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Thesis

Factors influencing the time of hospital arrival among stroke patients: A Multicenter prospective study, Ethiopia

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Abbreviations &Acronyms

AAU	Addis Ababa University
ASA	American Stroke Association
CHS	College of Health Sciences
CT	Computerized tomographic scan
CVA	Cerebrovascular accident
GBD	Global burden of disease
HRQOL	Health related quality of life
LMICs	Low- and middle-income countries
MD	Medical Doctor

MRI	Magnetic resonance imaging
NIHSS	National institutes of health stroke scale
SPSS	Statistical package for the social science
IRB	Instititional review board
TASH	Tikur Anbesa Specialized Hospital
TIA	Transient ischemic attack
WHO	World Health Organization
OTD	Onset to door
DIDO	Door in door out

Abstract

Background

Delayed hospital arrival remains a major barrier to effective stroke treatment. Early hospital presentation improves eligibility for time dependent therapies such as thrombolysis. In Ethiopia, limited local data exist on determinants of prehospital delay. This study assessed time to hospital arrival and factors associated with delayed presentation among stroke patients in tertiary hospitals in Addis Ababa.

Methods

A prospective analytical cross sectional study was conducted from October 2025 to February 2026 at Tikur Anbessa Specialized Hospital, Zewditu Memorial Hospital, and Yekatit 12 Hospital. A total of 80 adult stroke patients were included using census sampling. Data were collected using a structured questionnaire. Arrival time greater than 4.5 hours after symptom onset was defined as delayed presentation. Data were analyzed using SPSS version 27. Descriptive statistics summarized patient characteristics. Bivariable and multivariable logistic regression identified independent predictors of delayed arrival. Statistical significance was declared at p less than 0.05.

Results

A total of 80 stroke patients were included, with a mean age of 55.66 ± 17.1 years. The mean arrival time to the final treating hospital was 6.01 ± 11.86 hours, while the median arrival time was 1.5 hours. Among patients with ischemic stroke, only 11 of 53 patients received thrombolytic therapy. Multivariable logistic regression identified referral status, khat use, and belief that stroke is preventable as independent predictors of delayed arrival. Patients referred from another health facility had significantly higher odds of delay (AOR 8.33, p = 0.002). Khat use showed a strong association with delayed arrival (AOR 83.70, p = 0.008). Belief that stroke is preventable showed a protective effect against delay (AOR 0.15, p = 0.048). Prior history of stroke was associated with earlier arrival at the first health facility (AOR 0.01, p = 0.039). Stroke awareness remained low, with many participants failing to recognize symptoms and delaying care seeking.

Conclusion

Prehospital delay remained high among stroke patients in tertiary hospitals in Addis Ababa. Referral between facilities, khat use, and low awareness contributed to delayed hospital arrival. Prior stroke history improved early health seeking behavior. Strengthening referral systems, expanding ambulance use, and improving public stroke awareness represent priority actions to reduce delay and improve access to time dependent stroke treatment.

Key word - Stroke, prehospital delay, time to hospital arrival, stroke awareness, referral systems, health seeking behavior

1. Introduction

Stroke remains a leading cause of mortality and long-term disability worldwide and is a major contributor to years lived with disability(1). The clinical course of acute stroke is highly time-dependent, as irreversible neuronal injury begins within minutes of arterial occlusion, and the probability of favorable functional recovery declines progressively with increasing delays to reperfusion. Evidence-based acute interventions, intravenous thrombolysis for eligible ischemic stroke and endovascular thrombectomy for large-vessel occlusion, provide substantial benefit when delivered within guideline-recommended therapeutic windows (2). Even beyond these windows, early initiation of organized stroke unit care, secondary prevention strategies, and complication management improves outcomes. Consequently, the interval between symptom onset or last-known-well time and hospital arrival is a critical determinant of access to effective treatment and overall prognosis.

Despite advances in emergency medical services (EMS), regional stroke networks, and public awareness initiatives, prehospital delay remains common across high-, middle-, and low-income countries. Prehospital delay is multifactorial and reflects the interaction of patient-related, social, geographic, and health-system determinants. At the individual level, limited recognition of stroke warning signs, misattribution of symptoms to non-serious conditions, low perceived urgency, and attempts at self-management are frequently reported contributors to delayed presentation (3). Clinical characteristics such as gradual symptom onset, mild or fluctuating deficits, posterior circulation symptoms, and wake-up strokes are particularly associated with prolonged delays. Demographic and socioeconomic factors, including advanced age, living alone, low educational attainment, and lower socioeconomic status, further influence time to hospital arrival.

Social and cultural contexts substantially shape help-seeking behavior following stroke onset. The presence of bystanders or caregivers, location at symptom onset, cultural beliefs regarding illness, initial consultation with traditional or informal healthcare providers, concerns about out-of-pocket healthcare costs, and reliance on private transportation rather than EMS have all been shown to prolong prehospital intervals (3,4). Public knowledge of stroke recognition tools such as FAST or BE-FAST and exposure to community education campaigns are associated with earlier presentations, although their effectiveness may diminish over time without sustained reinforcement.

Geographic access and transportation logistics are additional determinants of delay. Greater distance to stroke-capable facilities, rural residence, poor road infrastructure, traffic congestion, and limited ambulance availability increase travel time and delay care. In contrast, EMS utilization is generally associated with shorter onset-to-door times due to earlier triage, prehospital notification, and direct transport to appropriate facilities. Health-system factors, including dispatcher recognition of stroke, use of prehospital stroke assessment tools, triage and bypass protocols, hospital designation, and the maturity of regional stroke systems of care, further influence timely access to acute stroke treatment.

In Africa, stroke represents an increasing public health burden, driven by population aging, epidemiological transition, and limited access to healthcare services. Approximately 316,000 to 500,000 new stroke cases are reported annually, and sub-Saharan Africa has one of the highest stroke mortality rates globally, with a 30-day case fatality of approximately 40%, compared with 10–20% in high-income countries(1). In Ethiopia, although ischemic stroke is more prevalent than hemorrhagic stroke, available data remain limited. Local studies report high in-hospital mortality rates approaching 30% attributed in part to delayed presentation and limited access to intensive care services(5). Acute medical interventions, particularly intravenous thrombolysis, must be administered within a narrow therapeutic window, typically within 3 to 4.5 hours of symptom onset (2). However, in many low-resource settings,

including Ethiopia, a substantial proportion of patients present beyond this window, severely limiting treatment options and contributing to poor clinical outcomes. Despite increasing global awareness of stroke, significant barriers to early care persist across many African settings.

Studies from both high-income and low- and middle-income countries consistently identify socioeconomic status, transportation availability, stroke symptom awareness, cultural beliefs, geographic accessibility, and emergency medical system capacity as key determinants of time to hospital arrival(3–5). Evidence from Ghana highlights the role of traditional beliefs and limited stroke awareness, while studies from Uganda and Ethiopia emphasize infrastructural constraints and underdeveloped EMS as major contributors to delay.

This study aims to investigate factors influencing time to hospital arrival among patients with acute stroke presenting to Tikur Anbessa Specialized Hospital. Understanding the local determinants of prehospital delay is essential for designing contextually appropriate, evidence-based interventions to improve timely access to acute stroke care and reduce stroke-related morbidity and mortality.

Problem Statement

Stroke is a leading cause of mortality and long-term disability worldwide. Its time-critical nature renders delays in hospital arrival especially detrimental each passing minute increases the extent of brain tissue damage and diminishes the potential for effective treatment with therapies like intravenous thrombolysis or mechanical thrombectomy. In Ethiopia, and particularly in Addis Ababa, acute stroke care faces persistent delays that limit patients' access to life-saving interventions.(6)

At Tikur Anbessa Specialized Hospital, data show that in one cross-sectional study, the **median arrival time of stroke patients to the emergency department was 24 hours** after symptom onset, only **15% arrived within the critical 3-hour–window** for reperfusion therapies(7). Another study conducted at a nearby teaching hospital (Yekatit-12) corroborates this trend: cases presenting after more than 4 hours had a median delay of **24 h**, compared to just **2 h** among those arriving on time.(6)

This prolonged prehospital delay severely limits the opportunity for acute reperfusion treatment, likely contributing to high morbidity and mortality rates observed in these settings. The underlying contributors to these delays are multifaceted. For instance, factors identified at Yekatit-12 included younger age (≤60 years), residence outside Addis Ababa, onset occurring at night, and lack of health insurance all significantly predicting late presentation(6).

Additional system-level barriers shape the local context. Emergency medical services (EMS) remain limited and underutilized in Ethiopia. Many stroke patients rely on taxis or private automobiles for transport rather than ambulance services, reducing pre-notification and delaying arrival . In fact, Tikur Anbessa's study also highlighted that only 30% of stroke patients arrived by ambulance(7).

Despite the known danger of delays, there is a gap in systematically collected, context-specific evidence detailing the relative impact of patient-level (e.g., awareness, behavior), sociodemographic (e.g., insurance, residence), and system-level (e.g., EMS utilization) factors on prehospital delay in your study context. Without such localized insight, interventions face risks of inefficacy or misalignment with patient realities.

Therefore, the core problem this research addresses is the persistently delayed hospital arrival among stroke patients at Tikur Anbessa Hospital and the underlying lack of context-specific

understanding of the contributing factors. Identifying and quantifying patient-, social-, and system-level determinants of these delays is essential for designing targeted strategies, such as public education, EMS strengthening, prehospital triage protocols, or insurance reform, that could significantly shorten prehospital times and improve acute stroke outcomes.

Why this matters:

Factor	Local Findings & Relevance
Arrival Delays	Median arrival = 24 h; only about 15% within 3 h window (7)
EMS Usage	Only 30% arrived by ambulance—remainder via private transport(7)
Predictors of Delay	Age ≤ 60, rural residence, night onset, uninsured status (Yekatit-12 data)(6)
Stroke Severity & Type	High prevalence of hemorrhagic strokes and delayed presentations beyond 48 h
System Gap	Limited EMS capacity and utilization in Addis Ababa

The reason behind pre hospital delays arrival to health care facilities among stroke patients in Ethiopia remains inadequately explored and these factors result in missed opportunities for life-saving treatment. Contributing factors remain under-investigated , particularly in tertiary centers like TASH. Identifying these factors is crucial for improving patient outcomes and reducing the burden of stroke-related disability.

This study seeks to comprehensively explore the individual , social and systemic factors which influence the time of arrival to the hospital , with the ultimate goal of improving early detection , response and access to stroke care

1.3 Significance of the study

Stroke is a leading cause of morbidity, disability, and mortality worldwide, and timely hospital arrival is critical for effective management and improved outcomes. Understanding the factors influencing the time of arrival to hospitals among stroke patients has significant implications across multiple levels:

1. **Clinical Significance**

   Early hospital arrival is directly linked to the timely administration of acute stroke therapies, such as thrombolysis and mechanical thrombectomy, which are highly time-dependent. By identifying barriers to prompt hospital arrival—whether due to transportation, financial constraints, awareness, or cultural beliefs—this study provides clinicians with valuable insight to implement targeted interventions that can reduce delays, enhance treatment effectiveness, and ultimately improve patient prognosis.

2. **Public Health and Community Impact**

Delays in seeking medical care contribute to increased stroke-related complications, long-term disability, and mortality. This study will inform community health initiatives and educational programs, helping to raise awareness about stroke symptoms and the importance of immediate medical attention. Public health campaigns can be tailored based on the factors identified, promoting early recognition and swift hospital presentation, particularly in high-risk populations.

3. Policy and Health System Implications

Findings from this research can guide policymakers and hospital administrators in developing strategies to reduce pre-hospital delays. For example, it can highlight the need for improved transportation infrastructure, emergency medical services, and financial support mechanisms for stroke patients. This evidence can support resource allocation and the design of stroke-specific health policies to optimize patient access to care.

4. Academic and Research Contribution

This study will contribute to the existing body of knowledge regarding pre-hospital delays in stroke care, particularly in low- and middle-income countries like Ethiopia. By examining local contextual factors alongside global evidence, it will provide a foundation for future research on interventions aimed at reducing treatment delays and improving stroke outcomes. Moreover, it can serve as a reference point for comparative studies in similar healthcare settings.

5. Societal and Economic Importance

Reducing time to hospital arrival can substantially decrease the long-term burden of stroke on families and society by minimizing disability, promoting faster recovery, and reducing healthcare costs associated with prolonged hospital stays and rehabilitation. The study's insights can, therefore, have broader socioeconomic benefits by informing cost-effective strategies to improve stroke care.

Ultimately these research has the potential to save lives , improve quality of life of stroke survivors and reduce the economic and societal impact of stroke

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1. Literature Review

Stroke is defined by the World Health Organization as a clinical syndrome characterized by the rapid development of clinical signs of focal neurological dysfunction, or global cerebral dysfunction in the setting of coma, with no identifiable cause other than a vascular origin(1). This definition highlights three fundamental components. First, stroke has an abrupt onset, reflecting an acute disruption of cerebral blood flow. Second, it results in objective neurological deficits, typically presenting as focal manifestations such as hemiparesis, aphasia, or visual field defects, and in severe cases may progress to global cerebral dysfunction, including coma. Third, the underlying pathophysiology is vascular, arising from either cerebral ischemia or intracranial hemorrhage.

The American Heart Association/American Stroke Association (AHA/ASA) expanded this definition to describe stroke as an episode of acute neurological dysfunction caused by focal cerebral, spinal, or retinal infarction or hemorrhage, confirmed by neuroimaging or pathological evidence (3). This updated definition permits the diagnosis of stroke even when clinical symptoms resolve rapidly, provided that objective evidence of tissue injury is demonstrated on imaging or pathology.

Stroke is broadly classified into two major subtypes: ischemic and hemorrhagic. Ischemic stroke occurs as a result of arterial occlusion, most commonly due to thrombus or embolus formation, leading to cerebral hypoperfusion and infarction. It represents approximately 80–85% of all stroke cases. Hemorrhagic stroke results from rupture of a weakened cerebral blood vessel, causing bleeding within or around the brain parenchyma. Although hemorrhagic strokes account for only 15–20% of all cases, they are associated with disproportionately higher mortality and worse early outcomes. Globally, stroke is the second leading cause of death after ischemic heart disease(1). In sub-Saharan Africa, reported stroke incidence varies widely, ranging from 25 to 260 per 100,000 person-years, reflecting regional differences and methodological variability across studies.

Timely arrival at a hospital is a critical determinant of effective stroke management and favorable outcomes. Early presentation allows access to time-sensitive interventions, including intravenous thrombolysis, which is most effective when administered within 4.5 hours of symptom onset. Endovascular thrombectomy for large-vessel occlusion provides maximal benefit when performed within 6 hours, with selected patients deriving benefit up to 24 hours after onset. In hemorrhagic stroke, early surgical interventions such as minimally invasive hematoma evacuation within the first 24 hours have demonstrated benefits in both mortality and functional outcomes.

Prompt medical intervention also plays a crucial role in preventing stroke progression. In ischemic stroke, rapid restoration of cerebral blood flow aims to salvage the ischemic penumbra—brain tissue that is functionally impaired but still viable if reperfused in a timely manner. In hemorrhagic stroke, early blood pressure control is essential to limit hematoma expansion. Furthermore, early treatment reduces the risk of life-threatening complications such as cerebral edema, mass effect, and raised intracranial pressure, as well as secondary complications including aspiration pneumonia and deep vein thrombosis.

Beyond clinical outcomes, early hospital arrival is associated with reduced long-term healthcare costs. Timely treatment decreases long-term disability, thereby reducing the need for prolonged hospitalization, rehabilitation services, institutional care, and productivity loss. Despite these benefits, numerous studies have shown that a substantial proportion of stroke patients arrive at hospital beyond recommended therapeutic windows. Factors influencing prehospital delay are multifactorial and include demographic, clinical, behavioral, and health-

system determinants(8,9). Several studies consistently report delayed presentation as a major barrier to effective stroke care(5,10,11).

2.1 Awareness and Cultural Beliefs

Limited awareness of stroke symptoms is a well-established and persistent barrier to timely hospital presentation. Poor recognition of classic stroke warning signs—such as facial drooping, unilateral arm weakness, and speech disturbance—remains common in many communities. A community-based study conducted in northern Tanzania found that only 27.4% of participants were able to correctly identify more than one conventional stroke symptom, and only 7.6% perceived themselves to be at risk despite having underlying medical conditions (11). Similarly, a study from Nigeria reported that only 30% of respondents correctly recognized stroke symptoms, with many attributing manifestations to supernatural or non-medical causes (12).

In contrast, evidence from high-income settings demonstrates the importance of symptom recognition in prompt care-seeking behavior. A study conducted in California, United States, showed that patients who were able to recognize stroke symptoms were significantly more likely to seek immediate medical attention(10). In many African contexts, however, culturally embedded beliefs and practices contribute to delayed presentation. Visiting religious or traditional healers before seeking hospital care is commonly reported and has been shown to delay emergency medical evaluation and treatment(13).

2.1.2 Limited awareness of time-dependent stroke treatment and EMS utilization

Limited public awareness of the time-sensitive nature of acute stroke management—particularly intravenous thrombolysis and mechanical thrombectomy—significantly contributes to delayed hospital presentation and underutilization of emergency medical services (EMS). In the United States, only 32.2% of adults had heard of tissue plasminogen activator (tPA), and among these, approximately half were aware of the narrow therapeutic window for administration(14). Similarly, a population-based study from China reported that only 23.3% of participants were aware of thrombolytic therapy for acute ischemic stroke, with higher awareness observed among younger individuals, those with higher income, health insurance, and greater educational attainment(15).

A 2025 African meta-analysis demonstrated that nearly 80% of patients experienced significant prehospital delay, largely driven by poor symptom recognition, lack of awareness of time-dependent treatments, and long distances to healthcare facilities. Ethiopian case–control studies conducted at Zewditu and Yekatit hospitals similarly reported markedly delayed median arrival times, reflecting low public awareness of stroke symptoms and therapeutic windows(16).

Evidence from pooled and multicenter studies consistently shows that EMS utilization significantly increases the likelihood of receiving intravenous thrombolysis and reduces both onset-to-needle and door-to-needle times(17). Furthermore, EMS pre-notification has been shown to independently shorten door-to-imaging and door-to-needle intervals, with recent cohort data demonstrating an adjusted reduction of approximately 11 minutes in thrombolysis initiation among pre-notified patients (17).

2.1.3 Initial reliance on lay care: traditional and faith healers

Traditional and faith healers remain deeply embedded and trusted providers of care across many low- and middle-income countries (LMICs) and among immigrant communities in high-income settings. Their accessibility, cultural alignment, perceived effectiveness, affordability, and social authority often position them as the first point of contact for both

acute and chronic illnesses. Consequently, their widespread use substantially influences care-seeking pathways, time to presentation at biomedical facilities, and the likelihood of EMS-mediated transport.

For neurological emergencies such as stroke and seizures, qualitative and quantitative studies from sub-Saharan Africa indicate that spiritual or traditional explanations frequently precede biomedical help-seeking. Several community-based studies report that patients or caregivers initially consult traditional or faith-based providers, contributing to hospital arrival beyond the therapeutic windows for reperfusion therapies. A regional scoping review on stroke rehabilitation further highlights the role of spiritual and traditional beliefs in shaping early illness perception and care pathways(18).

Country-specific studies from Ethiopia and neighboring regions document common use of holy water, herbal remedies, and traditional healers. Research conducted in Addis Ababa shows that a substantial proportion of patients seek non-biomedical care, and similar behaviors in other disease contexts have been associated with delayed presentation to formal healthcare facilities(9).

2.1.4 Cost perceptions and mistrust in the health system

Timely hospital arrival following stroke onset is critical for eligibility for reperfusion therapies and for minimizing long-term disability. Across global studies of prehospital stroke care, socioeconomic factors—particularly perceived and actual costs of treatment—and mistrust in healthcare systems consistently emerge as modifiable determinants of prehospital delay. These factors interact with stroke literacy, EMS access, referral practices, and cultural care-seeking behaviors, making them important targets for intervention(19).

Qualitative and mixed-methods studies from South and East Asia repeatedly identify financial concerns as a primary reason for delayed hospital presentation. Participants frequently report postponing care until symptoms become severe due to fear of treatment costs or lack of insurance coverage, with transport costs posing an additional barrier for rural populations. Mistrust—manifested as fear of misdiagnosis or perceived poor quality of care—often leads families to consult multiple lower-cost providers before reaching appropriate facilities, thereby prolonging referral times(20).

In Tanzania, qualitative research identified high costs of stroke care, insurance limitations, transport expenses, and low stroke awareness as major barriers to timely access. Similar patterns across African settings show that patients commonly seek care from pharmacies, traditional healers, or lower-level clinics prior to arrival at stroke-capable hospitals, reflecting a complex interplay of cost concerns and confidence in the health system(21).

2.2 Transportation and infrastructure

Global scope and magnitude

Delays between stroke symptom onset and hospital arrival remain a major global barrier to timely reperfusion therapy. Systematic reviews and contemporary syntheses demonstrate a persistent international pattern in which a substantial proportion of stroke patients fail to reach hospitals within therapeutic windows. Transport-related factors—including mode of transport, EMS availability, and distance to healthcare facilities—are consistently identified as key contributors. While high-income countries report lower rates of extreme delay compared with LMICs, significant gaps in EMS utilization and onset-to-door times persist even in resource-rich settings(12).

2.2.1 Mode of transport: ambulance versus private vehicle

Across diverse healthcare settings, EMS and ambulance transport are consistently associated with shorter onset-to-door times and a higher probability of arrival within the thrombolysis

window. Ambulance services facilitate early stroke recognition, prehospital assessment, monitoring, and hospital pre-notification, thereby expediting in-hospital workflows. In contrast, private transport—such as taxis or personal vehicles—lacks these advantages and is commonly associated with prolonged delays. Observational studies and systematic reviews conclude that improving appropriate EMS utilization represents a high-impact strategy for reducing prehospital delay(15).

2.2.2 Innovations in prehospital care: mobile stroke units

Mobile Stroke Units (MSUs), equipped with on-board computed tomography, point-of-care laboratories, and specialized stroke personnel, have demonstrated significant reductions in onset-to-treatment times and increased thrombolysis rates in randomized and controlled trials conducted in high-income countries. Large trials, including BEST-MSU and B_PROUD, have shown faster thrombolysis and improved functional outcomes in urban settings. However, due to their high resource requirements, the scalability of MSUs in LMICs is limited. Current literature therefore emphasizes MSUs as an ideal model for well-resourced systems while advocating for more scalable interventions—such as EMS training and dispatcher-based strategies—in resource-limited contexts(22).

2.2.3 LMIC and African evidence

Systematic reviews and meta-analyses focusing on LMICs and African countries consistently report substantially higher rates of prehospital delay compared with high-income regions. Pooled estimates from African studies frequently exceed 70–80% for delayed arrival and identify low stroke symptom awareness and increased distance to health facilities as significant predictors. Low ambulance utilization and reliance on private transport are common, with rural residence, nocturnal symptom onset, and initial presentation to lower-level facilities further associated with prolonged delays(23).

2.2.4 Country-level African studies

Country- and hospital-level studies provide detailed insight into transport and infrastructure challenges. Research from Ghana and Uganda reports very high prevalence of prehospital delay, primarily driven by distance and limited symptom awareness. Studies conducted in tertiary hospitals across sub-Saharan Africa document median onset-to-door times ranging from several hours to multiple days. Reports from institutions such as Komfo Anokye Teaching Hospital in Ghana and tertiary centers in Nigeria highlight major bottlenecks, including prolonged ambulance response times, heavy reliance on private transport, and delays related to interfacility transfers(3,19).

2.2.5 Interfacility transfer and infrastructure limitations

Beyond initial transport from home to hospital, systemic factors such as referral pathways, road quality, traffic congestion, and ambulance routing significantly prolong total prehospital time. In many LMICs, patients are first taken to facilities lacking neuroimaging or specialist services, resulting in diagnostic and administrative delays prior to transfer. Poor road infrastructure and urban traffic congestion further extend transport times, while perceived delays in ambulance response encourage reliance on private transport, perpetuating cycles of delayed care.

2.2.6 Effectiveness of transport-focused interventions

Evidence suggests that prehospital delay is driven by both patient decision time and transport logistics, and effective interventions must address these components separately(24).

Transport-focused interventions show heterogeneous effectiveness. Strategies such as dispatcher and EMS training, public education emphasizing early EMS activation, and optimized regional destination protocols (e.g., direct-to-thrombectomy center versus drip-and-ship) have improved selected process indicators and thrombolysis rates in some settings. However, systematic reviews indicate that isolated transport interventions often yield only modest reductions in total call-to-hospital time. The most consistent improvements are observed when early stroke recognition, prehospital triage, EMS pre-notification, and system-level routing and hospital capacity enhancements are implemented concurrently. In LMICs, the literature emphasizes context-appropriate approaches—such as dispatcher training, expansion of basic ambulance services, community education to promote EMS use, and strengthened interfacility transfer coordination—over resource-intensive models like mobile stroke units(25).

2.2.7 Gaps and implications for Ethiopia

Global and African literature consistently identifies transportation and infrastructure as major determinants of prehospital delay, while also highlighting substantial contextual variability. In Addis Ababa, particularly at Tikur Anbessa Specialized Hospital, there is limited local evidence that disentangles patient decision time from transport-related delay, maps ambulance response and travel times against traffic and routing patterns, or quantifies delays attributable to interfacility referral pathways. Addressing these gaps would enable prioritization and evaluation of targeted interventions, including dispatcher training, EMS expansion, destination protocols, and public EMS-awareness campaigns tailored to local realities (7). Supporting this need, a study conducted at Yekatit 12 Hospital identified place of residence and lack of transportation as key predictors of delayed hospital presentation among stroke patients(6).

2.3 Financial barriers

2.3.1 Global evidence linking financial barriers to delayed care-seeking

Financial constraints—including lack of insurance coverage, high out-of-pocket expenditures, and user fees—are consistently associated with delayed presentation for acute, time-sensitive conditions such as stroke. Studies across diverse settings demonstrate that uninsured patients or those with financial concerns are more likely to postpone care-seeking, thereby reducing the likelihood of arrival within therapeutic windows. Financial considerations influence both the decision-to-seek-care interval and hospital choice, with patients often bypassing higher-level facilities perceived as more expensive. These associations are observed in both high- and middle-income settings and are mechanistically plausible, given anticipated costs related to admission, neuroimaging, medications (including rt-PA), and transportation(20).

2.3.2 User fees, out-of-pocket payments, and service utilization in LMICs

Health systems research consistently shows that user fees and high out-of-pocket payments reduce healthcare utilization in LMICs. Systematic reviews, including Cochrane analyses, demonstrate that user charges disproportionately limit access for lower-income populations, while fee removal or reduction improves service utilization. For acute stroke care, where diagnostic imaging and reperfusion therapies are costly, direct payment requirements or uncertainty regarding fees can prolong decision time or redirect patients toward less costly but clinically inadequate alternatives(26).

2.3.3 Cost of acute stroke care as a specific barrier

Acute stroke management involves high-cost components, including CT or MRI imaging, laboratory testing, and intravenous thrombolysis. Multiple LMIC-focused reviews and country-level studies identify the cost of neuroimaging and rt-PA as major barriers to timely presentation and treatment. Even when transport is available, families may delay hospital arrival while mobilizing funds or seeking lower-cost options, resulting in loss of eligibility for reperfusion therapy. Economic evaluations from African settings highlight substantial direct and indirect financial burdens on patients and caregivers.

The cost of rt-PA remains particularly prohibitive in LMICs; for example, in India, treatment costs approximate €1,300 per patient. Globally, fewer than 5% of patients with acute ischemic stroke receive intravenous thrombolysis within the recommended time window, with economic barriers identified as a primary contributor. In LMICs, the cost of rt-PA may represent up to 217.4% of per capita health expenditure, compared with approximately 17.6% in high-income countries, underscoring the disproportionate economic burden(21).

2.3.4 Empirical evidence from Africa and LMICs

Primary studies from sub-Saharan Africa and other LMICs consistently identify financial barriers as determinants of delayed hospital arrival. Hospital-based studies in Uganda, Ghana, Nigeria, Tanzania, and Ethiopia report high prevalence of prehospital delay and associate it with lack of insurance, perceived cost of care, and inability to pay for diagnostic services. Qualitative studies further document that unaffordable CT imaging, medications, and rehabilitation costs discourage immediate care-seeking. Meta-analyses of African studies demonstrate elevated pooled prevalence of delayed presentation and identify low socioeconomic status and absence of health insurance as significant predictors(19).

2.3.5 Mechanisms linking financial barriers to prehospital delay

Financial barriers contribute to delayed hospital arrival through several pathways. Anticipated or actual costs prolong the decision interval as families attempt to mobilize funds or explore alternatives. Cost considerations influence transport choices, often favoring cheaper but slower private transport lacking pre-notification. Concerns about affordability of diagnostics and treatment may also prompt initial presentation to lower-level facilities or traditional providers, introducing additional interfacility delays. Limited coverage by insurance or public subsidy mechanisms disproportionately affects poorer and rural populations, exacerbating inequities in timely access to stroke care.

2.3.6 Insurance coverage and protective effects

Evidence suggests that health insurance and prepayment mechanisms can reduce delays and improve access to appropriate acute care. Insured patients are more likely to seek care promptly and undergo essential diagnostic evaluation. However, the protective effect depends on the scope of coverage, administrative simplicity, and public awareness of entitlements. Partial coverage that excludes costly diagnostics or rt-PA may offer limited benefit. Policy reviews recommend expanding comprehensive financial protection for emergency diagnostics and essential acute treatments as a core strategy to reduce prehospital delay(24).

2.3.7 Gaps and relevance to Tikur Anbessa Specialized Hospital

Despite consistent documentation of financial barriers, few studies quantify their relative contribution to total onset-to-door delay, particularly in urban African tertiary centers such as Tikur Anbessa. Most reports demonstrate associations without disentangling delays attributable to decision-making, transport, or interfacility referral. Evidence on the effectiveness of financial interventions—such as emergency fee waivers or targeted subsidies for CT and rt-PA—remains limited. For Tikur Anbessa, integrating patient-reported financial

constraints, insurance status, and time spent arranging payment with transport and clinical timelines would identify actionable interventions to reduce delay.

2.3.8 Implications for policy and intervention

The literature supports several policy-relevant strategies: expanding financial protection for acute stroke care, including coverage for neuroimaging and reperfusion therapies; implementing emergency fee-exemption or rapid-payment mechanisms to remove financial barriers to immediate care; and incorporating clear messaging in public awareness campaigns that emergency stroke care pathways exist irrespective of ability to pay.

2.4 Urban–rural disparities in prehospital stroke care

Urban–rural differences in access to timely stroke care are consistently reported across settings. A large cross-sectional analysis found a median onset-to-door time in which only approximately 12% of patients arrived within 3 hours of symptom onset; rural residence was independently associated with longer delays and substantial geographic variation, indicating that rurality amplifies prehospital delay despite national awareness campaigns(1).

In the United States, rural areas demonstrate lower rates of EMS pre-notification and distinct transport patterns compared with urban settings. Geospatial analyses show that although hospital bypass is less frequent in rural regions, bypass events are associated with markedly longer transport times, dynamically influencing arrival within therapeutic windows(14).

Evidence from LMICs mirrors these findings. In Uganda, prehospital delay prevalence among patients residing outside Kampala approached 91%, underscoring the combined effects of distance, limited transport options, and constrained EMS availability in rural populations(23).

2.5 Referral systems

2.5.1 Importance of referral systems for stroke timelines

Acute stroke management is highly time dependent, with the benefits of intravenous thrombolysis and endovascular thrombectomy declining rapidly as treatment is delayed. Efficient referral systems are therefore critical to minimizing both onset-to-door and door-to-treatment intervals. Referral pathways influence triage accuracy, destination decisions, interfacility transfer efficiency, and communication between care levels, all of which directly affect access to reperfusion therapies (1).

2.5.2 Door-in–door-out delays at referring hospitals

For patients initially presenting to non–stroke-capable or non-thrombectomy hospitals, the door-in–door-out (DIDO) interval represents a major contributor to treatment delay. Prolonged DIDO times are consistently associated with reduced eligibility for reperfusion therapies and poorer clinical outcomes among thrombectomy candidates. Although benchmarks such as DIDO <60–120 minutes are recommended, these targets are rarely achieved without coordinated system-level interventions(17,26).

2.5.3 Administrative and communication barriers in referral pathways

Several administrative and communication factors prolong interfacility transfer times, including delayed referral activation, unclear transfer criteria, lack of standardized referral protocols, limited access to teleconsultation or CT image sharing, and ineffective inter-hospital communication. Observational studies demonstrate that structured referral pathways, standardized checklists, and advance notification of receiving centers are associated with shorter transfer times and improved process efficiency(24).

2.5.4 Impact of referral-system delays on clinical outcomes

Large observational studies and registry-based analyses consistently demonstrate that inter-hospital transfer and prolonged DIDO or onset-to-treatment intervals are associated with lower rates of reperfusion therapy and worse functional outcomes. Patients requiring secondary transfer are more likely to miss therapeutic windows for thrombectomy and experience longer onset-to-puncture times. Collectively, the evidence indicates that referral delays are not merely logistical inefficiencies but have a clinically meaningful impact on stroke outcomes(26).

2.6 Implications for context-specific intervention

The literature supports the need for integrated, context-sensitive interventions that address financial, geographic, and referral-system barriers simultaneously. In settings such as Addis Ababa, targeted pilot interventions—coupled with economic evaluation—are required to assess the feasibility and cost-effectiveness of measures such as emergency fee waivers, rapid payment mechanisms, optimized referral protocols, and streamlined interfacility transfer pathways. Evaluating the impact of these interventions on onset-to-door times and treatment eligibility will be essential to inform scalable policy decisions(11).

3. Objectives

General Objective

To identify and analyze the key factors influencing the time of arrival to the hospital among stroke patients within a 4 months period , using data collected from TASH, Zewditu memorial hospital and Yekatit 12 hospital

Specific Objectives

- To examine demographic and socioeconomic characteristics associated with time of arrival of patients
- To evaluate patient knowledge of stroke symptoms and initial response behaviors
- To recommend strategies to reduce pre-hospital delays and improve early stroke management.

4. Methodology

4.1 Study Setting

The study is multicenter study conducted in TASH, Zewditu memorial hospital and Yekatit 12 hospital. TASH was found in Addis Ababa which is a capital city of Ethiopia and was established in 1964. Tikur Anbessa Specialized Hospital (TASH) is the teaching hospital of the College. TASH is the largest specialized hospital in Ethiopia, with over 700 beds, and serves as a training center for undergraduate and postgraduate medical students, dentists, nurses, midwives, pharmacists, medical laboratory technologists, radiology technologists, and others who shoulder the health problems of the community and the country at large.

It has the first and largest neurology training center which is staffed with specialist and sub-specialist neurologists, giving neurology specialty programs for residents and pediatric fellows since 2006. It has a stroke unit which was established in September 2022 with the help of Professor Mehari. it consists of 4 beds, and a team consisting of consultant neurologists, stroke subspecialist, stroke nurses (stroke trained nurses), neurology residents. It is a specialized unit dedicated for acute stroke patients with administration of IV thrombolysis for the indicated patients and continuous monitoring of vital parameters.

The stroke clinic of Tikur Anbessa Hospital is one of the specialized outpatient clinics for patients who have completed their acute stroke care and need follow up. The clinic runs once a week every Friday with an average of 40-50 patients seen each day.

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4.2 Study Design and Period

A quantitative, prospective, analytical cross-sectional study was conducted from October 2025 to February 2026.

4.3 Source Population and study population

Source population is all stroke patient who visits TASH, Zewditu memorial hospital & Yekatit 12 hospital Emergency during the data collection period and patients who visits OPD and had stroke in the past 1 year

Study population included all stroke patients who full fill the inclusion criteria

Inclusion criteria

- All adult patients (≥18 years) admitted with clinical diagnosis of stroke and confirmed by CT scan or MRI
- All adult patients who visits OPD and stroke occurred in the past 1 year
- Able to report time of symptom onset

Exclusion criteria

- Patients with stroke onset while already admitted
- Patients too ill to participate
- Aphasic patients

4.3 Sample size Determination and sampling procedure

A census sampling technique was used, whereby all eligible stroke patients during the study period were included. This approach was chosen because the total number of patients was

relatively small, and including all cases ensured maximal statistical power and complete representation of the population during the study period, reducing selection bias.

4.4 Study variables

Dependent variables

- Time of arrival to the first health institution
- Total time taken to arrive at TASH/ZMH/Y12H

Independent variables

Sociodemographic variables

- Age
- Sex
- Residence
- Marital status
- Educational status
- Occupation
- Monthly income

Clinical variables

- Previous history of stroke or TIA
- Presence of comorbidities
- Type of stroke
- Severity of stroke at presentation
- Imaging findings

Knowledge and awareness variables

- Knowledge of stroke symptoms
- Knowledge of stroke risk factors
- Awareness of urgency of stroke treatment

Behavioral and decision-related variables

- First action taken after symptom onset
- Decision-making person
- Delay in recognizing symptoms

Access and system-related variables

- Mode of transportation to hospital
- Use of ambulance services
- Referral status
- Type of first health facility visited
- Time taken from referral to arrival

Time-related variables

- Time of symptom onset
- Time of hospital arrival

4.5 Operational Definitions

- Time of Hospital arrival - the time the patient physically arrives at the hospital emergency department , recorded from hospital registration or triage logs
- Awareness of stroke symptoms - weather the patient or caregiver was able to correctly identify the symptoms as a possible stroke prior to hospital arrival
    - Aware : Recognized symptoms and understood the urgency.
    - Unaware : Did not recognize or misinterpreted the symptoms
- Time of symptom onset - exact or estimated time when the patient or witness first noticed stroke related symptoms . If the exact time is unknown , the last known well time is used

4.6 Data Collection

Data was extracted from patients who arrives to the Emergency department and OPD during the data collection period using a structured and pilot-tested questionnaire. Key variables include:

- Sociodemographics
- Time of symptom onset vs. hospital arrival
- Stroke type and severity
- Mode and time of transportation
- Symptom awareness and initial response
- Referral or ambulance service use

4.7 Data Analysis

Data was analyzed using SPSS version 27. Descriptive statistics summarizes patient characteristics. Logistic regression us used to assess predictors of delayed arrival (arrival >4.5 hours after symptom onset). Missing data are handled using multiple imputation techniques where feasible.

4.8 Ethical Considerations

Ethical approval was obtained from Neurology department research and ethics committee and CHS IRB. All data was anonymized, and confidentiality was strictly maintained throughout the study. Data was stored in password-protected digital systems accessible only to the research team. Participants was informed about their rights, including the right to withdraw from the study at any point.

5. Result

5.1 Participant Characteristics (Sociodemographic Profile)

A total of 80 stroke patients were included in this study, with a relatively young-to-middle-aged distribution (mean age 55.66 ± 17.1 years). Notably, over one-third of participants were in the middle-aged group (45–64 years), reflecting a substantial burden of stroke among economically productive age groups.

The sex distribution was nearly equal, with a slight male predominance. The study population was predominantly urban and largely composed of Orthodox Christians. Most participants were married, and a considerable proportion were housewives or unemployed, indicating potential socioeconomic vulnerability.

Educational attainment was generally low to moderate, with primary education being the most common level achieved. In line with this, the majority of participants reported a monthly income between 4,000 and 10,000 Ethiopian birr, with very few in higher income brackets. Detailed sociodemographic characteristics are presented in Table 1.

Table 1: Sociodemographic Characteristics of Stroke Patients Admitted to TASH, ZMH and Y12H, Addis Ababa, Ethiopia, Oct 2025 - Feb 2026 (n=80)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Mean ± SD	55.66 ± 17.1	—
	Median (IQR)	57	—
	18–44 years	22	27.5
	45–64 years	30	37.5
	≥65 years	28	35.0
Sex	Male	41	51.2
	Female	39	48.8
Religion	Orthodox	50	62.5
	Protestant	19	23.8
	Muslim	11	13.8
Residence	Urban	67	83.8
	Rural	13	16.3
Educational Status	Cannot read/write	5	6.3
	Can read & write	5	6.3
	Primary school	35	43.8
	Secondary school	20	25.0
	College diploma	12	15.0
	MSc/MA and above	3	3.8
Marital Status	Single	4	5.0
	Married	60	75.0
	Widowed	16	20.0
Occupation	Unemployed/Student	19	23.8
	Housewife	25	31.3
	Government employee	15	18.8
	Farmer	4	5.0
	Private/Self-employed	8	10.0
	Retired	9	11.3

Monthly Income (ETB)	< 4,000	19	23.8
	4,000 – 10,000	57	71.3
	11,000 – 19,000	3	3.8
	≥ 20,000	1	1.3

5.2 Clinical Characteristics of Stroke Patients

At the time of symptom onset, most patients were conscious (66.3%), though a substantial proportion presented with impaired levels of consciousness.

Regarding comorbid conditions, hypertension was the most commonly reported chronic illness, present in 39 (48.8%) participants. Additionally, 23 (28.7%) patients had multiple comorbidities, including combinations of hypertension, diabetes mellitus, and cardiac diseases. Only 6 (7.5%) participants reported no known chronic illness.

A prior history of stroke or transient ischemic attack was relatively uncommon, as was a family history of stroke with prevalences of 12.5% and 3.8%, respectively. Similarly, substance use, including smoking, alcohol consumption, and khat chewing, was reported in a minority of patients

The most common presenting complaint was hemiplegia, reported in 64 (80.0%) patients. Other presenting symptoms included aphasia, loss of balance, headache, altered mentation or level of consciousness, and blurred vision. Table 2 summarizes the clinical characteristics of the study participants.

Table 2: Clinical Characteristics of Stroke Patients Admitted to TASH, ZMH and Y12H, Addis Ababa, Ethiopia, Oct 2025 - Feb 2026 (n=80)

Variable	Category	Frequency (n)	Percentage (%)
Level of consciousness at onset	Conscious	53	66.3
	Drowsy	20	25.0
	Unconscious	7	8.7
Comorbidities	None	6	7.5
	Hypertension	39	48.8
	Diabetes mellitus	2	2.5
	Cardiac disease	10	12.5
	Multiple comorbidities	23	28.7
Prior stroke/TIA	No	70	87.5
	Yes	10	12.5
Family history of stroke	No	77	96.3
	Yes	3	3.8
Smoking (current/past)	No	70	87.5
	Yes	10	12.5
Alcohol use	No	66	82.5
	Yes	14	17.5
Khat use	No	72	90.0
	Yes	8	10.0
Chief complaint	Hemiplegia	64	80.0
	Aphasia	8	10.0
	Loss of balance	2	2.5
	Headache	2	2.5

	Altered mentation/LOC	2	2.5
	Blurred vision	2	2.5

5.3 Stroke Symptom Awareness and Perception

Slightly more than half of the participants, 41 (51.2%), had not heard of stroke prior to the current event. Among those who were aware, the most common source of information was friends or family (69.2%), while health institutions and media were less frequently reported.

Recognition of stroke at symptom onset was low, with only 14 (17.5%) participants identifying the condition correctly. Regarding knowledge of symptoms, about half of the participants, 41 (51.2%), identified paralysis or one-sided weakness, whereas a notable proportion reported no knowledge of symptoms (27.5%). More than half of participants correctly identified the brain or nervous system as the organ affected (56.3%), while over one-third (35.0%) did not know.

In terms of urgency, 53 (66.3%) participants reported that stroke requires emergency treatment. Knowledge of risk factors was limited, with 41 (51.2%) participants unable to mention any cause, while hypertension was the most commonly identified factor (33.8%). Most participants were uncertain about stroke preventability (63.8%), while 29 (36.3%) believed it is preventable. (Tabel 3)

Table 3: Stroke Awareness and Perception Among Participants Admitted to TASH, ZMH and Y12H, Addis Ababa, Ethiopia, Oct 2025 - Feb 2026 (n=80)

Variable	Category	Frequency (n)	Percentage (%)
Heard of stroke	No	41	51.2
	Yes	39	48.8
Source of information	Friends/Family	27	69.2
	Health institution	6	15.4
	Media	6	15.4
Recognized stroke at onset	No	66	82.5
	Yes	14	17.5
Knowledge of symptoms	Paralysis/one-sided weakness	41	51.2
	Headache	17	21.3
	Do not know	22	27.5
Organ affected by stroke	Brain/nervous system	45	56.3
	Other organs	7	8.8
	Do not know	28	35.0
Perceived urgency	Yes (emergency)	53	66.3
	Do not know	27	33.8
Perceived causes/risk factors	Do not know	41	51.2
	Hypertension	27	33.8
	Multiple risk factors	10	12.5
	Others	2	2.5
Belief in preventability	Yes	29	36.2
	Do not know	51	63.8
Preventive methods	Lifestyle modification	12	41.4
	Medication adherence	12	41.4

	Exercise only	5	17.2

5.4 Symptom Onset and Decision-Making Behavior

Stroke symptoms were identified either by the patients themselves (48.8%) or by family members and neighbors (51.2%).Most participants, 52 (65.0%), reported that they sought medical care immediately after symptom onset, while 28 (35.0%) delayed or sought alternative care. (Table 4)

Decision-making was largely undertaken by family members, accounting for 71 (88.8%) of cases, whereas majority of patients had an attendant present (95.0%), most commonly a spouse (47.5%) or children (40.0%). Only a small proportion of participants (6.3%) reported experiencing similar symptoms in the past.

Table 4: Symptom Onset and Decision-Making Characteristics Admitted to TASH, ZMH and Y12H, Addis Ababa, Ethiopia, Oct 2025 - Feb 2026 (n=80)

Variable	Category	Frequency (n)	Percentage (%)
Who noticed symptoms first	Patient	39	48.8
	Family/neighbor	41	51.2
First action after symptom onset	Went to hospital/called healthcare provider	52	65.0
	Waited/sought traditional healer	28	35.0
Decision-maker for seeking care	Self	9	11.3
	Family	71	88.8
Presence of attendant	No	4	5.0
	Yes	76	95.0
Relationship of attendant	Spouse	38	47.5
	Children	32	40.0
	Siblings	8	10.0
	Parents	2	2.5
History of similar symptoms	No	75	93.8
	Yes	5	6.3

5.5 Health-Seeking Pathway and Prehospital Timeline

Stroke symptoms most commonly occurred in the morning (37.5%), while hospital arrival was also most frequent in the morning (55.0%). The median time to arrival at the first health facility was 1 hour (mean 4.31 ± 9.54 hours).

Regarding the first point of care, 33 (41.3%) participants initially visited a health center, while 27 (33.8%) presented directly to tertiary hospitals. More than half of the participants, 48 (60.0%), were referred from another healthcare facility, whereas 32 (40.0%) presented directly. Most patients were ultimately managed at Tikur Anbessa Specialized Hospital (77.5%). Among referred patients, additional delays were observed, with referral processing and transfer times commonly taking several hours, and in some cases extending to prolonged duration.

The majority of participants, 63 (78.8%), used private or public transportation, while only 17 (21.3%) utilized ambulance services, despite reported availability in 92.5% of cases. The most frequently reported barrier to timely hospital arrival was lack of awareness (73.8%), while other challenges were reported less frequently.

Table 5: Health-Seeking Pathway and Prehospital Timeline of Patients Admitted to TASH, ZMH and Y12H, Addis Ababa, Ethiopia, Oct 2025 - Feb 2026 (n=80)

Variable	Category	Frequency (n)	Percentage (%)
Time of symptom onset	Morning (7:00 am–12:00 pm)	30	37.5
	Afternoon (12:01 pm–6:00 pm)	16	20.0
	Evening (6:01 pm–12:00 am)	16	20.0
	Early morning (12:01 am–6:59 am)	18	22.5
Time of hospital arrival	Morning	44	55.0
	Afternoon	8	10.0
	Evening	28	35.0
Final treating hospital	TASH	62	77.5
	ZMH	15	18.8
	Yekatit 12	3	3.8
First health facility visited	Health center	33	41.3
	Tertiary hospitals	27	33.8
	Other hospitals	20	25.0
Mode of transport	Ambulance	44	55.0
	Private/public transport	36	45.0
Ambulance availability	Yes	74	92.5
	No	6	7.5
Referral status	Referred	48	60.0
	Not referred	32	40.0
Referral processing time (hours)*	1–2 hours	20	41.7
	≥3 hours	28	58.3
Referral to arrival time (hours)*	1–2 hours	40	83.3
	≥3 hours	8	16.7
Reported challenges	Lack of awareness	59	73.8
	Fear of stigma	11	13.8
	Distance/transport issues	5	6.3
	Waiting for family/symptom resolution	3	3.8
	Financial constraints	2	2.5

5.6 In-Hospital Timeline and Acute Stroke Care

Upon arrival, 40 (50.0%) patients were first evaluated by nurses or health officers, while 32 (40.0%) were seen by general practitioners. Only 7 (8.8%) were initially assessed by a neurology resident or neurologist. Evaluation by a neurologist or neurology resident most commonly occurred within 1–2 hours after arrival, with some patients experiencing longer waiting times. (Table 6)

Most patients underwent brain imaging within 1 hour of arrival, although some experienced delays extending beyond 2 hours. Among those who underwent imaging (n = 65), CT scan was the most commonly used modality (73.8%), while MRI was used less frequently (26.2%). Based on imaging findings, 53 (66.3%) patients were diagnosed with ischemic stroke, while 26 (32.5%) had hemorrhagic stroke. Only 6 (7.5%) patients received thrombolytic therapy, and among these, treatment was administered within 2 to 4 hours of arrival.

Table 6: In-Hospital Timeline and Acute Stroke Management of Patients Admitted to TASH, ZMH and Y12H, Addis Ababa, Ethiopia, Oct 2025 - Feb 2026 (n=80)

Variable	Category	Frequency (n)	Percentage (%)
First health professional seen	Nurse/Health officer	40	50.0
	General practitioner	32	40.0
	Neurology resident/neurologist	7	8.8
	Not sure	1	1.3
Time to imaging after arrival (hours)*	≤1 hour	42	52.5
	1–2 hours	34	42.5
	>2 hours	4	5.0
Time to neurologist evaluation (hours)*	≤1 hour	10	12.4
	1–2 hours	55	68.8
	>2 hours	15	18.8
Imaging modality (n = 65)	CT scan	59	73.8
	MRI	21	26.3
Stroke type (imaging result)	Ischemic	53	66.3
	Hemorrhagic	26	32.5
Received thrombolysis (rTPA)	Yes	6	8.1
	No	74	91.9

5.7 Descriptive Statistics of Arrival Time

The total time from symptom onset to arrival at the final treating hospitals (Tikur Anbessa Specialized Hospital, Zewditu Memorial Hospital, or Yekatit 12 Hospital) was calculated by incorporating both direct arrivals and referral-related delays. For patients who were referred, the time from referral to arrival at these hospitals was added to the initial delay, providing a more comprehensive measure of total prehospital delay.

Using this definition, the mean arrival time was 6.01 ± 11.86 hours, while the median arrival time was 1.5 hours, indicating a substantial discrepancy between mean and median values. Most patients (48%) reached the first health facility within 4.5 hours, while only 26% reached the final treatment center within the same time frame. Of the patients who arrived at the final institution within 4.5 hours, 4% arrived within 30 minutes (none were referred), 27% within 1 hour (none were referred), and 47% within 3 hours.

The distribution of arrival time was highly positively skewed (skewness = 3.28) with marked kurtosis (12.07), suggesting the presence of significant outliers. This indicates that while many patients arrived relatively early, a subset experienced prolonged delays, particularly those undergoing inter-facility referral, which increased the overall mean.

Given the skewed distribution and influence of extreme values, the median provides a more representative measure of central tendency for arrival time in this study population.

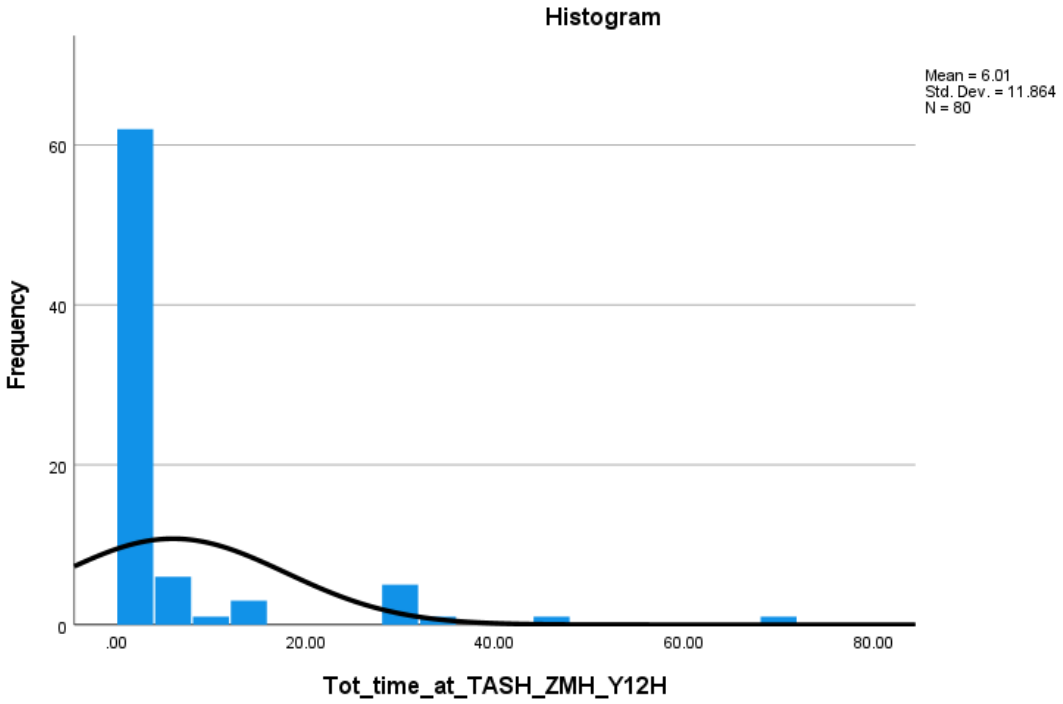


Fig 1: Time taken to reach hospital in hours

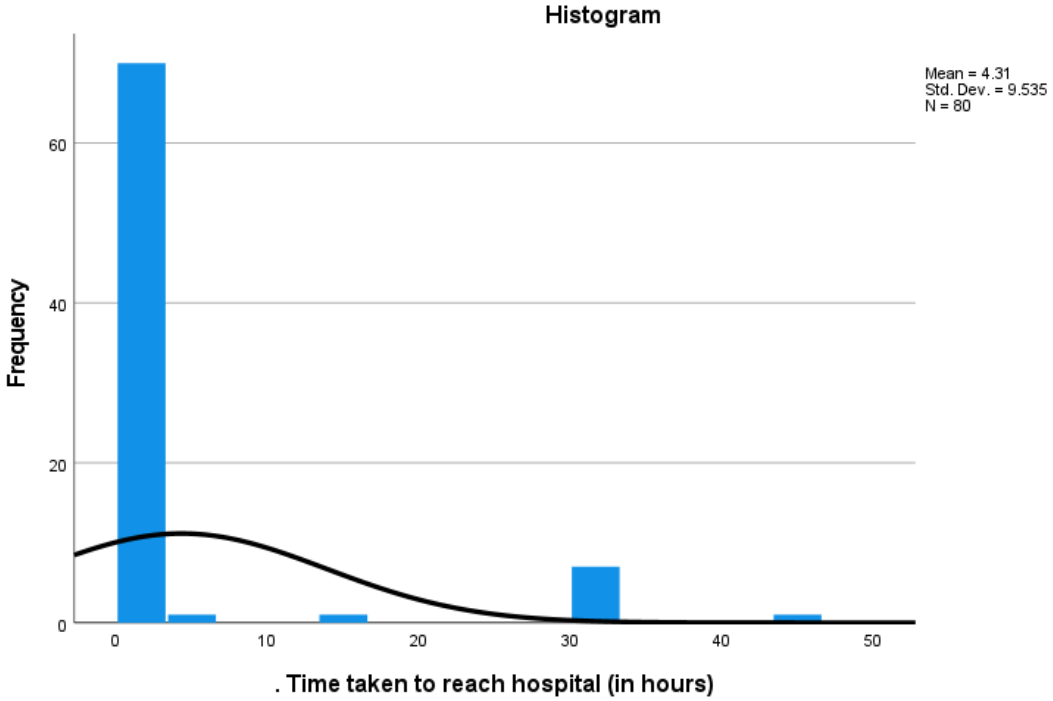


Fig 2: Time taken to arrive at the first health institution

5.8 Logistic Regression Analysis

5.8.1 Bivariable Logistic Regression

Bivariable logistic regression analysis was conducted to assess the association between each independent variable and delayed arrival to the hospital. Variables such as residence, decision-maker for seeking care, knowledge of the illness at symptom onset, perceived affected organ, perception of stroke as an emergency, belief in stroke preventability, type of first health facility visited, referral status, chronic comorbidities, prior history of stroke or transient ischemic attack, and khat use were

identified as candidates for multivariable analysis based on a liberal significance threshold and theoretical relevance. Several of these variables showed a potential association with delayed arrival and were therefore included in the final model.

5.8.2 Multivariable Logistic Regression

In the multivariable logistic regression analysis, **referral status, khat use, and belief that stroke is a preventable disease** were found to be independently associated with delayed hospital arrival. Patients who were referred from another healthcare facility had significantly higher odds of delayed arrival compared to those who presented directly. Similarly, khat use was strongly associated with delayed presentation. In contrast, participants who believed that stroke is a preventable condition were less likely to experience delay, suggesting a protective effect of health awareness. Other variables, including residence, decision-making patterns, prior knowledge of stroke, perceived urgency, and type of first health facility visited, were not statistically significant after adjustment.

Table 8: Bivariable and Multivariable Logistic Regression Analysis of Factors Associated with Delayed Arrival of Patients Admitted to TASH, ZMH and Y12H, Addis Ababa, Ethiopia, Oct 2025 - Feb 2026 (n=80)

Variable	COR	p-value	AOR	p-value
Residence	0.34	0.096	4.33	0.091
Decision-maker (family vs self)	2.44	0.233	0.24	0.218
Knowledge of illness at onset	2.66	0.127	0.46	0.392
Perceived affected organ (cat. 1)	0.39	0.059	0.83	0.632
Perception of stroke as emergency	3.30	0.016	0.34	0.161
Belief stroke is preventable	2.93	0.029	0.15	0.048
First health institution (cat. 2)	0.19	0.011	0.57	0.149
Challenges faced (overall)	—	0.645	1.06	0.841
Referral status	0.15	<0.001	8.33	0.002
Chronic comorbidity (overall)	—	0.320	1.00	0.998
Prior stroke/TIA	2.33	0.246	2.47	0.430
Khat use	0.11	0.042	83.70	0.008

5.9 Logistic Regression Analysis of Time to Arrival at First Health Facility

5.9.1 Bivariable Logistic Regression

Bivariable logistic regression analysis was conducted for all independent variables to assess their association with time to arrival at the first health facility. Variables with a p-value of less than 0.25 in at least one category were considered eligible for inclusion in the multivariable logistic regression model.

Based on this criterion, eight variables met the threshold and were included in the multivariable analysis. These included prior history of stroke or transient ischemic attack, chronic comorbidities,

imaging findings, imaging modality, time of arrival category, knowledge of stroke risk factors, knowledge of stroke symptoms, and educational level. Some variables demonstrated large standard errors and extreme odds ratios in certain categories, suggesting sparse data in those groups.

5.9.2 Multivariable Logistic Regression

All variables that met the inclusion criterion ($p < 0.25$ in at least one category) in the bivariable analysis were entered into the multivariable logistic regression model to identify independent predictors of delayed arrival at the first health facility.

In the adjusted analysis, time of arrival at the first health facility and prior history of stroke or transient ischemic attack were found to be significantly associated with delayed presentation. Patients in the later time category had significantly higher odds of delay compared to those in the reference (earliest) category. Similarly, individuals with a prior history of stroke or transient ischemic attack had significantly lower odds of delayed arrival, suggesting earlier health-seeking behavior in this group.

Other variables, including educational level, knowledge of stroke symptoms, perceived stroke risk factors, imaging results, imaging modality, and presence of chronic comorbidities, were not independently associated with delay after adjustment. These variables demonstrated very large standard errors and extremely high or unstable odds ratios in several categories, indicating sparse data and possible quasi-complete separation.

Table 9: Bivariable and Multivariable Logistic Regression Analysis of Factors Associated with Time to Arrival at First Health Facility of Patients Admitted to TASH, ZMH and Y12H, Addis Ababa, Ethiopia, Oct 2025 - Feb 2026 (n=80)

Variable	COR	p-value	AOR	p-value
Time of arrival (First facility)	7.80	0.047	2872.94	0.021*
Prior stroke/TIA	0.26	0.090	0.01	0.039*
Chronic comorbidity	6.67	0.219	—	0.999
Imaging result	5.32	0.123	0.76	0.867
Imaging modality	3.60	0.239	2.89	0.500
Stroke risk factor knowledge	1.07×10^{9}	0.999	—	0.198
Stroke symptom knowledge	0.35	0.178	—	0.970
Educational level	1.07×10^{9}	0.999	—	0.759

6. Discussion

This study assessed prehospital delay and its determinants among acute stroke patients. The findings show a high level of delayed arrival among stroke patients. Most patients reached the hospital after the recommended therapeutic window. Only a small proportion arrived within the first hours after symptom onset. This pattern reflects a major barrier to effective stroke care in low resource settings.

Stroke causes major disability and death worldwide. The global burden continues to increase, with a large share reported in low and middle income countries. Global burden estimates show rising stroke incidence and mortality across Africa, with growing demand for emergency stroke care (1,12,24). Limited emergency infrastructure, low public awareness, and restricted access to stroke treatment centers contribute to delayed hospital arrival in many regions (19,24).

The median arrival time observed in this study was prolonged. Many patients arrived several hours after symptom onset. This delay exceeds the recommended therapeutic window for thrombolytic therapy. Early treatment improves survival and functional recovery when delivered within a narrow time window. Clinical guidelines emphasize rapid recognition of symptoms, immediate transport, and early initiation of treatment as essential components of stroke care (2,3). Delayed arrival reduces eligibility for reperfusion therapy and increases the risk of disability and death (20).

Studies conducted in Ethiopia report similar findings. A prospective study at Tikur Anbessa Specialized Hospital documented delayed arrival among many stroke patients, with a large proportion presenting beyond the treatment window (7). Another study from Addis Ababa reported missed golden hours among stroke patients, with substantial delays between symptom onset and hospital arrival (16). These consistent findings show persistent delays in urban referral centers across the country.

Referral from other health facilities emerged as a strong predictor of delayed arrival in this study. Patients referred from primary or secondary facilities experienced longer delays compared with those who arrived directly. Interfacility referral increases total delay time due to repeated assessment, administrative processes, and transportation challenges. Similar findings were reported in studies conducted in Uganda and Senegal, where referral pathways contributed to prolonged prehospital delay among stroke patients (23,25).

Evidence from sub-Saharan Africa shows weak referral networks and limited diagnostic capacity at primary health facilities. Many primary centers lack imaging services and trained personnel to identify stroke early. Patients often receive initial evaluation at facilities without stroke readiness, followed by delayed referral to tertiary hospitals. This pattern has been described as a major contributor to delayed stroke care in several African settings (9,21,24).

Research from high income settings highlights the importance of streamlined transfer systems. Studies examining transfer time show delays during interfacility movement when referral pathways lack coordination. Standardized transfer protocols reduce time loss and improve treatment outcomes among stroke patients requiring advanced care (17). The absence of structured referral systems in many low resource settings explains the prolonged arrival times observed in this study.

Transport logistics also contribute to referral delay. Limited ambulance availability forces reliance on private vehicles or public transport. Traffic congestion and long travel distances increase transport time. Poor communication between referring and receiving facilities adds further delay. Similar transport related barriers have been documented across low and middle income countries, where emergency transport systems remain underdeveloped (5,19).

The high proportion of referred patients in this study suggests reliance on multi step care pathways. Many patients first visited nearby clinics or health centers before reaching specialized hospitals. These facilities often serve as the first contact point but lack stroke preparedness. Without clear triage protocols, patients move slowly through the referral chain. Each additional transfer increases delay and reduces the chance of timely thrombolysis. Similar multi step care patterns have been reported in several African countries, where fragmented referral pathways contribute to delayed treatment (21,23).

Public awareness also influences referral patterns. Patients often seek care at the nearest facility without recognizing stroke urgency. Lack of symptom awareness leads to delayed decision making and repeated visits to lower level facilities. Studies from Ghana and Tanzania report similar patterns, where patients failed to recognize stroke symptoms and delayed seeking specialized care (9,11).

Referral delay reflects both health system limitations and gaps in stroke preparedness. Improving early recognition at primary facilities reduces unnecessary transfer time. Training frontline providers strengthens early diagnosis and referral decisions. Structured communication between facilities shortens transfer time. These actions support faster arrival and improve access to treatment.

The findings emphasize the need for coordinated stroke networks. Evidence from Australia shows improved access to reperfusion therapy after implementation of structured referral frameworks that strengthened transfer coordination and emergency response systems (22). Similar approaches adapted to local contexts improve timely stroke care in low resource settings.

Khat chewing showed a strong association with delayed arrival in this study. Patients who reported khat use were more likely to arrive late compared with non users. This finding reflects behavioral and social patterns linked to substance use. Khat sessions often involve long periods of social interaction. Individuals may ignore early symptoms or delay seeking medical care during these sessions. Reduced symptom perception and delayed decision making increase total prehospital time.

Evidence from African settings supports the role of behavioral and lifestyle factors in delayed stroke response. Studies show that cultural practices and daily habits influence recognition of symptoms and health seeking behavior (11,18). Traditional beliefs and social norms affect how patients interpret neurological symptoms. Some individuals attribute stroke symptoms to spiritual or non medical causes. This interpretation delays urgent medical care and promotes home based remedies (18). Similar observations were reported in Tanzania, where community perception of stroke influenced delayed hospital arrival (11).

Stroke awareness strongly influenced arrival time in this study. Patients with poor awareness of stroke symptoms experienced longer delays. Many patients failed to recognize early signs such as weakness, speech difficulty, or facial drooping. Lack of recognition delayed the decision to seek medical care. This pattern reflects a major knowledge gap in the community.

Studies from several countries confirm the link between stroke awareness and early arrival. Research from China showed that patients who recognized stroke symptoms arrived earlier compared with those who lacked knowledge (8,15). African studies also report low public awareness as a major barrier to timely stroke care. A qualitative study from Ghana identified poor knowledge of stroke warning signs among patients and caregivers as a major contributor to delayed presentation (9). Similar findings were reported in Uganda, where limited awareness increased the risk of late arrival (23).

Community perception of stroke also affects decision making. Some individuals view stroke as a non urgent condition. Others believe symptoms resolve without treatment. These beliefs reduce the urgency to seek care. Studies in sub-Saharan Africa report that misinterpretation of symptoms leads to delayed action among patients and families (11,24). Improving public knowledge of stroke warning signs improves early hospital presentation and increases eligibility for reperfusion therapy.

History of previous stroke showed a protective effect in this study. Patients with prior stroke were more likely to arrive earlier compared with those without prior history. Previous experience improves symptom recognition and increases awareness of stroke urgency. Patients with prior stroke often receive education during earlier hospital visits. This education supports faster decision making during recurrent events.

Evidence from multiple studies supports this observation. Research shows that patients with prior stroke recognize symptoms faster and seek care earlier than first time stroke patients (13,15). Prior exposure to stroke care improves knowledge of treatment options and reduces delay time. Studies also report that caregivers of patients with previous stroke show greater readiness to respond to new symptoms (23).

Waiting time at home after symptom onset contributed to delayed arrival in this study. Some patients delayed seeking medical care despite recognizing symptoms. Fear, financial concerns, and uncertainty about symptom severity influenced this behavior. Household level decision making plays a major role in determining the timing of hospital arrival.

Studies across low and middle income countries report similar findings. Research from India showed that many stroke patients delayed hospital visits due to fear of cost and lack of transport (26). African studies also report delays caused by family consultation and financial preparation before seeking care (21,25). Patients often wait for symptom progression before taking action. This behavior reduces the likelihood of early treatment.

Social support influences early response to stroke symptoms. Patients living with family members often receive help in seeking care. Those living alone face greater delay due to lack of assistance. Studies from community based settings report that caregiver presence improves early transport decisions and reduces prehospital delay (11,23).

Financial barriers also influence early care seeking. Some patients delay hospital visits due to concern about treatment cost. Lack of health insurance increases hesitation to seek emergency care. Studies from sub-Saharan Africa identify financial limitations as a major barrier to accessing stroke services (21,24). These economic challenges contribute to prolonged arrival time and reduced treatment access.

Behavioral and knowledge related factors identified in this study highlight the need for community level interventions. Public education programs improve recognition of stroke

symptoms. Awareness campaigns using simple messages support early decision making. Community engagement through media, schools, and health extension programs strengthens public response to stroke emergencies.

Ambulance use showed a strong relationship with arrival time in this study. Patients who used ambulance services reached the hospital earlier than those who used private or public transport. This finding reflects the value of organized emergency transport in stroke care. Ambulance services reduce travel time and support early hospital notification. Early notification prepares hospital teams for rapid assessment and treatment.

Studies from multiple settings report similar findings. Research from the United States showed higher use of emergency medical services among stroke patients improved early hospital arrival (10). Other studies demonstrate that ambulance transport reduces prehospital delay and increases the likelihood of receiving thrombolytic therapy (Kim DH et al., Minnerup J et al.). In low and middle income countries, limited ambulance availability remains a major barrier to early stroke care (5,19). Many patients rely on taxis or private vehicles due to shortages of emergency transport systems. This pattern increases travel time and reduces coordination with receiving hospitals.

Low rates of thrombolysis were observed among patients in this study. Only a small number of patients arrived within the recommended treatment window. This limited eligibility reflects prolonged prehospital delay. Early arrival remains the main requirement for thrombolytic therapy. International stroke guidelines emphasize treatment within the first few hours after symptom onset to improve survival and reduce long term disability (2). When patients arrive late, the opportunity for reperfusion therapy declines sharply (20).

Studies from Ethiopia and other African countries report similar low thrombolysis rates. Limited access to imaging services and trained specialists contributes to reduced treatment availability (24). Research conducted in referral hospitals across Africa shows that many patients fail to receive reperfusion therapy due to late arrival and system level barriers (20,24). These findings align with the delayed arrival patterns observed in this study.

Comparison with global benchmarks shows major differences in prehospital performance. High income countries report shorter arrival times due to strong emergency response systems and public awareness campaigns. Structured stroke response frameworks improve coordination between emergency services and hospitals. A strategic framework implemented in Australia improved access to reperfusion therapy through organized referral and transport systems (22). Such structured approaches support early treatment and improved outcomes.

System level barriers remain a major contributor to delayed arrival in low resource settings. Weak referral pathways, limited emergency transport, and low community awareness create cumulative delays. Evidence from global reviews highlights similar challenges across low and middle income countries, including poor infrastructure and limited workforce capacity (19). Strengthening these system components improves timely stroke care and reduces mortality.

Public health action remains essential to address these delays. Community education programs improve early recognition of stroke symptoms. Public campaigns that promote simple recognition tools increase awareness and response time. Training primary healthcare providers improves early referral decisions. Development of organized stroke pathways

improves communication between facilities. These coordinated actions improve patient flow and reduce total delay time.

The findings of this study provide practical insights for improving stroke care delivery. Strengthening ambulance networks increases early transport. Establishing stroke triage protocols at primary facilities reduces unnecessary delay. Integrating stroke education into community health programs improves public awareness. These measures align with recommendations from global stroke care guidelines and regional policy frameworks (3,19).

This study has several strengths. Data were collected directly from stroke patients and caregivers. Multiple variables were assessed, including behavioral, clinical, and transport factors. This approach allowed identification of both patient level and system level determinants of delay. The study also contributes local evidence from an urban referral setting, where stroke burden continues to increase.

Some limitations should be considered. Recall bias may affect reported symptom onset time. Patients or caregivers may not accurately remember the exact timing of symptoms. Selection bias may also occur, since the study included hospital based participants. Patients who died before reaching the hospital were not included. Despite these limitations, the findings provide useful insight into prehospital delay patterns.

Future research should focus on intervention studies aimed at reducing delay. Community awareness programs should be evaluated for effectiveness. Health system reforms should measure the impact of improved referral and transport networks. Continuous monitoring of arrival time indicators supports quality improvement in stroke services.

This study highlights the urgent need to strengthen stroke response systems. Early recognition, rapid transport, and coordinated referral remain essential components of effective stroke care. Addressing these factors improves treatment access and reduces stroke related disability and mortality.

Limitations

This study used a cross sectional design. This design limits causal interpretation between predictors and delayed arrival. The sample size was 80 patients. This number limits statistical power and reduces precision for some estimates. Wider confidence intervals in regression results reflect this limitation. Participants were recruited from tertiary hospitals only. Patients who never reached tertiary care were excluded. This pattern likely underestimates total delay in the wider population. Urban residents formed the majority of participants. Rural patients were fewer. This imbalance limits applicability of findings to rural settings where transport barriers differ. Time of symptom onset relied on patient or caregiver recall. Recall error affects accuracy of reported timelines. This introduces recall bias in measurement of delay. Patients with severe illness and communication problems were excluded. These patients often face longer delays. Their exclusion reduces representation of severe stroke cases. Some variables relied on self reported responses. Social desirability bias affects responses related to awareness and behavior.

7. Conclusion

Prehospital delay remained high among stroke patients in this study. Referral status, khat use, and belief about stroke prevention showed strong association with delayed arrival. Prior stroke history reduced delay to the first health facility.

Stroke awareness remained low. Many participants had never heard of stroke before onset. Many failed to recognize symptoms and delayed seeking care. Family and friends served as the main source of information instead of health institutions.

Ambulance use remained low and referral between facilities increased total arrival time. Only 11 of 53 ischemic stroke patients received thrombolytic therapy. Delayed arrival reduced access to time dependent treatment.

These findings show gaps in awareness, emergency response, and referral systems. Addressing these gaps remains important for reducing treatment delay and improving stroke care outcomes.

RECOMMENDATIONS

• Provide routine stroke education during outpatient visits in hospitals and primary health centers.
• Train healthcare workers in primary facilities to recognize stroke early and refer patients without delay.
• Strengthen ambulance coordination and promote emergency transport use for suspected stroke.
• Conduct community education campaigns focused on stroke symptoms and urgency of hospital care.
• Improve referral communication between primary and tertiary facilities to reduce transfer delay.
• Conduct larger studies with rural inclusion to improve representativeness.
• Evaluate stroke awareness programs and measure their effect on hospital arrival time.

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Questionnaire for Assessment

Questionnaire for Assessment

Section 1: Demographics

1. Age: _____
2. Sex: ☐ Male ☐ Female
3. MRN:
4. Religion 1) Orthodox 2) Muslim 3) Protestant 4) Catholic 5) Others (specify)
5. Educational Level: ☐ Can not read/write
   ☐ Can read/write
   ☐ Primary school (1-8)
   ☐ Secondary school (9-12)
   ☐ College diploma
   ☐ College degree
   ☐ MSC/MA and above
6. Marietal status : single Married Divorced Widowed Living together

7. Monthly income in birr
   a. < 4000
   b. 4000 – 10,000
   c. 11,000 - 19,000
   d. > 20,000

8. Occupation 1) Farmer 2) Student 3) House wife 4) Government employee 5) Trader 6) Other (specify) 7) Jobless
9. Residence: ☐ Urban ☐ Rural Where ; specify.....

Section 2. Stroke symptoms awareness

10. Level of consciousness at onset
    a. Fully conscious
    b. Drowsy
    c. Unconscious

11. What were the symptoms first noticed (Multiple answer is possible)
    a. Unable to move one side of the body
    b. Inability to speak or slurred speech
    c. Blurring of vision
    d. Change in mentation
    e.Loss of consciousness
    f. facial weakness
    g. Loss of balance
    h. headache

i. combination of the above
j. others, specify---------

12. Who noticed the symptoms first
1) The patient 2) family 3) relatives 4) neighbours 5) Strangers

13. What was your first action after noticing symptoms? ☐ Waited ☐ Sought traditional help ☐ Went to holy water ☐ Went to hospital ☐ Called ambulance ☐ other

14. Who made the decision to seek medical help? ☐ Self ☐ Family ☐ Neighbor ☐

Stranger

15. Do you have an attendant present with you ☐ yes ☐ No

16. If yes, what is the relationship of the attendant to you
1) Husband 2) Wife 3) Son 4) Daughter 5) Brother 6) Sister 7) Others specify----------

17. Have you ever had similar symptoms as mentioned above which stayed for less or greater than 24 hours before
1) Yes 2) No

18. If yes, which symptoms and when ----------

19.When you developed the symptoms did you know the name of the illness ☐ Yes ☐ No

20. If no , have you heard of stroke before? ☐ Yes ☐ No

21. If yes, what is the source of your knowledge about stroke
1) Media (TV, Radio, Mobile) 2)Family 3) Friends 4) health institutions 3) internet 4) community 5) others
specify----------

22. Which organ/body part do you think is affected by stroke?

Brain
Heart
Blood/blood vessel
Limb muscle
Eye
Bone
Nerve
Kidney
Lung
Liver
Other(s), please specify_____

23. What are the symptoms of stroke you know? please list the symptoms you are aware of: _____

24 . Do you think stroke requires emergency treatment?

1.Yes
2.No
3.I do not know

25.What do you think causes or is a risk factor for stroke? (Multiples answers are allowed**)**

1. High BP
2. Diabetes mellitus
3. Heart Disease
4. Abnormal blood cholesterol
5. Physical stress
6. Evil spirit/spiritual possession
7. Genetically transmitted
8. I don't know any risk
9. Other causes or risk factors, mention

26 .Do you believe that stroke is preventable disease?

1.Yes
2. No
3. I do not know

If your answer is yes, how----------
If your answer is no, why not……

27 Risk factors (Multiple answer is possible)

Modifiable	Non modifiable
☐ History of hypertension	Age
☐ History of Diabetes Mellitis	Sex
☐ History of cardiac disease	Prior history of stroke or TIA If yes, when and outcome……
☐ Do you smoke? (current or past) If yes, how much?	Family history stroke
☐ Do you drink alcohol? If yes, how much?	Inherited conditions
☐ Do you chew khat If yes , how much ?	
☐ History of drug intake If yes , which drugs and for how long ……	

Section 3: Time and Mode of Arrival

28. When did the stroke symptoms first appear? (Date & Time) _____

29. Which health institution did you visit first

1. Health center 2. District hospital 3 . Other teaching hospital
4 .Nearby clinic 5. Directly to TASH/ZMH/Y12H

30. What time did you arrive at the hospital (First health institution)? (Date & Time) _____

31. Time taken to reach hospital (in hours): _____

32. Mode of transportation used: ☐ Ambulance ☐ Private car ☐ Public transport ☐ Other: _____

33. What was the status of health professional that saw you first?

1. GP 2. Nurse/health officer 3. Resident 4. Neurologist 5. Other health professionals

Section 4 . Barriers to Early Arrival

34. What challenges did you face in reaching the hospital? (Check all that apply)

☐ Lack of awareness about symptoms
☐ Distance to hospital
☐ Lack of transportation
☐ Financial constraints
☐ Preference for traditional medicine
☐ Fear or stigma
☐ Other: _____

Section 5: Health care accessibility and time for intra and inter hospital processes

35. Was an ambulance service available in your area? ☐ Yes ☐ No

36. Were you referred from another healthcare facility? ☐ Yes ☐ No

If referred, how many hours did it take you to process the referral……..

37. How long did it take from referral to current hospital? _____

38. After how many hours of arrival were you evaluated by a neurology resident or a neurologist

39. After how many hours of arrival were you scanned ……..

40. What was the imaging modality used (See file)

1) CT-Scan 2) MRI

41. Imaging Result (See file)

Ischemic stroke ….. Area of infarction

Hemorrhagic stroke .... Area of bleeding

42. Did you receive a blood thinner(rTPA)?

43. If yes a. How many hours after symptom onset

b. How many hours after imaging