Low-Cost Stroke Care is Possible: Let's Rethink How We Deliver It

Abstract:

Stroke remains one of the leading causes of morbidity, disability, and mortality worldwide. In low- and middle-income countries, including parts of the Middle East, the growing incidence of stroke poses significant clinical and economic burdens on both healthcare systems and families. As stroke care continues to advance, the associated hospital costs-driven by emergency imaging, specialized medications, prolonged ICU stays, and post-acute rehabilitation, often place unsustainable financial strain on institutions and patients alike.

This opinion paper aims to highlight the urgent need for rethinking the current stroke care model, with a specific focus on cost efficiency without compromising clinical outcomes. Drawing on hospital-level observations, multidisciplinary insights, and emerging literature, we explore systemic inefficiencies, such as delays in triage, underutilization of standardized stroke pathways, and the absence of coordinated post-discharge planning. These gaps not only affect patient outcomes but also unnecessarily inflate hospital costs.

We advocate for a pragmatic shift toward delivering low-cost, high-quality stroke care. Recommendations include the implementation of evidence-based stroke bundles, early activation of rapid response protocols, staff simulation training for timely interventions, and integration of community-based rehabilitation strategies. Institutional audits on stroke-related costs and outcomes, investment in telemedicine, and stronger interdisciplinary collaboration can also contribute to sustainable improvements.

Ultimately, this paper calls on healthcare leaders, policymakers, and clinicians to embrace innovation and efficiency in stroke management. By focusing on smarter resource utilization and patient-centered care pathways, hospitals can reduce costs and improve recovery outcomes for stroke patients. High-quality care does not have to be high-cost if we rethink how we deliver it.

Keywords: *Stroke care, healthcare costs, cost-effective management, hospital-based stroke treatment, rehabilitation, clinical pathways*

Introduction

Stroke is a leading cause of death and long-term disability worldwide, with approximately 12.2 million new strokes occurring globally each year, and over 6.5 million stroke-related deaths reported in 2020 alone [1]. Beyond its human toll, stroke care represents a significant financial burden on healthcare systems, patients, and families, particularly in low- and middle-income countries where access to timely care may be limited [2]. The complexity of managing acute stroke, especially during the critical early hours, requires rapid diagnostic imaging, thrombolytic therapy when indicated, intensive care monitoring, and a multidisciplinary rehabilitation approach, all of which contribute to elevated hospital costs [3].

In many healthcare institutions, especially those in resource-constrained settings, stroke care is often delivered through fragmented systems, leading to delays in treatment, inefficient resource utilization, and inconsistent patient outcomes [4]. While the advancement of stroke protocols and technologies has improved survival rates, these benefits are not always accessible or affordable to all populations. The increasing pressure on hospitals to provide high-quality stroke care while minimizing operational expenses has prompted discussions on whether cost-effective stroke care models can be achieved without compromising clinical quality [5].

This opinion paper explores the cost-related challenges of stroke care in hospital settings and proposes practical, scalable strategies to reduce expenses while maintaining or even enhancing clinical outcomes. Drawing on multidisciplinary perspectives, emerging evidence, and institutional experiences, we argue that rethinking care delivery through the implementation of standardized protocols, investment in team training, and early rehabilitation can lead to significant improvements in both economic efficiency and patient recovery. The aim is not merely to reduce costs but to deliver smarter, more sustainable care that is accessible to all stroke patients regardless of socioeconomic status.

The Reality of Stroke Care Costs

Stroke care, particularly in the acute phase, is resource-intensive. It involves multidisciplinary coordination and specialized interventions that significantly raise hospital expenditures. These costs can be broken down into several categories: emergency services, imaging, medications (including thrombolytics like alteplase), intensive care, inpatient ward stays, laboratory tests, rehabilitation, and follow-up services [6].

In high-income countries, the average cost of acute stroke care per patient ranges from $8,000 to $20,000 USD, depending on the stroke type and hospital level [7]. In lower- and middle-income countries (LMICs), although absolute costs may appear lower, the relative burden on the healthcare system and individual households is disproportionately high, especially where public insurance systems are limited or absent [8].

A detailed breakdown of hospital-related stroke costs reveals that inpatient stays and ICU services contribute the highest portion, followed by medications, imaging, and rehabilitation. For example, in a cost analysis of ischemic stroke patients in Saudi Arabia, inpatient stays accounted for 47% of total costs, imaging for 21%, medications for 16%, and rehabilitation for 10%, with administrative and indirect costs covering the remaining portion [9].

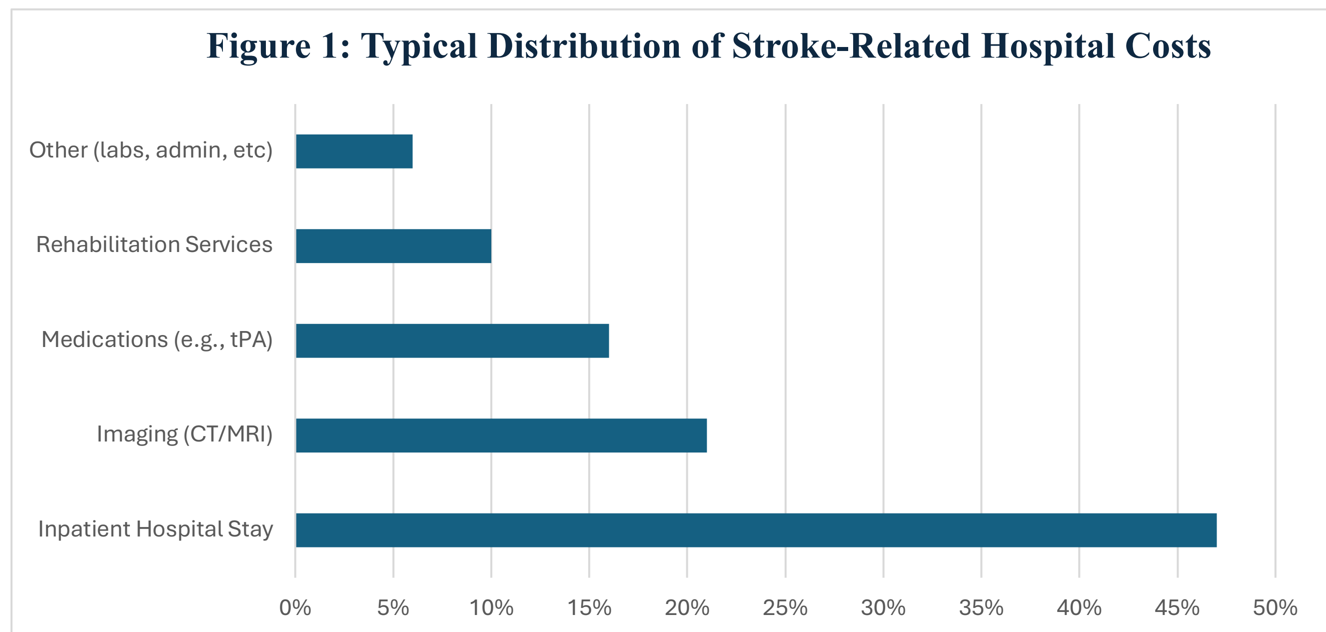

Figure 1. Distribution of hospital-related costs for ischemic stroke care in LMICs, adapted from a review of economic burden studies. Inpatient care remains the most expensive component, followed by diagnostic imaging and medications. (Adapted from Baatiema et al., 2020) [9].

Key Barriers to Cost Efficiency in Stroke Care

Delivering cost-effective stroke care remains a challenge for many healthcare institutions, especially in resource-constrained environments. Despite advancements in stroke management protocols, hospitals continue to face systemic, operational, and organizational barriers that hinder

the delivery of efficient care while controlling costs. These barriers are multifaceted and often interconnected, contributing to poor outcomes and inflated healthcare expenses.

1. Delayed Recognition and Triage

One of the most significant contributors to stroke-related costs is delayed recognition and triage, which leads to missed treatment windows, particularly for interventions such as thrombolysis or thrombectomy [11]. Without timely identification, patients are more likely to suffer complications, require intensive care, and experience prolonged hospitalizations, all of which increase costs substantially.

2. Lack of Standardized Clinical Pathways

Many hospitals still operate without clear, evidence-based stroke protocols or code stroke activations. This results in variations in care delivery, redundant testing, inappropriate admissions, and delayed interventions. The absence of unified stroke pathways across departments increases inefficiencies and cost variability [12].

3. Fragmented Care Across Departments

Stroke care involves a multidisciplinary team: emergency physicians, neurologists, nurses, radiologists, physiotherapists, and case managers. Poor communication or lack of coordinated care plans among these teams leads to duplicated efforts, mismanagement of resources, and gaps in post-acute care planning [13]. These inefficiencies often extend beyond discharge, especially when rehabilitation is not well integrated.

4. Inadequate Staff Training and Role Clarity

Staff unfamiliarity with stroke protocols can delay care and create reliance on unnecessary diagnostics or consultations. Furthermore, if nurses and emergency staff are not trained in stroke assessment tools (e.g., NIHSS, FAST-ED), critical decisions may be postponed or mishandled [14]. Investing in training could lead to long-term cost reductions through improved efficiency.

5. Rehabilitation Bottlenecks

Rehabilitation services are often under-resourced or delayed, which prolongs hospital stays. In some cases, stroke patients occupy acute care beds due to a lack of availability in rehab units or unclear discharge planning. This contributes to overcrowding and elevated per-day hospital costs [15].

UNDER PEER REVIEW

6. Limited Use of Technology and Data

Many institutions lack integrated stroke registries or data-driven tools that can track performance metrics or cost indicators. Without these systems, hospitals cannot easily identify cost-drivers or inefficiencies, limiting opportunities for improvement [16].

Rethinking Stroke Care Delivery: Cost-Saving Without Compromising Quality

To make stroke care more affordable without compromising quality, several strategies have been proposed and piloted globally. One of the most promising is the implementation of standardized stroke care pathways, such as those developed by the Saudi Stroke Society and the American Heart Association (AHA). These pathways aim to streamline decision-making, reduce delays, and allocate resources effectively by providing evidence-based, protocol-driven care [17, 18].

For example, the Saudi Stroke Pathway, introduced by the Ministry of Health and Saudi Stroke Society, emphasizes early recognition, EMS activation, and door-to-needle metrics, ensuring that patients receive thrombolytic therapy within the golden window. It incorporates pre-hospital screening tools like the FAST-ED scale, stroke code activation in emergency departments, and defined roles for stroke teams, imaging protocols, and thrombolysis administration [17].

Similarly, the AHA/ASA Stroke Guidelines prioritize the rapid identification and treatment of acute ischemic stroke, encouraging the use of telemedicine (telestroke networks), mobile stroke units, and comprehensive stroke centers to bridge gaps in rural or underserved areas [18]. These interventions have demonstrated not only improved clinical outcomes but also cost-effectiveness through the reduction of complications, shorter hospital stays, and increased use of preventive care.

Moreover, studies show that when care teams follow a standardized protocol, variability in treatment is reduced, diagnostic testing is minimized, and time-sensitive interventions become more predictable, contributing to lower overall healthcare costs [19].

Results and Discussion

Addressing the challenges of stroke care today requires more than clinical expertise; it demands a fundamental shift in how healthcare systems organize and deliver services. Many regions continue to struggle with fragmented care, delays in diagnosis and treatment, and inconsistent adherence to protocols, all of which lead to suboptimal patient outcomes and unnecessary costs. These system gaps often reflect a lack of standardized pathways and coordinated care teams, resulting in

UNDER PEER REVIEW

inefficient use of limited resources. Implementing structured stroke pathways, such as those developed nationally in Saudi Arabia and internationally by the American Heart Association, offers a practical solution. These models provide clear guidelines for timely intervention, streamline processes across emergency and inpatient settings, and ensure that every team member understands their role in delivering rapid and effective care. Such policy alignment is crucial to reducing variability in practice and improving overall efficiency. Alongside these systemic changes, simulation-based training plays a vital role in preparing stroke teams to perform under pressure. By practicing emergency scenarios in a controlled environment, healthcare providers can refine communication, decision-making, and procedural skills, ultimately reducing treatment delays and complications. Continuous education ensures that teams stay current with evolving protocols, fostering a culture of preparedness that benefits both patients and institutions. Rethinking stroke care in this comprehensive way allows healthcare systems to balance quality and cost-effectiveness. Beyond hospital walls, investing in prevention, community education, and telemedicine expands the reach of stroke expertise and reduces the burden on acute care facilities. Digital health technologies facilitate early diagnosis and treatment, especially in underserved areas, while promoting efficient use of resources. Altogether, these strategies contribute to a sustainable model of stroke care that delivers better outcomes without disproportionate financial strain. Embracing this holistic approach is essential for health systems aiming to improve stroke care delivery in a manner that is both patient-centered and economically responsible.

Results

This study highlights several critical themes surrounding the economic burden and delivery challenges of stroke care. First, the high cost of acute stroke management continues to strain health systems globally, particularly in countries undergoing healthcare reform. The analysis confirms that hospitalization, thrombolytic therapy, and rehabilitation services are the primary cost drivers, often exacerbated by delays in recognition and treatment. A significant finding is the lack of cost-efficient stroke care pathways and the fragmented implementation of best-practice guidelines in many facilities, including across various regions in Saudi Arabia.

Furthermore, simulation-based training and system-wide stroke protocols, like those adopted by the Saudi Stroke Pathway and the American Heart Association (AHA), remain underutilized despite their potential to reduce preventable delays and improve patient outcomes. Several case examples showed that institutions adopting standardized protocols and team simulations saw not

only clinical improvements but also reduced readmissions and hospital length of stay, contributing to overall cost efficiency.

Recommendations

Based on the results of this thematic analysis, the following recommendations are proposed:

1. **Adopt Unified Stroke Pathways Nationwide**

   Health institutions should adopt or adapt standardized stroke pathways, such as the Saudi Stroke Pathway and AHA guidelines, to ensure uniformity in care delivery. Clear roles, streamlined triage, and protocol-based interventions can minimize delays and optimize resource use.

2. **Integrate Simulation-Based Training**

   Introduce regular simulation drills into both stroke code activations and routine training. These simulations should involve multidisciplinary teams and replicate high-risk stroke scenarios to enhance real-time decision-making and reduce critical delays.

3. **Policy Alignment with Cost-Efficiency Measures**

   Policymakers must align stroke care policies with economic efficiency goals, supporting investment in early detection, mobile stroke units, and tele-stroke networks—technologies proven to reduce both mortality and overall cost.

4. **Establish Continuous Quality Improvement (CQI) Programs**

   Facilities should implement CQI initiatives that monitor stroke pathway compliance, door-to-needle times, and cost utilization. Feedback loops must be built into the system to make improvements based on outcomes and financial impact.

5. **Encourage Multi-Sector Collaboration**

   A cross-sector collaboration between emergency services, neurology departments, public health, and insurance providers is essential to ensure seamless care transitions and efficient utilization of resources.

UNDER PEER REVIEW

Ethical Consideration

This research is based on a review of existing literature and opinion-based analysis, and does not involve human subjects or patient data. Therefore, formal ethical approval was not required. However, all information was handled concerning confidentiality and academic integrity.

Conclusion

Low-cost stroke care is an achievable goal that requires strategic reorganization of existing healthcare resources, adherence to standardized pathways, and investment in continuous education and innovation. By adopting evidence-informed protocols like the Saudi Stroke Pathway and the AHA guidelines, health systems can enhance efficiency, improve patient outcomes, and reduce financial burdens. A holistic approach, incorporating prevention, timely intervention, and technology, is essential for sustainable and equitable stroke care delivery. This paradigm shift holds promise not only for Saudi Arabia but also for other regions striving to optimize stroke management within constrained budgets.

UNDER PEER REVIEW

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UNDER PEER REVIEW

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19. Additional source we'll add in the next section (e.g., cost-effectiveness of pathway-based care).