

# Perceptions of the Feasibility and Benefit of Emergent Hyperglycemia Correction Concurrent with Stroke Reperfusion Treatment

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## Abstract

**Background:** Hyperglycemia is common in acute ischemic stroke and is associated with worse outcomes and higher rates of symptomatic intracerebral hemorrhage following reperfusion therapy. Current stroke protocols prioritize time-sensitive reperfusion treatments, often overlooking hyperglycemia management during the emergent phase of care. This qualitative study explored emergency department registered nurses' (EDRNs) and stroke coordinators' knowledge, perceptions, and barriers regarding hyperglycemia management in acute stroke patients undergoing reperfusion therapy.

**Methods:** A phenomenological approach was used to conduct distance accessible web-based focus group and individual interviews with participants from certified American stroke centers. Thematic analysis identified key patterns related to hyperglycemia management and emergent stroke care.

**Results:** Participants (n=19) represented 9 primary, 3 thrombectomy-capable, and 7 comprehensive stroke centers from 6 states. Several barriers to the emergent management of hyperglycemia in stroke patients were identified, including staffing shortages, time constraints, and the absence of specific protocols. Despite the known impact of hyperglycemia on stroke outcomes, it was generally deprioritized in favor of achieving timely reperfusion treatment. The majority of participants reported that hyperglycemia management was not considered a priority in their institutions, particularly in the acute phase of stroke care. Suggestions to improve management included incorporating hyperglycemia treatment into order sets, improving staff education on its importance, and enhancing resource availability to support concurrent management alongside reperfusion therapies.



**Conclusions:** EDRNs and stroke coordinators recognize the importance of glucose measurement but lack focus on hyperglycemia management due to systemic barriers and time-sensitive treatment priorities. Incorporating hyperglycemia management into acute stroke protocols could improve post-reperfusion outcomes and warrants further investigation.

**Keywords:** Ischemic stroke, hyperglycemia, reperfusion treatment, reperfusion outcomes.

## Introduction

Hyperglycemia is common in patients with acute ischemic stroke, with etiologies that include type 1 and 2 diabetes, as well as stress response with the onset of stroke symptoms. Interestingly, in reperfusion-treated patients with hyperglycemia, numerous studies have consistently shown that brain injury and long-term outcomes are worse as compared to normoglycemic patients.<sup>1-5</sup> Hyperglycemic patients also experience higher risk of symptomatic intracerebral hemorrhage (sICH) following reperfusion therapy.<sup>3,6-10</sup> While current clinical practice standards do not exclude hyperglycemic patients from reperfusion treatment, standards remain silent on correction of hyperglycemia prior to or concurrent with reperfusion therapy.<sup>11</sup>

Clinical trials in stroke patients with hyperglycemia have focused on the management of hyperglycemia goals, targeting improvements in 1 to 3-month outcomes.<sup>12-15</sup> These trials have enrolled patients after reperfusion treatment or patients who were not reperfusion candidates, with some trials failing to provide specific details about the treatment initiation time in relation to reperfusion.<sup>16</sup> Collectively, while intravenous insulin management of hyperglycemia was feasible in these studies,<sup>17-21</sup> there were no improvements in functional status as measured by the modified Rankin Scale at 3-months post-stroke. To date, no published clinical trial data exist to support emergent hyperglycemia correction

in the early minutes after arrival to hospital for patients with acute stroke symptoms, limiting knowledge of whether a safe reduction of blood glucose levels is feasible alongside or prior to reperfusion treatment. Additionally, it remains unknown whether emergent correction of hyperglycemia would improve reperfusion outcomes comparable to those seen in normoglycemic patients.

Emergency department registered nurses (EDRN) and stroke coordinators are vital to the delivery of time-sensitive reperfusion treatment in hyperacute ischemic stroke patients. To date, no studies have explored EDRN and stroke coordinators' knowledge of the effect of hyperglycemia on reperfusion outcomes, nor their perceptions of potential barriers to the provision of concurrent hyperglycemia treatment in reperfusion patients. Understanding EDRN and stroke coordinators' knowledge and perceptions of barriers is essential to develop future interventions that may enable early control of hyperglycemic states in acute stroke patients. This study takes an important first step in exploring knowledge, perceived barriers, and facilitators in EDRNs and stroke coordinators using qualitative methods. This work will lay the foundation for an emergent glycemic control protocol for future testing in hyperglycemic acute stroke patients receiving reperfusion treatment.



## Methods

Ethics approvals were obtained to perform a qualitative study in a national sample of EDRNs and stroke coordinators. A phenomenological approach<sup>22</sup> was used to understand lived experiences tied to emergent treatment of hyperglycemia, awareness of reperfusion outcomes in hyperglycemic patients, and perceived barriers and facilitators to initiating glycemic control concurrent with or prior to reperfusion treatment. The study was funded by a directed grant from benefactor made to the University of Tennessee Health Science Center's College of Graduate Health Sciences.

## Sample

A list of publicly accessible The Joint Commission (TJC) and Det Norske Veritas (DNV) certified stroke centers was assembled from organizational websites and used to draw a random sample of stroke center hospitals to invite for study participation. We estimated the need for approximately 30 participants to reach data saturation, and targeted inclusion of EDRNs and stroke coordinators from primary stroke centers (PSC), thrombectomy-capable stroke centers (TSC), and comprehensive stroke centers (CSC) since immediate emergent processes for glucose measurement, glucose treatment (if any), and delivery of intravenous tissue plasminogen activator (tPA) drugs (tenecteplase [TNK] or alteplase) was expected to be similar across all levels of certified stroke center hospitals.

Ethics board-approved study information sheets were mailed to the chief nursing officers of the randomly selected stroke center hospitals inviting their EDRNs and stroke coordinators to participate in an interview session using distance accessible

web-based technology. Those agreeing to participate were asked to contact the principal investigator via email so that an interview date/time could be assigned. If a selected hospital failed to enroll a participant, a replacement hospital was randomly selected, and this process was repeated as needed to ensure adequate stroke center representation. EDRNs and stroke coordinators choosing to participate were expected to self-assess their eligibility using the inclusion and exclusion criteria listed in Table 1. We deliberately excluded advanced practice providers that were board certified as advanced neurovascular practitioners (ANVP-BC) out of concern for expert knowledge that would not reflect the typical knowledge levels of EDRNs or stroke coordinators responding to stroke alerts in emergency departments.

## Interview Conduct

All participants were provided with a code number to use in place of their names and places of employment during their assigned interview. Additionally, participants were instructed to remove any identifying photos, phone numbers, or names from their log-in, and to keep cameras turned off prior to joining the group. An interview consent script that detailed the study purpose and methods was read verbatim at the start of the interview, and verbal consent from each participant was obtained prior to moving forward with interview questions. The study was conducted using individual and group semi-structured interviews supported by a standardized interview guide (Table 2). Focus group and individual interviews were conducted to accommodate the scheduling challenges of working nurses and ensure their availability for participation. Following interview completion, participants were



compensated with a \$50 e-gift card for their contributions to the study.

### Data Analysis

Interviews were transcribed verbatim from interview recordings. Transcripts were

entered into NVivo 14 software (Lumivero , February 2024) for analysis. Responses were individually reviewed line by line with all contributions deemed equally important to the study. Data were coded based on emerging themes and ultimately clustered

**Table 1: Study Inclusion and Exclusion Criteria**

Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none"> <li>English language fluency</li> <li>≥ 2 years of emergency stroke response experience</li> <li>Clinical experience assisting with ≥ 5 tissue plasminogen activator (either alteplase or tenecteplase) and/or thrombectomy stroke treatments</li> <li>Employed in a certified primary stroke center, thrombectomy-capable stroke center, or comprehensive stroke center in the United States</li> </ul>	<ul style="list-style-type: none"> <li>Board certified as an advanced neurovascular practitioner (ANVP-BC) advanced practice provider</li> </ul>

**Table 2: Semi-Structured Interview Guide**

<ol style="list-style-type: none"> <li>1) Please describe your position and your responsibilities in managing acute stroke patients that are candidates for tPA/TNK and/or thrombectomy.</li> <li>2) When a patient arrives and is identified as a Code Stroke, describe for us the process used in your stroke protocol for obtaining a patient's blood sugar and what you do with that information.</li> <li>3) Where does management of hyperglycemia fit into the process of administering alteplase or TNK tPA? <ol style="list-style-type: none"> <li>a) Where does management of hyperglycemia fit into the process of transferring a patient with a large vessel occlusion for thrombectomy?</li> <li>b) What kind of protocols/procedures do you have in place for management of hyperglycemia in tPA treated and/or thrombectomy treated patients?</li> <li>c) In your opinion, what level of importance do members of your Stroke Team place on hyperglycemia? <ol style="list-style-type: none"> <li>i) Why do you believe the Stroke Team holds this level of importance for hyperglycemia?</li> <li>ii) Can you tell us if you disagree or agree with this level of importance and why this is?</li> </ol> </li> </ol> </li> <li>4) In your opinion, what barriers exist to providing glucose control treatment before or immediately after administering a tPA drug or prior to transfer to thrombectomy? <ol style="list-style-type: none"> <li>a) Given the barriers we've just talked about, what do you think would be the best way to make hyperglycemic treatment a higher Stroke Team priority in acute stroke patients?</li> </ol> </li> </ol>
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using a hierarchical approach to enable detection of recurrent concepts. Textualization was performed to illustrate identified themes with key phrases, and a comprehensive narrative description was developed to support each theme.

### Results

The study was conducted between June 2023 and June 2024. A total of 19 certified stroke



center hospitals (9 primary stroke centers, 3 thrombectomy-capable stroke centers, and 7 comprehensive stroke centers) representing 6 American states elected to enroll EDRNs or stroke coordinators in the study. Participants included 9 stroke coordinators and 10

EDRNs (Table 3). The study was closed to enrollment for data saturation in June 2024 when no new themes or insights emerged in the data.

**Table 3: Distribution of Stroke Center Sites and Participants**

	Primary Stroke Center	Thrombectomy Capable Stroke Center	Comprehensive Stroke Center
Stroke Coordinators	6	0	3
Emergency Department Registered Nurses	3	3	4

### Thematic Findings

Interview discussions evolved in a manner that made evident 5 broad themes as follows: 1) admission glucose measurement and management; 2) the reality of hyperglycemia non-management; 3) perceived importance of hyperglycemia in emergent stroke processes; 4) barriers to emergent hyperglycemia treatment in reperfusion patients; and, 5) perceived strategies for increasing emergent hyperglycemia treatment by stroke teams.

#### Admission Glucose Measurement and Management

**The Pivotal Blood Glucose Measurement Standard.** Opening interview discussions centered on the utility of blood glucose during the code stroke process in the emergency department. Participants emphasized the importance of immediate blood glucose measurement on arrival as a *standard practice* during a code stroke activation as illustrated by the following statement:

*“We just know we need a blood sugar before we kind of move forward.”*  
(Participant #006)

Glucose levels were perceived by participants as *pivotal* in directing next steps in acute stroke emergent management as illustrated by the following:

*“It’s just recorded into the medical record...we track that a blood sugar has been done prior to administration of TNK.”* (Participant #016)

**Stabilization Equates to Hypoglycemia Treatment.** Discussion evolved to the management of abnormal blood glucose values. Interestingly, participants indicated a consistent approach to emergently addressing only hypoglycemia once it is identified. Treatment of hypoglycemia was viewed as a key *stabilizing measure* before continuing with any form of management indicated on the stroke clinical pathway, as illustrated by the following statements:

*“I think we’re more concerned, probably on low than high, because if they’re under like 50 or 40, you know, they’re going to be altered due to that.”*  
(Participant #002)

*“The first step is to check their blood sugar and make sure they’re not hypoglycemic. If they’re not*



*hypoglycemic, they go immediately to CT and CTA” (Participant #035)*

*“If they were hypoglycemic ...we would of course treat that and then move forward.” (Participant #006)*

*“That’s one of the first things that we take to the room...the glucometer, to check the blood sugar that’s logged, really we use it to rule out hypoglycemia.” (Participant #009)*

*“They focus on a blood sugar only to obtain it, and after that, if it’s not hypoglycemic, it’s like, go!” (Participant #022)*

Interview discussions shifted to hyperglycemia treatment in acute stroke management, revealing consistency in clinical patterns and perceptions associated with hyperglycemia management. Overall, hyperglycemia was viewed as a low priority during emergent stroke care, with limited early intervention, and a lack of uniform guidelines to drive treatment processes. Three key categories emerged from this discussion, including *Emergent Hyperglycemic Treatment Holds Limited Value, Delayed Management is Normal, and Practice Gray Zone.*

### **The Reality of Hyperglycemia Non-Management**

***Emergent Hyperglycemia Treatment Holds Limited Value.*** For patients with elevated blood glucose levels, most participants indicated that intervention was not considered unless glycemic values were “grossly abnormal” or “wildly high.” For example, one participant stated, “I’d say the focus is more on trying to get the patient to CT so as long as like the glucose isn’t like grossly abnormal... for example, like, if the glucose was 400 [mg/dL], we’d probably

*communicate with the physician, and we’d probably get an order to treat it” (Participant #007).*

Another participant deemphasized treatment of hyperglycemia in acute ED management stating, “...as far as high [blood glucose], I can’t think of an instance where we’ve had to treat immediately” (Participant #025).

Yet there was some awareness that blood glucose was important in thrombolytic decision making as illustrated by the statement, “If it’s wildly low or high, we act before we would even consider TNK to make sure that they’re not altered due to that, and that it’s not the stroke” (Participant #002).

While discussing where hyperglycemia treatment fits into reperfusion treatment, participants reiterated that there was limited intervention for hyperglycemia at their practice sites. For example, one participant stated, “They won’t necessarily slow down TNK administration for hyperglycemia” (Participant #023), while another stated, “I’ve never seen it be an issue, I don’t treat the hyperglycemia, you know, before giving thrombolytics” (Participant #004).

Interestingly, one participant shared never having thought about treatment of hyperglycemia prior to or concurrent with thrombolytic administration until attending the interview, saying, “This is the first I really put the two of them [hyperglycemic treatment and thrombolysis] together” (Participant #009).

***Delayed Management is Normal.*** Many participants indicated that hyperglycemia management is typically deferred until after stroke reperfusion treatment, or upon stroke unit or critical care unit admission, highlighting the prioritization of immediate stroke diagnostics and as needed reperfusion



treatment over glucose management in the emergency department. One participant stated, *“I feel like it doesn't really start being controlled until those admit orders drop with that level of care, and then it's a very stereotypical schedule of like either like q4 hour or q6 hour, or that kind of thing”* (Participant #030). Another stated, *“We're not quite as worried about treating glucose to a tight glycemic control...usually it's not managed prior to tenecteplase”* (Participant #007).

Most participants from primary stroke centers emphasized a strong focus on ensuring timely stroke treatment and transfer for thrombectomy eligible patients, with hyperglycemia management viewed as less critical in the initial phases. One respondent noted, *“...I've never come across that...I mean we've had people who have had low sugars that we've corrected first, but I haven't had a situation where someone was an LVO [large vessel occlusion] to be transferred urgently, and they were so hyperglycemic that that was even a concern”* (Participant #002). Another stated, *“honestly...if it's a thrombectomy they come back from CT scan, and the doctor calls it as an LVO, and we start the transfer process immediately.”* (Participant #002). However, one participant from a primary stroke center did state that if time allowed, *“We would definitely try to treat prior to the transfer...it would be included in goals also as well for blood pressure... we definitely do [treat] if we can”* (Participant #016). These responses underscored the emphasis on time-sensitive treatments and transfer to higher level stroke centers over concurrent management of hyperglycemia.

**Practice Gray Zone.** Participants discussed the absence of established protocols or structured processes for hyperglycemia

treatment in acute stroke care at their hospitals. For example, one participant stated, *“It's not part of our order set, or anything like that”* (Participant #025), while another also expressed the same sentiment, *“We don't have a specific separate process carved out for those patients”* (Participant #019). Another stated, *“I quite honestly don't know that there is or if there's a policy, I'm not aware of it. A lot of time everything happens very quickly in the ER [emergency room] we usually don't address any of that”* (Participant #005), while another said, *“We would have our own hyperglycemia protocols, but nothing in combination or in coordination with stroke”* (Participant #009), meaning that while the hospital has policies for managing hyperglycemia, these are used for other patient diagnoses and are not considered part of any stroke protocol.

### **Perceived Importance of Hyperglycemia in Emergent Stroke Processes**

Participants generally regarded hyperglycemia as a low priority in acute stroke management, emphasizing greater importance of prompt diagnostics and emergent stroke reperfusion treatment.

**Stroke Reperfusion Treatment Takes Priority.** Participants consistently indicated that hyperglycemia is seen as a secondary concern compared to the urgency of achieving rapid treatment and/or transfer times for stroke. The emphasis was on minimizing any delays that could impact time-to-treatment quality improvement metrics, with one participant stating, *“If they were going for thrombectomy... then the urgency would be put on transferring the patient...getting them to their appropriate level of care for their intervention”* (Participant #009). Importantly, another participant stated, *“But since they don't really talk about it in the guidelines, there's not been*



*a push to do anything with that, you know. They want to go and get them out of here in 90 min, and sometimes, you know, it's a hard task just to get them out of here with doing the minimal that they have to do...so we have not [treated hyperglycemia] here,”* (Participant #022). Another participant stated, *“I don't think anyone's even paid attention to it”* (Participant #004), while yet another said, *“I feel like it's probably one of the lowest priorities”* (Participant #030).

Priorities were different across participants. One viewed hyperglycemic treatment as having slightly higher priority, stating, *“It's probably a medium concern. You know our primary concern is always those timely procedures. So specifically, since we're transferring patients out, it's usually finding a facility first or finding a thrombectomy-capable facility that's open and available to take that patient, and then the blood sugar is usually managed after ... stabilized somewhere”* (Participant #035). Participant #022 said, *“I mean on the inpatient side, absolutely. But the acute stroke? Not really much, because they want to treat that person... and get them hopefully back to their baseline, or as close as baseline as possible, as safely as quickly as possible, so really not much to do with the hyperglycemia”*. These responses reflect a consensus among participants that time-sensitive stroke diagnostics and reperfusion interventions should take precedence, with hyperglycemia management considered less critical during initial emergent care.

### **Barriers to Emergent Hyperglycemia Treatment in Reperfusion Patients**

Participants discussed in some detail whether emergent hyperglycemic treatment could be prioritized alongside delivery of thrombolysis and/or thrombectomy, and participants identified key barriers to

enacting this change. Three important themes emerged from this discussion: *Staffing Resource Barriers, Time Barriers, and Knowledge and Protocol Barriers.*

**Staffing Resource Barriers.** Short-staffing and “novice” nursing staff were frequently mentioned as a barrier. Participants noted that stroke care often requires significant charting and specific team resources, such as having two nurses available for both thrombolytic and insulin administration. As one participant explained, *“We have a lot of novice nurses in our ER right now, so again, if somebody is having a stroke and they have to give tenecteplase, I feel like they would probably be all focused on that...meeting the timed metrics”* (Participant #009). Another stated, *“We run on such a small amount of crew that ... you're low on resources”* (Participant #016). The significant impact of understaffing of nurses on the ability to add hyperglycemic treatment to high-priority acute stroke care was illustrated by the following comments: *“Unfortunately, they're short staffed, and they have 30 other beds they have to worry about, plus a triage that's usually overflowing and with holds”* (Participant #019), *“Obviously it would be staffing. Because, you know, you're busy, you're trying to chart, you're trying to do everything”* (Participant #005), and *“Here at the CSC, probably staffing, so we're short staffed, and then you're running to the next emergency and sort of that mindset of like, well, we've treated this patient [indicating responsibilities for continued care are concluded], and now they're waiting for a bed”* (Participant #007). These accounts highlight the impact of emergency staffing resource limitations on the ability to prioritize hyperglycemia management during acute stroke management.





**Time Barriers.** While quality metrics are essential to driving ongoing improvement in stroke care, these same metrics are considered barriers to the addition of hyperglycemic treatment during emergent stroke diagnostics and decision making for reperfusion treatment. For example, one participant stated, *“I think in our patient population, it's probably a little more prevalent [referring to hyperglycemia] than we immediately, maybe necessarily acknowledge, but the high importance is, you know, in our timing and our throughput”* (Participant #006). Another provided an example of the hard work involved in rapidly diagnosing, treating, and transferring patients to the catheterization lab for thrombectomy to meet quality improvement metrics, stating, *“Everything is very, very rapid. So in the event of a thrombotic stroke where we're giving TNK, especially if it's a large vessel occlusion we will push that TNK, and then typically we take that patient straight to neuro OR [operating room], so that whole process I would say, is probably about 35 minutes from us to passing off to the OR because we get them in, we pit crew... so it's my involvement with those patients ends up being a very, very brief period of time”* (Participant #030).

**Knowledge and Protocol Barriers.** Participants also highlighted a lack of education and protocols as a significant barrier to treating hyperglycemia prior to, or alongside, reperfusion treatment. Lack of familiarity with hyperglycemia management in the context of acute stroke was cited as an obstacle, in addition to hospitals' existing protocols not indicating hyperglycemia is a priority in emergent stroke care. For example, one participant shared, *“I think the biggest barrier with that would be retraining of the physician, since with ED physicians, I feel like it's really just not that big of a concern,*

*unless it's like grossly hyperglycemic where you're working like HHS [hyperosmolar hyperglycemic state] or DKA [diabetic ketoacidosis]”* (Participant #030). Another stated, *“I would say if anything, I think that potentially physicians and staff wouldn't consider hyperglycemia and critical as ‘Time is Brain’, as protecting the brain I think it would be a secondary concern”* (Participant #020). Another suggested, *“Awareness would be the biggest thing, I think. Maybe like some...collaborating with the physicians, to have an order set”* (Participant #019).

### **Perceived Strategies for Increasing Emergent Hyperglycemia Treatment by Stroke Teams**

Participants suggested several strategies to enhance the prioritization of hyperglycemia management within stroke care protocols. Strategic themes included *Enhanced Education and Awareness*, and *Standardization is Key*.

**Enhanced Education and Awareness.** Many participants emphasized the need for increased education on the importance of hyperglycemia management in emergent stroke care. One participant stated, *“I think education and ... the evidence-based cycle, you know, just bringing it forth, explaining why it's important, or how it would affect care or outcomes”* (Participant #009). Another stated, *“...Probably be like an education piece, and I know that sounds so odd, but I feel like, if we knew the link, if we better understood how hyperglycemia is potentially affecting this patient, I mean beyond the stuff we know in general...the stroke specifically”* (Participant #006). Interestingly, one participant's comment reflected basic nursing knowledge about the negative consequences of hyperglycemia and the need for treatment: *“definitely providing education like... this is what happens when our patients are*



*hyperglycemic, they have really bad outcomes, and I feel like it's something we that we already know as nurses but isn't really stressed"*(Participant #016), while another suggested, *"Since...we're not doing it now, it's just going to be another process to hardwire...that comes education, that becomes training, that becomes doing it every single time to make sure it's done right practicing"* (Participant #022). Although some of these participants did not mention education or awareness was a barrier, they suggested that education and awareness were key to making hyperglycemia treatment a higher stroke team priority.

**Standardization is Key.** Participants also recommended revising the electronic health record order sets to include specific parameters for hyperglycemia management so that approaches to treatment could be standardized. Statements supporting this perception included, *"...an order set, or...a hard and fast order, like, if administering tPA...glucose level must be..., and having PRNs [pro re nata {when necessary}] for insulin...something like that, like that's built into the order set that's just a protocol"* (Participant #007), and, *"We are very...order set driven and so potentially having it part of that, you know, pathway protocol would be probably the best way for like implementing at our facility"* (Participant #035). While agreeing with these perspectives, one participant added that making changes to order sets is challenging within large national health systems, stating, *"I think that it needs to be better called out in our order sets, our order sets drive the care. And so, I think if we had a hard stop in there, you know that that might help particularly within the TNK order set...but it's not as easy as me just requesting that it be in the order set; we have to have buy-in, an agreement from across the national organization"* (Participant #019).

These perspectives underscore the critical role of standardizing care within electronic health record order sets to drive improvements in stroke care delivery, with participants emphasizing that protocol integration could make hyperglycemia management a higher stroke team priority.

## Discussion

Our study found that EDRNs and stroke coordinators understand the importance of blood glucose testing and the need for the correction of hypoglycemia. Yet, they may lack knowledge about the impact of hyperglycemia on reperfusion outcomes. Despite the known association between hyperglycemia and poorer outcomes in reperfusion-treated stroke patients<sup>1-5,8,10</sup>, participants had no recollection of treating elevated blood sugar levels prior to, concurrent with, or immediately after reperfusion therapy. This suggests a critical disconnect, while there is evidence highlighting the risk of poor outcomes, the primary focus remains on reducing time to thrombolysis and thrombectomy, potentially overlooking other important factors. While time to reperfusion treatment is arguably the number one priority in the emergent management of acute ischemic stroke, experience in the emergency phase of care demonstrates numerous timepoints either immediately before, during, or immediately after administration of thrombolytics when insulin treatment could be feasible in hyperglycemic patients.

While we cannot accurately gauge knowledge among emergency physicians and neurologists based on our methods, our participants felt that hyperglycemia was not viewed by their physician colleagues as a significant priority requiring emergent treatment except in extreme value cases (e.g.,



400 mg/dL). Interestingly, our participants consistently reported that the current acute stroke processes in their hospitals are silent on hyperglycemia management during emergent acute stroke diagnosis and treatment decision-making, and this finding was true across all levels of certified stroke center hospitals (primary, thrombectomy-capable, and comprehensive stroke centers) that were represented in this study. This aligns with the broader emphasis on minimizing time-to-treatment metrics, where the urgency of reperfusion therapies takes precedence over concurrent management of other factors, such as hyperglycemia.

Although specific guidelines for the hyperacute management of hyperglycemia prior to reperfusion therapy are lacking, research highlights the critical importance of controlling blood glucose levels, especially within the first 48 hours of hospitalization<sup>23,24</sup>. Our study revealed that while hyperglycemia is recognized as a factor in stroke care, it is often deprioritized compared to hypoglycemia and the urgency of time-sensitive stroke treatments. Participants identified significant barriers to hyperglycemia management in the hyperacute phase, including insufficient staffing, time limitations, and the lack of specific protocols or guidelines. Addressing these barriers requires targeted interventions, and our participants suggested important strategies that may elevate hyperglycemic treatment to an emergent priority. These strategies may include incorporating hyperglycemia management into order sets, enhancing staff education, and increasing resource availability to support concurrent treatment alongside or immediately prior to reperfusion treatment. These actionable steps could potentially improve care delivery.

### Future Directions

This study is among the first to examine the perceptions of EDRNs and stroke coordinators regarding hyperglycemia management during emergent acute stroke care prior to reperfusion therapy. By focusing on the perspectives of frontline providers and program facilitators, this research provides unique insights into the practical challenges and barriers to hyperglycemic treatment faced in real-time stroke care, a topic that has received limited attention in existing literature.

The impact of emergent hyperglycemic management on post-reperfusion outcomes is not yet fully understood, particularly regarding whether it can improve outcomes to match those of normoglycemic patients. Additionally, how best to integrate emergent hyperglycemic management into existing acute stroke workflows has not yet been explored, including the feasibility and effectiveness of the strategies proposed by our participants, such as order set modifications and staff training.

Our findings offer valuable preliminary insights for informing policy and protocol development in stroke centers by highlighting critical gaps in knowledge, resource allocation, and procedural workflows that may hinder effective hyperglycemia management in emergent stroke patients. However, given the small sample size and limited representation of certified American stroke centers, further research with a larger and more diverse sample is needed to validate and expand upon these findings. Importantly, our findings serve as a foundation for designing future pilot work aimed at evaluating the feasibility of treating hyperglycemia prior to or concurrent with time-based reperfusion treatment, a significant step toward



understanding whether emergent treatment can make a difference in patient outcomes.

## Conclusions

This qualitative study sheds light on current knowledge, practice, and perceived barriers and strategies tied to hyperglycemia management in emergent stroke care,

identifying key challenges such as gaps in provider knowledge, staffing constraints, time limitations, and lack of standardized protocols. This work underscores the importance of addressing systemic barriers to enhance glycemic control, with the goal of improving patient outcomes, and will inform next steps to improve emergent stroke management.

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