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Prehospital Emergency Care

Publication details, including instructions for authors and subscription information:

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A nationwide prehospital stroke survey

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Online Publication Date: 01 July 1999

To cite this Article Crocco, Todd J., Kothari, Rashmi U., Sayre, Michael R. and Liu, Tiepu(1999)'A nationwide prehospital stroke survey',*Prehospital Emergency Care*,3:3,201 — 206

To link to this Article: DOI: 10.1080/10903129908958937

URL: <http://dx.doi.org/10.1080/10903129908958937>

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A NATIONWIDE PREHOSPITAL STROKE SURVEY

Todd J. Crocco, MD, Rashmi U. Kothari, MD, Michael R. Sayre, MD, Tiepu Liu, MD, DrPH

ABSTRACT

Objectives. To identify deficiencies in stroke knowledge among prehospital providers. **Methods.** A nationwide multiple-choice survey was sent to 689 paramedics (EMT-Ps) and 294 advanced EMTs (EMT-Is) from a random selection of the National Registry of Emergency Medical Technicians database. Of the 23 questions, five addressed demographic information, four quantity of training, five general knowledge, and seven management, and two open-ended questions addressed the signs, symptoms, and risk factors of stroke. The EMT-P and EMT-I answers were compared using chi-square analysis or Fisher's exact test. **Results.** Of the 355 (36%) respondents, 256 (72%) were EMT-Ps and 99 (28%) were EMT-Is. Virtually all the EMT-Ps (99%) and EMT-Is (98%) knew that a stroke injures the brain, but only 199 (78%) of the EMT-Ps and 47 (47%) of the EMT-Is correctly defined a transient ischemic attack (TIA) ($p < 0.001$). Slurred speech, weakness/paralysis, and altered mental status were the three most commonly cited symptoms of stroke by both groups. The EMT-Ps were more likely to recognize that dextrose is potentially harmful to stroke patients [EMT-P = 216 (85%), EMT-I = 71 (72%), $p = 0.005$]; 169 (66%) of the EMT-Ps and 75 (76%) of the EMT-Is felt that elevated blood pressures should be lowered in the prehospital setting. Only 93 (36%) of the EMT-Ps and 22 (22%) of the EMT-Is knew that tissue plasminogen activator (tPA) must be given within three hours of symptom onset ($p = 0.01$). **Conclusion.** Most EMS providers are knowledgeable about the symptoms of stroke but are unaware of the therapeutic window for thrombolysis and the recommended avoidance of prehospital blood pressure reduction. In addition, further education is needed regarding TIAs. **Key words:** stroke; emergency medical services; thrombolytics; transient ischemic attack.

PREHOSPITAL EMERGENCY CARE 1999;3:201-206

Received January 22, 1999, from the Department of Emergency Medicine, University of Cincinnati, Cincinnati, Ohio (TJC, RUK, MRS, TL). Revision received March 12, 1999; accepted for publication March 12, 1999.

Presented at the Midwest Society for Academic Emergency Medicine Regional Research Forum, Columbus, Ohio, April 1998, the Society for Academic Emergency Medicine annual meeting, Chicago, Illinois, May 1998, and the National Association of EMS Physicians mid-year meeting, Lake Tahoe, Nevada, July 1998.

Supported by an unrestricted educational grant from Janssen Pharmaceutica Inc.

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Tissue plasminogen activator (tPA) has been shown to improve neurologic outcome if administered within three hours of symptom onset in a patient with acute ischemic stroke.¹ A major exclusionary factor to the use of thrombolytics in stroke patients is delayed time to evaluation from symptom onset.² Previous studies have shown that up to 50%–60% of acute stroke patients present to the hospital within three hours of symptom onset.^{3,4} Emergency medical services (EMS) personnel may be instrumental in reducing the time to thrombolysis if they are able to quickly and accurately recognize the symptoms of stroke and alert the receiving hospital of their impending arrival.^{5,6} As a preliminary step in designing a new stroke curriculum for all levels of EMS education, it is prudent to discern the existing knowledge base of these personnel. The purpose of this survey was to define the current strengths and weaknesses of EMS personnel knowledge as it relates to stroke and to compare the stroke knowledge bases between paramedics (EMT-Ps) and advanced EMTs (EMT-Is).

METHODS

A nationwide survey was sent to a sample of EMT-Ps and EMT-Is, which was randomly generated from the National Registry of Emergency Medical Technicians database in Columbus, Ohio. The database's random generation function was employed separately for the EMT-P and EMT-I registrants. A total of 1,000 individuals were selected from the combined registries of approximately 38,500 EMT-Ps and 11,500 EMT-Is. If an individual was selected more than once ($n = 17$), then the duplicate selection was discarded. Identical surveys were mailed to EMT-Ps in 46 states plus the District of Columbia and to EMT-Is in 26 states plus the District of Columbia. All surveys were mailed to civilian EMS personnel. Military EMS personnel were excluded due to the differences in personnel training and patient population. The survey consisted of 21 multiple-choice questions and two open-ended questions (Appendix). Specifically, five questions addressed participant demographic information, four addressed quantity of stroke training, five assessed general stroke knowledge, seven assessed stroke management, and the two open-ended (fill-in-the-blank) questions addressed the signs, symptoms, and risk factors of stroke. Any survey recipient who did not return the initial mailing within six to eight weeks was sent an identical second survey. No further follow-up with nonresponders was attempted. Individuals whose surveys were returned as undeliverable were considered to be nonrespondents.

TABLE 1. Demographic Information of the Survey Respondents and Nonrespondents

Demographics	EMT-P	EMT-I	EMT-P Nonrespondents	EMT-I Nonrespondents
States represented	39	14	45	25
Age (years)	21-30	21-30	21-30	21-30
Years of experience	1-5	1-5	1-5	1-5
Urban participants	33%	28%	N/A	N/A
Suburban participants	34%	23%	N/A	N/A
Rural participants	33%	49%	N/A	N/A

Ranges for age and years of experience as well as proportions for signs/symptoms and each risk factor were calculated. Chi-square (χ^2) analysis was used to examine differences between responders and nonresponders by groups of age and years of experience. The EMT-P and EMT-I responses were compared using the χ^2 test or Fisher's exact test. Differences in proportion of each response between the two EMT groups were presented together with 95% confidence intervals (CIs) of the difference. If the 95% CI of the difference excludes zero, then it is considered to be statistically significant.

This study qualified for exemption from review by the institutional review board at our institution.

RESULTS

A total of 983 surveys were mailed (689 surveys mailed to EMT-Ps, 294 surveys mailed to EMT-Is). Three hundred fifty-five (36%) surveys were returned (256 EMT-P, 99 EMT-I). Survey responders were similar to nonresponders in terms of age and years of experience. Among the responders, there was no significant difference in response rates between the EMT-Ps (37%) and the EMT-Is (34%) (95% CI: -3% to 10%). In addition, there was no demographic difference between the

paramedics and advanced EMTs, except that a larger proportion of EMT-Is were from rural areas (Table 1).

Stroke Education and General Knowledge

The majority of the EMTs reported having between one and five hours of stroke instruction during their initial training [172 (68%) EMT-Ps, 59 (60%) EMT-Is, $p = 0.14$]. Twenty-three (9%) of the EMT-Ps reported having less than one hour of instruction on stroke during their initial training, while 24 (24%) of the EMT-Is responded the same ($p = 0.001$). Following their initial training, 120 (47%) EMT-Ps and 56 (57%) EMT-Is stated they had never had a subsequent review session on stroke. When asked whether they felt their knowledge of stroke was adequate, 96 (38%) EMT-Ps answered "no," as did 47 (48%) EMT-Is. Of the 128 EMT-P and 41 EMT-I participants who did report having a stroke review session, 87 (68%) EMT-Ps and 26 (63%) EMT-Is felt their stroke knowledge was adequate.

Both groups of prehospital care providers could correctly identify the organ system affected by strokes [253 (99%) of EMT-Ps, 97 (98%) of EMT-Is]. However, 56 (22%) of EMT-Ps and 51 (52%) of EMT-Is could not correctly define a transient ischemic attack (TIA), $p < 0.001$. The most common incorrect answer was "A TIA is a stroke with only a small neurologic deficit." The majority of EMT-Ps and EMT-Is recognized that cerebral infarction, intracerebral hemorrhage, and subarachnoid hemorrhage were types of stroke, but EMT-Is were more likely to consider subdural and epidural hematomas to be types of stroke (Fig. 1).

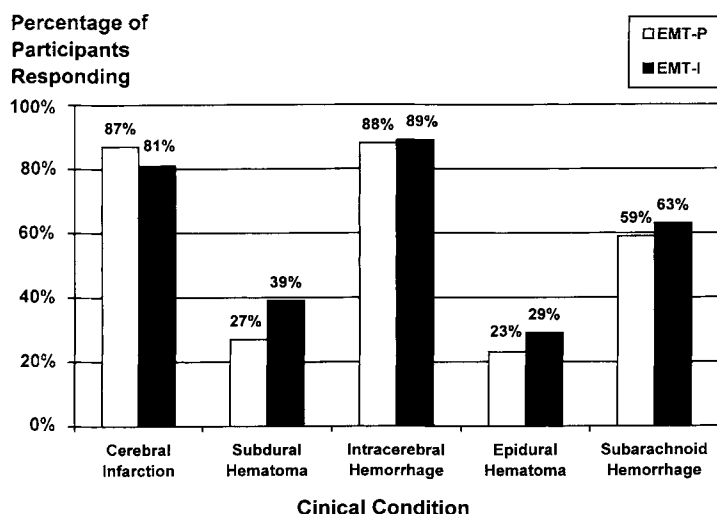


FIGURE 1. Clinical entities thought to be a type of stroke by EMT-Ps and EMT-Is.

Knowledge Regarding Signs, Symptoms, and Risk Factors

Participants were asked to list signs, symptoms, and risk factors of stroke. In the open-ended question format, 100% of both the EMT-Ps ($n = 256$) and the EMT-Is ($n = 99$) knew at least one correct sign or symptom of stroke. The most frequent response among symptoms was paralysis (Table 2). Incorrect answers included angina, shoulder pain, and automatisms. Also, 100% of all the EMT-Ps and EMT-Is could identify at least one risk factor for stroke (Table 3). Hypertension and smoking were the most commonly cited risk fac-

TABLE 2. Commonly Reported Signs and Symptoms of Stroke by EMT-Ps and EMT-Is

Sign/Symptom	EMT-Ps	EMT-Is	Difference (95% CI)
Paralysis	55%	72%	-17% (-28% to -6%)
Weakness	51%	27%	24% (13% to 34%)
Altered mental status	48%	58%	-10% (-21% to 2%)
Slurred speech	56%	46%	10% (-2% to 21%)
Facial droop	41%	26%	15% (4% to 25%)
Headache	20%	27%	-7% (-18% to 2%)
Hypertension	30%	24%	6% (-4% to 16%)

TABLE 3. Risk Factors for Stroke Most Commonly Reported by EMT-Ps and EMT-Is

Risk Factor	EMT-Ps	EMT-Is	Difference (95% CI)
Hypertension	77%	68%	9% (-1% to 20%)
Smoking	52%	51%	1% (-11% to 13%)
Diabetes mellitus	26%	16%	10% (1% to 19%)
Family history	26%	23%	3% (-7% to 13%)
Atherosclerosis	26%	24%	2% (-8% to 12%)
Hypercholesterolemia	25%	23%	2% (-8% to 12%)
Obesity	21%	21%	0% (-9% to 10%)
Age	15%	23%	-8% (-17% to 1%)
Prior stroke	12%	13%	-1% (-9% to 7%)

tors. Incorrect answers included seizure disorder, poor nutrition, and angina.

All the survey recipients were asked to select medical conditions that may manifest as symptoms similar to those seen in stroke patients (Fig. 2). Two hundred seventeen (88%) of the EMT-Ps and 74 (80%) of the EMT-Is recognized that hypoglycemia may clinically manifest as symptoms similar to stroke.

Stroke Management

The survey contained a question that described a patient with acute neurologic deficits consistent with a severe stroke. When asked about the need for prehospital evaluation, 64 (25%) of the EMT-Ps and 35 (35%) of the EMT-Is felt this should occur on a nonemergent (EMS response could occur up to one hour after 911 call) basis. Only 93 (36%) of the EMT-Ps and 22 (22%) of the EMT-Is knew that tPA must be given within three hours of symptom onset in stroke patients. Both groups agreed, however, that the patient should be transported in an advanced life support ambulance [246 (97%) of EMT-Ps, 82 (83%) of EMT-Is]. More EMT-Ps ($n = 216, 85%$) than EMT-Is ($n = 71, 72%$) recognized that the administration of glucose to a potential stroke victim who is not hypoglycemic may be harmful ($p = 0.005$). Fully 169 (66%) of the EMT-Ps felt elevated blood pressures in stroke patients should be lowered in the prehospital setting. Seventy-five (76%) of the EMT-Is answered the same.

One hundred ninety-six (79%) of the EMT-Ps and 62 (65%) of the EMT-Is responded that all stroke patients should have an IV inserted, oxygen administered, serum blood sugar measured, and cardiac monitoring (Fig. 3).

DISCUSSION

Stroke is the third leading cause of death in the United States and the leading cause of adult disability.⁷ Recent studies have estimated that approximately 800,000 new strokes occur each year, and the estimated annual cost of stroke is thirty billion dollars.^{8,9}

Recent large randomized trials of tPA in patients with acute ischemic stroke suggest that thrombolysis is more efficacious when given earlier in the course of cerebral ischemia.^{1,10,11} Furthermore, benefit has been shown only if the patient receives thrombolysis within three hours of symptom onset. Based on these findings,

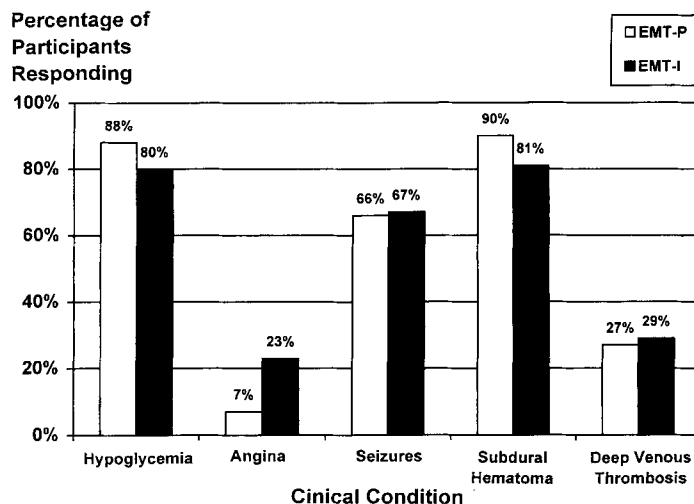


FIGURE 2. Medical conditions thought by EMT-Ps and EMT-Is to manifest similar to stroke.

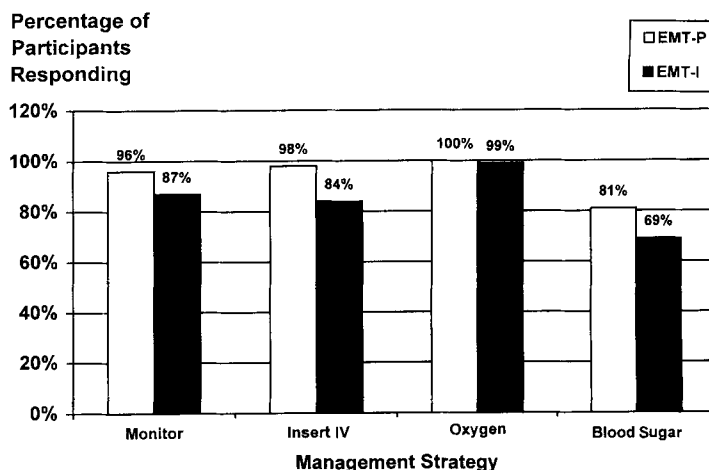


FIGURE 3. EMT-P and EMT-I management strategies for potential stroke patient.

it has been recommended that EMS personnel assign an "emergent" priority to these patients.¹² Prehospital care providers should be appropriately trained to recognize, assess, manage, and transport stroke victims.

Prior studies have evaluated the accuracy of paramedic identification of stroke and TIA in the prehospital setting.^{6,13,14} These studies reported that paramedics had 61%–74% sensitivity and 77% positive predictive value in identifying stroke/TIA patients. The authors suggest that efforts should be taken to improve early stroke identification by EMS personnel.

In our survey, the majority of EMT-Ps and EMT-Is reported having only minimal (one to five hours) initial training in stroke. Despite the recent educational emphasis on stroke by the American Heart Association, the National Stroke Association, and the National Institutes of Health, a large percentage of both groups deny having any subsequent review sessions. Almost half of all the prehospital personnel surveyed did not feel their knowledge of stroke was adequate. An informal review of major textbooks for EMS training reveals that stroke receives little discussion. In three well-recognized prehospital textbooks,^{15–17} fewer than five pages are dedicated to stroke, despite each text's exceeding 700 pages. Considering that stroke is the third leading cause of death and the leading cause of adult disability in the United States, increased textbook emphasis on this topic may be warranted. Furthermore, more extensive and routine prehospital care provider education on stroke-related developments and recommendations may improve the prehospital management of these patients.

The majority of both groups were able to correctly define a stroke, but significantly fewer could do the same for TIAs. The majority of the EMT-Ps and EMT-Is recognized that a TIA is a warning sign for a subsequent stroke and that patients need medical attention; however, their survey responses suggest that both groups are unclear as to what constitutes a TIA.

Regarding the use of tPA in patients with acute ischemic stroke, fewer than half of both groups knew that tPA should be given within three hours of symptom onset to be effective. The lack of knowledge regarding the need for rapid evaluation and treatment is further emphasized by the fact that 25% of the EMT-Ps and 35% of the EMT-Is felt that a patient with an acute stroke could be evaluated on a nonemergent basis. The survey participants who reported having a review session on stroke were not more likely to know the time limitation for using tPA; however, this may not have been an educational aspect of their review session.

With the exception of rapid evaluation and transport, both groups advocated thorough monitoring and management of stroke patients (IV insertion, blood glucose measurement, oxygen administration, and cardiac monitoring). The majority of the EMT-P and EMT-I an-

swers suggested that cardiac monitoring, IV insertion, oxygen application, and blood sugar measurement would be routine components of their management of a patient with an acute stroke. However, a significant portion of both groups (66% of EMT-Ps, 76% of EMT-Is) wanted to lower elevated blood pressures, which is not recommended in the prehospital setting.¹⁸ An abrupt decrease in stroke patients' blood pressure can worsen cerebral perfusion as a consequence of impaired cerebral autoregulation in the ischemic state (especially those with long-standing hypertension).¹⁹

Prior studies have suggested that up to 28% of stroke patients are not recognized as having a stroke in the field.⁶ This has been thought to be secondary to a lack of knowledge regarding the signs and symptoms of a stroke by prehospital personnel. However, this study suggests that most EMT-Ps and EMT-Is know at least one sign or symptom of a stroke. An alternative explanation for the poor sensitivity in identifying stroke patients may be that prehospital care providers do not elicit these signs and symptoms in clinical practice. Investigators have developed "prehospital stroke scales" in an attempt to standardize the prehospital evaluation of stroke patients and improve diagnostic accuracy.^{6,14} These scales are simple and reproducible and often can be performed in less than 30 seconds.^{6,14,20}

Since this study was designed as a survey, it has several intrinsic limitations. First is the return rate of 36%. Only 355 (36%) surveys were returned from the initial mailing of 983. After the first mailing, 25% ($n = 246$) of survey recipients had participated. The second mailing recruited an additional 11% ($n = 109$). The low response rate exposes the study results to potential selection bias. However, comparing responders with nonresponders revealed no significant difference in major demographic factors, including age and years of experience. Second, the National Registry of Emergency Medical Technicians database is relatively new and has a bias toward younger prehospital care providers, as evidenced by the fact that the majority of our survey participants had one to five years of training. Recruitment into this database is made at the time an individual takes the nationally standardized exam. The majority of these individuals are younger and new to the field of EMS. With the current emphasis on stroke, the more recently trained EMS personnel would be expected to be more comfortable with their stroke knowledge base. A survey involving a more comprehensive sample of EMT-Ps and EMT-Is might reveal more extensive lack of knowledge. A third limitation of our study is that it did not evaluate basic EMTs (EMT-Bs). The majority of EMS responses are performed by EMT-Bs.²¹ The stroke knowledge base of EMT-B personnel may be less than that of EMT-Ps and EMT-Is due to fewer hours of mandatory training. A future survey should target this population for assessment of their stroke knowledge

base. Finally, all survey recipients were asked to complete the survey without the assistance of a textbook or another individual. Participant compliance with this request was not assessed.

CONCLUSIONS

Paramedics (EMT-Ps) and EMT-Is are very knowledgeable about the signs, symptoms, and risk factors of stroke. However, they are less informed about recent advances in stroke therapy and the need for rapid evaluation and treatment. In addition, though they recognized the morbidity associated with TIAs, the majority of EMT-Is could not correctly define what constitutes a TIA. Further prehospital stroke educational efforts should focus on correcting these deficiencies. Since a large percentage of EMS personnel surveyed did not feel their stroke knowledge base was adequate, increased efforts in EMS stroke education are needed.

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APPENDIX

Stroke Survey, with Answer Percentages for Emergency Medical Technicians in Parentheses (EMT-P, EMT-I)

1. What is your age range?

A. < 20 years	(2%, 7%)
B. 21-30 years	(65%, 58%)
C. 31-40 years	(27%, 26%)
D. 41-50 years	(6%, 5%)
E. > 50 years	(0%, 4%)
2. What is your highest level of training?

A. EMT-Basic	(0%, 0%)
B. EMT-Intermediate	(0%, 100%)
C. EMT-Paramedic	(100%, 0%)
D. RN	(0%, 0%)
E. Other	(0%, 0%)
3. How many years have you been either an EMT, paramedic, nurse, or other prehospital care provider?

A. < 1 year	(6%, 12%)
B. 1-5 years	(46%, 63%)
C. 6-10 years	(34%, 12%)
D. 11-15 years	(9%, 8%)
E. > 15 years	(5%, 5%)
4. How would you describe your department?

A. Full-time members	(39%, 27%)
B. Part-time members	(8%, 20%)
C. Combination full-time and part-time	(52%, 53%)

5. How many hours of instruction did you receive on stroke in your initial training as an EMT, para medic, or nurse?
- A. None (0%, 1%)
 - B. Less than 1 hour (9%, 24%)
 - C. 1 hour to 5 hours (68%, 60%)
 - D. Greater than 5 hours (23%, 15%)
6. Has your department ever had review sessions dedicated to the topic of stroke?
- A. Yes (53%, 43%)
 - B. No (47%, 57%)
7. Does your department have a stroke protocol (that is, a specific set of instructions on the management of stroke)?
- A. Yes (66%, 44%)
 - B. No (33%, 56%)
8. How would you describe your department?
- A. Urban setting (33%, 28%)
 - B. Suburban setting (34%, 23%)
 - C. Rural setting (33%, 48%)
9. Do you feel that your knowledge of stroke is adequate?
- A. Yes (62%, 52%)
 - B. No (38%, 48%)
10. A stroke injures which part of the body?
- A. Heart (0%, 0%)
 - B. Lungs (0%, 0%)
 - C. Spinal cord (0%, 1%)
 - D. Brain (99%, 98%)
 - E. Arms and/or legs (0%, 1%)
11. A transient ischemic attack (TIA) is:
- A. A stroke that completely resolves within 24 hours (78%, 47%)
 - B. A stroke that only leads to weakness in one arm (2%, 8%)
 - C. A stroke with only a small neurologic deficit (18%, 30%)
 - D. A stroke due to a bleeding cerebral aneurysm (1%, 9%)
 - E. A stroke that is due to heart attack (0%, 5%)
12. The significance of a TIA is:
- A. The patient will have permanent neurologic deficits (0%, 0%)
 - B. It is a signal that a "silent" heart attack has occurred (0%, 3%)
 - C. It is frequently the first sign of an impending seizure (1%, 0%)
 - D. It warns of a potential future stroke (96%, 79%)
 - E. They usually cause severe headaches (2%, 18%)
13. Which IV fluid is appropriate for the routine stroke patient?
- A. D5W at a wide open rate (0%, 3%)
 - B. D5 normal saline at 150 mL/hr (0%, 5%)
 - C. Normal saline at KVO (94%, 75%)
 - D. D5W at 100 mL/hr (4%, 13%)
 - E. Normal saline at 200 mL/hr (2%, 3%)
14. Current research demonstrates that the treatment of stroke patients with tissue plasminogen activator (tPA) must begin within _____ hours of symptom onset.
- A. 1 (24%, 40%)
 - B. 1½ (13%, 13%)
 - C. 3 (36%, 22%)
 - D. 6 (23%, 22%)
 - E. 12 (4%, 2%)
15. A patient who is alert and breathing normally with sudden onset of right-sided paralysis that started one hour ago needs to be evaluated by prehospital personnel:
- A. Emergently (within 8 min. of 911 call) (75%, 65%)
 - B. Urgently (within 20 min. of 911 call) (22%, 30%)
 - C. Nonurgently (within 1 hour of 911 call) (3%, 5%)
 - D. Does not require EMS response (0%, 0%)
16. The above patient should be transported by:
- A. Private car (0%, 0%)
 - B. Basic ambulance (3%, 16%)
 - C. Paramedic ambulance (97%, 83%)
 - D. No transport at this time; only follow-up in 1 to 2 days (0%, 1%)
17. Administration of dextrose, either by bolus or in IV fluids, may be harmful to the stroke patient.
- A. True (85%, 72%)
 - B. False (15%, 28%)
18. When caring for patients with stroke in the pre-hospital setting, the blood pressure (BP) should be lowered if it is higher than:
- A. 120/80 (0%, 0%)
 - B. 140/90 (6%, 14%)
 - C. 180/110 (32%, 37%)
 - D. 240/140 (28%, 24%)
 - E. BP should not usually be lowered (34%, 24%)
- Questions 19, 20, and 21 may require one or more answers. Circle all that are correct.
19. All patients with symptoms of a stroke that started within the last 24 hours should: (*circle one or more*)
- A. Be placed on a cardiac monitor (96%, 87%)
 - B. Have an IV started (98%, 84%)
 - C. Be placed on oxygen (100%, 99%)
 - D. Have blood sugar measured (81%, 69%)
20. Which medical problems listed below may present with symptoms similar to those seen in stroke patients? (*circle one or more*)
- A. Hypoglycemia (88%, 80%)
 - B. Angina (7%, 23%)
 - C. Seizures (66%, 67%)
 - D. Subdural hematoma (90%, 81%)
 - E. Deep venous thrombosis (27%, 29%)
21. Which of the following are types of strokes? (*circle one or more*)
- A. Cerebral infarction (87%, 81%)
 - B. Subdural hematoma (27%, 39%)
 - C. Intracerebral hemorrhage (88%, 89%)
 - D. Epidural hematoma (23%, 29%)
 - E. Subarachnoid hemorrhage (59%, 63%)
- For questions 22 and 23, write your answers on this survey!
22. Name four signs or symptoms commonly seen in stroke patients.
- A. _____
 - B. _____
 - C. _____
 - D. _____
23. Name four factors that increase the risk of having a stroke.
- A. _____
 - B. _____
 - C. _____
 - D. _____