Language Validation of the Air Transport Minimum Data Set: Time-Related Terms

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Introduction: Transport times, such as time of call, are an essential part of the patient record. The purpose of this study was to validate a previously proposed minimum data set of time-related terms.

Methods: A stratified sample of 508 nurses, physicians, paramedics, pilots, and communication specialists was selected to participate in the validation survey. Subjects indicated their agreement/disagreement with the proposed terms and their definitions on a scale of 1 (low) to 3 (high). In addition, subjects indicated whether they currently collect the data elements or could do so easily. Finally, subjects said whether they were willing to release aggregate data for benchmarking purposes.

Results: One-hundred-eighteen subjects (23.2%) responded to the survey with usable data. Agreement to include the terms (level 3) ranged from 71.2% to 95.8%. Agreement with the proposed definition ranged from 72.9% to 95.8%. Seventy-eight of the respondents were willing to release all the data elements.

Conclusion: Fourteen of the 19 terms are recommended for inclusion in a minimum data set for rotor-wing transport. Most persons expressed willingness to release data for benchmarking efforts.

Introduction

Demonstration of the impact of air transport on patient morbidity and mortality requires access to valid and reliable patient and transport data. Not only must these data be valid and reliable within the context of a single transport program, but data also should be comparable across programs. Minimum data sets consist of collections of data elements with specified definitions. These data elements are grouped together for specific purposes[1] and can facilitate data sharing.

The creation of one or more minimum data sets directed at the information needs of air transport professionals will facilitate research studies and quality improvement programs. Aggregated data from several programs within a single research study provide increased statistical power because of increased sample size. Equivalent data terms and definitions ease comparisons of research results across multiple studies.

Several data set development efforts have been directed at emergency medical services (EMS). In 1973, the Emergency Medical Services System Act specified that EMS maintain a standardized patient record-keeping system. The federal government commissioned an original minimum data set from Macro Systems, Inc., but it was not widely implemented. Subsequently, the National Highway and Traffic Safety Administration (NHTSA) funded a grant to the University of

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Table 1.

SURVEY RETURN RATE

Professional Role	*Surveys Mailed*	*Surveys Returned**
Communication specialists	41	13 (31.7%)
Nurses	282	75 (26.6%)
Paramedics/EMTs	108	18 (16.7%)
Physicians	41	6 (14.6%)
Pilots	36	10 (27.8%)

**Professional role based on person to whom the survey was mailed, even if completed by someone else. Includes 4 returned surveys without data related to terms.*

Pittsburgh to develop an advanced life support minimum data set, which again met with limited success. An attempt by the American Society for Testing and Materials (ASTM) to develop an EMS minimum data set in the late 1980s also was unsuccessful.[2]

In the early 1990s, the 81-element Uniform Prehospital EMS Data Set was created after a series of meetings and subsequent consensus conference.[2,3] The data set, which consisted of both "essential" and "desirable" elements, included a name, a brief definition, and a discussion of data type. Data elements described the patient, provider, intervention, and system (*time unit responds, vehicle type*). This data set includes several concepts relevant to air transport, but the terms used for those concepts and their specific definitions usually are different from those traditionally related to air transport. For example, *time unit left scene* is defined as the time the response unit began physical motion from the scene. Neither the term *unit* nor *physical motion* were found in any of the 98 records used to identify potential terms for an air transport minimum data set.[4] This finding indicates that the terms do not reflect the language used by air transport personnel.

In 2002, the National EMSC Data Analysis Resource Center (NEDARC) evaluated the extent of use of this data set. Forty-three states collect some of the data elements, six states either have no statewide data collection or their system is under development, and one state did not respond to the request for information.[5] Of the 43 states that collect NHTSA data elements, on average 64 (79%) of the 81 data elements are collected.

The Crash Outcome Data Evaluation System (CODES) is another initiative sponsored by NHTSA. The purpose of this effort is to connect information from accident reports with medical data.[6] Finison[6] notes that more than half of the states have projects, but CODES data reporting has not been standardized. Thus, the ability to compare data between states is limited.

International efforts to create minimum data sets of relevance to EMS include several "Utstein Style" data sets, named for a consensus meeting held at the Utstein Abbey in Norway. These data sets are research-oriented, contain clinical and time-related terms, and have elements that are neither minimum nor necessary to meet the operational needs of transport programs. Utstein Style data sets have been created by task forces for out-of-hospital cardiac arrests,[7] trauma,[8] in-hospital cardiac arrest,[9] pediatric advanced life support,[10] disaster medical response,[11] and laboratory cardiopulmonary resuscitation research.[12]

Data Elements for Emergency Department Systems (DEEDS)[13] describes a minimum data set for voluntary use in emergency department (ED) patient records. The 156 data elements are arranged into eight sections: patient identification data, facility and practitioner identification data, ED payment data, ED arrival and first assessment data, ED history and physical examination data, ED procedure and result data, ED medication data, and ED disposition and diagnosis data. Except for date/time of illness or injury onset date and time, data are limited to events in the ED.

A final potential source of data elements is hospital-based trauma registries, which contain data related to patient injury and subsequent hospital care. However, collection of registry data is not standardized across sites,[14] and data elements are not specific to patients transported by air.

Despite the unavailability of a standardized data set, air transport programs do collect transport data. However, inconsistencies in data collection exist across programs. Thompson and Shaffer[4] found within actual transport records as many as 51 different terms referring to a single concept. In addition, individual terms, such as *response time*, may not always refer to the same concept.[15] Consequently, a need for a set of data elements specific to air transport exists.

Efforts to address the data needs within the air transport community began with the development of the Air Transport Minimum Data Set (ATMDS), a data set focused on times of relevance to air transport by helicopter. Time elements were the first to be included because most if not all critical care air transport programs consider the recording of time variables within the patient record to be essential.[16,17] All terms for the data set were obtained originally from transport records. The set of terms then was consolidated and definitions developed using the Delphi Technique.[4]

Because of the relatively small sample size used in the Delphi study and the purposive nature of the sample, bias may have been introduced into the data set.[4] Thus, validation of the ATMDS is essential. The purpose of this study was to evaluate the terms and definitions included in the ATMDS.

The research questions for the study were:

1. What is the degree of consensus on retaining the 19 terms proposed for the ATMDS?
2. What is the degree of consensus on the proposed definitions for the 19 terms in the ATMDS?
3. Is collection of the 19 proposed data elements feasible?
4. Are programs willing to release aggregate data for these terms to the Association of Air Medical Services (AAMS)?

Methods

The study chose a survey design because of the desire to obtain opinions from a wide international sample of persons representing multiple air transport programs. The University of Utah Institutional Review Board and the AAMS Survey Review Committee approved the study. Return of the question-

Table 2.

SAMPLE DEMOGRAPHICS*

Gender	*Count*	*%*
Female	51	41.8
Male	47	38.5
Missing	24	19.7
Race		
American Indian/Alaskan	1	0.8
Asian/Pacific Islander	0	0.0
Black (Non-Hispanic)	1	0.8
Hispanic	4	3.3
White	115	94.3
Missing	1	0.8
Professional Role**		
Communications specialist	7	
Nurse	85	
Respiratory therapist	2	
Pilot	9	
Physician	3	
Paramedic/EMT	31	
Unidentified	1	
Highest Educational Degree		
Certificate	9	
Associate degree	24	
Diploma	11	
Bachelor's degree	47	
Master's degree	25	
Doctorate	3	

Variable	**Mean + STD Dev**	**Minimum**	**Maximum**
Age	40.7 ± 7.0	25	59
Years experience	17.0 ± 7.5	2	37
Years transport experience	9.6 ± 5.9	0.5	32

** Includes 4 returned surveys without data related to terms*

***Several people have dual educational preparation (eg, nurse/paramedic). These data also reflect actual role of person and not role of person to whom the survey was mailed.*

naire was considered consent to participate in the study.

Sample

Nurses, paramedics, pilots, physicians, and communications specialists associated with a national or international program that transports patients by rotor wing were eligible to participate. A list of nurses, paramedics, pilots, and communications specialists was obtained by using the mailing lists from the National Flight Nurses Association (now Air and Surface Transport Nurses Association), the National EMS Pilots Association, the National Flight Paramedics Association, and the National Association of Communication Specialists. Because a mailing list was not available from the Air Medical Physician Association, a list from was obtained from AAMS so that surveys could be sent to the medical directors of the selected programs.

The authors desired a final sample of 100 subjects. Because response rates for mailed surveys are typically low,[18] oversampling was done to ensure a sufficient sample size. Approximately 500 subjects were selected so that an expected 20% return rate would provide the needed 100 subjects.

Sampling was proportional by professional role. Approximately 16.4% of the persons in each specialty were chosen to receive a questionnaire; Table 1 breaks down response by profession. The first subject was selected at random from the first six persons on the list.[18] Subsequently, every sixth person was invited to participate. Persons involved in the Delphi Study to create the data set[4] were not eligible for participation. If a selected person had participated in the first study, the next person on the list was chosen instead.

Instruments

The primary data collection instrument was an author-developed survey that asked subjects to indicate their agreement with keeping a term in the data set and their agreement with the definition on a 3-point Likert scale. If they did not agree with the provided term or definition, they were asked to suggest an alternate term or definition. Respondents were asked to indicate how easy collection of the data elements would be for their program. Respondents also were asked if they would be willing to release these data to AAMS in an aggregate format.

Procedures

Subjects were sent an information letter describing the study, a demographic data collection form, and the primary data collection tool. They were asked to return the anonymous surveys in the enclosed self-addressed stamped envelope. Postage for the return envelopes was not available for surveys mailed outside the United States.

Results

One-hundred-twenty-two of the 508 (24.0%) mailed questionnaires were returned. One person worked for a fixed wing–only program and provided demographic data only, no input on terms. One subject was not active in air transport and did not respond to terms. Two subjects did not respond to the terms but did not provide a reason. Thus, 118 usable surveys were returned. Four questionnaires were returned unopened because of bad addresses.

Although the surveys were anonymous, they were coded by professional role. Several surveys were returned by persons other than those to whom the survey was mailed, as evidenced by a mismatch between demographic data provided and the code number. Table 1 describes return rate by professional role, based on the addressee. Other demographic data for the sample are described in Table 2 and reflect the profession of who actually returned the surveys.

Research questions 1 and 2 addressed whether the terms and their definitions should be retained. Agreement regarding retention of the terms was expressed with a 3-point Likert Scale (3 = agreement, 2 = neutral, and 1 = disagreement). The percentage of persons indicating agreement with retaining the terms ranged from 95.8% to 71.2% with a mean of 85.4% ±

Table 3.

AGREEMENT WITH TERM INCLUSION

Term	Agreement %	Agreement % or neutral	No response
Point in time			
Time of incident	78.8	88.1	2
Time of call	95.8	99.2	0
Time of alert	75.4	83.9	5
Dispatch	84.7	88.1	3
Depart base	90.7	92.4	1
Arrive location	95.8	96.6	1
Arrive bedside	78.8	86.4	4
Depart bedside	72.9	82.2	7
Depart location	94.9	95.8	3
Arrive destination	94.1	95.8	2
Depart destination	87.3	90.7	4
Arrive base	86.4	89.8	5
In service	71.2	78.0	8
Time aborted	92.4	95.8	1
Intervals			
Delay	87.3	92.4	6
Response time	83.9	86.4	9
Ground time	83.1	89.0	5
Transport time	86.4	90.7	4
Total mission time	83.1	88.1	6

n = 118

Table 4.

AGREEMENT WITH TERM DEFINITION

Term	Agreement %	Agreement or neutral%	No response
Point in time			
Time of incident	90.7	93.2	4
Time of call	95.8	96.6	2
Time of alert	79.7	85.6	14
Dispatch	75.4	83.1	10
Depart base	90.7	92.4	5
Arrive location	82.2	89.8	5
Arrive bedside	81.4	86.4	10
Depart bedside	78.8	83.9	12
Depart location	80.5	88.1	8
Arrive destination	74.6	79.7	5
Depart destination	83.1	87.3	10
Arrive base	86.4	88.1	12
In service	78.8	83.1	13
Time aborted	90.7	94.1	7
Intervals			
Delay	84.7	88.1	6
Response time	72.9	78.0	13
Ground time	83.9	87.3	10
Transport time	87.3	89.8	10
Total mission time	79.7	86.4	10

n = 118

7.5%. Percentage of subjects agreeing or neutral regarding the appropriateness of the term ranged from 99.2% to 78.0% with a mean of 89.5% ± 5.4%. See Table 3 for details.

Agreement with the proposed definitions also was expressed with a 3-point scale. The percentage of persons indicating agreement (3) with the proposed definition ranged from 95.8% to 72.9% with a mean of 83.0% ± 6.1%. The percentage agreement including 2s and 3s ranged from 96.6% to 78.0%, with an average of 87.4% ± 4.7%. See Table 4 for details.

Research question 3 sought to determine if collecting each of the 19 proposed terms would be feasible. Subjects were asked to describe the status of data collection for each proposed term. Subjects could respond *already collected, can be determined from current data, do not currently collect but are willing to collect, would not be willing to collect,* or *do not know/no opinion.* Subjects answering 1, 2, or 3 were classified as instances where data collection is feasible. Data collection feasibility for the individual terms ranged from 99.1% to 81.3% with a mean of 92.5% ± 5.2%. *Depart bedside* (81.3%), *arrive bedside* (84.1%), *time of incident* (86.1%), and *time of alert* (89.3%) were the only terms with a feasibility rating of < 90%.

The final research question addressed whether programs would be willing to release the data to AAMS in aggregate form. Seventy-eight of the respondents said they were willing to release all the data elements to AAMS. Eight persons said they were not willing to release any data. The remaining 32 subjects were either willing to release some data elements or said they did not have the authority to make this decision.

Subjects could comment on either the term or the definition proposed. The number of subjects commenting on a single term ranged from 10 to 38. No single suggestion was made by more than 20% of the subjects. More common comments included using *lift off* instead of *depart base* (11 subjects, 9.3%) and *arrive receiving facility* (or similar term) instead of *arrive destination* (14 subjects, 11.9%). Seventeen (14.4%) subjects commented that *time of incident* usually is unknown or only approximate.

Discussion

A minimum data set for documenting time-related terms for patient transport by rotor wing was developed during a previous study[4] using the Delphi technique. The current study used a survey to evaluate the language proposed in the Delphi study. The results support retention of 14 terms in the ATMDS and continued evaluation of the other five terms.

Time of incident, time of alert, arrive bedside, depart bedside, and *in service* were removed from formal recognition in the ATMDS as a result of lack of strong support from the current study. *Time of incident* received 90.7% approval for the definition but only 78.8% approval for retention. In addition, 17 subjects commented that obtaining accurate data for this data element is difficult.

Time of alert was removed from the data set because of low approval of both the term (75.4%) and the definition (79.7%). In addition, a number of subjects expressed confusion between the terms *time of alert* and *dispatch* or suggested alternatives for these similar concepts. The confusion may have arisen because of the complexity of the definition of *time of alert*; one subject commented, "Time crew is notified of pending flight may be the same as dispatch if no delays encountered. This could be time flight crew placed on standby for possible flight." Continued evaluation of data needs related to transport might clarify the need for this or related concepts.

Arrive bedside (78% and 81.4% approval) and *depart bedside* (72.9% and 78.8% approval) received relatively low consensus on both the term and the definition, respectively. Both terms received a feasibility score of less than 80%. Ten subjects commented on the fact that the time from helicopter arrival at a location to flight crew reaching the patient could be quite long, greatly affecting *ground time*. However, others questioned the ability to collect accurate data given the fact that the communications specialists couldn't record this data directly and that the flight crew may be "too busy to notice." One subject called *arrive bedside* "yet another thing to monitor." Consequently, further study is needed to determine the relative value of the data compared with the collection cost and accuracy.

In service also received low approval for the term (71.2%) and the definition (78.8%). Comments indicated that this term also is used in the context of helicopter maintenance, rather than flight times. Consequently, further evaluation is necessary.

Once the data set was reduced to 14 terms, the research team noted several problems with the definitions. For example, *total mission time* could not be the interval between *dispatch* and *in service* because the latter was no longer contained in the data set. Consequently, definitions were altered to provide internal consistency.

The authors also noted that although all terms had originated with the first study, several naming inconsistencies were present. For example, the word *time* was sometimes included in the term name and sometimes not. All terms were modified so that points in time began with the word *time* (eg, *time arrive location*) and intervals ended in the word *time* (eg, *response time*). Other authors[7,15] have suggested using the word *interval* for terms referring to interim. However, the authors preferred to stay close to the terms used within actual transport records and the language suggested by experts in the Delphi study.

The term *delay* is the one exception. *Delay* inherently implies an interval, and *delay time* did not sound correct. Consequently, the word *time* was not added to the term *delay*.

The concepts evaluated in this study are not unique to air transport. Some of the concepts are relevant for fixed-wing and ground transport. The authors envision that the ATMDS can be used for fixed-wing transport in its current form, although several important concepts (points in time and intervals) undoubtedly are missing. Future research to address concepts specific to fixed-wing transport is warranted.

Conclusion

In summary, approval of the data set was high, ranging from 95.8% to 71.2% for the terms and 95.8% to 72.9% for the definitions. Feasibility of collecting the terms ranged from 99.1% to 81.3%. The authors conclude that the ATMDS language is generally acceptable to the air transport personnel who will collect and use the data. Further research is needed to verify the ability of transport programs to reliably collect the data and demonstrate the validity of the concepts for answering questions related to transport quality.

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Air Transport Minimum Data Set

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Purpose
The Air Transport Minimum Data Set (ATMDS) was developed with the purpose of describing time points and intervals relevant to transport of patients by air. At this time, the data set is specific to rotor wing. This set of data elements is not necessarily the complete set of items that an individual program will collect. Rather this is a "minimum" set that can be used to compare programs on essential elements.

Creation
The ATMDS was developed during 2 research studies. The first study identified possible terms from a set of patient transport records (Thompson & Schaffer, 2002**). These terms were evaluated by a panel of transport experts for inclusion in a minimum data set. The panel also provided definitions for each of the selected terms. The second study, an international survey of flight professionals, was used to validate the content of the data set (Thompson & Schaffer, 2003***).

Use
 However, transport programs may use the data elements and their definitions freely. Research publications should reference the data set appropriately.

TERM	DEFINITION
Time of Incident*	Time the injury or medical event occurred.
Time of Call	Time request/inquiry received.
Time of Alert*	Time crew is notified of pending flight. May be same time as Dispatch if no delays encountered.
Time of Dispatch	Time crew notified flight is a "go" post pilot ok's flight.
Time Depart Base	Time of lift off for mission from base or other site.
Time Arrive Location	Time helicopter arrives at landing zone or helipad. May be same time as arrive bedside for scene call.
Time Arrive Bedside*	Time crew arrives at patient (bedside or scene).
Time Depart Bedside*	Time crew leaves scene or patient bedside.
Time Arrive Destination	Time patient transferred to receiving clinical team. In unusual circumstances, this time may not be at a healthcare facility.
Time Depart Destination	Time left patient destination. Will be recorded for flights not ending at base.
Time Arrive Base	Time arrive base after call completed.
Time Aborted	Time authorized flight aborted/cancelled after dispatch.
Delay	Length of delay in departure (specify cause).
Response Time	Time interval between Time of Dispatch and Time Arrive Location.

Ground Time	Time interval between Time Arrive Location and Time Depart Location.
Transport Time	Time from Time Depart Location and Time Arrive Destination
Total Mission Time	Time interval between Time of Dispatch and Time Arrive Base.

*These elements remain under investigation. They are not included within the CAMTS 2004 standards, however, transport programs may wish to use the terms and their definitions.

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