# Reducing Prehospital Stroke Delays: The Impact of Stroke Education on Suburban High School Students

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## ABSTRACT

This study aimed to reduce prehospital stroke treatment delays by raising awareness of strokes, symptoms, and hospital designations in suburban high-school students. Limited access to stroke centers in rural and suburban communities significantly contributes to treatment delays, with lack of symptom awareness, treatment urgency, and hospital designations being a factor in reducing delays. A convenience sample of 25 high school students (ages 16-18) from Amherst, Ohio participated in an educational intervention about strokes, stroke types, symptoms, risk factors, treatment, and local stroke centers. Pre- and post- tests measured knowledge of stroke and facility awareness, asking the participants to rate their understanding of stroke and symptoms on a 1-5 scale. Additionally, students were asked about their local hospital and their knowledge of its designation as a stroke center. Results showed statistically significant improvement in stroke understanding, stroke symptom recognition, and hospital designation. The understanding of strokes increased, with mean scores rising from 3.36 to 4.87 (p<0.05). The participants' confidence in stroke symptom identification increased, with mean scores rising from 3.64 to 4.92 (p<0.05). Additionally, there was a 100% decrease in students answering 'I don't know' when asked to identify stroke facilities. Findings suggest that stroke education can effectively improve stroke symptom recognition in youth, emphasizing the potential of early stroke education as a strategy for reducing prehospital delays in stroke treatment. Future research could explore age-diverse populations and broader geographic regions to further assess the impact of stroke education on prehospital response times.

## Introduction

In metropolitan areas where stroke centers were plentiful, patients who require stroke treatment could more easily access appropriate facilities as they were a quick ambulance ride away. Contrarily, people living in rural and suburban regions have more challenges accessing stroke care, as stroke centers could be hours away, or a helicopter ride away. According to Klaus et al. (2020), undertreatment of stroke was higher in rural areas because most stroke centers were in metropolitan areas. In a retrospective study of a mixed rural-urban area, patients who lived in rural areas had a 4 minute longer dispatch-to-EMS arrival time, and a 50 minute longer transport time when compared to patients living in urban areas (Varjoranta et al., 2019). While transport time was a significant contributor to prehospital delays, solutions are difficult because transport times are a non-modifiable variable, as distances do not change during an emergency.

While transport time is an unmodifiable contributor, early stroke recognition is a modifiable factor that could aid in reducing prehospital delays. A main attributor of prehospital delay was poor knowledge about the urgency of a stroke (Klaus et al., 2020). The inability to recognize stroke symptoms caused patients to self-treat or seek non-medical support before going to the hospital, which resulted in significant delays in appropriate treatment (Potisopha et al., 2022). Recognizing stroke symptoms and seeking timely medical care is important for effective treatment and recovery.

# Purpose

The purpose of the study was to reduce delays in stroke treatment by educating suburban high school-aged students about strokes, stroke symptoms, and the critical importance of seeking timely care at a designated stroke center. Although adolescents are not typically at risk for stroke and are not primary decision-makers in managing stroke-related emergencies, existing research indicates that youth had a critical role in minimizing prehospital transport delays. Studies have shown that children were capable of expediting emergency response by contacting emergency services upon recognition of stroke symptoms, thereby contributing to reduced prehospital delays (Beal et al., 2016).

# Methods

## Participants

A convenience sample of 25 subjects participated in the study. Subjects were both male and female, and ages ranged from 16-18 years old. Seven participants were 16, twelve participants were 17, and six participants were 18 years old. The participants were junior and senior-level students in a medical technology course at a suburban high school in Northeast Ohio. Written informed consent forms were signed by parents or legal guardians before the study took place. Inclusion criteria were all students who attended the class. Exclusion criteria were unsigned consent forms. IRB approval was granted by the researcher's institution prior to the study.

## Procedure

The target population for this study were the attendees of a high school located in a suburban community. A suburban community in Northeastern Ohio with a population of 12,681 residents and 5,378 housing units in 2020 was selected for this education intervention (U.S. Census, 2020). The participating school was a public high school serving grades 9-12, with a student population of 1,200, and a student-teacher ratio of 21:1.

An educational presentation about strokes was created to serve as an educational intervention. The presentation included types of strokes, symptoms, side effects, risk factors, and treatments. Ten local stroke centers were within a one-hour commuting radius from the community, and were included in the presentation. A map labeled with the ten stroke centers, complete with their addresses, approximate distances in miles, and estimated commuting times via ground vehicle was also provided (Google Maps, 2024). Ischemic and hemorrhagic strokes were differentiated (Cleveland Clinic Foundation). Side effects of permanent disability, paralysis, headaches, memory and vision problems, dysphagia, and urinary incontinence were discussed (Cleveland Clinic Foundation). Risk factors of high blood pressure, heart disease, diabetes, obesity, sedentary lifestyle, smoking, drugs, and the ages 55 and older were identified (Cleveland Clinic Foundation). Treatments of tPA and urgent surgery were addressed (Cleveland Clinic Foundation). The presentation emphasized the BEFAST stroke symptoms of balance and dizziness, vision changes such as blurred or spotted vision, facial droop, arm drift, slurred speech, and the critical importance of timely treatment by calling for emergency services (Genentech, 2021).

A paper questionnaire was created to assess learning through a pre- and post-test. The same questionnaire was given for both tests. It documented the number of attendees and included the following questions: What is your age?; What is the closest hospital to you? (free response); Is it a stroke center? (Yes, No, I don't know). The questionnaire also included two self-rating questions, asking the participants to rate the following on a scale of 1-5 (1 being "I am not confident" and 5 being "I am confident"): (1) I understand what a stroke is, (2) I can recognize stroke symptoms.

The pretest was administered prior to the educational intervention. Following the pretest, the educational intervention was presented to the class. The posttest was then administered after the education. Results and statistical

analysis were organized and performed using Microsoft Excel 2024 for Mac, with a significance level of $p<0.05$. A qualitative data review was performed for the question, "Is it a stroke center?" Two paired sample t-tests were conducted to assess significant differences in pre- and post-intervention learning for the self-rated scale of 1-5 questions: (1) I understand what a stroke is, (2) I can recognize stroke symptoms.

## Results

**Table 1.** Summary of "Is it a stroke center?"

| Participant Answer | Pre-test | Post-test | Percent Change (%) |
|---|---|---|---|
| Yes | 7 | 23 | +228.57 |
| No | 2 | 2 | 0 |
| I don't know | 16 | 0 | -100 |

**Table 2**. Paired T-Test Results for Self-Rated Questions on a 1-5 Scale

| | Pre-test | | Post-test | | P (T<=t) two tail |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| I understand what a stroke is. | 3.36 | 0.66 | 4.87 | 0.46 | 9.9e-11 |
| I can recognize stroke symptoms. | 3.64 | 0.99 | 4.92 | 0.4 | 1.25e-6 |

Table 1 summarizes responses to the question, "Is it a stroke center?" Table 2 displays the paired t-test results for the self-rated question on a scale of 1-5: (1) I understand what a stroke is, (2) I can recognize stroke symptoms. There was a 228.75% increase in participants answering "Yes" (Table 1). There was no percent change in "No" answers, and there was a 100% decline in participants answering, "I don't know" (Table 1). Results show significant differences in stroke understanding ($p<0.05$, Table 2). Results also show significant differences in stroke symptom recognition ($p<0.05$, Table 2).

## Discussion

The findings of the study show a significant difference between pretest and posttest answers in all questions. A qualitative data review showed significant differences between pretest and posttest answers for the question 'Is it a stroke center?'. Two paired t-tests showed significant differences between pretest and posttest results for the self-rated on a scale of 1-5 questions: (1) I understand what a stroke is, (2) I can recognize stroke symptoms.'

Following the educational intervention, there was a significant change in answers for the question "Is it a stroke center?" A notable change was in the "I don't know" category, where a 100% decline was observed in the posttest, indicating that the educational intervention was successful and effective in teaching the students about stroke

designation. This reduction demonstrates that the educational intervention was able to eliminate uncertainty, confusion, or lack of information that students previously had. In the "Yes" category, a 228.57% increase was observed, highlighting the improved awareness and knowledge about stroke centers, which is crucial in reducing prehospital stroke delays. The stable "No" response suggests that participants recognized that certain facilities do not qualify as stroke designated hospitals, reinforcing that participants retained accurate information about the hospitals that qualify as stroke designations, which is a critical aspect of making informed decisions in stroke emergencies.

Paired t-test results showed significant differences in both self-rated questions on a scale of 1-5: (1) I understand what a stroke is, (2) I can recognize stroke symptoms. With stroke understanding, the increased mean from 3.36 (SD=0.66) to 4.87 (SD = 0.46) suggested that participants' were more confident about their knowledge of strokes. With symptom recognition, the increased mean from 3.64 (SD = 0.99) to 4.92 (SD = 0.4) showed an improvement in stroke symptom recognition, indicating increased confidence in their ability to identify stroke symptoms. Both results had very low p-values ($p<0.05$), indicating that the participants' confidence in their understanding of a stroke and their ability to recognize stroke symptoms significantly improved after the educational intervention. This improved confidence and awareness in stroke understanding and symptom recognition could lead to reduced prehospital delays through early symptom detection and timely contact to emergency services. The increased confidence in stroke recognition in combination with stroke center awareness will allow participants to make quick and informed decisions during stroke emergencies, leading to timely interventions and better patient outcomes.

A notable limitation was a small sample size, with only 25 high school students participating in the study. This limitation restricts the generalizability of the findings, as it may not reflect the broader population's knowledge of stroke symptoms, treatment urgency, and hospital stroke designations. Small sample sizes also increase the risk of sampling bias, as the participants may not reflect diverse backgrounds, education levels, and community awareness. While the results were statistically significant for this group, future studies should include a larger and more diverse sample, which can enhance the validity and applicability of the findings. Populations could include diverse geographic regions, such as rural and urban areas, and a wider range of ages to better evaluate the impact of stroke education on prehospital response times.

## Conclusion

This study effectively demonstrates that stroke education can significantly improve stroke understanding, symptom recognition, and hospital designations in suburban high school students. Statistical significance indicates improvements in confidence, suggesting that the educational intervention was successful in equipping students with necessary skills to respond appropriately in stroke emergencies. The elimination of uncertainty regarding stroke designations further emphasizes the positive impact of educational intervention. By fostering greater awareness and preparedness among youth, such initiatives have the potential to reduce prehospital delays in stroke treatment, ultimately improving patient outcomes. Future research could expand on these findings by including diverse geographics and broader age groups, which could further validate and enhance the effectiveness of stroke education in promoting timely medical intervention. This study highlights the importance of education in community health and the critical role that young people can have in facilitating rapid responses to strokes, contributing to the overall well-being of the community.

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