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Dispatcher Recognition of Stroke Using the National Academy Medical Priority Dispatch System

Brian H Buck, MD FRCPC^{1,2}, Sidney Starkman, MD^{1,3}, Marc Eckstein, MD MPH^{4,5}, Chelsea S Kidwell, MD⁶, Jill Haines, RN¹, Rainy Huang, RN¹, Daniel Colby, BSc¹, and Jeffrey L Saver, MD¹

¹University of California at Los Angeles (UCLA) Stroke Center, Department of Neurology, UCLA Medical Center, Los Angeles, CA

²University of Alberta, Division of Neurology Department of Medicine, Edmonton, Canada

³University of California at Los Angeles (UCLA) Department of Emergency Medicine, UCLA Medical Center, Los Angeles, CA

⁴Keck School of Medicine of the University of Southern California, Los Angeles, CA

⁵Los Angeles Fire Department, Los Angeles, CA

⁶Georgetown University, Department of Neurology, Washington, DC

Abstract

Background—Emergency Medical Dispatchers (EMDs) play an important role in optimizing stroke care if they are able to accurately identify calls regarding acute cerebrovascular disease. This study was undertaken to assess the diagnostic accuracy of the current national protocol guiding dispatcher questioning of 911 callers to identify stroke, QA Guide v 11.1 of the National Academy Medical Priority Dispatch System (MPDS).

Methods—We identified all Los Angeles Fire Department paramedic transports of patients to UCLA Medical Center during the 12 month period from January to December 2005 in a prospectively maintained database. Dispatcher-assigned MPDS codes for each of these patient transports were abstracted from the paramedic run sheets and compared to final hospital discharge diagnosis.

Results—Among 3474 transported patients, 96 (2.8%) had a final diagnosis of stroke or transient ischemic attack. Dispatchers assigned a code of potential stroke to 44.8% of patients with a final discharge diagnosis of stroke or TIA. Dispatcher identification of stroke showed a sensitivity of 0.41, specificity of 0.96, positive predictive value of 0.45, and negative predictive value of 0.95.

Conclusions—Dispatcher recognition of stroke calls using the widely employed MPDS algorithm is suboptimal, with failure to identify more than half of stroke patients as likely stroke. Revisions to the current national dispatcher structured interview and complaint identification algorithm for stroke may facilitate more accurate recognition of stroke by EMDs.

Keywords

Stroke; Emergency Medical Services; Prehospital Care

Corresponding Author: Brian H Buck, Division of Neurology, Department of Medicine, University of Alberta, 5223-1100 Youville Drive West NW, Edmonton, Alberta T6L 5X8, E-mail: brianhbuck@gmail.com.

Conflict of Interest
None.

INTRODUCTION

Emergency Medical Dispatchers (EMDs) play an important role in optimizing acute stroke care and facilitating rapid transport by initiating pre-arrival instructions to callers and dispatching emergency resources at the appropriate high level of priority. Studies in the United States in the 1990s, however, demonstrated dispatchers were only able to correctly identify about one-third to one-half of patients eventually diagnosed with stroke or TIA.^{1, 2} A more recent study of EMS calls in Germany similarly found that dispatchers recognized stroke in only 51% of stroke patients.³

In response to the availability of thrombolytic stroke therapy, a new algorithm for dispatcher use in interrogating 911 callers to identify stroke was implemented nationally in 2000. The QA Guide version 11.1 of the Medical Priority Dispatch System (MPDS, Priority Dispatch Corporation, Salt Lake City, UT) is the most widely employed dispatcher guide in the United States. This version of the MPDS consists of interview protocols to identify 33 conditions, with stroke constituting condition 28 (Table 1). When a stroke is identified, the QA Guide instructs dispatchers that “Some STROKES can now be effectively treated, but the time for successful therapy is quite short. Lights-and-sirens are not recommended; however, there should be a sense of urgency. STROKE must receive an immediate response that is not subject to delay.”

The separate interview protocol for stroke and high prioritization of stroke in the QA Guide v11 represent progress over prior instruction manuals for dispatchers, which sometimes failed to recognize stroke as a separate entity or as an emergency requiring high priority response. However, the stroke interview algorithm employed has not been prospectively evaluated.

The goal of this study was to examine the ability of EMDs using MPDS algorithms to recognize stroke in a cohort of all consecutively transported patients in an urban EMS region.

METHODS

All patients transported by Los Angeles Fire Department (LAFD) ambulances to the University of California, Los Angeles (UCLA) Medical Center Emergency Department during a 12-month period from January 1, 2005 to December 31, 2005 were identified in a prospectively maintained database, the Los Angeles EMS Agency Trauma and Emergency Management Information System (TEMIS). For TEMIS, paramedics complete 25 data fields on every patient they transport. Among these patients, neurologic complaint patients were identified by analysis of the TEMIS chief complaint field. In this field, paramedics categorize the patient’s chief complaint among 29 response options. Prior studies have demonstrated that 7 of the 29 complaint response options reflect neurologic processes and identify nearly all stroke patients: (1) altered level of consciousness, (2) local neurological signs, (3) seizure, (4) syncope, (5) head pain, (6) nausea/vomiting (6) the cluster category of weak/dizzy.⁴ Examples of the 22 categories that are not directly neurologically relevant include chest pain, allergic reaction, abdominal pain, and shortness of breath.

The hospital administrative database for the same 12-month period was queried for field identifying the final International Statistical Classification of Diseases and Related Health Problems (ICD-9) coded discharge diagnosis for all patients admitted to the hospital. All patients with an ICD-9 discharge diagnosis consistent with ischemic / hemorrhagic stroke or TIA (codes 430 through 437) during the study period were identified.

For all patients presenting with neurologic complaints to paramedic personnel and all patients with a final discharge diagnosis of acute cerebrovascular disease, the prehospital medical record (paramedic “run sheet”) was examined to abstract the MPDS code assigned by the

dispatchers. For paramedic run sheets with missing or illegible dispatch codes, incident numbers were employed to query a database maintained by the Los Angeles Fire Department to recover as many dispatch codes as possible. Stroke patients were admitted to a specialized stroke neurology service at a tertiary university-affiliated medical center. Investigations typically included multimodal neuroimaging, including diffusion weighted magnetic resonance imaging (MRI) which is amongst the most sensitive means to diagnose ischemic stroke. The study was approved by the UCLA Institutional Review Board.

Statistical Methods

Test performance characteristics were analyzed based on the directly measured number of true positives (TP), false positives (FP), and false negatives (FN). The number of true negatives (TN) was imputed using the equation: $TNs = \# \text{ of pts with MPDS code retrieved} / NCR - (TPs + FPs + FNs)$, where NCR is the rate of neurologic complaints in the transported population. Sensitivity, specificity, predictive values and likelihood ratios for the dispatcher assigned stroke MPDS codes were calculated in standard fashion, with the final discharge diagnosis as the reference standard. Confidence intervals for these values were calculated using efficient-score method.⁵

RESULTS

During the 12-month study period, 3474 patients were transported by LAFD ambulances to UCLA Medical Center. Amongst these, 1283 (36.9%) involved patients with chief complaints potentially referable to the nervous system, and potentially related to acute cerebrovascular disease. 96 patients had a final diagnosis of stroke or TIA (2.8% of total transports). Of the patients identified with neurologic chief complaints, 871 (67.9%) had retrievable dispatcher assigned MPDS codes. In the remainder, MPDS codes were not recorded or illegible on the paramedic run sheets and could not be retrieved from the LAFD mainframe due to missing or invalid incident numbers.

Among the 871 patients, there were 58 patients with a MPDS dispatch code of stroke, of whom 26 (44.8%) had a final diagnosis of acute cerebrovascular disease (true positives) and 32 (55.2%) a non-stroke diagnosis (false positives). The leading final discharge diagnoses for the 32 false positive patients were: cardiac / respiratory related (19%), vertigo / syncope / altered level of consciousness (22%), hypotension / hypovolemia (13%), malignancy (9%), infection (9%).

Eight hundred and thirteen patients had non-stroke MPDS codes and within this group there were 38 (4.7%) with stroke discharge diagnoses (false negatives) and 775 (95.3%) with non-stroke discharge diagnoses (true negatives). For the group of 38 stroke patients not correctly identified by dispatchers, the most commonly (>5% frequency) assigned non-stroke MPDS codes were: not alert (29.6%), unconscious (16.1%) and cardiac (10.7%). Test performance characteristics for the MPDS dispatch codes for stroke are shown in Table 2. While specificity was high, sensitivity and positive predictive value were modest.

The mean (\pm SD) age for stroke patients correctly and incorrectly identified by dispatchers did not differ (correct 75.5 \pm 19.7 vs. incorrectly 71.9 \pm 21.4). With regard to gender, 71.3% of male stroke patients were misidentified compared to 56.2% of female; however, this difference failed to achieve significance (p=0.187)

DISCUSSION

In this study, the current national algorithm for EMD diagnosis of stroke demonstrated only modest sensitivity and positive predictive value. Over the 12-month study period, EMS

dispatchers correctly recognized 45% of patients with a final discharge diagnosis of stroke or TIA as suffering from acute cerebrovascular disease. Conversely, more than half of the patients assigned a stroke code by EMDs were non-stroke patients. Our findings confirm and expand those of a study of MPDS dispatch algorithm in the city of San Diego published after the initial submission of this manuscript.¹⁶ Both studies found that the MPDS exhibited only modest positive predictive value, 45% in Los Angeles and 42.5% in San Diego, indicating that the majority of patients identified as having stroke by dispatchers using the MPDS do not actually have stroke. As we identified stroke final diagnoses in all transports, not just those with dispatcher diagnosis of stroke, we were able to delineate specificity and negative predictive value and more accurately delineate sensitivity than in the San Diego investigation. We found that high rates of specificity and negative predictive value, but only modest sensitivity performance. More than half of patients who had a final diagnosis of stroke were not recognized as having stroke by dispatchers.

A content analysis of the MPDS stroke recognition algorithm suggests inadequate emphasis upon motor stroke symptoms as a likely cause of suboptimal performance. Dispatchers are instructed to ask directly only about symptoms of talking abnormally and decreased level of consciousness. These symptoms and signs are present in only about 50–65% of strokes. Motor weakness, especially asymmetric, is the most discriminating sign of stroke in the prehospital setting. Motor symptoms are present in 80–90% of all stroke patients, and an even greater proportion of patients for whom the 911 call system is activated.^{4, 6–10} However, inquiry regarding motor symptoms only occurs in the QA Guide v11 protocol if the caller first states the patient is having a stroke.

In a study by Italian investigators of dispatcher phone encounters with 177 consecutive potential stroke patients, among 8 questions evaluated, only 3 were found to be statistically associated with stroke: mouth asymmetry, arm weakness, and leg weakness.¹¹ Demonstrating poor sensitivity and specificity for stroke were queries regarding level of consciousness, comprehension, speech output, headache, and vertigo. However, level of consciousness and speech abnormality are emphasized in the current MPDS algorithm, despite their lack of sensitivity and specificity for stroke. The misidentification of multiple stroke-mimicking conditions as representing stroke that we documented, including multiple cardiovascular and respiratory conditions, is to be expected given the many other conditions that disturb language output and alertness and the large number of true strokes that leave speech output and alertness undisturbed.¹¹

Contributing to poor dispatcher recognition of stroke is the lack of public awareness of stroke symptoms. In a population based survey conducted in 1995, a majority of elderly individuals failed to list at least one stroke warning sign.¹² In studies of EMS calls related to stroke, “stroke” was identified as the problem by the caller less than half of the time (range 19.8–44%)^{3, 13} and even when patients use the word “stroke” they are frequently assigned non stroke codes.^{2, 14}

This study has some limitations, many inherent to research conducted using prehospital forms and administrative databases. Data from 32% of the paramedic run sheets had MPDS codes that were either illegible or not recorded, a rate typical in prehospital studies.¹⁵ We could not identify any systematic difference between cases in which a transport form was retrievable and interpretable, and cases in which forms were not available; however, it not possible to fully exclude a selection bias. Due to the unavailable forms, the specificity and NPV values derived in this study were arrived at by combining direct measures with the assumption of no difference between available and unavailable form cases. However, for low frequency conditions, test utility is better indicated by PPV and sensitivity than by NPV and specificity. Sensitivity and PPV were directly measured in this study.

In conclusion, this study shows that the current national algorithm for EMS dispatcher recognition of stroke is suboptimal, with EMDs failing to recognize stroke in more than half of true stroke 911 calls. Revision of the algorithm to emphasize asymmetric motor deficits and de-emphasize altered level of consciousness likely would improve dispatcher performance without increasing interview duration and merits prospective study. Furthermore, the results emphasize that paramedics and emergency medical technicians, as the next stage of contact in the chain of prehospital care, must perform well in identifying stroke as dispatch codes will often be incorrect.^{4, 17} Accurate identification of acute stroke patients in the field permits pre-arrival notification of the receiving hospital, clearing of the CT or MR scanner for rapid imaging, earlier assessment by stroke team physicians, more frequent recanalization therapy treatment¹⁸ and direct routing of appropriate patients to designated Stroke Centers.

Additionally, efforts to educate the public on the symptoms of stroke should continue as this may enhance the ability of callers to communicate relevant information and assist dispatchers in identifying stroke.¹⁹ Finally, public education regarding the appropriate use of 911 for stroke should continue as the Emergency Medical Services system remains the timeliest means of accessing acute stroke care.²⁰

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Table 1

Stroke interview algorithm in QA Guide version 11.1 of the Medical Priority Dispatch System.

When a question of stroke is raised, dispatchers are instructed to ask the caller the following key questions in the following sequence:

- 1) Is s/he completely awake (alert)?
 - 2) Is s/he breathing normally?
 - 3) Is s/he able to talk normally?
 - 4) Tell me why you think it's a STROKE?
 - Movement problems
 - Speech problems
 - Numbness or tingling
 - 5) When did this start (happen)?
 - 6) Has s/he ever had a STROKE before?
-

Table 2

Test parameters and 95% confidence intervals for dispatcher assigned MPDS stroke codes validated against final discharge diagnosis of stroke or transient ischemic attack

	Estimated Value	95% Confidence Interval	
		Lower Limit	Upper Limit
Sensitivity	0.41	0.29	0.54
Specificity	0.96	0.94	0.97
PPV	0.45	0.32	0.58
NPV	0.95	0.94	0.97
Test Accuracy	0.92	0.90	0.94
LR+	10.25	6.52	16.08
LR-	0.62	0.51	0.76

PPV=positive predictive value; NPV=negative predictive value; LR=likelihood ratio