Comparison of Emergency Medical Dispatcher Stroke Identification and Paramedic On-Scene Stroke Assessment

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ABSTRACT

Introduction: Some have argued that there is no need for a dispatcher stroke evaluation because emergency medical services (EMS) responders can perform a more detailed, in-person stroke evaluation in the field. In fact, little or no research exists to determine whether dispatch stroke evaluations are actually redundant when compared with EMS field responder assessments.

Objective: The purpose of this study is to determine whether some strokes identified by emergency medical dispatchers (EMDs) are not identified by field paramedics.

Methods: The descriptive study utilized data from three sources (EMD, EMS, and hospitals) collected between June 2012 and December 2013 in Salt Lake County, Utah, USA. Using only hospital-confirmed strokes, the study compared EMD-identified and paramedic-identified evidence of stroke.

Results: Of 231 strokes identified by either EMDs or EMS or both, EMD and EMS identification agreed on 49 cases (41 stroke identifications and 8 misses). In four cases, the EMD found no evidence of a stroke, but the paramedics on scene did identify the stroke. In 17 cases, the EMD identified a stroke that EMS responders on the scene evaluated as "not a stroke." Finally, there were 82 cases in which the EMD positively identified a stroke, but the responders did not record the completion of a stroke evaluation at all, while in 50 cases, the responders identified a stroke when the EMD did not use the SDxT at all.

Conclusion: Both the EMD-based SDxT and the paramedic on-scene CSS assessment tools have been shown to have very high sensitivity to identify stroke—when they are used. Performing multiple stroke assessments during the prehospital period is not redundant, but critically important.

INTRODUCTION

Stroke is a time-sensitive condition; early identification and treatment are critical to reduce both immediate damage and long-term disability.[1,2] In particular, the early administration of tissue plasminogen activator (tPA) can significantly reduce, or even halt, physical damage to the brain resulting from stroke.[2] To be effective, tPA must be administered within a short time window (generally a few hours after symptom onset).[3] While there is some debate as to what percentage of stroke patients receive tPA, it is estimated that as little as 7% of all stroke patients are receiving this life- and brain-saving treatment at all.[4] Accessing the hospital via EMS and use of stroke identification scales in the prehospital environment have both been shown to decrease the amount of time between the call for help and the administration of tPA.[5,6] Thus, prehospital identification of stroke is a critical factor in increasing the number of stroke patients who receive treatment.

However, accurate identification of stroke can be difficult. While strokes with typical symptoms are identified a high percentage of the time, symptoms of stroke are extremely variable, and atypical presentations (such as seizure or altered level of consciousness) and comorbidities (such as diabetes) can reduce accurate identification significantly. Moreover, as many as one-third of suspected strokes are actually "stroke mimics," conditions such as sepsis, migraine, or spinal cord lesions that can cause similar symptoms.[7,8] In one study, paramedics missed more than a third of all strokes, mostly because of atypical presentations and comorbidities.[9] Experienced emergency department nurses have been reported as missing as many as two-thirds of atypical strokes, and the rate of overall missed stroke diagnoses may be as high as 38% even for emergency physicians.[10] Moreover, stroke diagnosis is further complicated by the

fact that a transient ischemic attack (TIA), sometimes called a "mini-stroke," can last a few seconds to a few minutes, come and go, or disappear completely before responders arrive or the patient can reach the hospital.

Given this reality of highly variable presentations, numerous "mimics," and symptoms that may change quickly, a stroke can easily be missed at any point in the prehospital chain of care, or even in the hospital. Yet, despite the fact that emergency medical dispatchers (EMDs) have been shown to be able to identify strokes with a high level of sensitivity using a scripted stroke scale,[11,12] some have argued that there is no need for a dispatcher stroke evaluation because emergency medical services (EMS) responders can perform a more detailed, in-person stroke assessment in the field. Conducting an evaluation at dispatch, they argue, simply takes time without adding any additional information or clinical value. In fact, little or no research exists to determine whether dispatch stroke evaluations are actually redundant when compared with EMS field responder assessments. If they are not, completing stroke assessments at multiple points in the prehospital chain of care may increase the overall number of correctly identified strokes (and TIAs) and thus increase the number of patients receiving treatment within the effective time window.

OBJECTIVE

The purpose of this study was to determine whether some strokes identified at dispatch were not subsequently identified by field paramedics (and vice versa).

METHODS

Design and Setting

This descriptive study utilized EMD, EMS, and hospital datasets collected between June 2012 and December 2013 in Salt Lake City and County, Utah, USA. EMS data were collected from two metro-level Fire/EMS departments, and EMD data came from two IAED Accredited Centers of Excellence (ACEs). The Utah Department of Health (UDoH) matched the EMS and hospital records directly using a secure linkage process; EMD records were then linked probabilistically to the combined EMS-hospital set. All records were reviewed for accuracy of match following the statistical linkage.

Using only hospital-confirmed strokes, the study compared EMD-identified and EMS-identified evidence of stroke. Strokes identified by EMS were based on the Cincinnati Stroke Scale (CSS),[13,14] as administered in person by paramedics. EMDs used the Medical Priority Dispatch System™ (MPDS®) CSS-based Stroke Diagnostic Tool (SDxT), as part of MPDS version 12.2. Using the SDxT, the EMD instructs the caller to ask the patient to perform three actions (raising arms, smiling, and saying a commonly known phrase) and report back what the patient is able to do. The responses are entered into the SDxT, which analyzes the results and determines the level of evidence that the patient is experiencing a stroke.

For both EMD and EMS stroke assessments, all possible responses were grouped into three categories: "evidence of stroke identified," "no evidence of stroke identified," and "unable to identify stroke." The "unable" group included any cases for which a stroke assessment was performed, but the results were inconclusive, usually because the patient was simply unable to perform any of the tasks required by the assessment at all. In some cases, paramedics or EMDs did not record any stroke evidence, whether because no stroke assessment was performed or because no record was made of the outcome.

Study Population

The study sample included all the hospital-confirmed strokes that arrived at the hospital via EMS, and for which corresponding dispatch data was available. Strokes were classified at the hospital using the International Classification of Diseases, 9th edition—Clinical Modifications (ICD-9-CM).

Outcome Measures

The outcome measures in this study were (a) the number of cases classified as "evidence of stroke identified" by EMD and EMS, (b) the number of cases classified as "evidence of stroke identified" by EMD but missed ("evidence of stroke not identified") by EMS, (c) the number of cases classified as "evidence of stroke identified" by EMS but missed by EMD, and (d) the number of cases in which one of the stroke scales showed evidence of stroke but the other was not performed at all.

Data Analysis

STATA for Windows software (STATA Statistical Software: releases 14.1, ©1985-2015 StataCorp, College Station, TX) was used for data analysis, using already de-identified hospital-confirmed outcomes and corresponding medical dispatch data. Another analysis identified the proportion of identified versus non-identified strokes handled on the *Stroke (CVA)/Transient Ischemic Attack (TIA)* Chief Complaint Protocol.

RESULTS

603 hospital-confirmed stroke cases (as identified using ICD-9-CM codes) were obtained by linking EMD, EMS, and hospital datasets (Fig. 1). Overall, at least one stroke evaluation was performed on 61.2% (n=369) of all the cases. Of these, the on-scene paramedic assessment was performed somewhat more often; the SDxT was performed by the EMD 215 times, while the paramedic performed the on-scene CSS 266 times. Both assessments were completed for 112 cases (18.6% of all the strokes).

Of the cases for which at least one stroke assessment was performed (n=369), the EMD identified evidence of stroke in 46.3% (n=171), and the paramedics on scene identified evidence of stroke in 27.4% (n=101); 41 of these cases were overlaps, identified by both the EMD and the paramedic (Table 1). Overall, 38.3% (n=231) of the total hospital-confirmed strokes were identified before the patient reached the hospital, by either the EMD or the paramedic or both.

EMDs and paramedics reported the same outcome from their stroke scales for just 8.5% (n=51) of all the stroke cases. In 17 cases, the EMD identified a stroke that EMS responders on scene evaluated and recorded as "no evidence of stroke." In 4 cases, the EMD performed the SDxT and found no evidence of stroke, whereas the paramedics on scene identified the stroke. Finally, there were 82 cases in which the EMD positively identified a stroke but the responders did not record the completion of

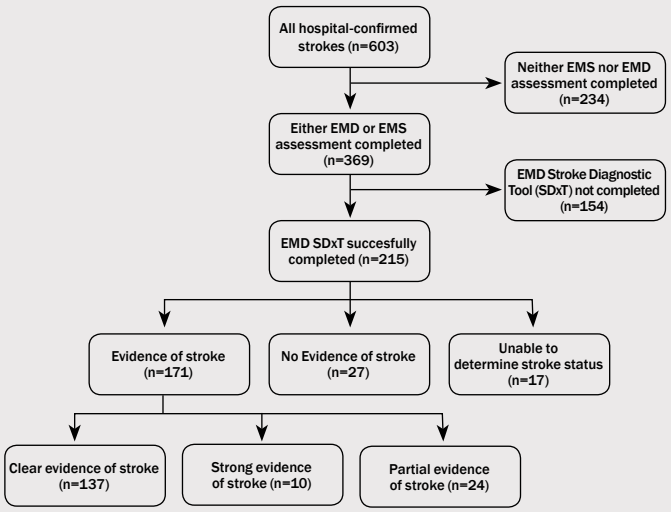

Figure 1. Sampling process for hospital-confirmed stroke cases on EMD side

Chief Complaint Protocol (#)	Chief Complaint Protocol (#)
Stroke *(28)*	90 (23.2)
Sick Person *(26)*	78 (20.1)
Unconscious/Fainting *(31)*	59 (15.2)
Falls *(17)*	58 (15.0)
Chest Pain *(10)*	23 (5.9)
*Other protocols**	80 (20.6)

*Breathing Problems (3.9%), Diabetic Problems (2.6%), Headache (2.6%), Convulsions/Seizures (2.3%), Heart Problems (1.6), Unknown Problems (1.6), Transfer/Interfacility/Palliative Care (1.6), Cardiac/Respiratory Arrest (1.0%), Hemorrhage/Lacerations (1.0%), Overdose/Poisoning (0.8%), Traffic/Transportation Incidents (0.8%), Psychiatric/Suicide Attempt (0.5%), and Traumatic Injuries (0.5%).

Table 2. Chief Complaint Protocols for Cases Where SDxT was Not Used

a stroke evaluation at all (data missing), and 50 cases in which the responders identified a stroke when the EMD did not record the use of the SDxT at all.

The selection of the *Stroke (CVA)/Transient Ischemic Attack (TIA)* Chief Complaint Protocol by the EMD (Protocol 28 in the MPDS) was very significantly correlated with the use of the SDxT, and thus with the subsequent EMD identification of stroke. Of the 215 cases for which the SDxT was used, 214 were handled by the EMD on Protocol 28, and one was handled on Protocol 6: Breathing Problems. However, of the 388 cases for which the SDxT was not used, only 90 (23.2%) were handled on the Stroke Protocol. Approximately 80% of all the hospital-confirmed stroke cases where the SDxT was not used were handled on five Chief Complaint Protocols: *Stroke, Sick Person, Unconscious/Fainting, Falls, and Chest Pain* (Table 2).

DISCUSSION

Of the 231 hospital-confirmed strokes in the study that were identified by either EMDs or paramedics, 130—a full 56%—would have been missed if the EMD had not performed the SDxT before the arrival of the paramedics, either because the paramedics' stroke assessment returned a negative or uncertain outcome or because they did not record a stroke assessment at all. On the other hand, 60 strokes were identified by paramedics on the scene that were missed by the EMDs. Clearly, performing multiple stroke assessments during the prehospital period is not redundant, but critically important, particularly since as many as 70% of stroke patients access care via 9-1-1 and the EMS system.[15]

Stroke symptoms are highly variable and may change significantly between the initial presentation and the time the patient is seen by a physician or evaluated for the need for imaging. Some recent research suggests that any stroke assessment is likely be more accurate closer to the time of the initial stroke.[16] In particular, TIAs often present with typical stroke symptoms very briefly, then disappear. Since risk of a full stroke is heightened following a TIA[17], these patients may also require imaging to determine the full extent of the damage or risk; if the symptoms have disappeared before the first responder arrives, a stroke assessment is unlikely to be completed, and the TIA may be missed altogether. These findings can help explain

EMD Stroke Evidence: n(row%, column%)					
EMS Stroke Evidence	**Yes**	**No**	**Unable***	**SDxT not used**	**Total**
Yes	41 (40.6, 24.0)	4 (4.0, 14.8)	5 (5.0, 29.4)	51 (50.5, 13.1)	101
No	17 (22.7, 9.9)	8 (10.7, 29.6)	1 (1.3, 5.9)	49 (65.3, 12.6)	75
Non-conclusive	31 (34.4, 18.1)	3 (3.3, 11.1)	2 (2.2, 11.8)	54 (60.0, 13.9)	90
Data Missing†	82 (24.3, 48.0)	12 (3.6, 44.4)	9 (2.7, 52.9)	234 (69.4, 60.3)	337
Total‡	171	27	17	388	603

*Unable to identify implies the person is unable to perform any of the actions required by the stroke diagnostic tool.
†Missing data indicates that no stroke assessment was recorded.

Table 1. Identification of Stroke by EMD and EMS

why, in the current study, so many of the identified strokes were identified by the EMD only (or the paramedic only, in some cases). Moreover, the findings indicate why it is so important for the assessment's outcome to be recorded. Without a record of the prehospital stroke findings, hospital staff may not know that stroke symptoms were ever present, and they may not conduct a CT scan or provide stroke treatments if the symptoms have already changed or subsided.

Clinical researchers have long known that stroke identification across all clinical settings is lower than is desirable.[6-9] As is the case in many other healthcare settings, the majority of the strokes in this study were missed. Both of the stroke assessments evaluated here have demonstrated high sensitivity, but only if they are used.

The results of this study indicate some ways to potentially improve stroke recognition in the prehospital environment without significant additional expense or time. The first is to ensure that every EMD has access to a scripted, clinically-approved stroke assessment tool, such as the SDxT studied here, with proven sensitivity to identify strokes. The SDxT has been shown to take only an average 34 seconds to complete,[18] so adding it to the dispatch work flow does not substantially add to call time, nor increase response time or time to treatment.

Moreover, Quality Assurance (QA) processes must be in place to ensure that EMDs are performing the SDxT on every suspected stroke. In this study, 90 strokes were handled on the Stroke Protocol that did not receive SDxT evaluation, despite the fact that the tool automatically opens whenever the EMD uses the Stroke Protocol (although in some of these cases, EMDs did record Key Question answers indicative of known stroke symptoms). Given the demonstrated sensitivity of the tool, this number reflects as many as 78 strokes (12.9% of the total) that could have been identified at dispatch. Since paramedics do not always perform their stroke evaluation either, taking advantage of these obvious opportunities for assessment should be a priority in improving stroke identification.

The difference in the stroke evaluation processes in the field and at dispatch argue for even greater focus on the dispatch assessment. The paramedic stroke evaluation process offers far more latitude, since paramedics determine whether the conditions on scene necessitate a stroke screening, then conduct the screening in an unscripted manner—often in the midst of very complex or chaotic situations. EMD evaluations, on the other hand, are both scripted and automatic. As a result, EMD stroke assessment compliance may be easier to assess and improve, and scripted protocols also reduce inter-user variability compared to a more "freelance" process.

Also important is to provide training to help EMDs (and paramedics) more often identify situations in which a stroke should be suspected earlier. One study found that both EMDs and paramedics missed a significant number of stroke cases even when callers or patients reported typical stroke symptoms (such as one-sided weakness or facial droop) or even used the word "stroke."[15] Providing targeted training, as well as QA feedback on all stroke calls (and runs), can help orient EMDs and paramedics to look for the signs and symptoms of stroke, even if only reported over the phone.

Limitations

The major limitation of this study is that it was retrospective, so none of the interventions that have been suggested (in the Discussion) to potentially improve stroke identification were tested as part of the study. However, both training and QA practices have previously been demonstrated to be effective both in improving compliance to scripted protocols and in increasing accurate identification of the patient's presenting problem.[19,20] It would also be helpful to know how many of the strokes missed by EMDs and paramedics were also missed by the ED physicians prior to imaging, to compare prehospital stroke assessment against more highly-trained medical professionals using essentially the same tools. However, the results of in-hospital stroke assessments, if performed, were not available for this study.

CONCLUSIONS

Both the EMD-based SDxT and the paramedic on-scene CSS assessment tools have been shown to have very high sensitivity to identify stroke—when they are used. Yet both EMD and EMS identification of stroke, like emergency department and primary care identification, remain low overall. Training both EMDs and paramedics to use their available stroke assessment tools whenever a stroke is suspected, or stroke symptoms are identified, is the first step in increasing stroke identification in the prehospital environment. Also, because stroke (and TIA) symptoms may change over time, even during the short time between dispatch and on-scene paramedic response, performing stroke assessments at multiple points in the prehospital chain of care is not redundant, but rather vitally important to the identification and timely treatment of this time-critical and highly variable condition.

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