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Short communication

Documentation discrepancies of time-dependent critical events in out of hospital cardiac arrest☆

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ABSTRACT

Objectives: The timing of and interval between events in prehospital care is important for system design, patient outcome, and prehospital research. Since these data can guide treatment recommendations, it is imperative that time-based prehospital documentation is accurate and precise, especially for time-sensitive conditions such as out-of-hospital cardiac arrest (OHCA). We compared the times of select events documented in the medical record (PCR) with times from time-stamped audio recordings in the monitor-defibrillator (AUD).
Methods: A retrospective cohort of prehospital, adult, atraumatic OHCA resuscitations from two regional EMS agencies over a 10-month period was performed. Primary outcome was absolute difference (minutes) between PCR and AUD documented times for select events during OHCA resuscitation (IV access, IO access, first epinephrine administration, supraglottic airway insertion, endotracheal intubation, and return of spontaneous circulation). We describe the magnitude and direction of differences, and estimate the potential error in time intervals abstracted from the medical record.
Results: Of 411 patients treated by EMS, 192 had complete data for ≥1 event and 136 had complete data for ≥2 events. 422 total events were identifiable in both PCR and AUD. Median absolute time discrepancy between PCR and AUD was 2 (IQR 1–4) min. Median differences between the smallest and largest PCR–AUD discrepancy was 2 (IQR 1–4.5) min. Discrepancies were both positive and negative, and not consistent within individual records.
Conclusion: We found a 2 (IQR 1–4) min imprecision in the documented timing of select events during OHCA resuscitation. This imprecision contributes to uncertainty in analyses that incorporate time-stamped variables.

1. Introduction

Many interventions and patient-related events occur in the prehospital environment. The timing of, and interval between, some events and interventions is important for system design and patient outcome. These can be described as 'critical events'. As prospectively deploying independent observers is usually not feasible, most prehospital research on critical events relies on the prehospital medical record for data collection. In fact, the medical record time of certain critical events, or the documented time interval between critical events, is the usual variable incorporated into analysis. These data can change care guidelines or result in new treatment recommendations. Thus, it is imperative that time-based prehospital documentation is both accurate and precise. However, the prehospital environment poses unique challenges in simultaneously managing patient care, providing safe transportation, and ensuring accurate documentation, all with limited resources and personnel.

Out-of-hospital cardiac arrest (OHCA) is one time-sensitive disease that necessitates specialized care and rapid intervention. Critical events for OHCA include recognition of unresponsiveness, notification of the emergency dispatch system, arrival of prehospital providers, initiation of basic life support, procedures performed,

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medications administered, rescue shocks delivered, and return of spontaneous circulation (ROSC).[1,2] Multiple studies have focused on the timing of prehospital events during OHCA resuscitation, including the relationship between CPR duration and functional outcome,[3] the optimal timing of epinephrine administration,[4] the optimal timing of advanced airway placement,[5] the optimal timing of defibrillation,[6] and therapeutic hypothermia for patients with certain duration of pulselessness.[7]

This study evaluated the accuracy and precision of prehospital data collection for OHCA. As our local systems had deployed audio recordings during OHCA, we compared the times of selected critical events documented in the medical record with times from the time-stamped audio recordings in the monitor/defibrillator.

2. Methods

This study was approved by the University of Pittsburgh Institutional Review Board.

2.1. Data source

We abstracted both the documented times of critical events in the prehospital medical record and the time of the same events on the audio recording. The electronic prehospital medical record is built around a patient care report (PCR) that contains a structured narrative that allows paramedics to record times for each intervention (EMS Charts, Pittsburgh, PA and EMMA Inc., Pittsburgh, PA). EMS providers electronically complete their documentation after each call. Times for critical events are manually placed by providers at the time of documentation. Additionally, each ambulance in our region is equipped with a Phillips HeartStart MRx monitor/defibrillator (Phillips Electronics, Amsterdam, Netherlands), and the internal clock is synchronized to the Eastern Time zone of standard atomic time a minimum of every 6 months. These monitors electronically record audio of the immediate surroundings when the device is set to therapy mode. Using the internal clock of the monitor/defibrillator, we abstracted time-stamped data from cases of OHCA using these audio recordings (AUD). All audio data abstraction is performed by a single individual (JC), who has more than 8 years of experience with this process. AUD abstracted times were recorded only if there was an audible definitive statement attesting to the successful occurrence of a critical event. Paramedics are encouraged, but not mandated, to verbalize all interventions for audio recording.

2.2. Study design and population

This was a retrospective cohort study of patients suffering OHCA with attempted resuscitation by prehospital providers from February 2012–December 2012. The agencies provide EMS services to the city of Pittsburgh, PA and surrounding rural and suburban regions. The combined agencies respond to approximately 650 cases of OHCA per year. We de-identified any agency affiliation prior to analysis.

2.3. Study definitions and outcomes

Our primary outcome was the absolute difference in minutes between PCR documented times and AUD abstracted times for critical events. We were able to identify the following critical events for our analyses: intravenous (IV) access, intraosseous (IO) access, first epinephrine administration, King-LT supraglottic airway placement, endotracheal intubation, and ROSC.

2.4. Statistical analyses

We used STATA 12.0 (StataCorp, College Station, TX) to analyze the data. We rounded the absolute difference in minutes between PCR and AUD sources to the whole minute, because seconds were not recorded on the PCR. This was the most conservative estimate, which by allowing for minor discrepancies in seconds between the two data sources minimized the chances of finding larger differences than actually exist. We describe the overall magnitude and direction of actual differences (PCR–AUD), as well as absolute differences (|PCR–AUD|) for each critical event. For cases with PCR and AUD data for more than one critical event, we calculated the range of discrepancies within each patient case. This was an estimate of the potential error in time intervals estimated from the medical record.

3. Results

A total of 411 patients suffered OHCA and were treated by EMS during the specified time frame. Of these, 192 patients had complete data for at least once critical event. We identified a total of 422 critical events present in both PCR and AUD.

The overall magnitude and direction of actual time discrepancies (PCR–MRX) ranged from −18 min to 58 min. The 95% limit of agreement was −14 min to 13 min (Fig. 1).

Altogether, there was a median absolute difference of 2 min (IQR: 1–4 min) between the PCR and AUD time for critical events. The differences ranged between 0 min and 53 min (Table 1).

A total of 136 (32.8%) cases had both audio and PCR times for more than one intervention. The difference between the smallest and largest AUD–PCR discrepancy in these cases ranged from 0 to 27 min, with a median of 2 min (IQR: 1–4.5 min).

4. Discussion

We observed a median error of about 2 min in the documented times of certain critical events and in the interval between actions within the prehospital medical record for patients suffering OHCA. These errors were both positive and negative, and were not consistent within individual records. Prehospital research that incorporates time-stamped variables relies heavily on the documentation of critical events in the medical record. This inherent imprecision of times recorded for critical events in the medical record should be incorporated as a known uncertainty in any analysis.

Discrepancies in recorded times likely results from the array of tasks competing for the attention of prehospital providers, often in stressful or austere environments. Patient care takes priority over and usually precludes concurrent documentation, especially in critically ill patients with time-sensitive conditions such as

Table 1
Distribution of time discrepancies (minutes) between the prehospital electronic medical record and time-stamped audio recordings.

Critical event	*n*	Median (IQR)	Minimum	Maximum
Intra-venous access	52	2 (0–3)	0	13
Intra-osseous access	83	2 (1–4)	0	58
First epinephrine administration	124	15 (0–3.5)	0	16
Endotracheal intubation	35	2 (0–4)	0	7
Supraglottic airway insertion	64	2 (0–4)	0	53
Return of spontaneous circulation	64	2 (1–5)	0	23