its mission to reduce crashes, injuries, and fatalities involving large trucks and buses. It is 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 of reports 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 13] The states are responsible for identifying and reporting qualifying crash involvements. Accordingly, improved completeness and accuracy must ultimately reside with the individual states.

In this report, we focus on MCMIS Crash file reporting by Iowa. In recent years, Iowa has reported from 1,300 to 1,700 involvements annually to the MCMIS Crash file. According to the 2002 Vehicle Inventory and Use Survey, in 2002, Iowa had almost 82,000 trucks registered, ranking 27th among the states and accounting for 1.5 percent of all truck registrations.[1] Iowa is the 30th largest state by population and generally falls very close to the median in terms of the number of annual truck and bus fatal involvements.

The method employed in this study is similar to previous studies.

1. The complete police accident report file (PAR file hereafter) from Iowa was obtained for the most recent year available, 2004. This file was processed to identify all cases that qualified for reporting to the MCMIS Crash file.

2. All cases in the Iowa 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 Iowa.

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 Iowa's statewide files as of July 25, 2005 were used in this analysis. The 2004 PAR file contains the computerized records of 101,885 vehicles involved in 59,128 crashes that occurred in Iowa

2. Data Preparation

The Iowa PAR file and MCMIS Crash file each required some preparation before the Iowa records in the MCMIS Crash file could be matched to the Iowa PAR file. In the case of the MCMIS Crash file, the only processing necessary was to extract records reported from Iowa and to eliminate duplicate records. The Iowa PAR file required more extensive work to create a comprehensive vehicle-level file from fourteen individual accident and vehicle files, and an occupant-level file from two input 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 2004 MCMIS Crash file, as of May 23, 2006, was used to identify records submitted from Iowa. For calendar year 2004 there were 1,620 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 duplicate records were found.

In addition, records were examined for identical values for accident date, time, crash county, officer badge number, vehicle identification number, and driver date of birth, even though their case numbers were perhaps different. One would not expect all of these variables to be identical between two cases. Three such duplicate instances were found.

In the first pair, all data except driver-specific variables were the same. The first record had missing data for some of the driver variables, so it appears the second record was meant to be an update. In this case the first record was excluded. In the second and third pairs all variables appeared to match between both members of the pair. In both of these instances it appears that the case was mistakenly entered a second time. The member of the pair that appeared on the PAR file was kept, and the other member was excluded.

After eliminating the three duplicate records identified above, the resulting MCMIS file contained 1,617 records.

2.2 Iowa Police Accident Report File

The Iowa PAR data for 2004 (dated July 25, 2005) was obtained from the state of Iowa. The data were contained in a set of 22 files in dBase format. The combined files contain records for 59,128 crashes involving 101,885 vehicles. Data for the PAR file are coded from the Investigating Officers Report of Motor Vehicle Accident (Iowa DOT) 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 such instances. 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 small variations of the format of the case numbers (such as 2004009235 and 2004-09235, for example). However, cases were also examined to determine if there were any records that contained identical time, place, and vehicle/driver variables, but with different case numbers. Two cases would not be expected to be identical on all variables. To identify such cases, records were examined for duplicate occurrences based on accident date, time, county, city, license plate number, driver's license number, and vehicle identification number (17-digit VIN). A total of 25 duplicate instances were found, representing twelve unique occurrences of the examined variables.

Duplicate pairs (and one triplicate) were examined more closely for any patterns that might explain why they were occurring. In all instances, case number was different for each member of the pair. 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 as being in a second crash after the first one has stabilized, one would expect accident date, time, location, driver and vehicle information to be identical, but accident time to vary by a couple of minutes or longer. However, in the case of these records, accident hour and minute are identical, suggesting they are in fact duplicate records. Further examination of each record indicated that perhaps one record was meant to be an update, since a few of the variables differed between the two cases.

Thus, the pairs identified above were considered to be duplicates and one (or more) member(s) 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 fewest unrecorded variables was kept, and the other member excluded, resulting in deletion of thirteen records. The resulting PAR file has 101,872 records.

3. Matching Process

The next step involved matching records from the Iowa PAR file to corresponding records from the MCMIS file. After removing duplicates, there were 1,617 Iowa records from the MCMIS file available for matching, and 101,872 records from the Iowa PAR file. All records from the Iowa 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 should not have been reported.

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 as well as specific vehicles within an accident. Case Number, which is the identifier used to uniquely identify a crash in the Iowa PAR data, and Report Number in the MCMIS Crash file, are obvious first choices. Indeed, there appeared to be a correspondence between the two numbers, and case number was never unrecorded in either file. Case Number in the Iowa PAR file is a ten-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 (IA, in this case), followed by ten digits. Since these digits were consistent with the PAR Case Number, the last ten digits of the MCMIS Report Number were extracted and these two variables were used in the match.

Other variables that were available for matching at the accident level included crash date, crash time (hour/minute), and crash county. A variable designating "city" could not be used, as the PAR file contained a 2-digit numeric code, but city code on the MCMIS file was four digits.

Variables in the MCMIS file that could distinguish one vehicle from another within the same accident included vehicle license plate number, driver license number, vehicle identification number (VIN), and driver date of birth. Driver's license number was unrecorded in 11.3% of PAR cases and in 10.9% of MCMIS cases. Vehicle license plate number was unrecorded 6.5% of the time in PAR data and 3.1% of the time in MCMIS. Driver's date of birth was unrecorded in 7.1% of PAR cases and in 1.9% of MCMIS cases. Of the available variables, VIN was the most reliable, as it was unrecorded only 2.4% of the time in the PAR file, and in only 0.4% of MCMIS cases.

Four separate matches were performed using the available variables. In each match 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, crash time, crash county, VIN, license plate number, driver's date of birth, and driver's license number. The second match step dropped driver's license number. The third match step matched on case number, crash date, crash time, VIN, and license plate number (eliminating crash county and driver's date of birth). After reviewing the remaining non-matched cases, the fourth match just used case number, VIN, and driver's date of birth. This process resulted in matching 98.5% of the MCMIS records 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/Iowa PAR File Match, 2004

Match step	Matching variables	Cases matched
Match 1	case number, crash date, crash time, crash county, VIN, license plate number, driver birth date, and driver license number	960
Match 2	case number, crash date, crash time, crash county, VIN, license plate number, driver birth date	554
Match 3	case number, crash date, crash time, VIN, license plate number	28
Match 4	case number, VIN and driver birth date	50
Total cases matched		1,592

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 1,592 matches, representing 98.5% of the 1,617 non-duplicate records reported to MCMIS.

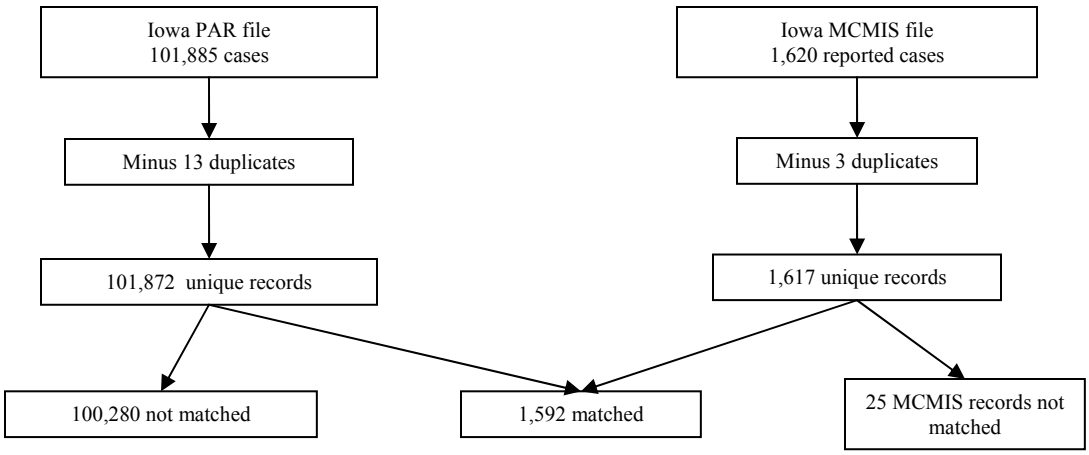


Figure 1 Case Flow in MCMIS/Iowa Crash File Match

Of the 1,592 matched cases, 130 are not reportable and 1,462 are reportable.

4. Identifying Reportable Cases

The next step in data preparation is to identify records that qualified for reporting to the MCMIS Crash file. It was necessary to develop a set of criteria using the variables in the Iowa PAR file to identify records that should have been reported. The purpose of the criteria is to approximate as closely as possible the reporting threshold of the MCMIS file. 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—reproducing the criteria set out in Table 2 above—is fairly straightforward in the Iowa PAR file. The Iowa crash data includes most of the variables and levels needed to identify reportable cases. In some cases, the information is not directly available, but reasonable substitutes can be applied.

Table 3 shows the vehicle types, identifiable using the vehicle configuration variable, that meet the MCMIS reporting criteria. The code levels that Iowa uses match precisely to the configuration variable in MCMIS. The MCMIS criteria actually uses a GVWR threshold for trucks, but the vehicle types identified all would meet that threshold. The bus definitions also are

identical with the bus definitions in the MCMIS file. As a consequence, it is easy to determine the vehicles that meet the vehicle criteria set out in Table 2.

Table 3 Vehicle Types in Iowa Crash file That Meet the MCMIS Reporting Criteria

Vehicle configuration	N
SUT (2 axle/6 tire)	804
SUT (>3 axles)	515
Truck/trailer	390
Truck tractor (bobtail)	59
Tractor/semitrailer	2,000
Tractor/doubles	34
Tractor/triples	4
Other Heavy Truck(can't classify)	111
School bus (seats >15)	186
Small school bus (seats 9-15)	19
Other bus (seats >15)	135
Other small bus (seats 9-15)	40
Total	4,297

In addition to these vehicle types, any vehicle, regardless of size, displaying a hazardous materials placard, also meets the MCMIS vehicle type definition. Iowa includes variables that indicate if a vehicle was placarded and record the one and four digit hazardous materials codes. Unfortunately, the hazardous materials data comes from an area on the police report that is only supposed to be filled out if the officer determines the crash is reportable to MCMIS. This is less than desirable when trying to independently identify all cases that meet the reporting criteria. However, as explained below, there are no cues on the police report itself to remind the officer not to fill out the section if the crash doesn't meet the reporting criteria. Moreover, the overwhelming majority of hazardous materials cargoes are carried in vehicles that otherwise meet the vehicle criteria as medium or heavy trucks, so missing a few light vehicles with hazmat placards will have only a negligible effect on reporting rates.

In any event, the variable that records whether a vehicle displayed a hazmat placard is coded "not reported" for all cases. However, the variables that record the class of hazardous materials did include some information. We reviewed all the four-digit codes recorded and determined that they corresponded to valid hazmat types. Accordingly, if a vehicle was coded with a valid hazmat code, we used that as an indication that the vehicle was placarded. By this method, we were able to identify vehicles that met the MCMIS hazardous materials criterion.

It was necessary to use indirect means to identify records that met the crash severity criteria: Crashes that involve a fatality; an injury transported for immediate medical attention; or a vehicle towed due to disabling damage. Crashes that include a fatality are easily and

unambiguously identifiable. However, identifying a crash that includes an injured person transported for treatment is less straightforward. It was necessary to develop a method using coded injury severity levels and two text variables in which officers enter information about where and by whom a person was transported.

The injury severity information is coded for each involved person. There are also two alphabetic variables in which the reporting officer can enter where a person was transported (transported to) and by whom (transported by). The contents of these fields were reviewed to determine the type of information entered. In most cases where a person was coded with an injury, the transported to variable contained the name of a medical facility or stated that the injured person was transported to a doctor. But there were a number of cases in which the officer indicated that treatment was refused (e.g., "refused EMS at scene") or that the person would seek medical treatment on his own (e.g., "seeking own medical attention") Accordingly it was necessary to review the non-blank transported to variables for all cases in which a person was injured in a crash involving an appropriate vehicle, approximately 3,000 responses. Only responses that indicated transport for immediate medical attention were retained. Where the transported to variable was blank, the transported by variable was reviewed. Injured persons transported by ambulance or other emergency personnel were considered to be transported for medical attention.

Identifying crashes with vehicles towed due to disabling damage was similarly indirect. Iowa does not include a variable that indicates a vehicle was towed due to damage. However, the damage severity variable can be used as a surrogate. Iowa uses a five-level damage severity scale. The two most severe levels were used as an indicator that the vehicle was towed. The most severe level is vehicle totaled, which obviously qualifies. The second most severe is for "disabling damage—Damage that precludes departure of the vehicle from the scene of the accident in its usual daylight-operating manner after simple repairs." [1, page 10] The next damage level specifically excludes disabling damage. Accordingly, the two most severe categories were used to identify crashes in which a vehicle was towed due to disabling damage.

Applying the vehicle and crash severity criteria as described above identified 2,042 trucks and buses involved in a crash meeting the MCMIS reporting criteria. Table 4 shows the distribution by crash severity. Of the 4,298 vehicles that were either a reportable truck, bus, or vehicle displaying a hazmat placard, 2,042 were involved in a crash that met the MCMIS crash severity criteria. These 2,042 cases were eligible for upload through the Safetynet system. Of these, 1,462 cases were actually reported, for a reporting rate of 71.6 percent.

Table 4 Iowa Cases Reportable to MCMIS Crash File, 2004

Crash severity	Reported to MCMIS Crash File		Total
	Yes	No	
Fatal	64	4	68
Injured, transported	641	101	742
Towed, disabled	757	475	1232
Reportable subtotal	1,462	580	2,042
Not reportable	0	2,256	2,256
Total	1,462	2,836	4,298

There are two primary ways states may identify eligible cases for MCMIS: (1) The officer is expected to understand the MCMIS reporting criteria and, for cases that qualify, is instructed to fill out a separate form or a designated area on the crash report itself. (2) All criteria are incorporated into the crash report form, so that state officials can then determine which cases should be submitted to the MCMIS Crash file.

In addition to the 1,462 cases that were reportable to the Crash file and in fact reported, there were 130 cases reported that did not qualify for reporting, using the method for identifying reportable cases described above. The vehicle in almost all of these extra cases (127 of 130) was a truck but the crash did not meet the severity criteria, i.e., there was no transportable injury or vehicle towed. In three cases, the vehicle was a light duty truck (two axles, four tires). In two of these cases, the crash met the severity criteria, but the case was not reportable because the vehicle was a light vehicle.

5. Factors Associated with Reporting

Iowa does not use a separate, supplemental form to collect the required data for the MCMIS Crash file. Moreover, Iowa also does not include the MCMIS data elements in a special box, or any other indication on the form that certain information is collected for MCMIS. Some states have an area on the crash form, along with instructions on the form to fill out the information if the MCMIS-reporting threshold is met. This is typically explicitly stated, as in: If the crash involves specific vehicle types and if the crash meets the specified severity threshold, then complete the data elements in the box. Instead the data elements reported to the MCMIS file are included by Iowa on its regular motor vehicle accident report form, without instructions on the form as to when they are to be completed. The instruction manual for the PAR directs the officer to fill out a section that has data elements specific to motor carriers, if the crash meets the MCMIS reporting threshold.[1] (Iowa kindly provided a blank copy of its Form 433003, 01-01, as an example of the forms used to report motor vehicle crashes in 2004. The report is reproduced in Appendix B.)

In the *Investigating Officers Accident Reporting Guide*, the officer is instructed to fill out the commercial vehicle section if the crash involves a MCMIS-reportable vehicle[1] and the crash meets the MCMIS-reportable severity. The information in the commercial vehicle (CMV) section includes the carrier's name and address, DOT or MC number, the number of axles on the vehicle, the gross vehicle weight rating, the hazardous materials placard number, a box to indicate if hazardous materials were released in the crash, and the license plate number and state for up to two trailers. The *Guide* instructs that the CMV section is **not** to be filled out (emphasis in the *Guide*) for crashes not meeting the severity threshold or if the vehicle is operated by a government, county, or city, or if the crash occurred on private property.

The CMV section includes all carrier-specific data elements. This section alone is to be completed only for crashes meeting the MCMIS reporting criteria. Most[2] of the other MCMIS Crash file data elements are elsewhere on the form and completed for all crashes and all vehicles. That is, all the various vehicle and crash variables required for MCMIS but which are also common in most crash data files—vehicle type, cargo body, light condition, sequence of events—are collected on all vehicles and the details collected are mostly compatible with MCMIS.

Thus, when an officer fills out the crash report, he collects most of the MCMIS data elements for all crashes. This includes most of the information, with qualifications discussed above, needed to identify reportable vehicles and crashes meeting the reporting threshold. Whether the carrier-specific information in the Commercial Vehicle section is filled in depends on the reporting officer recognizing, based on the *Reporting Guide* instructions and previous experience, whether the crash meets the MCMIS criteria. The report itself offers no cues to fill out the CMV section. This might result in the CMV section being filled out for vehicles that do not meet the instructions, e.g., for minor crashes or vehicles operated by units of government.

Completing the CMV section appears to be a necessary but not a sufficient condition for reporting to the MCMIS Crash file. In the data sets provided by Iowa for this analysis, information from the CMV section was contained in a CMV file. There were 2,120 records in that file. All of the cases that were reported to the MCMIS file had a record in the CMV file, except for the 25 cases that could not be matched to the Iowa PAR file. Table 5 shows that of the 2,120 records in the CMV file, 1,592 were reported to the MCMIS Crash file, and 528 were not, but no records were matched that were in the MCMIS file and confirmed to be not contained in the CMV file.

[1] The January 2001 guide uses the older definition of a bus (16 or more passengers including the driver) rather than the revised standard of seating for nine including the driver.

[2] Certain crash-level aggregate variables such as number of fatalities and number of injuries are generated at a file-processing stage.

Table 5 MCMIS Crash file reporting and Completing CMV Section of Iowa PAR

CMV section completed?	Reported	
	Yes	No
Yes	1,592	528
No	25*	0

* These cases could not be matched in the Iowa PAR file.

Note that the instructions to the officer specify that the CMV section should not be completed if the truck or bus involved is operated by a government, county, or city. If completing the CMV section is a necessary condition for reporting to the MCMIS crash file, then the exclusion of government-operated vehicles is an additional filter, over and above the FMCSA's requirements. In fact, this may be operating to prevent reporting of reportable cases. There were 192 cases in the CMV file that meet the MCMIS reporting criteria and yet were not reported. Fifty one of these cases, or almost 27 percent, were buses, while only 6.6 percent of reportable vehicles were buses. So MCMIS-reportable bus involvements with a record in the CMV file are less likely than other vehicle types to be uploaded to the MCMIS Crash file. Many buses are operated by school districts and transit buses are typically operated by urban transit authorities, both of which might be considered units of government. It is possible that these cases were excluded from reporting because they were operated by a unit of government and, according to the instructions for filling in the CMV section of the police report, should not have had an entry in the CMV section. It could not be determined if the type of operator for buses is the explanatory factor. To do so would require examining the names of the entities operating the vehicles, to determine if units of government were more likely to be excluded. However, the names of the entities involved were not supplied with the data, in accordance with Iowa's privacy policy.

The month of crash also affects the rate at which reportable crash involvements are uploaded to the MCMIS Crash file. FMCSA requires reportable involvements to be uploaded to the Crash file within 90 days of the crash. This period accommodates reasonable delays in identifying and preparing cases for reporting. The usual pattern is that reporting rates are lower later in the year and higher toward the beginning of the year. However, in Iowa, the usual pattern is reversed, with higher rates of reporting later in the year and lower earlier. (See Table 6.) Reporting rates for October, November, and December were 79.2 percent, 76.3 percent, and 75.6 percent, respectively. But the first three months of the year had lower rates: March 61.7 percent, February 63.7 percent, and January only 57.2 percent. This pattern cannot be explained by the usual delays in identifying and preparing records for upload to the MCMIS system. More likely is some exogenous event that interfered with the activity, either some activity that regularly occurs in the beginning of a calendar year, or a one time event, such as the transition to a new system. But it does not appear that Crash file underreporting is related to delays in preparing and uploading cases, but rather to some other factor(s) that reduced reporting at the beginning of the year. Note that reporting was above the overall average for all the months from May to December.

Table 6 Reporting by Month of Crash, Iowa 2004

Month	Reportable	Reporting rate	Unreported	% of total unreported
January	173	57.2	74	12.8
February	204	63.7	74	12.8
March	167	61.7	64	11.0
April	163	68.1	52	9.0
May	147	76.2	35	6.0
June	166	75.3	41	7.1
July	138	80.4	27	4.7
August	169	74.6	43	7.4
September	187	73.8	49	8.4
October	178	79.2	37	6.4
November	186	76.3	44	7.6
December	164	75.6	40	6.9
Total	2,042	71.6	580	100.0

Other factors were found to be associated with reporting rates that are related to the MCMIS reporting criteria. Table 7 shows that reportable crash involvements that are more severe are much more likely to be reported than less severe crashes. Over 94 percent of fatal involvements—64 of 68—were correctly reported. The reporting rate for crashes involving an injured person transported for immediate treatment was 86.4 percent, substantial but still significantly less than the rate for fatal crashes. The reporting rate for crashes with no injury but at least one vehicle towed due to disabling damage was 61.4 percent. This latter category accounted for 81.9 percent of all unreported involvements that qualified for the MCMIS Crash file.

Table 7 Reporting by MCMIS Severity Categories, Iowa 2004

MCMIS Severity categories	Reportable	Reporting rate	Unreported	% of total unreported
Fatal	68	94.1	4	0.7
Injured, transported	742	86.4	101	17.4
Towed, disabled	1,232	61.4	475	81.9
Total	2,042	71.6	580	100.0

Table 7 shows reporting rates by the MCMIS Crash file severity thresholds, and Table 8 shows reporting of qualifying crashes by Iowa's scale of categorizing crash severity. This scale utilizes the common KABCO injury classification and ranks crashes by the most severe injury. Note that all injury crashes have about the same reporting rate, roughly 83 to 84 percent. If a person is

injured in a crash, the reporting officer is more likely to fill out the crash report form resulting in a report to the crash file, than if there is no injury. The reportable property damage involvements in Table 8 are reportable because there was a vehicle towed. Note that some of the reportable injury involvements may also have been reportable not because the injured was transported but because a vehicle was towed. Relatively few possible injuries are transported for treatment; they may be reportable because a vehicle was disabled. Yet the rate at which reportable possible injury crash involvements was reported was very near the rate for major injuries, which are mostly transported for treatment. Apparently, officers are much more likely to recognize a reportable crash if it includes an injury than if it only includes a disabled and towed vehicle.

Table 8 Reporting by Most Severe Injury in Crash, Iowa 2004

Crash severity	Reportable	Reporting rate	Unreported	% of total unreported
Fatal	68	94.1	4	0.7
Major injury	156	84.0	25	4.3
Minor injury	373	84.2	59	10.2
Possible injury	447	83.4	74	12.8
Property damage only	998	58.1	418	72.1
Total	2,042	71.6	580	100.0

Vehicle type also affects the probability of reporting, with truck involvements much more likely to be reported than bus involvements. Table 9 shows reporting rates by the categories of vehicles identified in the MCMIS reporting criteria. Almost 74 percent of reportable truck involvements were uploaded to the MCMIS Crash file. The reporting rate for buses was lower at 43.6 percent. The rate for buses is lower than for trucks, but actually compares favorably with bus reporting rates in several other states that have been evaluated. However, the lower rate does indicate that officers are less likely to recognize bus crashes as reportable than truck crashes. Only one vehicle qualified as reportable solely because it displayed a hazardous materials placard. The case was not reported. Such cases are rare and probably very difficult for an officer to recognize. Note that, even though trucks are reported at the highest rate, unreported truck involvements still account for 86.2 percent of all unreported involvements.

Table 9 Reporting by Vehicle Type, Iowa 2004

Vehicle type	Reportable	Reporting rate	Unreported	% of total unreported
Truck	1,901	73.7	500	86.2
Bus	140	43.6	79	13.6
Hazmat placard	1	0.0	1	0.2
Total	2,042	71.6	580	100.0

In general, officers are less likely to recognize smaller vehicles are reportable and more likely to recognize the rigs that are the typical heavy truck configuration as meeting the MCMIS Crash

file reporting criteria. Table 10 shows the reporting of qualifying involvements by the vehicle configuration categorization scheme used by Iowa.[3] The largest trucks, such as tractor-semitrailers and tractor-double trailer combinations, are reported at the highest rates, 79.7 percent and 83.3 percent. Only half of triple trailer combinations were reported, but there were only two reportable involvements, so that is not meaningful. Smaller trucks, particularly single-unit trucks—trucks not pulling a trailer—are reported at lower rates. About 64 percent of 2-axle and 3-axle single-unit trucks were reported. About 67 percent of bobtail (truck tractor with no trailer) were reported.

Table 10 Reporting by Vehicle Configuration, Iowa 2004

Vehicle configuration	Reportable	Reporting rate	Unreported	% of total unreported
Van or mini van	1	0.0	1	0.2
SUT (2 axle/6 tire)	360	63.9	130	22.4
SUT (>=3 axles)	251	64.1	90	15.5
Truck/trailer	174	73.0	47	8.1
Truck tractor (bobtail)	33	66.7	11	1.9
Tractor/semitrailer	1,019	79.7	207	35.7
Tractor/doubles	18	83.3	3	0.5
Tractor/triples	2	50.0	1	0.2
Other Heavy Truck (can't classify)	44	75.0	11	1.9
School bus(seats >15)	71	49.3	36	6.2
Small school bus (seats <=15)	6	33.3	4	0.7
Other bus (seats >15)	47	44.7	26	4.5
Other small bus (seats <=15)	16	18.8	13	2.2
Total	2,042	71.6	580	100.0

The different categories of buses were reported at lower rates than trucks, with large buses more likely to be reported than buses with seating for 15 or fewer. Almost 50 percent of school buses with more than 15 seats in reportable traffic crashes were reported, but only one-third of smaller school buses. Almost 45 percent of crash-involved large “other” buses—these are all buses other than school buses, such as transit, tour, and intercity buses—were reported, but less than 20 percent of buses with 15 or fewer seats. Buses overall are underreported compared with trucks, and small buses are even more likely to be underreported than larger buses.

Reporting rates are also associated with the license state of the vehicle. This could indicate that officers believe that vehicles in interstate commerce are covered by the MCMIS Crash file requirements. There is no information to determine directly whether a vehicle is involved in

[3] Note that the vehicle type classification method uses the SafetyNet vehicle categories, which is highly desirable.

interstate commerce, so it is not possible to measure the impact directly. But vehicles with out-of-state licenses are clearly involved in interstate commerce, while vehicles registered in Iowa may or may not by operated by interstate carriers. Table 11 shows that over 80 percent of reportable vehicles registered out-of-state were actually reported, compared with 69.0 percent of in-state vehicles. This difference is statistically significant. The involvements of Iowa-plated vehicles make up 71.0 percent of the unreported cases, so reporting the involvements of Iowa-registered at the same rate as out-of-state vehicles would result in about 149 additional reports, reducing the number of unreported cases by one-quarter.

Table 11 Reporting by Vehicle License State, Iowa 2004

Vehicle license state	Reportable	Reporting rate	Unreported	% of total unreported
Iowa	1,328	69.0	412	71.0
Other	652	80.2	129	22.2
Not coded	62	37.1	39	6.7
Total	2,042	71.6	580	100.0

Reporting rates also varied by the type of agency that reported the case. Reportable crash involvement covered by the Iowa State Police were the most likely to be reported, with over 84 percent of reportable cases actually reported. County sheriffs and local police departments reported at a rate of approximately 73 percent. Differences in training and jurisdiction could explain the difference. Unfortunately, the reporting agency could not be determined in almost half of the cases, reducing the reliability of this finding.

Table 12 Reporting by Agency Type Reporting, Iowa 2004

Reporting agency	Reportable	Reporting rate	Unreported	% of total unreported
State patrol	320	84.1	51	8.8
Sheriff	315	72.7	86	14.8
Police department	567	72.8	154	26.6
Unknown	840	65.6	289	49.8
Total	2,042	71.6	580	100.0

6. Data Quality of Reported Cases

In this section, we consider the quality of data reported to the crash file. Two aspects of data quality are examined. The first is the amount of missing data. Missing data rates are important 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 Iowa 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, important variables in the MCMIS Crash file. Missing data rates vary widely. 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 other variables are higher. Variables relating to driver licensing are missing for 10 to 13 percent of cases. Road access and trafficway type are missing for roughly 22 percent of cases. Weather is not recorded in almost 45 percent of cases. Body type is missing in 34.1 percent of reported records, though vehicle identification number (VIN) is missing in only 0.4 percent. The rates of missing data in the event sequence variables should not be over-interpreted. Frequently, only one event is recorded because the crash consisted of only one event. Subsequent events are then left blank and reported as missing, but this is reflective of the nature of the crashes and not a defect in the data.

Table 13 Missing Data Rates for Selected MCMIS Crash File Variables, Iowa 2004

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	0.0
Accident day	0.0	Light	0.6
Accident hour	0.3	Event one	4.5
Accident minute	0.3	Event two	59.2
County	0.0	Event three	81.0
Body type	34.1	Event four	91.7
Configuration	0.0	Number of vehicles	0.0
GVWR class	24.4	Officer badge number	1.0
DOT number*	0.6	Road access	22.3
Carrier state	0.0	Road surface	1.2
Citation issued	0.0	Road trafficway	22.3
Driver condition	100.0	Towaway	0.0
Driver date of birth	1.9	Truck or bus	0.0
Driver license number	10.9	Vehicle license number	3.1
Driver license state	10.9	Vehicle license state	3.1
Driver license class	13.4	VIN	0.4

Variable	Percent unrecorded	Variable	Percent unrecorded
Driver license valid	0.0	Weather	44.5

* Counting cases where the carrier is coded interstate.

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

The second part of Table 13 shows missing data rates for variables related to hazardous materials. The top of the second part of the table shows the percentage of cases in which the variable recording whether the vehicle displayed a hazardous materials placard was missing. Only vehicles with a hazardous materials placard should have coded the 1-digit and 4-digit class numbers, the material's name, and whether there was a release of the material as a consequence of the crash. Thus, the variable recording the existence of a hazardous materials placard should be coded for all vehicles, but only vehicles that have a placard should have information in the other hazmat variables.

There were some problems with coding of hazardous materials. The variable to record a hazmat placard was marked "N" for all cases, indicating that there was no hazmat placard. However, the other variables had valid information that indicated they in fact were carrying hazardous materials. Five cases had valid information on hazardous materials class; 23 cases had valid information on the hazardous materials name; and 15 cases had valid information for hazardous materials 4-digit number.

We also compared the values of comparable variables in the MCMIS Crash file with the value as recorded in the Iowa 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. Iowa has adopted in many instances the same code levels for certain variables as are used in the MCMIS Crash file. This is a real advantage in simplifying the problem of ensuring consistency between the record of a case in the Iowa crash file and the record of the case as it appears in MCMIS. By using the same values, no translating is necessary before uploading to Safetynet. This eliminates one possible source of error.

Overall, the consistency between comparable variables in MCMIS and the Iowa crash file was very good. We compared the values for vehicle configuration, cargo body type, number of fatally injured persons, light condition, roadway surface condition, weather, number of vehicles, hazardous materials release, the sequence of events variables, and vehicle license state.

Table 14 compares how vehicle configuration was coded in the MCMIS Crash file and in the Iowa PAR file. Overall the coding was identical, indicating a very good match between the variables in the Iowa PAR file and the MCMIS Crash file. There are a few cases that are inconsistent, which are shaded in the table. In total, only five cases are coded inconsistently between the two files, out of the total of 1,592 total records (including both reportable and not reportable cases). These few cases might be explained by a correction made to the Iowa file that was not transmitted to the MCMIS file.

Table 14 Vehicle Configuration Coding Comparison In MCMIS Crash file and Iowa PAR file, 2004

MCMIS value	Iowa Crash file value	N	%
Bus (seats 9-15, incl driver)	Small school bus (seats 9-15)	2	0.1
Bus (seats 9-15, incl driver)	Other small bus (seats 9-15)	3	0.2
Bus (seats >15, incl driver)	School bus (seats>15)	35	2.2
Bus (seats >15, incl driver)	Other bus (seats>15)	21	1.3
SUT, 2-axle, 6-tire	4-tire Large Truck (Pickup/panel)	2	0.1
SUT, 2-axle, 6-tire	SUT (2 axle/6 tire)	257	16.1
SUT, 2-axle, 6-tire	SUT (>3 axles)	1	0.1
SUT, 3+ axles	4-tire Large Truck (Pickup/panel)	1	0.1
SUT, 3+ axles	SUT (>3 axles)	168	10.6
SUT, 3+ axles	Other Heavy Truck (can't classify)	2	0.1
Truck trailer	SUT (>3 axles)	1	0.1
Truck trailer	Truck/trailer	143	9.0
Truck tractor (bobtail)	Truck tractor (bobtail)	22	1.4
Tractor/semitrailer	Truck/trailer	1	0.1
Tractor/semitrailer	Tractor/semitrailer	874	54.9
Tractor/double	Tractor/semitrailer	2	0.1
Tractor/double	Tractor/doubles	19	1.2
Tractor/triple	Tractor/triples	1	0.1
Unk. heavy truck>10,000	Other Heavy Truck (can't classify)	37	2.3
Grand total		1,592	100.0

A comparison of cargo body showed a greater degree of discrepancy between the codes in the MCMIS Crash file and in the original Iowa Crash file. The discrepancies were largely due to unrecorded values in the MCMIS Crash file, rather than errors in code translation between the two files. Table 15 shows that where the MCMIS cargo body variable is not missing data, the code values in the two files are identical, except for buses. All 61 vehicles recorded as a bus in the MCMIS file are coded as either NA (not applicable) or not reported in the Iowa crash file. However, there is no value available to identify a bus in the cargo body variable, so that is not an inconsistency, strictly speaking. The larger question has to do with the 93 cases coded as van,

cargo tank, or flatbed, that readily translate to the corresponding values in the MCMIS Crash file, but which instead were missing data in that file. The other code levels in the Iowa cargo body variable are primarily related to trailers and do not correspond to a cargo body.

Table 15 Cargo Body Comparison in MCMIS Crash File and Iowa PAR file, 2004

MCMIS value	Iowa Crash file value	N	%
(missing data)	NA	163	10.2
	Truck Cargo Type: Van/enclosed box	56	3.5
	Truck Cargo Type: Cargo tank	1	0.1
	Truck Cargo Type: Flatbed	36	2.3
	Truck Cargo Type: Other truck cargo type (explain in narrative)	100	6.3
	Trailer type: Small utility (one axle)	12	0.8
	Trailer type: Large utility (2+ axles)	92	5.8
	Trailer type: Camper	1	0.1
	Trailer type: Large mobile home	1	0.1
	Trailer type: Oversize load	2	0.1
	Trailer type: Towed vehicle	3	0.2
	Trailer type: Other trailer type (explain in narrative)	59	3.7
	Not reported	13	0.8
Bus(seats 9-15,incl.dr)	NA	4	0.3
Bus(seats 9-15,incl.dr)	Not reported	1	0.1
Bus(seats >15,incl.dr)	NA	56	3.5
Van/enclosed box	NA	2	0.1
Van/enclosed box	Truck Cargo Type: Van/enclosed box	528	33.2
Cargo tank	Truck Cargo Type: Cargo tank	85	5.3
Flatbed	Truck Cargo Type: Flatbed	143	9.0
Dump	Truck Cargo Type: Dump truck (grain/gravel)	162	10.2
Concrete mixer	Truck Cargo Type: Concrete mixer	21	1.3
Auto transporter	Truck Cargo Type: Auto transporter	8	0.5
Garbage/refuse	Truck Cargo Type: Garbage/refuse	34	2.1
Pole	Trailer type: Pole	1	0.1
Other	Unknown	8	0.5
Total		1,592	100.0

The Iowa police report allows up to two weather conditions to be recorded. This allows police officers to record more complete details about certain combinations of weather, such as severe winds and freezing rain. The *Investigating Officers Accident Reporting Guide* gives some brief

instructions to avoid inconsistencies, such as coding "clear" and "cloudy." Overall, weather is coded consistently between the MCMIS Crash file and the Iowa PAR file, though with one major exception. Over 44 percent of the records in the MCMIS Crash file are missing data on weather condition, while Table 16 shows that there is valid weather data for the records in the Iowa Crash file. It cannot be determined why this information was not uploaded to the MCMIS file with the rest of the record. Table 16 does not show the coding of the second weather variable, but there is nothing unusual in how that variable was coded for these cases. Other than the missing data problem, consistency where weather was reported to the MCMIS file was good. The Iowa weather variables are somewhat more detailed than the MCMIS weather variable, but the translation performed by Iowa is appropriate. Note that clear, partly cloudy, and cloudy are all mapped to the no adverse conditions value in the MCMIS weather variable. There are 39 cases in which the Iowa PAR weather variable indicated rain, mist, fog, snow, or some other condition, that were coded no adverse conditions in the MCMIS weather variable. In each case, the second weather Iowa crash file variable was coded cloudy, or partly cloudy. This problem can be readily addressed by small changes in the extraction algorithm. The larger issue is the amount of missing data.

Table 16 Weather Comparison in MCMIS Crash File and Iowa PAR File, 2004

MCMIS Value	Iowa Crash file value	N	%
(missing data)	Clear	251	15.8
	Partly cloudy	119	7.5
	Cloudy	99	6.2
	Fog/smoke	8	0.5
	Mist	10	0.6
	Rain	47	3.0
	Sleet/hail/freezing rain	13	0.8
	Snow	126	7.9
	Severe winds	16	1.0
	Blowing sand/soil	11	0.7
	Not Reported	4	0.3
Missing data subtotal		702	44.2
No adverse conditions	Clear	451	28.3
	Partly cloudy	163	10.2
	Cloudy	123	7.7
	Fog/smoke	2	0.1
	Mist	17	1.1
	Rain	14	0.9
	Sleet/hail/freezing rain	2	0.1
	Snow	2	0.1
	Blowing sand/soil	2	0.1
Rain	Mist	13	0.8
Rain	Rain	47	3.0
Sleet, hail	Sleet/hail/frRain	3	0.2
Sleet, hail	Snow	2	0.1
Snow	Snow	11	0.7
Fog	Fog/smoke	14	0.9
Fog	Mist	4	0.3

MCMIS Value	Iowa Crash file value	N	%
Blowing sand, dirt, snow	Blowing sand/soil	6	0.4
Severe crosswinds	Severe winds	2	0.1
Other	Snow	1	0.1
Other	Other	2	0.1
Unknown	Not Reported	4	0.3
Unknown	Unknown	3	0.2
Total		1,592	100.0

Other variables showed only a handful of inconsistencies. The variables for number of fatalities were identical, except for six cases, in which the number of fatalities differed by one. In the case of light condition, there were nine cases with inconsistent values. For example, there were five cases coded daylight in the Iowa crash file that were coded dusk in the MCMIS file, two cases coded dawn in the Iowa file and dusk in MCMIS, and so on. There were also minor discrepancies in the coding of road surface condition, with three cases with valid codes in the Iowa data, but missing in the MCMIS file, and two other minor discrepancies. Overall, the match between the files was good.

7. Summary and Discussion

In recent years, Iowa has reported about 1,500 crash involvements per year to the MCMIS Crash file, ranging from a low of about 1,300 in 2001 to a high of 1,702 in 2003. In 2004, 1,620 cases were reported. In this evaluation, we attempted to determine the completeness and accuracy of cases reported to the MCMIS Crash file.

Identifying reportable cases in the Iowa crash file was relatively straightforward, though it was necessary to use indirect means to establish certain details of the reporting criteria. Iowa uses the MCMIS vehicle classification definitions for trucks and buses in its own system, making it very simple to identify trucks and buses that meet the MCMIS reporting criteria. Vehicles displaying hazmat placards are also reportable, but Iowa does not capture whether a vehicle displayed a hazmat placard for all vehicles. Instead, hazmat placard is only captured in a commercial vehicle section of the police report, and officers are instructed to fill out that section only if they judge the case falls within the MCMIS reporting criteria. All hazmat information is only captured in the commercial vehicle section of the police report. This is less than ideal for the present purpose, but does not raise major difficulties, since relatively few vehicles that are not trucks are used to transport hazardous materials. In any event, the variable indicating a hazmat placard was all coded not reported, but we were able to use a variable that indicated the type of hazardous material to determine if hazmat was transported.

Similar indirect means were necessary to identify crashes that met the MCMIS crash severity criteria. Fatal crash involvements can be cleanly identified, but it was necessary to use other indicators to determine if any person in the crash was transported for medical attention or any vehicle towed due to disabling damage. Text fields are used to record where a person was transported and by whom. Review of the text fields showed that in a significant number of cases, the text indicated that the person was not transported for medical attention. Accordingly, it was not sufficient to just take all cases with any text in the field as indicating transportation for

treatment. The text fields of all records of injured persons were reviewed to identify those transported for treatment. This method was labor-intensive but likely reliably identifies transported injuries. No variable directly codes whether a vehicle was towed due to disabling damage, but a damage severity scale was used to identify disabled vehicles. It was assumed that crashes with disabled vehicles satisfied the towed vehicle criteria for the MCMIS Crash file. Overall, 2,042 records were identified as reportable.

It should be noted that this method of identifying reportable cases seems reasonable and the best use of available data, but likely does not perfectly match the MCMIS reporting criteria. Accordingly, there could be reportable cases that were missed or some cases identified as reportable but which did not actually meet the reporting criteria. It is believed, however, that the number of errors is small relative to the total of reportable cases.

All records in the Iowa crash file were matched to the MCMIS Crash file, whether the case met the MCMIS reporting criteria or not. This procedure allowed us to identify cases that should not have been reported, as well as how well Iowa identified and uploaded records to the file. The match of Iowa records to the MCMIS Crash file was effective. In 2004, Iowa reported 1,617 unique records to the Crash file. The match procedure matched 1,592, or 98.5 percent of the uploaded records. Of the 1,592, 1,462 met the MCMIS reporting criteria. So, overall, Iowa reported 1,462 of the 2,042 reportable cases in 2004, 71.6%.

Completing the commercial vehicle section, mentioned above, appears to be a necessary but not sufficient condition for reporting to the Crash file. All cases reported had some information in the CMV section, though not all records with information in that section were reported. About a third of reportable cases that were not reported had some information in the CMV section. It could not be determined why these cases were not uploaded. Instructions for filling out the CMV section exclude vehicles operated by a unit of government. These vehicles are not supposed to be excluded from the MCMIS file, but it is possible that that played a role. However, since the names of the carriers were not supplied as part of the data, it could not be determined if some were excluded for that reason.

Other factors associated with reporting rates largely corresponded to the reporting criteria. Reporting rates were lower for less serious crashes. Over 94 percent of fatal involvements were reported, as were 86.4 percent of injury, but only 61.4 percent of towed involvements. Trucks were more likely to be reported than buses, and large trucks and buses were reported at a higher rate than small trucks and buses. About 80 percent of the reportable involvements of tractor-semitrailers were reported, compared with only about 64 percent of single-unit trucks. Similarly, half of buses with seating for 15 or more occupants were reported, compared with only about a third of smaller school buses and 19 percent of smaller other buses. Officers are more likely to fill out the CMV section for large vehicles in serious crashes. It is more difficult to recognize towaway crashes and vehicles closer in size to light vehicles as meeting the reporting criteria.

It also appears that crash involvements of vehicles licensed out of state were more likely to be reported than in-state vehicles, though the difference was not large. About 80 percent of the reportable involvements of vehicles licensed out of state were reported, compared with 69 percent of Iowa-licensed vehicles. This difference is statistically significant. The explanation for the difference could be that reporting officers assume in some cases that the crashes of in-state

vehicles are not of interest to the national, MCMIS file. This has been a problem in other states as well, though the effect in Iowa is not large.

Finally, reporting rates differ by the type of agency that covered the crash. The Iowa State Patrol had the highest reporting rate, with 84.1 percent of reportable crashes correctly reported. The rates were lower for county sheriffs and police departments, at around 72 percent each. Unfortunately, reporting agency could not be determined for about 40 percent of the cases. The reporting rates would likely change if the data were more complete.

Iowa uses the same code levels for many variables as the MCMIS Crash file, which is helpful in ensuring consistency between the MCMIS file and the Iowa Crash file. Several variables, including vehicle configuration, cargo body, weather, light condition, and roadway surface condition, were checked for consistency and a small number of discrepancies were found. The source of the discrepancies is likely related to updating information in records. There was no evidence of any systematic errors is translating variables prior to upload to the Safetynet system.

The major finding in comparing pairs of variables between the Iowa Crash file and the MCMIS file is in missing data. In certain variables, records with valid codes in both files agreed very well, but the amount of missing data was large. For example, there were only a handful of discrepancies between the MCMIS and Iowa weather variables, but 44.2 percent of MCMIS cases had missing data for the weather variable. Agreement on cargo body was also good, but cargo body was missing in 34.1 percent of cases. Certain other variables also had high rates of missing data in the MCMIS file, including the variables for road access, road trafficway, driver license number, class, and state. It is not known why the rates of missing data for some MCMIS Crash file variables are high, when it appears that the information is available in the Iowa crash file. However, since the information is available, the problem should be readily solvable.

Iowa's approach of collecting most of the information required for the MCMIS Crash file for all cases should support a high reporting rate. If all information necessary to apply the reporting criteria were available in the crash file, then a well-crafted selection algorithm could unambiguously identify all reportable cases. Conditioning completion of the CMV section on recognizing that the crash meets the MCMIS reporting criteria, however, puts the burden back on the reporting officer. The reporting officer must then recall and apply correctly the criteria. Although the overall reporting rate is 71.6 percent, certain crash types and vehicle types are less likely to be reported. Smaller vehicles, less serious crashes, crashes involving in-state vehicles, and crashes reported by county sheriffs or local police departments, are all less likely to be reported. Targeted training is one resource for increased reporting. Some small changes in the approach to filling out the police report might also be effective.

References

1 U.S. Bureau of Census, 2002 Economic Census, Vehicle Inventory and Use Survey.

2 Iowa Department of Transportation, Motor Vehicle Division Office of Driver Services, *Investigating Officers Accident Reporting Guide*. Revised: January 2001.

3 Blower, D., and Matteson, A., *Evaluation of the Motor Carrier Management Information System Crash File, Phase One.* University of Michigan Transportation Research Institute, Ann Arbor, Michigan. March 2003. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

4 Blower, D., and Matteson, A*., Patterns of MCMIS Crash File Underreporting in Ohio.* University of Michigan Transportation Research Institute, Ann Arbor, Michigan. August 2003. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

5 Blower, D., and Matteson, A*., Evaluation of Missouri Crash Data Reported to MCMIS Crash File.* University of Michigan Transportation Research Institute, Ann Arbor, Michigan. January 2004. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

6 Blower, D., and Matteson, A*., Evaluation of Michigan Crash Data Reported to MCMIS Crash File.* University of Michigan Transportation Research Institute, Ann Arbor, Michigan. September 2004. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

7 Blower, D., and Matteson, A*., Evaluation of Florida Crash Data Reported to MCMIS Crash File.* University of Michigan Transportation Research Institute, Ann Arbor, Michigan. December 2004. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

8 Matteson, A*.,* and Blower, D*., Evaluation of California Crash Data Reported to MCMIS Crash File.* University of Michigan Transportation Research Institute, Ann Arbor, Michigan. February 2005. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

9 Green, P.E*.,* and Blower, D*., Evaluation of New Jersey Crash Data Reported to MCMIS Crash File.* University of Michigan Transportation Research Institute, Ann Arbor, Michigan. February 2005. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

10 Green, P.E., and Blower, D., *Evaluation of New Mexico Crash Data Reported to MCMIS Crash File.* University of Michigan Transportation Research Institute, Ann Arbor, Michigan. July 2005. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

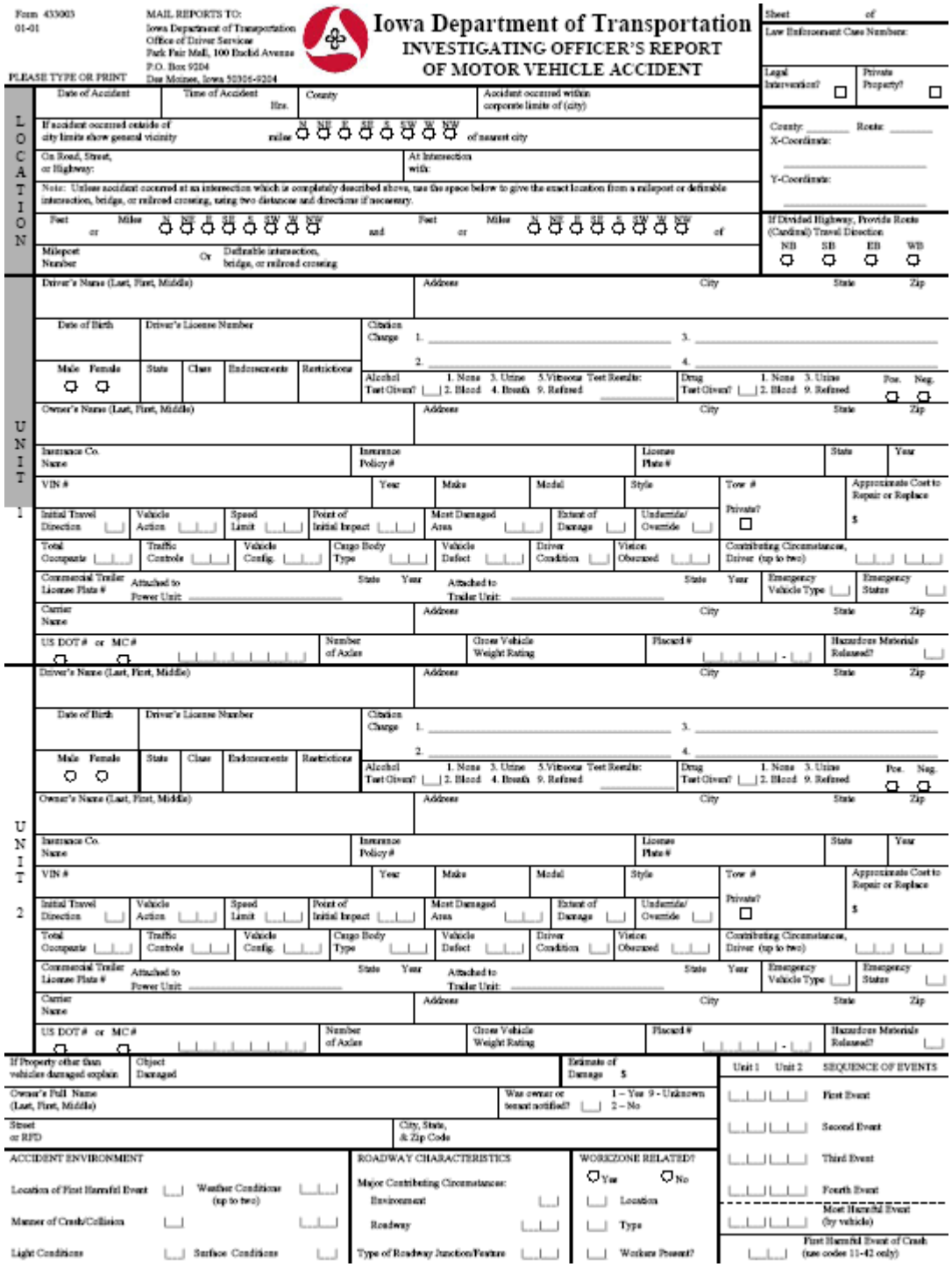
11 Matteson, A., and Blower, D., *Evaluation of North Carolina Crash Data Reported to MCMIS Crash File.* University of Michigan Transportation Research Institute, Ann

Arbor, Michigan. May 2005. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

12 Matteson, A., and Blower, D., *Evaluation of Illinois Crash Data Reported to MCMIS Crash File.* University of Michigan Transportation Research Institute, Ann Arbor, Michigan. July 2005. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

13 Blower, D., and Matteson, A., *Evaluation of Washington Crash Data Reported to MCMIS Crash File.* University of Michigan Transportation Research Institute, Ann Arbor, Michigan. June 2006. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

Appendix A: Iowa Crash Report Form



Form 433003
01-01

MAIL REPORTS TO:
Iowa Department of Transportation
Office of Driver Services
Park Fair Mall, 100 Euclid Avenue
P.O. Box 9204
Des Moines, Iowa 50306-9204

PLEASE TYPE OR PRINT

Iowa Department of Transportation
INVESTIGATING OFFICER'S REPORT
OF MOTOR VEHICLE ACCIDENT

Sheet of
Law Enforcement Case Number:

Legal Intervention? ☐ Private Property? ☐

LOCATION

Date of Accident | Time of Accident Hrs. | County | Accident occurred within corporate limits of (city)

If accident occurred outside of city limits show general vicinity | miles N NE E SE S SW W NW of nearest city

County: Route:
X-Coordinate:
Y-Coordinate:

On Road, Street, or Highway: | At Intersection with:

Note: Unless accident occurred at an intersection which is completely described above, use the space below to give the exact location from a milepost or definable intersection, bridge, or railroad crossing, using two distances and directions if necessary.

Feet Miles N NE E SE S SW W NW or and Feet Miles N NE E SE S SW W NW of

Milepost Number | Or | Definable intersection, bridge, or railroad crossing

If Divided Highway, Provide Route (Cardinal) Travel Direction
NB SB EB WB

UNIT 1

Driver's Name (Last, First, Middle) | Address | City | State | Zip

Date of Birth | Driver's License Number | Citation Charge 1. 2. 3. 4.

Male Female | State | Class | Endorsements | Restrictions

Alcohol Test Given? 1. None 2. Blood 3. Urine 4. Breath 5. Witness 9. Refused Test Results: | Drug Test Given? 1. None 2. Blood 3. Urine 9. Refused Pos. Neg.

Owner's Name (Last, First, Middle) | Address | City | State | Zip

Insurance Co. Name | Insurance Policy # | License Plate # | State | Year

VIN # | Year | Make | Model | Style | Tow # Private? | Approximate Cost to Repair or Replace $

Initial Travel Direction | Vehicle Action | Speed Limit | Point of Initial Impact | Most Damaged Area | Extent of Damage | Undamage/ Override

Total Occupants | Traffic Controls | Vehicle Config. | Cargo Body Type | Vehicle Defect | Driver Condition | Vision Obscured | Contributing Circumstances, Driver (up to two)

Commercial Trailer License Plate # | Attached to Power Unit: State Year | Attached to Trailer Unit: State Year | Emergency Vehicle Type | Emergency Status

Carrier Name | Address | City | State | Zip

US DOT # or MC # | Number of Axles | Gross Vehicle Weight Rating | Placard # | Hazardous Materials Released?

UNIT 2

Driver's Name (Last, First, Middle) | Address | City | State | Zip

Date of Birth | Driver's License Number | Citation Charge 1. 2. 3. 4.

Male Female | State | Class | Endorsements | Restrictions

Alcohol Test Given? 1. None 2. Blood 3. Urine 4. Breath 5. Witness 9. Refused Test Results: | Drug Test Given? 1. None 2. Blood 3. Urine 9. Refused Pos. Neg.

Owner's Name (Last, First, Middle) | Address | City | State | Zip

Insurance Co. Name | Insurance Policy # | License Plate # | State | Year

VIN # | Year | Make | Model | Style | Tow # Private? | Approximate Cost to Repair or Replace $

Initial Travel Direction | Vehicle Action | Speed Limit | Point of Initial Impact | Most Damaged Area | Extent of Damage | Undamage/ Override

Total Occupants | Traffic Controls | Vehicle Config. | Cargo Body Type | Vehicle Defect | Driver Condition | Vision Obscured | Contributing Circumstances, Driver (up to two)

Commercial Trailer License Plate # | Attached to Power Unit: State Year | Attached to Trailer Unit: State Year | Emergency Vehicle Type | Emergency Status

Carrier Name | Address | City | State | Zip

US DOT # or MC # | Number of Axles | Gross Vehicle Weight Rating | Placard # | Hazardous Materials Released?

If Property other than vehicles damaged explain | Object Damaged | Estimate of Damage $

Owner's Full Name (Last, First, Middle) | Was owner or tenant notified? 1 – Yes 9 – Unknown 2 – No

Street or RFD | City, State, & Zip Code

SEQUENCE OF EVENTS

Unit 1 Unit 2

First Event
Second Event
Third Event
Fourth Event
Most Harmful Event (by vehicle)
First Harmful Event of Crash (use codes 11-42 only)

ACCIDENT ENVIRONMENT

Location of First Harmful Event | Weather Conditions (up to two)
Manner of Crash/Collision
Light Conditions | Surface Conditions

ROADWAY CHARACTERISTICS

Major Contributing Circumstances:
Environment
Roadway
Type of Roadway Junction/Feature

WORKZONE RELATED?

Yes No
Location
Type
Workers Present?

Page 1

NON-MOTORIST

Type ☐ Location ☐

Action ☐ Condition ☐

Safety Equipment ☐

Contributing Circumstance ☐ ☐

Unit No. of Vehicle Striking ☐

Motorcycle Seating Position
01 - Motorcycle Driver
04 - Motorcycle Passenger
88 - Other (explain in narrative)

SEATING POSITION

01	02	03
04	05	06
07	08	09

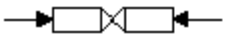
10 - Sleeper Section
11 - Enclosed Cargo Area
12 - Unenclosed Cargo Area
13 - Trailing Unit
14 - Exterior
15 - Pedestrian
16 - Pedalcyclist
17 - Pedalcyclist, passenger
88 - Other (explain in narrative)
99 - Unknown

	Sex	Unit No.	Seating Position	Injury Status	Occupant Protection	Airbag Deployment	Airbag Switch Status	Ejection	Ejection Path	Trapped
DRIVERS										
DRIVER OF UNIT 1										
Phone										
Transported to:	Transported by:									
DRIVER OF UNIT 2										
Phone										
Transported to:	Transported by:									
PERSONS INJURED										
Name 1.	Date of Birth									
Address	Transported to:	Transported by:								
Name 2.	Date of Birth									
Address	Transported to:	Transported by:								
Name 3.	Date of Birth									
Address	Transported to:	Transported by:								
Name 4.	Date of Birth									
Address	Transported to:	Transported by:								

DIAGRAM

DIAGRAM WHAT HAPPENED: *Instructions*

Number each vehicle and show direction of travel by arrow:



INDICATE NORTH

Use solid line to show path before accident:

Use dotted line to show path after accident:

Show pedestrian by: 

Show railroad by: 

Show utility poles by: 

Show motorcycles by: 

Show animal by: 

NARRATIVE

Describe what happened (refer to vehicles by number)

WITNESS

Name (Last, First)	Street or RFD	City	State	Zip	Phone

Signature of Officer	Badge No.	Time Officer Notified of Accident Hrs.	Time Officer Arrived At Scene Hrs.
Name of Agency	Date of Report	Investigation made at scene? Y N	Supplemental Information Will Follow? Y N / T.I.#
Report Reviewed by	Date Reviewed	Report Given to All Drivers? Y N	Other Technical Investigating Agency

Form 433013
01-01

MAIL REPORTS TO:
Iowa Department of Transportation, Office of Driver Services
Park Fair Mall, 100 Euclid Avenue, P.O. Box 9204
Des Moines, Iowa 50306-9204

PLEASE TYPE OR PRINT

Supplemental

Iowa Department of Transportation

INVESTIGATING OFFICER'S REPORT OF MOTOR VEHICLE ACCIDENT

Sheet ___ of ___

Law Enforcement Case Numbers:

Date of Accident	Time of Accident Hrs.	Accident occurred within corporate limits of (city)	On Road, Street, or Highway:	At Intersection with:	County

UNIT

Driver's Name (Last, First, Middle) | Address | City | State | Zip
Date of Birth | Driver's License Number | Citation Charge 1. ____ 2. ____ 3. ____ 4. ____
Male Female | State | Class | Endorsements | Restrictions
Alcohol Test Given? 1. None 2. Blood 3. Urine 4. Breath 5. Vitreous 9. Refused | Test Results:
Drug Test Given? 1. None 2. Blood 3. Urine 9. Refused | Pos. Neg.
Owner's Name (Last, First, Middle) | Address | City | State | Zip
Insurance Co. Name | Insurance Policy # | License Plate # | State | Year
VIN # | Year | Make | Model | Style | Tow # | Private | Approximate Cost to Repair or Replace $
Initial Travel Direction | Vehicle Action | Speed Limit | Point of Initial Impact | Most Damaged Area | Extent of Damage | Underride/Override
Total Occupants | Traffic Controls | Vehicle Config. | Cargo Body Type | Vehicle Defect | Driver Condition | Vision Obscured | Contributing Circumstances, Driver (up to two)
Commercial Trailer License Plate # | Attached to Power Unit: | State | Year | Attached to Trailer Unit: | State | Year | Emergency Vehicle Type | Emergency Status
Carrier Name | Address | City | State | Zip
US DOT # or MC # | Number of Axles | Gross Vehicle Weight Rating | Placard # | Hazardous Materials Released?

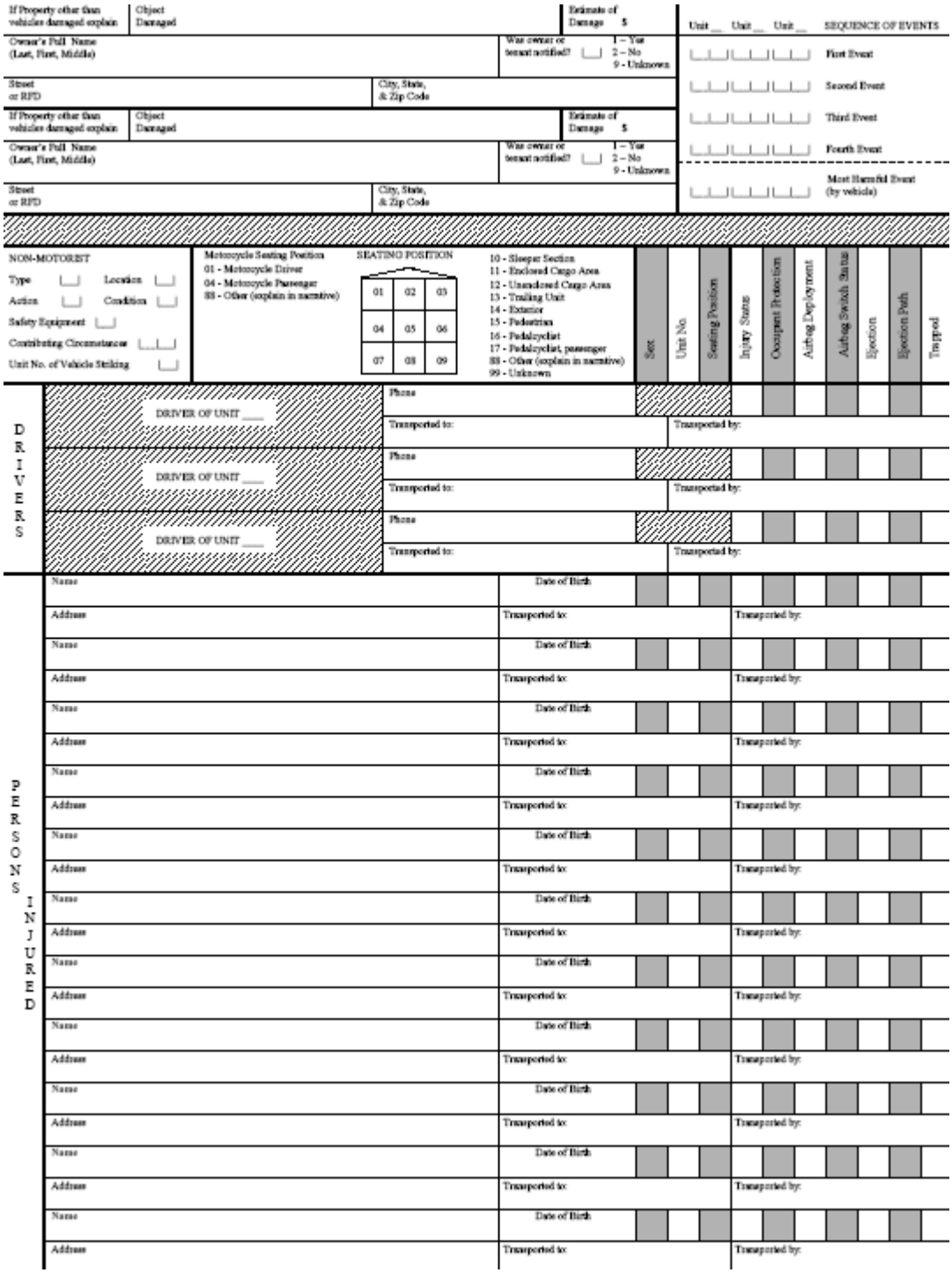
UNIT

Driver's Name (Last, First, Middle) | Address | City | State | Zip
Date of Birth | Driver's License Number | Citation Charge 1. ____ 2. ____ 3. ____ 4. ____
Male Female | State | Class | Endorsements | Restrictions
Alcohol Test Given? 1. None 2. Blood 3. Urine 4. Breath 5. Vitreous 9. Refused | Test Results:
Drug Test Given? 1. None 2. Blood 3. Urine 9. Refused | Pos. Neg.
Owner's Name (Last, First, Middle) | Address | City | State | Zip
Insurance Co. Name | Insurance Policy # | License Plate # | State | Year
VIN # | Year | Make | Model | Style | Tow # | Private | Approximate Cost to Repair or Replace $
Initial Travel Direction | Vehicle Action | Speed Limit | Point of Initial Impact | Most Damaged Area | Extent of Damage | Underride/Override
Total Occupants | Traffic Controls | Vehicle Config. | Cargo Body Type | Vehicle Defect | Driver Condition | Vision Obscured | Contributing Circumstances, Driver (up to two)
Commercial Trailer License Plate # | Attached to Power Unit: | State | Year | Attached to Trailer Unit: | State | Year | Emergency Vehicle Type | Emergency Status
Carrier Name | Address | City | State | Zip
US DOT # or MC # | Number of Axles | Gross Vehicle Weight Rating | Placard # | Hazardous Materials Released?

UNIT

Driver's Name (Last, First, Middle) | Address | City | State | Zip
Date of Birth | Driver's License Number | Citation Charge 1. ____ 2. ____ 3. ____ 4. ____
Male Female | State | Class | Endorsements | Restrictions
Alcohol Test Given? 1. None 2. Blood 3. Urine 4. Breath 5. Vitreous 9. Refused | Test Results:
Drug Test Given? 1. None 2. Blood 3. Urine 9. Refused | Pos. Neg.
Owner's Name (Last, First, Middle) | Address | City | State | Zip
Insurance Co. Name | Insurance Policy # | License Plate # | State | Year
VIN # | Year | Make | Model | Style | Tow # | Private | Approximate Cost to Repair or Replace $
Initial Travel Direction | Vehicle Action | Speed Limit | Point of Initial Impact | Most Damaged Area | Extent of Damage | Underride/Override
Total Occupants | Traffic Controls | Vehicle Config. | Cargo Body Type | Vehicle Defect | Driver Condition | Vision Obscured | Contributing Circumstances, Driver (up to two)
Commercial Trailer License Plate # | Attached to Power Unit: | State | Year | Attached to Trailer Unit: | State | Year | Emergency Vehicle Type | Emergency Status
Carrier Name | Address | City | State | Zip
US DOT # or MC # | Number of Axles | Gross Vehicle Weight Rating | Placard # | Hazardous Materials Released?

Supplement, Page 1



Supplement, Page 2