Model Performance Measures for State Traffic Record Systems
White Paper: Request for comment on proposed measures and guidance
July 1, 2009

Introduction

The National Highway Traffic Safety Administration (NHTSA), with the assistance of the Governors Highway Safety Association (GHSA), is developing a model set of minimum data quality performance measures for State traffic records systems. As specified in the Statement of Work, the minimum set will include "a minimum of six quality performance measures addressing timeliness, accuracy, completeness, uniformity, integration, and accessibility for each of the six State traffic safety core data systems (crash, vehicle, driver, roadway, citation/adjudication and injury surveillance)."

The measures are being developed for NHTSA by the Preusser Research Group (PRG), in collaboration with GHSA, with critical input from 25 State and 11 Federal data experts with extensive experience in collecting, processing, and using data from the six core data systems (see Appendix A for the names and affiliations of the State and Federal experts who provided critical and invaluable assistance in this effort and Appendix B for the names of PRG and GHSA representatives who worked on this paper). PRG and GHSA met with the Federal and State experts on February 18-19, 2009 and, on the basis of the experts' thoughts and input, then developed a draft list of measures and draft guidance on the criteria the measures should satisfy and how the measures should be calculated and used.

This White Paper presents the draft recommendations for public comment. It also presents several issues on which the authors invite comment. These are noted in bold as "**Issue for comment**." All other comments are equally welcome, from all interested parties. The authors will consider all comments and will seek additional input regarding the comments from the same Federal and State experts listed in Appendix A, with whom they will meet again on September 29, 2009. The authors then will finalize the White Paper, which will include a model list of minimum performance measures and related guidance.

Comments on the White Paper must be submitted to GHSA no later than 5:00 p.m. EDT on Friday, September 4, 2009. Comments should be submitted by email if possible, to headquarters@ghsa.org, with the subject heading "Record system performance measure comments from (name of organization or individual)." Comments may be made directly on an electronic copy of this White Paper; please use Microsoft Word "track changes" so that comments can be located easily. Comments also may be made in a separate document. Written comments also will be accepted, if mailed or delivered to GHSA, 444 North Capitol Street NW, Suite 722, Washington, DC 20001 and received by 5:00 p.m. EDT on Friday, September 4. All comments should identify the organization or individual providing the comments and should provide contact information for a person who can answer any questions on the comments.

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Executive Summary

The National Highway Traffic Safety Administration (NHTSA), with the assistance of the Governors Highway Safety Organization (GHSA), is developing a minimum set of data quality performance measures for State traffic records systems. As specified in the Statement of Work, the minimum set will include "a minimum of six quality performance measures addressing timeliness, accuracy, completeness, uniformity, integration, and accessibility for each of the six State traffic safety core data systems (crash, vehicle, driver, roadway, citation/adjudication and injury surveillance)."

The measures are being developed for NHTSA by the Preusser Research Group (PRG), in collaboration with GHSA, with critical input from 25 State and 11 Federal data experts with extensive experience in collecting, processing, and using data from the six core data systems (see Appendix A for the names and affiliations of the State and Federal experts who provided critical and invaluable assistance in this effort and Appendix B for the names of the PRG and GHSA representatives who worked on this paper). PRG and GHSA met with the Federal and State experts on February 18-19, 2009 and, on the basis of the experts' thoughts and input, then developed a draft list of measures and draft guidance on the criteria the measures should satisfy and how the measures should be calculated and used.

A performance measure specifies what to measure. It does not set a numerical performance goal or standard. States set their own performance goals.

NHTSA hopes that States will use these model standards in their State Data programs, particularly in the development and implementation of their Traffic Records Data System Strategic Plans and programs.

General recommendations

This paper recommends four actions extending beyond the performance measure matrix.

- G1: Each State should establish a statewide traffic citation reporting system and single statewide data file. States may need resources to implement the citation reporting system in all jurisdictions.
- G2: Model minimum data elements, definitions, and protocols for traffic citation and adjudication data systems should be developed, to serve the same role that the Model Minimum Uniform Crash Criteria (MMUCC), the Model Minimum Inventory of Roadway Elements (MMIRE), the National EMS Information System (NEMSIS), and the National Trauma Data Standards (NTDS) play for their data systems. This recommendation likely will involve a cooperative effort of several organizations representing courts, prosecutors, law enforcement, State motor vehicle and transportation departments, and federal agencies.

- G3: Each State should establish a common set of identifiers (link keys) to enable records on different files to be linked. All data transfers and all personal identifiers used in these transfers should follow National Information Exchange Model (NIEM) formats and protocols.
- G4: Each State should conduct data audits of its traffic safety data systems at regular intervals. Appropriate national organizations representing courts, prosecutors, law enforcement, State motor vehicle and transportation departments, and federal agencies should work with States to establish recommended data audit procedures.

Performance measure recommendations

This paper recommends 58 performance measures, distributed by data system and performance area as shown in Table E-1.

Table E-1. Distribution of recommended performance measures

	Timeliness	Accuracy	Completeness	Uniformity	Integration	Accessibility	**Total**
Crash	3	3	2	1	2	1	12
Vehicle	1	1	1	1	1	1	6
Driver	3	2	2	1	1	1	10
Roadway	2	2	2	1	2	2	11
Cit/Adj	1	1	1	2	1	2	8
Injury	1*	1*	4*	1*	3*	1*	11
Total	11	10	12	7	10	8	58

* Some measures apply to more than one Injury data system.

The 58 recommended measures are summarized in Table E-2, again by data system and performance area. In the Table, the text of each recommended measure is condensed substantially. See the full White Paper for the precise wording of each recommended measure. In the full White Paper, the measures are labeled by their cell in the table: first a code for the data system (C, V, D, R, C/A, and I), followed by a code for the performance area (T, A, C, U, I, and X, where X is the code for Accessibility), and then numbered sequentially within the cell. In Table E-2, only the measure's number is given. Thus the measure in Table E-2's Crash-Timeliness cell that reads:

1- median days fr. crash to file entry

is found in the full report on p. 10, under the Crash data system, Timeliness:

C-T-1: Median number of days from the date of a reported crash until it is entered into the State crash file.

Details, discussion, and questions raised for each measure are found in the full White Paper.

Table E-2. Summary of recommended performance measures

Data System	Performance Area					
	Timeliness	**Accuracy**	**Completeness**	**Uniformity**	**Integration**	**Accessibility**
Crash	1- median days from crash to file entry 2- % crashes on file in #XX days 3- median days from crash to location coding on crash file	1- % crashes w/ < #XX data elements w/ errors 2- % in-State vehicles VIN match to vehicle file 3- % crashes w/ location code	1- % crashes missing ≥ 1 critical data elements 2- % crashes w/ ≤ #XX incomplete data elements	1- # MMUCC-compliant data elements	1- % in-State drivers on crash file linked to driver file 2- % crashes w/ EMS linked to EMS file	1- # auth. agencies capable of accessing crash file
Vehicle	1- median days from owner change to vehicle file update	1- % vehicles on vehicle file w/ valid VIN	1- % vehicles on vehicle file w/ no missing MMUCC data elements	1- % vehicle file data elements comply w/ AAMVA and MMUCC stds.	1- # relevant data files linked to vehicle file	1- avg. # days from temp. vehicle reg. to vehicle file entry
Driver	1- median days from conviction to driver file entry 2- % convictions on driver file in 10 days 3- median days from final adjudication to driver file entry	1- % in-State driver convictions linked to driver file 2- % drivers on file w/ verified Soc. Sec. #	1- % missing or unknown critical data elements on driver file 2- % adjudication agencies reporting convictions to driver file	1- % driver data elements complying w/ AAMVA, MMUCC, Real ID standards	1- # relevant data files linked to driver file	1- % adj. agencies or adjudicators w/ immediate driver file access
Roadway	1- avg. days from construction project end to road file update 2- avg. days from critical data element collection to entry on road file	1- % road segments w/ errors on critical data elements 2- % crashes on public roads located on basemap or file	1- # or % of public road miles on basemap 2- # or % of public road miles w/ critical data on basemap or file	1- # or % of MMIRE data elements collected and entered on road file	1- road file linked to crash, other files 2- # or % of highway inventory files linked to basemap or road file	1- # or % of auth. users acquiring data from road file 2- % requests filled by State deadline

Data System	Performance Area					
	Timeliness	**Accuracy**	**Completeness**	**Uniformity**	**Integration**	**Accessibility**
Cit/Adj	1- median days from citation to file entry at first repository	1- % citation file records w/ errors in critical data elements	1- % missing critical data elements on citation files	1- % citations on driver file w/ unif violation codes 2- % law enforcement agencies w/ common citation form	1- % law enforcement agencies w/ policies for citation data transfer	1- % citation files accessible to auth. users 2- % auth. users w/ access to citation files
Injury	1- median days from event to file entry[abcd]	1- % error-free records[ad]	1- % agencies reporting[ad] 2- % EMS records w/ no missing NEMSIS data elements 3- % records w/ ICD-9 E-code[bcd] 4- % records w/ missing data for ≤ 5 standard data elements[ad]	1- % records compliant w/ national standards[ad]	1- % Trauma Reg records w/ EMS linked to EMS file 2- % EMS records fr. crash linked to State file[bc] 3- % records on file[bcd] w/ crash E-code linked to crash file	1- # days after Jan. 1 until file closed and available[abcd]

number
% percent
#XX a number to be specified by each State

The data systems to which the Injury performance measures apply are indicated by superscripts (note that not all States have each of these statewide data files):

[a] State EMS file
[b] State Emergency Department file
[c] State Hospital Discharge file
[d] State Trauma Registry file

Performance Measures for State Traffic Record Systems

Performance measures to be developed

The performance measures to be developed are specified as follows:

> "Develop … a minimum set of data quality performance measures that is intended to be used by Federal, State, and Local governments in the development and implementation of their traffic record data systems, strategic plans and programs.
>
> "A minimum of six quality performance measures are required, addressing timeliness, accuracy, completeness, uniformity, integration, and accessibility, for each of the six State traffic safety core data systems (crash, vehicle, driver, roadway, citation/adjudication and injury surveillance)."

Thus at least one performance measure is required for each of the six performance areas for each of the six data systems, or at least one measure for each cell of the 6x6 matrix of Table 1.

Table 1. Matrix of data systems and performance areas

Data system	Performance area					
	Timeliness	Accuracy	Completeness	Uniformity	Integration	Accessibility
Crash						
Vehicle						
Driver						
Roadway						
Citation/Adj						
Injury						

A performance measure is not a performance goal or standard. For example, a performance measure for crash data timeliness could be "the average number of days from a reportable crash until it is entered into the crash file" or "the percent of crashes entered into the file within 30 days of the crash." Performance goals using these measures would take the form "the average number of days from a crash until entry into the crash file is less than 30" or "95% of crashes are entered into the file within 30 days of the crash." States will set their own performance goals.

Background

Performance measures for traffic record systems became critical when in 2005 the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) authorized grants to States for traffic safety record system improvements under Sec. 408 of 23 U.S.C. (the "Sec. 408 grants"). To receive a grant, Congress required a State to set goals for its traffic safety record systems, to identify "performance-based measures by which progress toward those goals will be determined," and, for grants after the first year, to demonstrate "measurable progress toward achieving the goals and objectives" in the State's plan (see Resources in

www.nhtsa-tsis.net/triprs). The Federal Register notice implementing the Sec. 408 grants (USDOT, 2006) explicitly stated the six core traffic safety data systems and the six performance areas in the 6x6 matrix of Table 1 and briefly discussed how each performance area should be interpreted for each of the data systems.

To assist States in applying for and monitoring progress under their Sec. 408 grants, NHTSA, the Federal Highway Administration (FHWA), and the Federal Motor Carrier Safety Administration (FMCSA) formed a 408 team, developed guidance materials, and conducted regional workshops. The materials most relevant to performance measures are the performance measure discussion (NHTSA, 2007) and examples (NHTSA, 2008a). Other useful materials are listed in the References.

The 408 team reviewed all State grant applications. Applicants for FY 2007 grants were required to establish some satisfactory performance measures for some cells of the 6x6 matrix. Applicants for FY 2008 grants were required to demonstrate measurable progress on at least one of their performance measures. The team frequently worked at length with States to resolve what constituted a valid performance measure and what constituted measurable progress. Forty-nine States, the District of Columbia, and the five additional jurisdictions of Puerto Rico, American Samoa, Guam, the Commonwealth of the Northern Marianas, and the Virgin Islands received Sec. 408 grants in 2008 and all demonstrated progress on at least one performance measure. South Carolina and the Indian Nations did not apply for Sec. 408 grants in 2008. A report from Traffic Safety Analysis Systems & Services (TSASS, 2008) summarized and catalogued the performance measures used by the States and other jurisdictions in 2008. Appendix C briefly summarizes the measures used in 2008.

In 2008 NHTSA established a model minimum set of performance measures for behavioral highway safety programs: Traffic Safety Performance Measures for States and Federal Agencies (NHTSA, 2008c). They also were developed with input from Federal and State experts. These measures use data from the traffic record systems for which performance measures are being developed in the current effort. Thus, high-quality traffic record systems are essential to measuring and improving behavioral traffic safety performance.

The use of performance measures is increasing rapidly throughout both public and private sector organizations. Performance measures likely will be prominent in the forthcoming federal surface transportation program reauthorization.

The 6x6 performance measure matrix

Core traffic safety data systems

The six core data systems are defined in NHTSA's Performance Measure Discussion (NHTSA, 2007).

- Crash: "the State repository that stores police officer crash reports."
- Vehicle: "the State repository that stores information on licensed vehicles within the State" (also known as the vehicle registration system).

- Driver: “the State repository that stores information on licensed drivers within the State and their driver histories” (also known as the driver license and driver history system). The driver file also contains a substantial number of records for drivers who are not licensed within the State.
- Roadway: “the State repository that stores information about the roadways within the State. It should include information on all roadways within the State and is typically composed of roadway centerline and geometric data, location reference data, geographical information system data, travel and exposure data, etc.”
- Citation and Adjudication: “the State repository, or component repositories where the data are managed by multiple State agencies as a pooled data system, that stores traffic ticket data from the time that the tickets are assigned to an officer, through the court adjudication system and ultimately into the driver history files at the driver license data system.”
- Injury surveillance: “the State repository, or component repositories where the data are managed by multiple State agencies as a pooled data system, that stores data on motor vehicle injuries and deaths. Typical components on an injury surveillance system are pre-hospital emergency medical services (EMS) data, hospital emergency department data systems, hospital discharge data systems, trauma registries, and long term care / rehabilitation patient data systems.”

Each data system is described further in the Recommended Performance Measures section beginning on p. 5.

Performance areas

The six performance areas are interpreted somewhat differently across the six data systems. In general, the performance areas are intended to capture the following attributes (USDOT, 2006).

- Timeliness usually measures the time from the event generating the data (crash, vehicle registration, etc.) until the data are placed on file and available for use. For data that should be provided to another system, timeliness also can measure the time from the event until the data are passed on to the user system (e.g., citations sent to courts, court actions sent to driver history file).
- Accuracy has aspects both internal and external to the data file. Internal accuracy means that the data are valid (legitimate codes for the variable) and satisfy internal consistency checks and that there are no duplicate records for the same event (e.g., duplicate license records for the same driver). External accuracy means that the data are coded properly as determined by external sources or audits. For some data elements, accuracy can be tested by matching with external sources (e.g., match a vehicle’s VIN (Vehicle Identification Number) with a national VIN file, match location coding with a statewide location data base).
- Completeness also has internal and external aspects. Internal completeness means that all variables are recorded for each event (no missing or unknown data); it can be measured by the amount of missing or unknown data. External completeness means that the data file contains all applicable events, sometimes tested by matching data files (e.g., match injury crashes with EMS reports).
- Uniformity, also called consistency, also has internal and external aspects. Internally within a State, all jurisdictions should collect and report the same data using the same

definitions and procedures. If the same data elements are used in different State files, they should be identical or at least compatible (e.g., names, addresses, geographic locations). Externally, data collection procedures and data elements should agree with nationally accepted guidelines and standards (such as the Model Minimum Uniform Crash Criteria, MMUCC).

- Integration: Data files should be able to be linked to other appropriate data files using common identifiers or other methods if necessary.
- Accessibility: Information from the data files should be readily and easily available to the principal users.

Performance measure criteria

The authors, based on input from Federal and State experts, used the following criteria in developing the performance measures. Each measure should be:

- Specific and well-defined.
- Defined by data system performance, not supporting activities or milestones: "awarded a contract" or "formed a Traffic Records Coordinating Committee" are not acceptable performance measures.
- Practical: uses data that are readily available at reasonable cost.
- Timely: the measure can be determined in a timely manner.
- Accurate: the measure itself uses data that are accurate.
- Important: captures the essence of this performance area for this data system (for example, an accuracy measure should not be restricted to a single unimportant data element).
- Usable by all States, though not necessarily immediately.

These criteria take a broad view of performance measures, broader than that currently used by States in their Sec. 408 applications. For example, performance on some of the recommended measures may not change from year to year: once a State has incorporated uniform data elements (see V-U-1), established data linkages (D-I-1), or provided appropriate data file access (C/A-X-1), further improvement may not be expected. Some measures cannot or should not be used by all States: for example, States that do not currently maintain a statewide data file cannot use measures based on this file (see in particular the injury data files at p. 19). Some measures require States to define a set of critical data elements. Many measures require States to define their own performance goals or standards. The recommended measures should serve as a guide for States to use in assessing and improving performance of their data systems. But each State must select which measures to use and how to define and modify them to fit the State's specific circumstances.

Measurement methods for timeliness

For any system, each data record has a time from the event generating the record until the information is entered on the file. The recommended performance measures use two methods to define a single number that captures the entire distribution of times:

1) Average time for events to be entered on the file (counting all events). The average can be calculated as the mean (the sum of the times for all events divided by the number of events) or the median (the time of the 50th percentile event).
2) Percent of events on file within some fixed time (such as 24 hours or 30 days).

Each method is appropriate in different situations. The first method uses data from all events. Typically a few events will not be entered for a long time; these will influence the mean more than the median. The second is useful when a State has established a target reporting time.

Recommended performance measures

Terminology used

- data system: one of the six component systems, such as crash, driver, etc.
- data file (sometimes just "file"): database, such as "crash file" or "driver file". A data system may contain a single data file (such as a State's driver file) or more than one (the injury system has several data files).
- record: the thing that is recorded on a file (a crash, a driver, etc.).
- data element: individual fields coded within each record.
- data element code value: the allowable code values, or attributes, for a data element.
- State: the 50 States, the District of Columbia, and the six additional jurisdictions eligible to receive Sec. 408 grants.

Measure labels and numbers.

Performance measures are labeled by their cell in the data system – performance area matrix: first a code for the data system (C, V, D, R, C/A, and I), followed by a code for the performance area (T, A, C, U, I, and X, where X is the code for Accessibility) – and then numbered sequentially within the cell. Thus C-T-1 is the first Crash – Timeliness measure; C/A-U-2 is the second Citation/Adjudication – Uniformity/Consistency measure. For injury data system measures that apply to more than one data file, the data file code is attached to the label. Thus I-C-2-EMS is the second Injury – Completeness measure as applied to the EMS data file. Table 2 summarizes the 58 recommended measures by the matrix cell.

Table 2. Recommended performance measures

	Timeliness	Accuracy	Completeness	Uniformity	Integration	Accessibility	**Total**
Crash	3	3	2	1	2	1	12
Vehicle	1	1	1	1	1	1	6
Driver	3	2	2	1	1	1	10
Roadway	2	2	2	1	2	2	11
Cit/Adj	1	1	1	2	1	2	8
Injury	1*	1*	4*	1*	3*	1*	11
Total	11	10	12	7	10	8	58

* Some measures apply to more than one Injury data system.

How measures are classified in the 6x6 performance measure matrix

Data system: Performance measures are classified in the data system to which they apply and where they are calculated. Some measures involve data transferred from one file (the origin data file) to another (the destination file) or data whose collection is not under the control of the destination data file. For example, D-T-1 measures the timeliness of entering conviction data into the driver file. It's classified as a driver measure because it is calculated from the driver file (take each conviction on file and determine the time from the conviction date until it was entered onto the file) and because it measures the timeliness of data on the driver file. But the driver file owners and managers at a State Department of Motor Vehicles (DMV) have little or no control over the timeliness with which courts provide conviction data. As another example, a record on the crash file typically contains information from all five other data systems: data on vehicle registrations, driver histories, roadway characteristics, driver citations and convictions, and occupant injuries.

This classification has an important consequence that's worth highlighting. The six traffic safety data systems are not independent but are highly interconnected, with data flowing almost constantly from one to another. The responsibility for improving performance on a measure classified with one data system may rest with persons associated with other data systems.

Performance area: The boundaries between some performance areas are not precise. For example, NHTSA recommends correct location coding in the crash system as an accuracy measure (NHTSA, 2007; coded using the State's roadway database), as a completeness measure (NHTSA, 2008a; coded with lat/long coordinates), and as an integration measure (NHTSA, 2007; linked to a GIS master database). The recommended measures are classified in the performance area where they appear to be most important. Some measures could well be classified elsewhere: for example, the accessibility measure V-X-1 could be considered a timeliness measure. The authors do not consider this a major issue: the important consideration is whether a measure is included in the recommended minimum set, not where it is classified.

General recommendations

This paper recommends the following four actions not tied to specific cells of the performance measure matrix.

G1: Each State should establish a statewide traffic citation reporting system and single statewide data file. States may need resources to implement the citation reporting system in all jurisdictions.

G2: Model minimum data elements, definitions, and protocols for traffic citation and adjudication data systems should be developed, to serve the same role that MMUCC, the Model Minimum Inventory of Roadway Elements (MMIRE), the National EMS Information System (NEMSIS), and the National Trauma Data Standards (NTDS) play for their data systems. This recommendation likely will involve a cooperative effort of several organizations representing

courts, prosecutors, law enforcement, State motor vehicle and transportation departments, and federal agencies.

A project to address this recommendation for impaired driving citations and adjudications is underway. Under a NHTSA contract, TSASS is developing a Model Impaired Driver Records Information System. It will include a data dictionary with data elements and code values. The system will contain data elements appropriate for traffic citations, adjudication, treatment, and driver records. It will include data elements to be provided to federal data systems such as FMCSA's Commercial Driver's License Information System (CDLIS). The draft data dictionary was issued for public comment in spring 2009 and will be presented at the 2009 Traffic Records Forum. The project is being conducted in cooperation with the Association of Transportation Safety Information Professionals (ATSIP), NHTSA, FMCSA and various states. For more information, see www.nhtsa-tsis.net/MIDRIS.

G3: Each State should establish a common set of identifiers (link keys) to enable records on different files to be linked. All data transfers and all personal identifiers used in these transfers should follow National Information Exchange Model (NIEM) formats and protocols.

The ability to link data files is absolutely critical to the entire traffic record system – which is a single system, not a collection of unrelated systems. Records on individual systems contain information from other systems: for example, crash records contain driver, vehicle, roadway, citation, and injury data; driver records contain crash and citation data. Analyses frequently use linked information from different systems: for example, roadway analyses examine the crashes occurring on a roadway segment. Officials in one system need immediate access to information from other systems: for example, court officials need driver record information.

Linking data files requires that records on different files share common identifiers, or link keys. These may include a driver's name and driver license number, a vehicle's VIN and registration number, a roadway's milepost or GPS coordinates, a citation number, an emergency run number, and many more.

Data file linkage and access are closely connected. Both raise broad issues of individual privacy and the use of personal identifiers. As a general principle, persons in official capacities who deal with individuals (law enforcement, courts, DMVs) need both access to and linkage of data files with personal identifiers. These links sometimes are called deterministic to denote that individual records in different files are linked precisely using personal or other specific identifiers.

Persons who use aggregated data for research or planning use "sanitized" data with personal identifiers removed. Sometimes they can link files using probabilistic methods, for example by matching a record on one file with the set of all records on a second file that agree on the data elements common to the two files and then by estimating the probabilities that the record on the first file actually matches each of the records from the set on the second file. These probabilistic methods may not produce completely accurate results. Throughout this document, file linkage means deterministic, not probabilistic, linkage. Recommendation G3 will help facilitate deterministic file linkage.

States must establish link keys that facilitate both types of data system use while protecting the privacy of individuals. They should conform to NIEM, which provides standards and an on-line repository of information to support information sharing. NIEM is supported by the U.S. Department of Justice and the U.S. Department of Homeland Security to facilitate timely, secure information sharing across all relevant justice, public safety, emergency and disaster management, intelligence, and homeland security activities. For more information, see http://www.niem.gov/index.php.

G4: Each State should conduct data audits of its traffic safety data systems at regular intervals. Appropriate national organizations representing courts, prosecutors, law enforcement, State motor vehicle and transportation departments, and federal agencies should work with States to establish recommended data audit procedures.

Data audits are essential to preserve the integrity of the data systems and the data themselves. Audits can assess the data file's external completeness – whether the data file contains all applicable events – and its external accuracy – whether the data on file agree with the documents or other sources from which the data were obtained. Audits also can examine overall system operations.

Data audits can vary substantially in scope, procedures, and required resources. While the Federal and State experts with whom the authors met indicated that States should conduct regular audits of all traffic safety data systems, any further discussion of audits is beyond the scope of this paper. Responsibility for establishing audit procedures and conducting audits likely will be a cooperative effort between States and the appropriate national organizations involved with and affected by each data system.

Performance measure recommendations for the data systems

Notes.

1) Specified number of days: Some measures are defined in terms of "a specified number of days (such as 30, 60, or 90)." Each State will set its own benchmark for these measures.

2) Critical data elements: Some measures are defined using a set of "critical data elements." Unless specifically defined in the measure in terms of a national standard, each State will define its own set of critical data elements.

3) When should measures be calculated: Many measures can be calculated and monitored using data from some period of time such as a month, a quarter, or a year. All measures should be calculated and monitored at least annually. A few measures are defined explicitly for annual files.

4) Missing data: Some completeness measures are defined in terms of "missing" data (see for example C-C-1). "Missing" means that the data element is not coded: nothing was entered. Many data elements have null codes that indicate that information is not available for some reason.

Typical null codes are “not available,” “not documented,” “not known,” or “not recorded.” A data element with a null value is not counted as missing data, because it does contain a valid code, but the data element contains no useful information. For accuracy measures, a data element with missing data or a null value is not considered an error (see for example C-A-1).

> **Issue for comment:** The authors invite comments on whether some or all completeness measures should take account of null codes as well as missing data.

5) Incomplete data files: Many data files have records or data elements added to them well past the date of the event producing the record, so the files may not be “complete,” “final,” or “closed” for a long time. For example, autopsy or alcohol test data sometimes are not added to the crash file for many months after the crash. To calculate a performance measure that refers to the data file, States should do the following:

(1) Define the time period of the data file to be measured.
(2) Define the date when the measure is to be calculated.
(3) Calculate the measure using the data from time period (1) that’s on file on date (2).

Example: to calculate the first Crash Completeness measure C-C-1, Percent of records on the State crash file with missing data for one or more critical data elements:

(1) Select the time period: say calendar year. For example, use the 2007 crash file.
(2): Select the date for calculation: say April 1 of the following year. So calculate using the 2007 crash file as it exists on April 1, 2008.
(3) Calculate: take all crashes from 2007 on file as of April 1, 2008; calculate the percent with missing data for one or more critical data elements.

This method’s advantages are that it’s easy to understand and use and can produce performance measures in a timely manner. Its disadvantage is that performance measures calculated fairly soon after the end of the data file’s time period may not be based on complete data. For example, NHTSA’s FARS (Fatality Analysis Reporting System) is not closed and complete for a full year: the 2007 file was not closed until Jan. 1, 2009. This may bias the calculated performance measures in various ways. Timeliness measures will exclude any records that have not yet been entered by the calculation date, so timeliness measures will make the file appear to be more timely than it eventually will be. Completeness measures will exclude any information that will be entered after the calculation date for records on file on the calculation date, so completeness measures will make the file appear to be less complete than it eventually will be.

Alternatively, performance measures could be calculated only after a file (say an annual file) is closed, so that no further information can be added to it. This method reverses the suggested method’s advantages and disadvantages: it provides performance measures that are accurate but in many cases not timely.

Finally, some but not all measures could be calculated using all records entered into a file during a specified time period. For example, the Crash Timeliness measure C-T-1, Median number of days from the date of a reported crash until it is entered into the State crash file, could be calculated as follows:

(1) Select the time period: say calendar year 2007.

(2) Take all records that were entered onto the State crash file during the time period; if the time period is calendar year 2007 the crashes could have occurred in 2007 or 2006 (or perhaps even earlier).
(3) Calculate the measure using these crashes: the median time between the crash date and the date when it was entered into the crash file.

The timeliness measures produced by this method will be accurate but the accuracy and completeness measures will not, because the records entered during a given time period may not be complete at the time when the measure is calculated.

Issue for comment: The authors invite comments on whether either of the alternate methods is preferable to the suggested method for some or all performance measures. The authors also invite commenters to suggest other methods.

6) How to measure accessibility: Accessibility describes the degree to which a system's principal users can obtain information readily and easily from the file. This seemingly-simple statement includes three different aspects, all of which are used in the performance measures.

1. Data are available for use: see V-X-1, C/A-X-1, and I-X-1.
2. Users have access: see C-X-1, D-X-1, and C/A-X-2.
3. Users are successful in accessing: see R-X-1 and R-X-2.

Each of these is important; each has advantages and disadvantages as a candidate for the minimum set of performance measures. The proposed measures for each data system attempt to capture the most important and practical accessibility measures for the minimum set. See also Appendix C at p. C-3 and following for discussion and examples of current accessibility measures.

Issue for comment: The authors invite comments on how accessibility should be defined and measured both in general and also for each data system, keeping in mind the performance measure criteria of p. 4 above (measures should be well-defined, practical, timely, etc.).

Crash data system

Each State has a statewide crash data file that contains a record for each reported crash. All States require all serious injury crashes to be reported. Reporting criteria and practices for minor injury or property damage crashes vary substantially. The basic information on a crash is recorded and entered by the investigating law enforcement officer. Other information comes from driver, vehicle, roadway, citation/adjudication, and injury records and from other sources (e.g., alcohol test results from laboratories). MMUCC and the American National Standards Institute guidelines ANSI D.16, and ANSI D.20 provide national standards. FHWA's Crash Data Improvement Guide (FHWA, 2008) provides an excellent discussion of the crash data system and of relevant performance measures.

Timeliness

C-T-1: Median number of days from the date of a reported crash until it is entered into the State crash file.

C-T-2: Percent of crash reports entered into the State crash file within a specified number of days (such as 30, 60, or 90).

C-T-3: Median number of days from the date of a reported crash until its location coding is entered into the State crash file.

> Some States require a crash's location be determined before the crash can be entered into the State crash file. For these States, this measure should not be used because it is identical to C-T-1.

Accuracy

C-A-1: Percent of records on the State crash file that contain no more than a specified number of total data elements with errors.

C-A-2: Percent of in-State vehicles on the State crash file with Vehicle Identification Numbers (VINs) matched to the State's vehicle registration file.

C-A-3: Percent of records on the State crash file successfully located using one or more recognized location referencing methods (Link-Node, Linear Referencing System, X-Y coordinates, etc.).

> See also R-A-2, which measures the percent of crashes on public roads that can be location coded on the State's basemap or roadway inventory file.

Completeness

C-C-1: Percent of records on the State crash file with missing data for one or more critical data elements.

C-C-2: Percent of records on the State crash file that contain no more than a specified number of incomplete or null data element code values.

> See Note 4) above for a discussion of null data element code values.

Uniformity/consistency

C-U-1: Number of MMUCC-compliant data elements on the State crash file or obtained through linkages with other files.

Integration

C-I-1: Percent of in-State driver records on the State crash data file that are linked to the driver's record on the State's driver record file.

> In an ideal system, a law enforcement officer at a crash would enter an in-State driver's license number into the officer's laptop (or swipe the license into a card reader). The license number would be transmitted instantly to the State driver record file. Relevant information from the driver's record would then be transmitted instantly back to the officer and entered automatically onto the crash report. This process sometimes is called "auto-population" because the information flows automatically from the driver record file to the crash report and subsequently to the crash file. Less automatic methods can achieve the same result: for example, once a crash record has been entered into the crash file, information can be requested from the driver record file for each in-State driver in the crash. This performance measure asks only that the records are linked but does not specify how the linkages are made. Similar comments apply to other Integration measures.

C-I-2-EMS: Percent of records on the State crash file with an EMS response that are linked to a corresponding record on the State EMS data file.

Accessibility

C-X-1: Number of authorized State and local agencies capable of utilizing an in-depth crash analysis software application to access State crash data.

Vehicle data system

Each State has a one or more central files that record information on all vehicles that are titled and licensed in the State. States that require vehicle safety or emissions inspections also record this information. The American Association of Motor Vehicle Administrators (AAMVA) provides standards, policies, guidelines, and best practices for vehicle title and registration files. For example, all States are required to meet the standards of the National Motor Vehicle Title Information System (NMVTIS).

Timeliness

V-T-1: Median number of days from the date of a change of ownership until the State vehicle registration file is updated.

Accuracy

V-A-1: Percent of records on the State vehicle registration file with successfully validated Vehicle Identification Numbers (VINs) using standardized VIN verification software.

Completeness

V-C-1: Percent of records on the State vehicle registration file with no missing data for all MMUCC-required vehicle data elements.

> Some MMUCC vehicle data elements are not relevant to or appropriate for a State vehicle registration file. Each State will determine the set of data elements on its vehicle registration file that fit the definition of "MMUCC-required."

Uniformity/consistency

V-U-1: Percent of data elements on the State vehicle registration file that comply with applicable national standards from AAMVA (ANSI D.20) and MMUCC.

Integration

V-I-1: Number of applicable data files from the four relevant traffic record data systems (crash, driver, citation/adjudication, and injury) that are linked to the State vehicle registration file.

> An "applicable data file" is one containing information that should be shared with the vehicle registration file.

Accessibility

V-X-1: Average number of days from the date of a temporary vehicle registration until the record is entered into the State vehicle registration file and available to law enforcement.

> **Issue for comment:** Another potential measure of accessibility is the percent of successful queries of the vehicle registration file by law enforcement officers, though this may be difficult to measure (see Note 6).The authors invite comments on which measure is most appropriate for the minimum set.

Driver data system

Each State has one or more central files that record information on all drivers licensed, domiciled, or cited while driving in the State. These files are maintained by the State's DMV. In addition to license information (type, status, restrictions, points, and the like), the driver files also contain some information on the driver's involvement in crashes and on traffic citations and convictions. AAMVA's DL/ID Standard 2005 provides standards for information on driver license applications and files. AAMVA's Driver License Compact and Non-Resident Violator Compact provide standards for driver history files, to provide greater uniformity when exchanging information on convictions, records, licenses, and withdrawals between States and other jurisdictions. The Real ID Act (P.L. 109.13 §37.11) provides standards for driver license data elements.

Driver license and history files are linked nationally through the National Driver Register (NDR). The NDR allows a State to make a single query to determine if a driver license applicant has had a license revocation or suspension or has been convicted of a serious driving offense in any State. If so, the State making the query can obtain information on the driver from the State where the license action or conviction occurred. Information on drivers with commercial licenses (CDLs) is linked nationally through CDLIS. Both the NDR and the CDLIS have internal data element and file standards.

Timeliness

D-T-1: Median number of days from the date of a conviction or relevant adjudication until it is entered into the State driver record file.

> "Relevant adjudication" refers to the traffic offense adjudications other than convictions, such as dismissals of alcohol offenses, that some States record on the State driver record file.

D-T-2: Percent of convictions and relevant adjudications entered into the State driver record file within 10 days of the date of conviction or adjudication.

> "Relevant adjudication" refers to the traffic offense adjudications other than convictions, such as dismissals of alcohol offenses, that some States record on the State driver file. "10 days" is the Motor Carrier Safety Improvement Act (MCSIA) standard, which applies to all commercial drivers.

D-T-3: Median number of days from the date of a citation's final adjudication until it is entered into the State driver record file.

> **Issue for comment:** The three timeliness measures all focus exclusively on the entry of citation and adjudication data into driver's records. Other information, such as changes in a driver's license status, also should be added in a timely fashion. The authors invite comments on whether one or more of the proposed measures should be replaced by a measure involving information other than citations and adjudications.

Accuracy

D-A-1: Percent of convictions and relevant adjudications for in-State drivers, from conviction files, that are matched to drivers in the State driver record file.

> "Relevant adjudication" refers to the traffic offense adjudications other than convictions, such as dismissals of alcohol offenses, that some States record on the State driver record file.

D-A-2: Percent of records on the State driver record file with Social Security Numbers successfully verified using SSOLV (Social Security Online Verification).

Completeness

D-C-1: Percent of missing or unknown critical data elements on the State driver record file.

Critical elements are those required by CDLIS except for those that apply only to commercial drivers.

D-C-2: Percent of adjudicatory agencies in the State that report convictions to the State driver record file.

Issue for comment: The completeness of reporting can be measured in two quite different ways for data such as convictions that are produced by many agencies and reported to a central data file.

- One way, used in D-C-2 and C/A-U-2, is to measure the number or percent of agencies that report. These measures are easy to calculate and quickly identify gaps in reporting that in turn produce missing data on the central data file. However, these measures may not accurately reflect the completeness of the central data file. If only a few agencies do not report, but the non-reporting agencies are large, then these measures will indicate a high reporting percentage but the central file will include a lower proportion of the State's total convictions.
- The other way is to measure the percent of total convictions statewide that are contained in the central data file. This accurately measures the central file's completeness. However, it's difficult to calculate. Each non-reporting adjudicatory agency must be queried to determine how many convictions were not reported.

The authors invite comments on which method is preferable or whether both should be used in separate performance measures.

Uniformity/consistency

D-U-1: Percent of data elements on the State driver record file that comply with applicable national standards from AAMVA (ANSI D.20), Real ID, and MMUCC.

Integration

D-I-1: Number of applicable data files from the four relevant traffic record data systems (crash, vehicle, enforcement/adjudication, and injury) that are linked to the State driver record file.

An "applicable data file" is one containing information that should be shared with the State driver record file.

Accessibility

D-X-1: Percent of adjudicators or adjudicatory agencies that have immediate access to the State driver record file.

Roadway data system

The key roadway data are contained in several files maintained by each State's Department of Transportation (DOT). These files contain information on the roadway's physical characteristics, including traffic control devices, pavement markings, roadway lighting, guardrails, and bridges; the roadway's condition; and its Average Annual Daily Traffic (AADT). The various files may or may not be linked electronically. Municipalities and counties may maintain their own files. A standard set of variables for roadway inventory files has not yet been developed. A proposed set, the Model Minimum Inventory of Roadway Elements (MMIRE), is in development (FHWA, 2007). A program to determine pavement condition and other measures of highway performance is already in place – the Highway Performance Monitoring System (HPMS). Inventories of performance are conducted and reports issued biennially.

Timeliness

R-T-1: Average number of days from the completion of a roadway construction project until the critical data elements on the State roadway inventory file are updated or revised.

> Each State will determine its list of roadway construction projects and will specify how it determines the project completion date. Potential definitions of completion include "open to traffic," "substantially complete," and "final acceptance."

R-T-2: Average number of days from the time when data for each critical roadway inventory data element are collected until the data are entered on the State roadway inventory file.

> Each State will determine its short list of critical elements, which should be a subset of MMIRE. For example, it could be some or all of the elements required for HPMS sites.

Accuracy

R-A-1: Percent of road segment records on the State roadway inventory file with errors in critical roadway inventory elements found during a data audit.

R-A-2: Percent of crashes on public roads that can be location coded on the State's basemap or roadway inventory file.

> If a State's crash file contains location codes from the State's basemap or roadway inventory file, then R-A-2 can be calculated from the crash file. If the State's crash file uses some other form of location coding, then R-A-2 can be calculated by matching each crash's location code against the roadway basemap or inventory file. Note that C-A-3 measures successful location of a crash using any standard method while R-A-2 measures whether the crash location is determined on the State's basemap or roadway inventory file.

Completeness

R-C-1: Number or percent of public road miles identified on the State's basemap or roadway inventory file.

R-C-2: Number or percent of public road miles for which critical roadway inventory elements are collected and recorded on the State's basemap or roadway inventory file.

Uniformity/consistency

R-U-1: Number or percent of MMIRE roadway inventory elements collected and entered into the State roadway inventory file.

Integration

R-I-1: Ability to link the State roadway inventory file to the State crash file and to other traffic record data files that contain location information.

R-I-2: Number or percent of individual highway inventory files (bridge, signal, etc.) that are linked to the State basemap or the roadway inventory file.

Accessibility

R-X-1: Number or percent of authorized users accessing, requesting, and receiving information or data from the State roadway inventory file.

R-X-2: Percent of requests received for information or data from the State roadway inventory file that were filled within the State's defined timeline.

Citation/Adjudication data system

Citation and adjudication data are contained in files of traffic citations, traffic arrests, convictions, and sentences. They are maintained by law enforcement agencies and by courts. Whereas each of the previous four systems was defined by a small number of State-level data files maintained by a single State agency, this system consists of multiple data files at the State, municipal, and local levels. For example, traffic citations are issued and recorded by State police; county sheriffs; city, town, and village police; and specialized law enforcement agencies such as college and university police. The systems themselves are evolving rapidly as law enforcement agencies and courts adopt electronic traffic citation and court processing procedures. Various organizations have established guidelines for some of these systems. Uniformity, completeness, and data integration across the various systems are critical; for example, at present few States are able to track traffic citations statewide.

All the recommended performance measures in the minimum set are based on traffic citations because citations provide the starting point for all citation and adjudication data. The accessibi

lity measures also include adjudication data. Due to the complexity of the citation and adjudication data system, many of the recommended performance measures allow States to determine the citation and adjudication data files to which they refer.

> **Issue for comment:** The authors invite comments on whether the minimum set should include measures for other components of the citation/adjudication system, such as arrests and convictions.

Timeliness

C/A-T-1: Median number of days from the date when a citation is issued until it is entered into the citation file at the first repository (outside the originating agency).

> Depending on the State and the nature of the citation, the first repository may be a court, a prosecutor's office, or a State agency such as a Department of Revenue.

Accuracy

C/A-A-1: Percent of records on the citation files that have errors for critical data elements.

> Each State must decide how to apply this measure within its citation data system. The measure does not specify which citation file or files to use in calculating the measure. States that have a central citation file could use that file alone. States that do not have a central file could use some large or important citation files. States that calculate the measure using more than one citation file should report the measure separately for each file. A similar comment applies to C/A-C-1 below.

Completeness

C/A-C-1: Percent of required critical data elements on the citation files that are missing.

> Each State must decide how to apply this measure within its citation data system. The measure does not specify which citation file or files to use in calculating the measure. First, each State should determine the critical data elements for a citation. Then the State should choose which citation file or files should be examined. As with C/A-A-1 above, States that have a central citation file could use that file alone. States that do not have a central file could use some large or important citation files. States that calculate the measure using more than one citation file should report the measure separately for each file. This measure should help some States encourage their courts, law enforcement agencies, and others to agree on a common set of critical data elements that should appear on each citation and on each citation data file.

Uniformity/consistency

C/A-U-1: Percent of citation records on the State driver record file that use common statewide violation codes.

Some law enforcement agencies in some States do not use common statewide violation codes, especially for citations based on municipal or county ordinances rather than State statutes. Such citations must have their violations recoded into the common violation codes before they can be entered into the State driver record file. This performance measure calculates the extent of this recoding. It can be calculated at the jurisdiction level because each jurisdiction either will or will not use common statewide codes.

> **Issue for comment:** An alternative measure would be to count jurisdictions instead of citations, for example "Percent of law enforcement agencies that use common statewide traffic violation codes." See the discussion at C/A-U-2 below for some advantages and disadvantages of the two alternatives. The authors invite comments on which method is preferable or whether both should be used in separate performance measures.

C/A-U-2: Percent of reporting law enforcement agencies that use a common statewide traffic citation form.

> **Issue for comment:** As with the completeness of reporting (see D-C-2), the use of a common citation form can be measured in two quite different ways.
>
> - One way, used in C/A-U-2, is to measure the number or percent of agencies that use a common citation form. This measure is easy to calculate and quickly identifies the agencies that do not use a common form, and the use of different forms may produce errors or inconsistencies. However, this measure may not accurately reflect the proportion of total citations that were issued using the common form. If only a few agencies do not use the common citation form, but these agencies are large, then the proportion of agencies using the common form will be large but the proportion of total citations issued using the common form will be smaller.
> - The other way is to measure the percent of total citations statewide that were issued using the common citation form. This accurately measures the use of the common form. However, it's difficult to calculate. Each law enforcement agency not using the common form probably must be queried to determine how many citations it issued. Some law enforcement officers may use different citation forms in different situations, which makes the measure even more difficult to calculate.
>
> The authors invite comments on which method is preferable or whether both should be used in separate performance measures.

Integration

C/A-I-1: Percent of law enforcement agencies issuing traffic citations that have policies in place to facilitate the transfer of citation data between authorized users.

Accessibility

C/A-X-1: Percent of citation and adjudication data files that are accessible to other authorized users.

> Each State will specify its citation and adjudication data files that should be accessible.

C/A-X-2: Percent of authorized user agencies that have access to citation and adjudication records.

> Authorized users can view individual records but cannot modify the records. Authorized users are required to be trained in use of the data. Typical authorized users include law enforcement agencies, courts, probation and parole agencies, other criminal justice agencies, and DMVs.

Injury data system

The Injury data system consists of four statewide files: Emergency Medical Services (EMS), Emergency Department (ED), Hospital Discharge (HD), and Trauma Registry (TR). These data files are discussed briefly below. Not all States have each of these statewide data files. Each State should use only the recommendations for its own statewide data files.

Some of the performance measure recommendations apply to more than one of the four statewide data files. These parallel measures are numbered separately, with the data file noted as part of the number. For examples, see the Timeliness measures I-T-1-EMS, I-T-1-ED, I-T-1-HD, and I-T-1-TR.

The Emergency Medical Services (EMS) file: About half the States maintain a statewide data file that records information from each EMS run. The National Emergency Medical Service Information System (NEMSIS) provides States with national standards and guidance to develop, implement, and improve their EMS data systems. NEMSIS is working toward merging information from State EMS data systems into a national data file. For more information, see http://www.nemsis.org/index.html.

The Emergency Department (ED) file. About half the States maintain a statewide data file that records patient information from hospital emergency departments. Data guidelines, established in the Universal Billing Code of 1992 (UB-92) act and updated in 2004 to UB-04, are available from the US Department of Health and Human Services. For more information, see http://www.cms.hhs.gov/.

The Hospital Discharge data file (HD). Nearly all states currently collect hospital discharge data in some form. Differences among the states abound, however, with regard to the specific data elements collected, how they are defined, data completeness, voluntary vs. mandatory data submission, and policies regarding data release. In particular, not all States routinely collect and record the external cause of injury codes (E-codes) and the ICD-9-CM diagnosis codes that are necessary to determine whether the patient was hospitalized due to injuries sustained in a traffic crash. While there are no national standards, many states use the UB-04 as the basis of their statewide hospital discharge data file. For more information, see J. Schoenman et al., The Value of Hospital Discharge Databases (2005), http://www.hcup-us.ahrq.gov/reports/final_report.pdf.

The Trauma Registry file (TR). Many States maintain a Trauma Registry that contains information on patients from the State's trauma centers. The American College of Surgeons

(ACS) provides guidelines for State trauma registry data files. The ACS has established the National Trauma Data Standards (NTDS) and maintains the National Trauma Databank. For more information, see http://www.ntdsdictionary.org/.

Timeliness

I-T-1-EMS: For a calendar year, the median number of days from the date of an EMS run until the run report is entered into the State EMS file.

I-T-1-ED: For a calendar year, the median number of days from the date of emergency department discharge until the record is entered into the State Emergency Department data file.

I-T-1-HD: For a calendar year, the median number of days from the date of a hospital discharge until the record is entered into the State Hospital Discharge data file.

IT-1-TR: For a calendar year, the median number of days from the date of hospital discharge until the record is entered into the State Trauma Registry data file.

Accuracy

I-A-1-EMS: Percent of records on the State EMS data file that are error-free (based on an audit of the file's NEMSIS National Data Elements).

> The NEMSIS National Data Elements are defined on the NEMSIS website at http://www.nemsis.org/softwaredevelopers/downloads/datasetDictionaries.html

I-A-1-TR: Percent of records on the State Trauma Registry data file that are error-free (based on an audit of the file's data elements from the NTDS or compliant State standards).

> The National Trauma Data Standards are found on the National Trauma Data Bank website http://www.ntdsdictionary.org/

Completeness

I-C-1-EMS: Percent of EMS agencies providing data to the State EMS data file.

I-C-1-TR: Percent of trauma hospitals providing data to the State Trauma Registry.

I-C-2-EMS: Percent of records on the State EMS data file with no missing data for the NEMSIS National Elements subset.

I-C-3-ED: Percent of injury records on the State Emergency Department data file with an ICD-9-CM External Cause of Injury Code (E-code; not E849.x).

I-C-3-HD: Percent of injury records on the State Hospital Discharge Data file with an ICD-9-CM External Cause of Injury Code (E-code; not E849.x).

I-C-3-TR: Percent of injury records on the State Trauma Registry with an ICD-9-CM External Cause of Injury Code (E-Code; not E849.x).

I-C-4-EMS: Percent of records on the State EMS data file with missing data for five or fewer of the file's data elements from the NEMSIS National Elements subset.

I-C-4-TR: Percent of records on the State Trauma Registry data file with missing data for five or fewer of the file's data elements from the National Trauma Data Standards data elements.

Uniformity/consistency

I-U-1-EMS: Percent of records on the State EMS data file that are NEMSIS compliant: contain all NEMSIS National Data Elements, are coded using the NEMSIS Data Dictionary, and comply with NEMSIS XML Standards.

I-U-1-TR: Percent of records on the State Trauma Registry data file that are NTDS compliant: contain all NTDS data elements, are coded using the NTDS Data Dictionary, and comply with NTDS XML Standards.

Integration

I-I-1: Percent of State Trauma Registry records indicating transport by EMS that are linked to a corresponding record on the State EMS data file.

I-I-2-ED: Percent of State EMS records, related to a motor vehicle crash, that are linked to a corresponding record on the State Emergency Department data file.

I-I-2-HD: Percent of State EMS records, related to a motor vehicle crash, that are linked to a corresponding record on the State Hospital Discharge Data file.

I-I-3-ED: Percent of State Emergency Department file records, with an ICD-9-CM External Cause of Injury code (E-code) of E810-E819, that are linked to a corresponding record on the State crash file.

I-I-3-HD: Percent of State Hospital Discharge Data file records, with an ICD-9-CM External Cause of Injury code (E-code) of E810-E819, that are linked to a corresponding record on the State crash file.

I-I-3-TR: Percent of State Trauma Registry file records, with an ICD-9-CM External Cause of Injury code (E-code) of E810-E819, that are linked to a corresponding record on the State crash file.

Accessibility

I-X-1-EMS: Time (number of days after January 1) until the annual State EMS file is closed and available for analysis by other stakeholders.

I-X-1-TR: Time (number of days after January 1) until the annual State Trauma Registry file is closed and available for analysis by other stakeholders.

I-X-1-ED: Time (number of days after January 1) until the annual State Emergency Department file is 'closed' and available for analysis by other stakeholders.

I-X-1-HD: Time (number of days after January 1) until the annual State Hospital Discharge Data file is closed and available for analysis by other stakeholders.

Acronyms used

AADT – Average Annual Daily Traffic
AAMVA – American Association of Motor Vehicle Administrators
ACS - American College of Surgeons
ATSIP – Association of Transportation Safety Information Professionals
CDL – Commercial Driver's License
CDLIS – Commercial Driver's License Information System
DMV – Department of Motor Vehicles
DOT – Department of Transportation
ED – Emergency Department
EMS – Emergency Medical Services
FHWA – Federal Highway Administration
FMCSA – Federal Motor Carrier Safety Administration
GHSA – Governors Highway Safety Association
HD – Hospital Discharge
HPMS – Highway Performance Monitoring System
MCSIA – Motor Carrier Safety Improvement Act
MMIRE – Model Minimum Inventory of Roadway Elements
MMUCC – Model Minimum Uniform Crash Criteria
NDR - National Driver Register
NEMSIS – National EMS Information System
NHTSA – National Highway Traffic Safety Administration
NIEM – National Information Exchange Model
NMVTIS – National Motor Vehicle Title Information System
NTDS – National Trauma Data Standards
SSOLV – Social Security Online Verification
TR – Trauma Registry
TSASS – Traffic Safety Analysis Systems & Services
USDOT – U.S. Department of Transportation
VIN – Vehicle Identification Number

References

FHWA (2007). Model Minimum Inventory of Roadway Elements – MMIRE. FHWA-HRT-07-046. /www.tfhrc.gov/safety/pubs/07046/07046.pdf.

FHWA (2008). Crash Data Improvement Guide. Federal Highway Administration draft final report.

MMUCC (2008). Model Minimum Uniform Crash Criteria Guideline, Third Edition. /www.mmucc.us/

NHTSA (2006). Traffic Records Program Assessment Advisory, November 20, 2006. National Highway Traffic Safety Administration.

NHTSA (2007)*. Performance Measures Discussion. 408 Team Document #005, October 29, 2007. National Highway Traffic Safety Administration.

NHTSA (2008a)*. NHTSA Section 408 Performance Measure Examples. 408 Team Document #010, January 9, 2008. National Highway Traffic Safety Administration.

NHTSA (2008b). Traffic Safety Information System Benchmarking Guide. September 12, 2008. National Highway Traffic Safety Administration internal document.

NHTSA (2008c). Traffic Safety Performance Measures for States and Federal Agencies. DOT HS 811 025. National Highway Traffic Safety Administration.

TSASS (2008). Current State of Traffic Safety Information Systems Quality Metrics. Traffic Safety Analysis Systems & Services draft final report for NHTSA.

USDOT (2006)*. Announcement of grants to support State traffic safety information system improvements. Federal Register: February 2, 2006 (Vol. 71, No. 22, pp. 5729-5734). U.S. Department of Transportation.

* Available at the NHTSA Traffic Records Improvement Program Reporting System website http://www.nhtsa-tsis.net/TRIPRS/Resources/Resources.htm.

Model Performance Measures for State Traffic Record Systems
State and Federal Experts

State

Karen Ballard Assistant Record Manager Iowa Department of Transportation 800 Lincoln Way Ames, IA 50010 515-237-3005 karen.ballard@dot.iowa.gov	Jack Benac Michigan Department of Transportation 425 West Ottawa Lansing, MI 48933 517-335-2975 banacj@michigan.gov
Major Barry Bratt District 4 Commander Colorado State Patrol 554 Jurassic Court Fruita, CO 81521 970-858-2250 970-589-6989 cell barry.bratt@cdps.state.co.us	Lt. John R. Carrico Criminal and Records Identification Branch 1250 Louisville Road Frankfort, KY 40601 502-227-8718 johnr.carrico@ky.gov
Charlie Compton University of Michigan Transportation Research Institute 2901 Baxter Road Ann Arbor, MI. 48109 734-763-9426 ccompton@umich.edu	Lt. David Corman Traffic Section Commander Metropolitan Nashville Police Department 200 James Robertson Parkway Nashville, TN 37201 615-862-7730 david.corman@nashville.org
Anne Dowling Deputy Director Institute for Traffic Safety Management and Research 80 Wolf Road, Suite 607 Albany, NY 12205-2604 518-453-0291 adowling@itsmr.org	James W. Ellison, P.E. County Traffic Engineer Pierce County Public Works and Utilities 4301 South Pine Street - Suite 446 Tacoma, WA 98409-7207 253-798-2267 jelliso@co.pierce.wa.us
Eugene Flango Executive Director Program Resource Development National Center for State Courts Williamsburg, VA 757-259-1823 gflango@ncsc.org	Holly Hedegaard, MD, MSPH Data Program Manager Emergency Medical and Trauma Services Section Colorado Department of Public Health and Environment 4300 Cherry Creek Drive South Denver, CO 80246-1530 303-692-3005 Holly.Hedegaard@state.co.us
Loren Hill MN State Traffic Safety Engineer (retired) 1721 Cloud Dr Blaine, MN 55449 651-485-9772 lordh4141@yahoo.com	Johnathan Jones, RN, BSN Trauma & Specialty Care Coordinator State of California Emergency Medical Services Authority 916-322-4336 ext 415 Johnathan.Jones@emsa.ca.gov

Timothy J. Kerns, MS Database Engineer National Study Center for Trauma and Emergency Medical Systems University of Maryland School of Medicine 701 West Pratt Street, 5th Floor Baltimore, MD 21201-1023 410-328-4244 tkerns@som.umaryland.edu	Chris Madill Traffic Records Coordinator Traffic Safety Commission 621 8th Avenue SE - Suite 409 Olympia, WA 98501 360-586-7104 cmadill@wtsc.wa.gov
Dan Magri Planning Div-Sec 85 Louisiana DOTD P.O. Box 94245 Baton Rouge, LA 70804-9245 225-379-1871 DanMagri@dotd.la.gov	John Miller, P.E. Traffic Safety Engineer Missouri Department of Transportation 105 W. Capitol Avenue Jefferson City, MO 65102 573- 526-1759 John.P.Miller@modot.mo.gov
Donald McNamara CPA's and Transportation Consultants 10902 Cardinal Lake Drive Frankfort, IL 60423-3390 815-469-4724 don6000@aol.com	Mehdi Nassirpour Chief, Research and Evaluation Division of Traffic Safety Illinois Department of Transportation 3215 Executive Park Drive Springfield, IL 62794 217-785-8905 mehdi.nassirpour@Illinois.gov
Greg Noose Chief, Records and Driver Control Bureau Montana Department of Justice 303 N. Roberts Street, Room 262 Helena, MT 59601-4543 406-444-1776 gnoose@mt.gov	Murray (Bud) Pendleton Chief, Waterford Police Department 41 Avery Lane Waterford, CT 06385-2819 860-442-9451 mpendleton@waterfordct.org
Michael Sandoval Chief, Traffic Safety Bureau Department of Transportation P.O. Box 1149, 604 West San Mateo Santa Fe, NM 87504-1149 505-827-0427 michael.sandoval@state.nm.us	Kyla Shelton, MPH Injury Epidemiologist Office of Injury Prevention Florida Department of Health 4052 Bald Cypress Way Bin # C15 Tallahassee, FL 32399-1735 850- 245-4444 ext. 2729 Kyla_Shelton@doh.state.fl.us
Al Tindall Central Region Supervisor New Jersey Division of Highway Traffic Safety P.O. Box 048 Trenton, NJ 08625-0080 609-633-9028 al.tindall@lps.state.nj.us	Colonel Bryan Tuma Nebraska State Patrol 1600 Nebraska Highway 2 Lincoln, NE 68502 402-479-4931 bryan.tuma@nebraska.gov

Joan Vecchi Senior Director Colorado Department of Motor Vehicles 1881 Pierce St. Lakewood, CO 80214-1497 303-205-5944 jvecchi@spike.dor.state.co.us	

Federal

Laurie Beck Epidemiologist National Center for Injury Prevention and Control Centers for Disease Control and Prevention 4770 Buford Hwy NE, MS F62 Atlanta, GA 30341 770-488-4327 LBeck@cdc.gov	Marietta Bowen (through 2/13/09) National Driver Register and Traffic Records Division National Center for Statistics and Analysis NHTSA NVS-422 1200 New Jersey Ave. SE Washington, DC 20590 202-366-0557 Marietta.Bowen@dot.gov
Tom Bragan (from 4/1/09) State Data Reporting Systems Division National Center for Statistics and Analysis NHTSA NVS-412 1200 New Jersey Ave. SE Washington, DC 20590 202-366-6978 Tom.Bragan@dot.gov	William Cosby (from 4/1/09) National Driver Register and Traffic Records Division (detail assignment) National Center for Statistics and Analysis NHTSA NVS-422 1200 New Jersey Ave. SE Washington, DC 20590 202-366-4969 william.cosby@dot.gov
Ralph Craft Analysis Division Federal Motor Carrier Safety Administration 1200 New Jersey Ave. SE Washington, DC 20590 202-366-0324 Ralph.Craft@dot.gov	Mario Damiata Regional Program Manager NHTSA Region 1 NTI-210 55 Broadway – Kendall Square Cambridge, MA 02142 617-494-2606 Mario.Damiata@dot.gov
Susan McHenry Office of Emergency Medical Services NHTSA NTI-140 1200 New Jersey Ave. SE Washington, DC 20590 202-366-6540 Susan.McHenry@dot.gov	Jack Oates Chief, Implementation Injury Control Operations and Resources NHTSA NTI-200 1200 New Jersey Ave. SE Washington, DC 20590 Jack.Oates@dot.gov 202-366-2730

Bob Pollack Safety Data Manager Office of Safety Federal Highway Administration 1200 New Jersey Ave., SE Washington, DC 20590 202-366-5019 Robert.Pollack@dot.gov	Barbara Rhea (through 3/31/09) Chief, State Data Reporting Systems Division National Center for Statistics and Analysis NHTSA NVS-412 1200 New Jersey Ave. SE Washington, DC 20590 202-366-2714 Barbara.Rhea@dot.gov
Jackie Schraf National Driver Register and Traffic Records Division National Center for Statistics and Analysis NHTSA NVS-422 1200 New Jersey Ave. SE Washington, DC 20590 202-366-2719 Jackie.Schraf@dot.gov	

Preusser and GHSA Representatives

Jim Hedlund Highway Safety North and Preusser Research Group 110 Homestead Road Ithaca, NY 14850-6216 607-273-5645 jhedlund@sprynet.com	Barbara Harsha Executive Director Governors Highway Safety Association 444 North Capitol Street NW, Suite 722 Washington, DC 20001 202-789-0942 bharsha@ghsa.org

Appendix C. Performance measures recommended for and used in FY 2008 State plans

Information on the measures used by States in 2008 was taken from the data file prepared by TSASS to accompany their report (TSASS, 2008). Measures that did not apply to one of the six data systems or did not measure something in one of the six specified performance areas were excluded. This leaves 967 measures in all. They are summarized in Table 2; this is identical to the first table in Sec. 6.1 of the TSASS report. Table 3 records for each cell the number of States that reported at least one measure in that cell.

The descriptions of all measures in each cell of Table 2 were reviewed to summarize characteristics of the measures used most frequently. The descriptions were taken from the States' 408 reports. States frequently did not use standard terminology or structure. In some instances it is not clear what a performance measure really means. Thus these summaries are only approximate. The tables and the discussions of each of the 6x6 cells that follow are intended only to provide the reader with a general sense of what measures are used currently and which measures are used most frequently.

Table 2. Number of performance measures used in FY 2008 State plans.

Data system	Performance area						
	timeliness	accuracy	completeness	uniformity	Integration	accessibility	total
crash	101	66	103	46	26	33	375
vehicle	10	12	8	3	5	5	43
driver	21	14	15	8	9	9	76
roadway	19	24	32	8	13	11	107
citation/adj	66	28	43	14	17	22	190
injury	43	19	51	25	23	15	176
total	260	163	253	104	93	94	967

Table 3. Number of States using at least one performance measure in FY 2008 State plans.

Data system	Performance area					
	timeliness	accuracy	completeness	uniformity	integration	accessibility
crash	49	34	47	25	17	26
vehicle	7	7	7	2	5	5
driver	14	9	11	6	9	9
roadway	13	16	20	6	12	10
citation/adj	32	21	22	10	13	15
injury	28	16	30	19	16	13

General observations on the measures used in FY 2008 State plans

Definition of the performance areas. The definitions of and boundaries between the six performance areas are somewhat imprecise. This means that similar measures may be submitted in different areas by different States. In fact, NHTSA recommends correct location coding in the crash system as an accuracy measure (NHTSA, 2007; coded using the State's roadway database),

as a completeness measure (NHTSA, 2008a; coded with lat/long coordinates), and as an integration measure (NHTSA, 2007; linked to a GIS master database). It is not surprising that States submitted quite a few measures in what appear to be inappropriate cells. Measures that appear to be misclassified were not moved to the apparently more appropriate cell.

Methods to improve performance. In general, there are two methods to improve performance.

1) Work within existing data collection and reporting procedures. For some performance areas this means improving how the persons who collect and report the data do their jobs; for example, individual investigating officers can improve crash data timeliness, accuracy, and completeness. This usually improves performance gradually, over time, and improvement may be measured from year to year. For some areas this means extending the reach of these procedures, for example by providing electronic access to more authorized users.
2) Change the procedures, for example by adopting a standard crash form in all jurisdictions, by providing machine-readable bar codes on driver licenses, or by introducing electronic data collection and reporting. These methods may improve performance quickly, if new procedures are adopted throughout the State, or gradually, as the new procedures are adopted by jurisdictions.

Process measures. Some of the measures States used in 2008 described a process or method for improving performance rather than measuring performance itself. For example, the use of bar codes on driver licenses is a method that should, but need not, improve the accuracy of crash reports. The use of electronic forms and electronic data transmittal should, but need not, improve timeliness. Performance measures in the minimum set must measure actual performance. Thus process changes such as these cannot be considered performance measures. Other process measures do relate directly to performance. For example, the use of a common crash reporting form, especially an electronic form, improves data uniformity because only the specified codes for each data element can be used.

Characteristics of the six performance areas. The first three performance areas – timeliness, accuracy, and completeness – generally describe characteristics of the individual records on file. Performance may be improved by working within existing procedures or perhaps by new procedures. The second three – uniformity, integration, and accessibility – generally describe characteristics of the structure and management of the entire data files. Performance improvements usually require new procedures, for example changing the data elements for greater compliance with national guidelines (uniformity) or data file redesign to allow file linkage (integration).

Accessibility was the most difficult area to define and measure. Accessibility describes the degree to which a system's principal users can obtain information readily and easily from the file. This requires that the principal users be specified and that "readily and easily" be defined. Users were defined most frequently as other components of the traffic record system or other State agencies; occasionally the general public was included. "Readily and easily" was defined most frequently as real-time electronic access, though sometimes regular reporting was included. Some States defined "readily and easily" to mean that the users could access the data while other States measured the extent to which users did access the data.

Appropriateness of the measures. Some of the measures States used in 2008 were clearly inappropriate. Some were vague; some did not apply to the data system; some did not specify what should be measured. Some examples are provided in the detailed discussions that follow.

Distribution of the measures by system and area. Table 2 shows that the crash system had the most measures by far, followed by the enforcement/adjudication and injury systems. As to area, timeliness and completeness were measured most frequently. Note again that States tended to use measures for which they might show improvement.

Measures used frequently. In 12 of the 36 cells, at least 10 States used similar measures.

Crash: timeliness (reporting time), accuracy (location coding, error rate), completeness (missing data rates), uniformity (MMUCC compliance), and accessibility (agency use).
Roadway: completeness (proportion of roads included).
Enforcement/adjudication: timeliness (citations to court, court actions to driver file), accuracy (error rates), and completeness (missing data).
Injury: timeliness (EMS data to crash file), completeness (EMS data on crash file), and uniformity (NEMSIS compliance).

In each of the other 24 cells (including all the vehicle and driver system cells and all the integration cells), no more than 9 States used remotely similar measures. More detail is provided in the following discussion.

Performance measures proposed and used for each data system

Each of the six data systems is discussed in turn. For each performance area, the guidance given States, the example performance measures proposed, and the measures used by States in their FY 2008 408 plans are summarized. See the main report for descriptions of each data system.

Crash data system

Timeliness. The basic performance criterion is the period from the time of a crash to the time when the crash record is placed on the file and available for use. As noted in the full report, this can be measured in three ways:

1) average time (mean number of days) for crashes to be placed on file (counting all crashes).
2) percentage of crashes on file within 30 (or some other fixed number of) days.
3) number of days required for 95% (or some other fixed percent) of crashes to be entered.

Because the crash file contains information drawn from several sources, some of which may not be timely (e.g., laboratory drug and alcohol reports, autopsy results), a crash may be placed on file before some data are available. The minimum amount of data needed to place a crash report on file differs from State to State.

Recommended performance measures: The Federal Register recommends that crash data should be available within 90 days (measure #2). NHTSA (2007) suggests either measures #2 or #3. FHWA (2008) suggests either #1 or #2.

Measures States used in 2008: 49 States used at least one crash timeliness measure, with a total of 101 measures overall. The most common measures were #2 (19 measures) and #1 (16). Only 2 measures used #3. Another 22 measures were not specified precisely, for example: "Time between crash and availability in database (days)." The remaining measures tracked some part of the process of entering a crash report on file, such as "Days from when a crash report is received from a trooper until it is entered into the database" or "percent of crash reports submitted electronically."

Accuracy. Internal accuracy, measured by consistency and range checks, depends on the extent of these checks incorporated into the crash file processing software. External accuracy can be measured by audits or by matching or validating using some external source such as a VIN file or a location data base. Accuracy also can be tested by examining data distributions for unlikely patterns or changes over time.

Recommended performance measures: Both NHTSA (2007) and FHWA (2008) suggest both internal and external accuracy, measured as follows:

I-1: percent of crash reports with fewer than a specified number of errors
E-1: percent of crash reports with correct location coding
E-2: percent of vehicles with valid VINs

Measures States used in 2008: 34 States used at least one crash accuracy measure, with a total of 66 measures overall. The most common measures were correct location coding (18) and internal accuracy measured by the number of errors (17). Only 11 measures matched the file with an external file: 4 with MCMIS, 2 with VIN, and 5 (all from the same State) matched total crashes in a category (such as fatal or pedestrian) with the total from city crash files. 12 measures tracked some part of the process, such as "Number of reports returned to agency for correction."

Completeness. Internal completeness, measured by the amount of missing data on a crash, is straightforward. External completeness can be measured by the extent to which the file contains all reportable crashes. This is difficult because the crashes not on file are by definition unreported so there is no way to tell how many there are. If crashes are reported in some other way, for example if a crash generates an EMS run report or if a commercial vehicle crash is reported to MCMIS, then some indication of missing crashes of specific types may be possible. As with accuracy, completeness can be tested by examining data distributions or trends, for example if a reporting jurisdiction shows a sudden drop in the number of reported crashes or if two similar jurisdictions have markedly different crash rates.

Recommended performance measures: NHTSA (2007) suggests examining external completeness using either crash reporting trends or matches with other files. FHWA (2008) suggests examining missing data. So the basic recommended measures are:

I-1: percent of crash reports with fewer than a specified number of missing data codes
E-1: number or percent of reporting agencies with change over time in reported crashes

exceeding some threshold (such as 5%)
E-2: percent of crashes matched with MCMIS

Measures States used in 2008: 47 States used at least one crash completeness measure, with a total of 103 measures overall. The most common measures were internal completeness (24) using missing data either overall or for specific variables such as belt use, BAC, or crash location. 13 measures used some form of external completeness check: 5 with trends (E-1), 5 with MCMIS (E-2), and 3 with some other source. Many measures listed in this category probably should have been classified elsewhere: 14 described uniformity, for example as the percent of MMUCC elements included, and 9 described accuracy, typically through location coding. One-quarter of all measures tracked process issues, most frequently electronic reporting.

Uniformity. Internal uniformity (or consistency) means that all jurisdictions within a State use the same variables (preferably the same crash report), definitions, and procedures. It also could mean that jurisdictions use the same crash reporting threshold. External consistency means that the crash file and its data elements agree with the national guidelines MMUCC, ANSI D-16, ANSI D-20, and NEMSIS.

Recommended performance measures: NHTSA (2007) suggests only measuring the number of missing MMUCC data elements; NHTSA's other recommendations in fact apply to other cells (unknown codes measure completeness and error checks measure accuracy). In addition to measuring MMUCC compliance, FHWA (2008) suggests the internal measure of a common crash report form and common procedures across all reporting jurisdictions.

Measures States used in 2008: 25 States used at least one crash uniformity measure, with a total of 46 measures overall. The most common measure by far was consistency with MMUCC (30); note that another 14 MMUCC uniformity measures were submitted as completeness measures, as discussed above. There was only one measure of internal uniformity, which dealt with the use of a common crash reporting form. (Many States use a common crash form already, so this is not a measure on which they can show improvement.)

Integration. The crash file should be linked directly to the State driver, roadway, citation/adjudication, and injury files.

Recommended performance measures: NHTSA (2007) suggests links to the driver history, EMS response, and statewide GIS files, measured either by the percent of crashes posted to these files (driver history) or by the proportion of crashes with information from these files (EMS and GIS). FHWA (2008) suggests measuring the file linkages that are most important to a State.

Measures States used in 2008: 17 States used at least one crash integration measure, with a total of 26 measures overall. Almost all (20) of the measures did in fact attempt to measure file linkage: 8 with a roadway or GIS database, 3 each with driver and EMS databases, and 1 each with citation and MCMIS databases. 4 were stated generally, in a way that cannot be measured, such as "Percent of data systems that are integrated (i.e., crash, citation, EMS etc.)" or "Integration of all systems with crash system." Note that integration with a roadway or GIS database is very similar to the accuracy measure of correct location coding, used in 18 measures.

Accessibility. Crash file users include law enforcement agencies and local governments.

Recommended performance measures: NHTSA (2007) suggests measuring the percent of law enforcement agencies or safe community programs that use the file on-line. FHWA (2008) provides other suggestions, such as the percent of counties that request data at least yearly or the number of weekly inquiries to a crash data website.

Measures States used in 2008: 26 States used at least one crash accessibility measure, with a total of 33 measures overall. The most common measure was use of the file by agencies (13), typically law enforcement, or by the general public (7). The remaining measures were scattered across reports produced from the file, customer service (time to address data requests), systems failure, and generic undefined statements ("Make information available to everyone").

Vehicle data system

Timeliness. The basic performance criterion is the period from the time of a vehicle title or license action to the time when it is posted on the appropriate file. As noted in the general discussion, this can be measured as an average time, the percent of actions posted within a fixed time, or the time required for 95% (or some other fixed percent) of actions to be posted. License and title actions are transacted at DMV offices and most are conducted electronically, so it's reasonable to expect actions to be posted very promptly, say by the next working day.

Recommended performance measures: NHTSA (2007) suggests the percent of actions posted within 24 hours.

Measures States used in 2008: 7 States used at least one vehicle timeliness measure, with a total of 10 measures overall. All measures in some way addressed the basic performance criterion: 5 used the recommended measure "percent of actions posted within 24 hours;" 1 used this measure but only for online actions, 1 used the percent of actions "processed at the point of application," 1 used the average processing time, and the remaining 2 used an unspecified time measure such as "Time between collection and data entry."

Accuracy. In addition to range and consistency checks, internal accuracy can be measured by the absence of duplicate records for the same vehicle's title or license action. External accuracy can be measured by validating to a VIN file. The Federal Register notice also suggests States should use bar-coded vehicle registration forms which could be scanned directly and accurately. This should improve the accuracy of vehicle information in crash and citation data systems.

Recommended performance measures: NHTSA (2007) suggests both internal accuracy, measured by the percent of duplicate records or the percent of errors found in audits of critical data elements, and external accuracy measured by VIN validation.

Measures States used in 2008: 7 States used at least one vehicle accuracy measure, with a total of 12 measures overall. 4 used the recommended VIN validation, 2 used the recommended audit of

critical data elements, 1 used the recommended percent of duplicate records, 3 used an imprecise measure such as "Percent of driver transactions that were accurate," and 2 tracked some part of the title or license process.

Completeness. External completeness could be measured by the number of vehicles in the State that do not have a valid title or license. Some information on external completeness could be obtained by considering vehicles (such as those stopped for a potential traffic violation or vehicles in a crash) for which law enforcement officers check the license against the State vehicle registration file.

Recommended performance measures: NHTSA (2007) suggests internal completeness, measured by the percent of records with a complete owner name and address.

Measures States used in 2008: 7 States used at least one vehicle completeness measure, with a total of 8 measures overall. 2 used the percent of missing data elements, 3 used the recommended percent of missing name and address, and 1 used the percent of missing records only for commercial vehicles. The remaining 3 were undefined ("Percent of missing records") or were not appropriate vehicle completeness measures ("Percent of commercial motor vehicle (CMV) crash reports are complete").

Uniformity. Internal uniformity or consistency should not be an issue because a single State agency collects and enters the data for each file using a standard form and standard procedures. External uniformity can be measured only for special vehicle types such as commercial vehicles, which have identifiers that meet national standards.

Recommended performance measures: The Federal Register notice recommends that information on file be consistent over time and consistent with information in other traffic records systems. NHTSA (2007) has no suggestions.

Measures States used in 2008: 2 States used at least one vehicle uniformity measure, with a total of 3 measures overall, the smallest number in any cell of the 6x6 matrix. 1 measure, used twice by the same State, used the percent of valid USDOT number validations for interstate commercial vehicles. The other measure was the percent of vehicle registrations with bar codes, as discussed above under accuracy.

Integration. The vehicle file should be linked to the State crash and driver files and to the national vehicle title and registration files.

Recommended performance measures: NHTSA (2007) suggests the percent of vehicle owners and operators that can be linked to "the state customer database."

Measures States used in 2008: 5 States used one vehicle integration measure, with a total of 5 measures overall. 1 used the NHTSA recommendation, 1 used the percent of records exchanged with National Motor Vehicle Title Information System (NMVTIS), and 3 were imprecise ("Percent of other Traffic Records System data linkage with the Vehicle File").

Accessibility. Vehicle title and registration data do not have many regular users aside from the other data files in the traffic safety data system. VMT data, if available, would be useful to engineering and planning agencies.

Recommended performance measures: NHTSA (2007) suggests the percent of engineering and planning agencies that can access vehicle registration data for origin-destination studies.

Measures States used in 2008: 5 States used one vehicle accessibility measure, with a total of 5 measures overall. 2 used the NHTSA recommendation and 3 were imprecise: 2 “improve automated access” and 1 “make summary information available.”

Driver data system

Timeliness. The basic performance criterion is the period from the time of an action that produces information for the driver license or history file to the time when the information is posted on the appropriate file. The three main action types are license renewals or status changes generated by the DMV (suspensions, reinstatements, change in license class or restrictions), traffic citations that impose “points” on the license, and court actions (convictions for traffic offenses). As noted in the general discussion, timeliness can be measured as an average time, the percent of information posted within a fixed time, or the time required for 95% (or some other fixed percent) of information to be posted.

Recommended performance measures: NHTSA (2007) suggests the percent of license renewals posted within 24 hours and the percent of convictions posted within 24 or 48 hours.

Measures States used in 2008: 14 States used at least one driver timeliness measure, with a total of 21 measures overall. The most common measure was posting convictions (9) followed by licensing actions (3) and citations (2). The remainder dealt with various process measures (“Addition of Citation Information to Drivers Abstract (days)” or “Number days behind DMV Traffic Accident Extract update”).

Accuracy. Internal accuracy can be measured by range and consistency checks and by the absence of duplicate records for the same driver. External accuracy can be measured by verifying driver identities against sources such as birth certificates or passports. This accuracy criterion is critical because of the use of driver licenses for identification.

Recommended performance measures: NHTSA (2007) suggests internal accuracy, measured by the percent of duplicate records or the percent of errors found in audits of critical data elements.

Measures States used in 2008: 9 States used at least one driver accuracy measure, with a total of 14 measures overall. 4 measured duplicate records and 2 measured the percent of errors in critical data elements found in audits. 5 were process measures, such as “Percentage of Death Certificates Reported Electronically” and the remaining 3 should be classified as timeliness measures (“Percent of electronic convictions posted within 24 hours of receipt”).

Completeness. Internal completeness can be measured by the amount of missing data, in particular data such as missing citations or convictions either from jurisdictions within the State or from other States. External completeness could be measured by the number of drivers in the State who are required to be licensed but do not have a record on the driver license or history files (usually drivers who have moved from another State or country). Some information on external completeness could be obtained by considering drivers stopped by law enforcement.

Recommended performance measures: NHTSA (2007) suggests the external completeness measure of the "percent of driver records checked [with records from the driver's previous State of licensure] for drivers moving into the State within 10 days." NHTSA also recommends the percent of serious violation convictions resulting in a PDPS or CDLIS record, a measure of completeness for the PDPS and CDLIS files, respectively.

Measures States used in 2008: 11 States used at least one driver completeness measure, with a total of 15 measures overall. Only 4 measures addressed completeness, 1 through NHTSA's suggested PDPS – CDLIS link and 3 through transferring information for drivers (though two of these were not well-defined: "Percent of complete driver history file that includes previous driving records from other state or territory"). The remainder addressed process issues ("Percent of courts submitting conviction data") or should be classified as crash or vehicle measures ("Percent semitrailer plates processed immediately").

Uniformity. Internal uniformity or consistency should not be an issue because a single State agency collects and enters the data for each file using a standard form and standard procedures. External uniformity can be measured by agreement with data element and file standards of the NDR PDPS, CDLIS, and AAMVANet.

Recommended performance measures: NHTSA (2007) suggests using the percent of Social Security numbers and immigration documents verified online (an accuracy measure, not a uniformity measure) and the percent of violations reported by other States that are added to the driver history file. The Federal Register notice suggests consistency with NDR, CDLIS, and AAMVANet standards.

Measures States used in 2008: 6 States used at least one driver uniformity measure, with a total of 8 measures overall. 4 used the percent of violations reported by other States that were added to the driver history file and 1 used Social Security and immigration verification. 2 others addressed process issues ("Percent of convictions entered manually") and 1 measured the percent of bar coded driver licenses (which should be considered an accuracy measure).

Integration. The driver files should be able to transfer information directly to the national NDR PDPS and CDLIS files. Law enforcement and court files should be linked to the driver files to transfer citation and conviction information.

Recommended performance measures: NHTSA (2007) suggests using the percent of drivers that can be linked to vehicle registrations to assure current address information.

Measures States used in 2008: 9 States used one driver integration measure, with a total of 9 measures overall. All measures addressed file linkage within the State's system; most specified one or more system files (crash, courts, etc.) or a specialized file (driver images).

Accessibility. The driver file users that require regular and immediate (preferably on-line) access are law enforcement and the courts and, of course, DMV agencies.

Recommended performance measures: NHTSA (2007) suggests using the percent of traffic courts that access the driver history file on-line.

Measures States used in 2008: 9 States used one driver accessibility measure, with a total of 9 measures overall. All measures but one addressed access, 3 by the courts (on-line), 1 by law enforcement (on-line), 2 by general users for analysis purposes (on-line), 1 by State agencies, and 1 by the public (drivers accessing their own records on-line). The final measure should be included under timeliness ("Number of District Courts updating the Driver License file weekly").

Roadway data system

Timeliness. The basic performance criterion for roadway inventory data is the period from the time of a change in roadway characteristics (construction, signage, etc.) to the time when the change is posted in the appropriate roadway files. The basic criterion for traffic flow is the schedule on which ADT data are recorded and posted on file.

Recommended performance measures: NHTSA (2007) suggests measuring the time from the end of the traffic count season until ADT data are available.

Measures States used in 2008: 13 States used at least one roadway timeliness measure, with a total of 19 measures. 3 measures dealt with the time from construction completion to data file changes and 3 used the recommended measure of ADT availability. The remaining 13 were completeness ("Populate all roadway inventory files"), crash ("Number of business days it takes to locate crashes"), or process measures ("Number of days for report generation").

Accuracy. The most important criterion is that the roadway system be accurately located geographically, for example using GPS methods. Internal accuracy can be measured by range and consistency checks and external accuracy by audits.

Recommended performance measures: NHTSA (2007) suggests measuring the percent of reported crashes that can be located in the roadway database and the percent of reported crashes that can be linked to GIS systems. Neither is a true roadway accuracy measure. The first measures both completeness (is the crash location in the roadway database) and integration (can the crash and roadway files be linked using a common location identifier) while the second measures crash file (or crash report) integration with GIS. NHTSA also suggests measuring the percent of local roads with "unknown" road names in the roadway database, which is a completeness measure.

Measures States used in 2008: 16 States used at least one roadway accuracy measure, with a total of 24 measures. The most common was some measure of the percent of crashes that could be located (9) while 3 others attempted to measure geographical accuracy of the roadway file ("Percent accuracy of locations"). Only 1 measure dealt with more specific accuracy issues: "Percent of state routes with accuracy of 3-5 feet for both lanes of travel". The remaining measures dealt with completeness ("Centerline miles of local system in basemap"), integration ("Percent of address data matched to postal service data"), or various process or other issues ("Train all officers as well as EMS staff").

Completeness. The basic performance criteria are that the roadway system databases include all public roads and include all important data elements. MMIRE (FHWA, 2007) contains a proposed list of priority data elements and coding.

Recommended performance measures: NHTSA (2007) suggests the percent of public roadway mileage in the roadway file and the percent of roadways with traffic count data within the past three years.

Measures States used in 2008: 20 States used at least one roadway completeness measure, with a total of 32 measures. 15 addressed the roadway database coverage in some manner, such as the percent of public roads, or DOT maintained roads, or the percent of counties with all local roads included. 13 addressed specific data elements such as the percent of roadway miles photo-logged, or with GIS data, or with recent traffic counts. The remaining 4 dealt with the crash system ("Number of days from crash event to location coding of 95 percent of crashes") or unspecified issues ("Data Integration (percent)").

Uniformity. The basic performance criterion is to assure that the same data elements are recorded in the same way for all roadways in the system. Because few States have a single roadway system covering all public roads, and because national guidelines are far more recent than for other systems, most State roadway systems are a long way short of meeting this criterion.

Recommended performance measures: NHTSA (2007) has no suggestions.

Measures States used in 2008: 6 States used at least one roadway completeness measure, with a total of 8 different measures (no two measures were even vaguely similar). Only one addressed uniformity directly ("Percent of databases using standard nomenclature for roads"). The others addressed completeness ("Percent of sign and signal locations within a centralized database") or various process issues ("Percent of the data available on a single system").

Integration. The roadway file should be linked to the crash file through a common location identifier.

Recommended performance measures: NHTSA (2007) suggests the internal integration measure of the percent of county and MPO GIS databases linked to the State database.

Measures States used in 2008: 12 States used at least one roadway completeness measure, with a total of 13 different measures. 4 dealt with integrating various roadway files into a central file along the lines suggested by NHTSA. 6 dealt with integrating the roadway file with other traffic system files, 4 of these with the crash file ("Link roads data with crash data and traffic data"). The remaining 3 dealt with process or completeness issues.

Accessibility. Roadway data should be accessible by law enforcement, for crash and citation reporting, and by municipal and county engineering and planning agencies.

Recommended performance measures: NHTSA (2007) suggests the percent of county engineers and MPOs that use on-line access to the State databases to maintain their own databases.

Measures States used in 2008: 10 States used at least one roadway accessibility measure, with a total of 11 different measures. 6 addressed access to specific agencies or to the public, similar to the NHTSA suggestion. The other 5 addressed the type of information that was accessible ("Data sets viewable via interactive web mapping").

Citation and adjudication data system

Timeliness. The basic performance criteria are the time required for posting citations, arrests, convictions, and sentences to the appropriate data file and the time required for transmitting the information on an action to the next responsible agency or system, for example transmitting a citation to the courts. As noted in the general discussion, timeliness can be measured as an average (mean or median) time, the percent of information posted within a fixed time, or the time required for 95% (or some other fixed percent) of information to be posted.

Recommended performance measures: NHTSA (2007) suggests the percent of citations sent to the courts within 10 days and the percent of convictions sent to DMV within 10 days. These are variants of the basic "time from event to posting on file" timeliness criterion. The first would agree with this criterion if it said "percent of convictions entered onto the court database." The second measures the timeliness of transactions between the court and DMV systems, not the timeliness of the court system itself. NHTSA also suggests the percent of cases scheduled within 90 days of the receipt of a citation and the number of days from citation to case appearance on a "pending case" system. These both measure the timeliness of court procedures, not the timeliness of the court data system.

Measures States used in 2008: 32 States used at least one citation and adjudication timeliness measure, with a total of 66 different measures. The most common measures were variants of the two NHTSA-recommended measures: the time from court action to posting on the driver file (20) and the time for a citation to be sent to the courts (15). 10 were measures of court procedures such as "Average number of days from citation filed with court to 1st case appearance." 8 were fairly straightforward (though sometimes not well specified) data system timeliness measures, such as "Time it takes for citation data to be entered into database." The remainder dealt with various process issues or properly should be classified under a different system ("Number of crash reports received electronically (percent)").

Accuracy. Internal accuracy can be measured by consistency and duplicate record checks and external accuracy by audits. External accuracy also could be checked by matching drivers to the driver file.

Recommended performance measures: NHTSA (2007) suggests the internal accuracy measure of the percent of violation narratives that "match the common code" and the external accuracy measures of the percent of errors found in audits and the percent of citation locations that match statewide location coding.

Measures States used in 2008: 21 States used at least one citation and adjudication accuracy measure, with a total of 28 different measures. All measures dealt explicitly or implicitly with the accuracy of citation data recorded and reported by law enforcement. 16 sought to measure accuracy directly; they ranged from fairly well specified ("Percent errors found during data audit of critical elements") to completely vague ("Improve Accuracy"). 3 measured the percent of location codes that matched statewide location coding. The rest were process measures, usually related to electronic capture of data (location) or electronic transmittal of citations, with the usual State-specific measure ("Percent of citations filed with correct prosecutor").

Completeness. The most important external completeness criterion is that all actions (citations, arrests, convictions, sentences) are recorded on the appropriate files. Some information on completeness can be obtained by following cases through the system; for example, an arrest should produce a court action; a conviction should produce a sentence. Internal completeness can be measured by checking for missing or unknown data.

Recommended performance measures: NHTSA (2007) suggests the external completeness measure of the percent of cases older than some period of time (90 days or 1 year) with a disposition record in the citation tracking system.

Measures States used in 2008: 22 States used at least one citation and adjudication completeness measure, with a total of 43 different measures. 15 measures dealt with missing data in some form, either overall or for specific data elements. 9 measured some form of electronic data entry and 4 measured the timeliness of court actions ("Percent of minor criminal court cases disposed later than 9 months"). 3 used some version of the percent of old cases. The rest were process measures of some sort.

Uniformity. Uniformity between the various citation and adjudication systems can be measured by the use of common forms within a system (such as citation forms throughout the State) and common data elements in different systems (common person names, addresses, and other personal identifiers; common violation codes).

Recommended performance measures: NHTSA (2007) suggests the percent of citations using a uniform citation form and the percent of cases under State court jurisdiction that have proper violation codes.

Measures States used in 2008: 10 States used at least one citation and adjudication uniformity measure, with a total of 14 different measures. 6 measured the use of a common citation form and 2 measured the use of proper violation codes. 1 was a general uniformity measure ("DUI-Percent of inconsistent forms submitted") and 3 should be classified as completeness measures ("Percent Non-DUI violations reported from other states added to driver history").

Integration. The citation and adjudication systems within a State should be linked to permit data transfer (such as citations to courts) and to populate the State-level files. The State-level files should be linked to the driver history and crash files.

Recommended performance measures: NHTSA (2007) suggests the percent of citations with standard codes that allow integration with local and State tracking systems.

Measures States used in 2008: 13 States used at least one citation and adjudication integration measure, with a total of 17 different measures. 10 use some measure of file linkage, such as "Percent of TCAS citation data linked to DMV license information." The rest address process issues, or data elements, or feasibility studies.

Accessibility. DMVs need prompt access to citation and adjudication data. Law enforcement needs prompt access as well, either directly or through the driver system.

Recommended performance measures: NHTSA (2007) suggests the percent of law enforcement agencies that access court data on-line and the percent of citations that can be tracked through a statewide system from issuance to the courts and then to the DMV.

Measures States used in 2008: 15 States used at least one citation and adjudication accessibility measure, with a total of 22 different measures. 2 used the NHTSA-suggested law enforcement access and 1 used the citation tracking measure. Most measures were both general and imprecise ("Percent of data and system availability"). Several were process measures ("Highway Patrol Officers Using Electronic citation (Percent)") or had no relation to enforcement and adjudication data ("Number of subscribers to state crash data report portal").

Injury data system

Timeliness. The primary criterion is the time required for initial medical data on a crash injury to be posted to an injury data file and available for use. As noted in the general discussion, timeliness can be measured as an average time, the percent of information posted within a fixed time, or the time required for 95% (or some other fixed percent) of information to be posted.

Recommended performance measures: NHTSA (2007) suggests measures of the time from a crash until the EMS run report is posted to a statewide EMS database, measured either as an average or as a percent available within a specified number of days. NHTSA also suggests a measure of the time from a traffic crash death until the record is posted on the statewide mortality database.

Measures States used in 2008: 28 States used at least one injury surveillance timeliness measure, with a total of 43 different measures. 21 used some measure of the time from a crash to the EMS run report availability. 9 others dealt with some aspect of the EMS system, from process issues ("Increase electronic submission of Run report") to aspects of EMS service rather than the EMS data system ("Ambulance response times in minutes"). The remaining 13 measures dealt with the timeliness of data from death reports (2), data posting in a trauma registry (2), a State health database (2), or some unspecified database ("Days between injury and edited data available").

Accuracy. Internal accuracy can be measured by range, consistency, and duplicate record checks. External accuracy can be measured by audits and perhaps by comparing files, for example comparing EMS run, hospital admission, and hospital discharge files.

Recommended performance measures: NHTSA (2007) suggests the external accuracy measure or the percent of EMS run locations that match State location coding and the internal measure of the percent of errors in the EMS run file found through audits.

Measures States used in 2008: 16 States used at least one injury surveillance accuracy measure, with a total of 19 different measures. 8 attempted to measure internal errors in some way, from well-specified ("Percentage of the total EMS reports submitted that are error-free") to vague measures that specify neither the data file nor the measurement criterion ("Percent of data submitted is of acceptable quality"). 4 used the suggested measure of matched location coding on EMS run reports. The rest were process measures ("Automate the EMS run report form (Percent)").

Completeness. Internal completeness can be measured by the amount of missing and unknown data (especially for personal identifiers and injury codes). External completeness means that all eligible crash injuries are in fact recorded on the files. This can be measured by matching crash and injury files, for example matching crash reports that recorded "transport to hospital" with EMS run reports.

Recommended performance measures: NHTSA (2007) suggests the external completeness measures of the percent of crash-related EMS runs in the State EMS database and the percent of crash-related trauma cases in the State trauma database.

Measures States used in 2008: 30 States used at least one injury surveillance completeness measure, with a total of 51 different measures. 19 measured some form of external completeness, 15 for EMS run reports (the percent of crashes with EMS run reports or the percent of EMS providers submitting reports), 4 for trauma registries (number of percent of hospitals submitting data) and 1 for hospitals ("Percent of out-of-state hospital records for in-state crashes"). 7 used various internal completeness measures, some for EMS databases and some quite unspecific ("Percent of data submitted has unacceptable number of unknown values"). The rest of the measures dealt with process, reporting, or uniformity issues (use of NEMSIS codes).

Uniformity. For internal uniformity, injury codes should agree with national standards such as NEMSIS, ICD-9, or ISS. For external uniformity, reports from all providers (all EMS services or all hospitals) should use the same forms, procedures, and data elements.

Recommended performance measures: NHTSA (2007) suggests the number of missing NEMSIS data elements and the percent of correct ICD-9 and E-codes (an accuracy measure).

Measures States used in 2008: 19 States used at least one injury surveillance uniformity measure, with a total of 25 different measures. 20 addressed NEMSIS compliance in some manner and another one addressed compliance with "national standards." 3 addressed electronic reporting and the last dealt with integration.

Integration. For the immediate traffic record system purposes the EMS and mortality system data should be integrated with the crash file. For the secondary purposes, other injury system data (such as hospital discharge) should be integrated with the crash, roadway, vehicle, and driver systems. It's also useful if the various injury system components are linked with each other.

Recommended performance measures: NHTSA (2007) suggests measuring the percent of linkage between EMS runs and hospital discharge records, hospital discharge and trauma registry records, and EMS runs and crash reports.

Measures States used in 2008: 16 States used at least one injury surveillance integration measure, with a total of 23 different measures. 15 addressed file linkage: 7 EMS to crash, 4 EMS to hospital, 2 EMS to trauma registry, and 2 trauma registry to crash. Another 2 were generic linkage statements ("Improve data linkage with the other Traffic Records System (Percent)"). The remaining measures should be classified under other performance areas or data systems.

Accessibility. The crash system requires direct linkage to obtain injury data for crash reports. Privacy considerations likely will limit access for other users to sanitized data files or summarized reports.

Recommended performance measures: NHTSA (2007) suggests only the "percent of regional injury surveillance systems with on-line access and download capability for their regional data to the state master repository of EMS run, trauma registry and hospital discharge databases."

Measures States used in 2008: 13 States used at least one injury surveillance accessibility measure, with a total of 15 completely different measures. 1 was the NHTSA-recommended measure. Most of the others were quite general, for example "To provide easy access at the aggregate level (percent)" and "Improve data access to other traffic records system for data analysis (percent)."