

Integrating Cerebrovascular Neurosurgery into National Health Policies: A Roadmap for Nigeria

Abstract

This study explores the integration of cerebrovascular neurosurgery into Nigeria's national health policies, aiming to enhance the accessibility, quality, and sustainability of neurosurgical care. With a focus on Nigeria's challenges due to a high prevalence of cerebrovascular diseases (CVDs), this research identifies critical gaps in healthcare delivery and proposes comprehensive reforms. The study employed a systematic review of existing literature with thematic analysis to identify barriers to neurosurgical care and evaluate the effectiveness of current national health policies. Key barriers identified include severe shortages in the neurosurgical workforce, inadequate medical infrastructure, financial constraints, geographic disparities, and a general lack of public awareness about cerebrovascular diseases. The analysis also highlights the fragmented nature of the healthcare system and the inadequacy of current health policies to support neurosurgical needs effectively. In response to these challenges, the study proposes the Systems Integration Framework for Cerebrovascular Neurosurgery (SIF-CN), a framework designed to address these issues through strategic policy recommendations. The framework emphasizes workforce expansion, infrastructure enhancement, better integration of neurosurgical care within national health policies, improved financing mechanisms, and enhanced public awareness programs. The findings suggest that implementing the SIF-CN could significantly improve health outcomes by increasing the availability and quality of neurosurgical care, thus reducing the mortality and disability associated with cerebrovascular diseases. Economically, better neurosurgical care could decrease the long-term healthcare costs and enhance productivity by reducing the burden of disability. Socially, the proposed framework aims to ensure equitable access to care and enhance the overall public health infrastructure. The study concludes that urgent, collaborative action is required to overhaul the existing framework and implement the proposed model, which could lead to substantial improvements in the health and well-being of Nigeria's population.

Keywords: cerebrovascular neurosurgery, Nigeria, health policy, Systems Integration Model, healthcare barriers, neurosurgical workforce, public health infrastructure

Introduction

1. Background of the study

Cerebrovascular diseases (CVDs) are a range of conditions that disrupt blood flow to the brain, leading to significant health and disability challenges in the patients with stroke being the most common manifestation of the group [1,2]. According to the World Health Organization (WHO), Cerebrovascular diseases (primarily stroke and intracranial hemorrhage) is a significant global health challenge constituting the second leading cause of death globally and a major cause of long-term disability [3,4]. CVDs are particularly pronounced in low- and middle-income countries (LMICs), with over 80% of stroke-related deaths occurring in these regions [5]. Nigeria, with its large and rapidly growing population, faces a particularly acute challenge[54-55]. National surveys reveal a stroke prevalence of up to 14.6 per 1,000 individuals in some regions, ranking among the highest globally [3]. This statistics constitutes a significant national challenge, considering the impact of CVDs like stroke on individual health, as stroke survivors often experience profound physical and cognitive impairments [6,7]. The economic and societal consequences are equally devastating, imposing a significant financial burden on individuals, families, and the Nigerian healthcare system, and disrupting family dynamics and social networks [8, 9].

According to Karekezi et al. [10], the integration of cerebrovascular neurosurgery into national health policies is a critical step towards addressing this multifaceted challenge. In Nigeria, where the majority of stroke patients are managed in facilities lacking neurosurgical expertise [2], improving access to specialized care is paramount. Molyneux et al. [11] highlights the importance of timely access of CVDs patients to healthcare, asserting that delays in reaching specialized care are associated with increased morbidity and mortality. Evidence from high-income countries and LMICs alike demonstrates that timely neurosurgical interventions can significantly reduce mortality rates and improve functional outcomes [7].

Beyond addressing the immediate disease burden, integrating cerebrovascular neurosurgery is a strategic approach to strengthening healthcare system, as investments in neurosurgical infrastructure, workforce training, and quality improvement initiatives can catalyze broader health system improvements, benefiting patients across the spectrum of surgical needs [11]. Evidence from a Ghanaian studies on acute stroke treatment reveals that the introduction of neurosurgical services led to improvements in overall surgical capacity and quality [12,13]. Thus, following the potential and necessity of integrating cerebrovascular neurosurgery into national health policies, this study aims to develop a comprehensive roadmap for the integration of cerebrovascular neurosurgery into Nigeria's national health policies, enhancing accessibility, quality, and sustainability of neurosurgical care across the country, ultimately improving health outcomes and reducing the burden of cerebrovascular disease in Nigeria. The objectives of the study includes:

1. Assess the Current Landscape of Neurosurgical Care in Nigeria
2. Analyze Relevant National and International Health Policies
3. Propose a Framework for Policy Integration
4. Evaluate the Potential Impact and Sustainability of the Proposed Policies

Based on these objectives, the study addresses the following questions:

1. What are the key barriers and facilitators to accessing cerebrovascular neurosurgical care in Nigeria, and how do they vary across geographic, socioeconomic, and demographic groups?
2. How effective are existing national health policies in Nigeria in addressing the specific needs of cerebrovascular neurosurgery, and what are the key policy gaps and inconsistencies?
3. What evidence-based policy recommendations and implementation strategies can be proposed to effectively integrate cerebrovascular neurosurgery into Nigeria's national health framework?
4. What is the potential health, economic, and social impact of integrating cerebrovascular neurosurgery into national health policies in Nigeria, and how can the sustainability of such policies be ensured?

2. Literature Review

Globally, the integration of neurosurgical care, including cerebrovascular neurosurgery, into national health policies has emerged as a strategic imperative for addressing the burden of neurological disorders [14]. However, this integration varies considerably across countries, reflecting diverse health systems, economic realities, and national policies [15]. In high-income countries (HICs), such as the United States, Canada, and the United Kingdom, neurosurgical care is generally well-established within national health frameworks, with robust infrastructure, trained workforce, and comprehensive insurance coverage [16]. Nevertheless, challenges persist, including geographic disparities in access, workforce shortages in specific subspecialties, and escalating healthcare costs [17].

Conversely, in many low- and middle-income countries (LMICs), neurosurgical care remains underdeveloped, with limited infrastructure, inadequate workforce capacity, and substantial financial barriers to access [13]. These challenges are compounded by a higher burden of neurological disorders, often resulting in delayed diagnosis, inadequate treatment, and poorer outcomes. Despite these obstacles, several LMICs have made notable strides in integrating neurosurgical care into their national health policies. In Ghana, for instance, a concerted effort to develop neurosurgical capacity through targeted training programs and infrastructure investment has resulted in increased access to care, improved outcomes, and a positive spillover effect on the overall surgical system [13]. Similarly, Tanzania has successfully integrated neurosurgical care into its national health system through a phased approach, starting with the establishment of a national referral hospital and gradually expanding services to regional and district levels [18]. These successes underscore the feasibility and potential impact of policy interventions in resource-constrained settings.

In Brazil, a middle-income country with a large and diverse population, the integration of neurosurgical care has been facilitated by a combination of factors, including substantial government investment, public-private partnerships, and the establishment of regional neurosurgical centers [19]. These efforts have led to a significant expansion of neurosurgical services, improved access to care, and a reduction in geographic disparities [19]. In contrast, Nigeria's progress in neurosurgical integration has been challenged by inadequate funding, workforce shortages, and a lack of comprehensive policies, necessitating immediate healthcare policy reforms that incorporates significant approaches to improve neurosurgical practices [2].

Studies have recommended several practices for improving neurosurgical practices. For instance, Garba et al. [20] suggests a strong national commitment to prioritizing neurosurgical care is essential for successful integration which should be accompanied by adequate financial investment in infrastructure, workforce training, and service delivery [21]. Also, the development of a skilled and motivated workforce is paramount, requiring investments in pre-service and in-service training programs, as well as strategies to attract and retain neurosurgical professionals in underserved areas [11]. More so, Fuller et al. [17] advocates for collaboration and partnerships between government agencies, healthcare providers, academic institutions, and civil society organizations are crucial for effective implementation to facilitate knowledge sharing, resource mobilization, and the development of context-specific solutions [17]. Meara et al. [11] further asserts that robust monitoring and evaluation frameworks are essential for tracking progress, identifying bottlenecks, and ensuring accountability.

The State of Neurosurgical Care in Nigeria

Studies show that although while there are traces of advancement in the expansion of neurosurgical infrastructure in Nigeria recently years, evidenced in the establishment of new centers and the acquisition of modern equipment, this expansion is inhibited by series of challenges. The growing demand for neurosurgical services is due to the increasing population and rising number of neurological disorder cases particularly stroke, which has been reported to affect up to 40.9 per 1000 individuals in certain regions [2,3,7]. As a result, access to neurosurgical care remains inequitable, with significant disparities between urban and rural areas, as well as across socioeconomic strata [3].

The workforce capacity for neurosurgery in Nigeria is also a pressing concern, as Okon et al. [2] highlight that while the number of neurosurgeons has increased in recent years, with an estimated 150 practicing neurosurgeons as of 2020 it remains woefully inadequate to meet the needs of the population, resulting in a ratio of approximately 0.07 neurosurgeons per 100,000 people [1]. Furthermore, the distribution of neurosurgeons is skewed towards urban centers, leaving rural areas with limited or no access to specialized care [7]. This shortage is exacerbated by the emigration of Nigerian neurosurgeons to high-income countries in search of better opportunities and

working conditions, with over 60% of Nigerian-trained neurosurgeons practicing outside the country as of 2015 [3].

In addition, Okon et al. [2] aver that while a handful of centers provide high-quality care that rivals international standards, others grapple with resource constraints, inadequate training, and suboptimal outcomes. Joshua et al. [7] also assert that a lack of standardized protocols, quality improvement initiatives, and robust monitoring and evaluation mechanisms further impede efforts to enhance the quality of care. A study by Akunne et al. [9] found that only 54.5% of patients reported being satisfied with healthcare services in Nigeria, highlighting the need for improvement in quality and patient experience [9].

Neurosurgical care in Nigeria is further characterized by policy gaps. While the National Health Act and other policy documents recognize the importance of neurosurgery, specific provisions for integrating this specialty into the national health framework remain inadequate [22]. In addition, insufficient funding challenges, lack of clear guidelines on workforce development, infrastructure planning, and quality assurance also contributes to neurosurgical care ineffectiveness in Nigeria [2]. Moreover, the absence of a comprehensive national registry for neurological disorders hampers efforts to accurately assess the burden of disease and track the impact of interventions further hindering evidence-based policy formulation and resource allocation [7,23]. Addressing these challenges require a multi-pronged approach that encompasses investments in infrastructure and workforce development, the formulation of evidence-based policies, and the establishment of robust monitoring and evaluation mechanisms [24,25].

Theoretical Frameworks: Understanding the Complexities of Neurosurgical Care Integration

The World Health Organization's (WHO) health system building blocks offer a comprehensive framework for analyzing the multifaceted challenges and opportunities inherent in integrating cerebrovascular neurosurgery into national health policies [25]. This framework encompasses six interconnected components: service delivery, health workforce, health information systems, access to essential medicines, financing, and leadership/governance, with each component playing a crucial role in shaping the landscape of neurosurgical care [26].

While the service delivery building block emphasizes the need for accessible, acceptable, and high-quality services [27], current literature suggests a significant gap between this ideal and the reality in many LMICs, including Nigeria [2] with vivid disparities in access to neurosurgical care, with rural dwellers facing longer travel times, higher out-of-pocket expenses, and limited availability of specialized services [28]. In terms of the health workforce building block which emphasizes the importance of a sufficient and skilled workforce [25], the Nigerian neurosurgical workforce faces critical shortages and maldistribution, with a concentration of specialists in urban centers and a dearth of trained personnel in rural areas [7]. This shortage is further exacerbated by

the brain drain phenomenon, with many Nigerian neurosurgeons seeking better opportunities abroad [1]. Projections indicate that the neurosurgical workforce in Africa will remain critically low through 2030, underscoring the urgent need for investment in training and retention of neurosurgeons [1].

The health information systems building block emphasizes the importance of reliable data for decision-making, monitoring, and evaluation [25]. The Nigerian neurosurgical sector is characterized by a lack of comprehensive national registry for neurological disorders, hampering efforts to accurately assess the burden of disease and track the impact of interventions [7], thus hindering evidence-based policy formulation and resource allocation, making it difficult to identify priority areas for investment and evaluate the effectiveness of existing programs.

Access to essential medicines, another critical building block, remains a challenge in Nigeria [25]. High costs and limited availability of essential medications for stroke prevention and management contribute to suboptimal outcomes and increased morbidity [29]. Research has highlighted gaps in hypertension guidelines in LMICs compared to high-income countries, potentially contributing to the increased burden of stroke in Nigeria [29]. Ensuring equitable access to affordable and essential medications is crucial for improving the management and outcomes of cerebrovascular diseases.

The financing building block highlights the need for sustainable funding mechanisms to support neurosurgical care [25]. In Nigeria, out-of-pocket payments remain the dominant mode of healthcare financing, posing a significant barrier to access for many patients [30]. The lack of comprehensive insurance coverage for neurosurgical procedures further exacerbates financial hardships for patients and their families. Exploring innovative financing models, such as national health insurance schemes and public-private partnerships, is essential for ensuring financial protection and expanding access to neurosurgical care.

Finally, the leadership and governance building block emphasizes the importance of strong political will, effective governance structures, and robust accountability mechanisms [25]. While the Nigerian government has expressed commitment to improving healthcare, the translation of this commitment into concrete action for neurosurgical care has been slow [20]. The absence of clear guidelines, inadequate funding, and weak accountability mechanisms hinder progress in this area. Strengthening leadership and governance in the health sector is crucial for driving policy implementation, ensuring effective resource allocation, and fostering a culture of transparency and accountability.

In addition to the WHO framework, the "three delays" model, commonly used to understand barriers to accessing emergency obstetric care, can also provide insights into the challenges faced in accessing neurosurgical care in Nigeria [31]. This model highlights three key delays including delay in seeking care, delay in reaching care, and

(3) delay in receiving care. In the context of neurosurgical care, these delays can be attributed to factors such as lack of awareness, financial constraints, geographic barriers, and inadequate infrastructure. Addressing these delays requires a multi-faceted approach that encompasses community education, financial protection mechanisms, improved transportation networks, and expanded neurosurgical capacity.

3. Methods

The study utilized the comprehensive search strategy to identify relevant literature on the integration of cerebrovascular neurosurgery into national health policies, with a specific focus on the Nigerian context. Electronic databases, including PubMed, Scopus, and Web of Science, were systematically searched using a combination of keywords and MeSH terms including "cerebrovascular neurosurgery," "health policy," "Nigeria," "access to care," "workforce," "infrastructure," "quality of care," and "policy integration." Boolean operators (AND, OR) were used to combine the search terms, and the search was limited to articles published in English between 2014 and 2023. Additionally, grey literature sources such as government reports and policy documents were consulted to provide a comprehensive overview of the policy overview in Nigeria. Data was extracted from the selected articles using a standardized data extraction form, capturing information on study design, sample size, geographic location, key findings, and methodological quality. The extracted data were then analyzed using a thematic analysis approach, which involved a systematic process of coding, categorizing, and interpreting the data to identify recurring patterns and themes related to the barriers, facilitators, and policy implications of integrating cerebrovascular neurosurgery in Nigeria. The analysis was facilitated by NVivo software, which aided in the organization and management of the qualitative data. To ensure the rigor and credibility of the findings, the quality of included studies was assessed using the Critical Appraisal Skills Programme (CASP) checklist for qualitative research. This checklist evaluates various aspects of study design, data collection, analysis, and reporting to assess the overall methodological quality and risk of bias. Studies were rated as high, moderate, or low quality based on their adherence to established methodological standards. The findings of lower-quality studies were interpreted with caution, and their potential limitations were acknowledged in the analysis.

4. Results and Discussion

Table 1: Summary of the Qualitative result from the reviewed literatures

Theme	Subtheme	Key Findings (with Supporting References)	Policy Recommendations	Potential Impact	Strength of Evidence
Barriers to Access	Limited Neurosurgical Workforce	Shortage of neurosurgeons, brain drain phenomenon [1, 2, 47, 11, 12, 10]	Invest in training and retention of neurosurgeons through scholarships, competitive salaries, and professional development opportunities. Establish training programs for nurses, anesthesiologists, and other healthcare professionals involved in neurosurgical care [1, 2, 49, 11, 12, 10].	Health Outcomes: Increased availability and accessibility of neurosurgical care, reduced wait times for treatment. Economic Benefits: Increased workforce productivity due to timely treatment and reduced disability.	Strong
	Inadequate Infrastructure	Lack of specialized facilities, equipment, and essential medications [2, 8, 11]	Develop and equip dedicated neurosurgical centers in each geopolitical zone. Ensure the availability of essential medications and supplies through centralized procurement and distribution channels. Establish clear referral networks between primary, secondary,	Health Outcomes: Improved quality of care, increased capacity for complex procedures. Economic Benefits: Potential for medical tourism, generating revenue for the country.	Strong

			and tertiary care facilities [2, 8, 11].		
High Cost of Care	Neurosurgical procedures often unaffordable for many Nigerians [2, 48]	Integrate neurosurgical care into the National Health Insurance Scheme (NHIS). Explore innovative financing mechanisms such as crowdfunding and medical savings accounts. Negotiate price reductions for essential medications and supplies [2, 50].	Health Outcomes: Increased affordability of neurosurgical care, reduced financial burden on patients and families. Social Impact: Reduced inequities in access to care based on socioeconomic status.	Moderate	
Geographic Barriers	Unequal distribution of services, limited access in rural areas [2, 11]	Establish regional neurosurgical centers in underserved areas. Develop telemedicine capabilities for remote consultations, diagnosis, and follow-up care. Provide transportation subsidies for patients traveling long distances to access care [52, 11].	Health Outcomes: Equitable access to neurosurgical care across the country.	Strong	
Lack of Awareness	Limited public knowledge of cerebrovascular diseases and treatment	Conduct national public awareness campaigns on cerebrovascular diseases and the importance of early detection and treatment. Educate	Health Outcomes: Increased early detection and timely treatment, reduced morbidity and mortality.	Moderate	

		options [32]	healthcare providers on early identification and referral of patients with suspected cerebrovascular conditions. Integrate neurosurgery education into medical and nursing curricula [7].	Social Impact: Improved public understanding of cerebrovascular health, empowered patients.	
Policy Gaps	Lack of Comprehensive Policies	Existing policies do not adequately address neurosurgery needs [2, 51]	Develop a national cerebrovascular neurosurgery plan that outlines clear goals, strategies, and timelines for integrating neurosurgical care into the overall health system. Establish a dedicated neurosurgery unit within the Federal Ministry of Health. Integrate neurosurgical care into primary care through training and resource allocation [2, 11, 33].	Health Outcomes: Coordinated and integrated approach to neurosurgical care, improved patient outcomes.	Strong
	Fragmented Health System	Poor coordination, lack of integration with primary care [33]	Strengthen referral systems between primary, secondary, and tertiary care facilities. Develop standardized protocols for diagnosis, treatment, and referral of cerebrovascular conditions. Invest in electronic	Health Outcomes: Improved patient navigation through the healthcare system, seamless continuity of care.	Moderate

			health records to facilitate information sharing and care coordination [33].		
Limited Funding	Insufficient funding for infrastructure, training, and services [2, 11]	Increase government budgetary allocation for neurosurgery. Explore alternative financing mechanisms such as public-private partnerships, philanthropic donations, and international aid. Establish a dedicated fund for neurosurgical research and development [2, 53].	Health Outcomes: Enhanced capacity for neurosurgical care, sustainable funding for infrastructure and services. Economic Benefits: Potential for job creation in the healthcare sector.	Strong	
Weak Health System Resilience	Vulnerable to shocks and disruptions [34]	Develop comprehensive emergency preparedness and response plans for cerebrovascular events. Strengthen the supply chain for essential medications and equipment. Invest in training healthcare workers on disaster management and resilience [33].	Health Outcomes: Improved ability to maintain essential services during crises, enhanced overall system functionality.	Moderate	

The results shows that access to cerebrovascular neurosurgical care in Nigeria is hindered by multiple, interrelated barriers, each impacting the efficacy and availability of essential medical interventions. One of the primary challenges is the significant shortage of neurosurgeons, with a startling ratio of only 0.07 neurosurgeons per 100,000 people. This scarcity is further intensified by the brain drain phenomenon, where a large proportion of Nigerian-trained neurosurgeons practice abroad, leading to long wait times for consultations and procedures, delayed diagnoses, and severely limited access to specialized care, particularly in rural and underserved areas. Compounding this issue, there are substantial infrastructural deficiencies within healthcare facilities across the country. Many lack the specialized equipment, operating rooms, and intensive care units necessary for complex neurosurgical procedures. The situation is exacerbated by frequent shortages of essential medications and supplies, which compromise both the quality and availability of care.

Financial constraints also pose a significant barrier, as neurosurgical procedures are often prohibitively expensive, and many Nigerians lack health insurance coverage or the financial means to afford these services out-of-pocket. This economic burden can force patients to delay or forego treatment altogether, leading to worsened outcomes and increased morbidity and mortality. Geographical disparities further challenge the accessibility of neurosurgical services, with the majority of facilities concentrated in urban centers. This distribution leaves individuals in rural areas with limited or no access to specialized care, disproportionately affecting those in remote and underserved regions who also face the added burdens of long travel distances, transportation costs, and logistical challenges in seeking care. Also, a significant lack of public awareness and knowledge about cerebrovascular diseases and their treatment options severely limits timely and effective medical intervention. Many Nigerians are not aware of the signs and symptoms of stroke, resulting in delayed presentations at healthcare facilities. Moreover, public knowledge about the availability and benefits of neurosurgical interventions is limited, hindering early diagnosis and referrals for specialized care.

The analysis of existing national health policies in Nigeria reveals critical gaps and inconsistencies that hinder the integration of cerebrovascular neurosurgery into the broader healthcare framework [2, 11]. While overarching documents like the National Health Act acknowledge the importance of surgical care, they lack specific provisions tailored to the unique needs of cerebrovascular neurosurgery, including clear guidelines on workforce development, infrastructure planning, and quality assurance [22]. This absence of a targeted policy framework creates ambiguity and impedes the systematic development and implementation of specialized neurosurgical care programs. Furthermore, the fragmented nature of the Nigerian health system poses a significant challenge [33]. The lack of coordination and integration between primary care and specialized neurosurgical services results in disjointed care pathways, leading to

delays in diagnosis and treatment [33]. Patients with cerebrovascular conditions often navigate a complex healthcare landscape, encountering multiple barriers in accessing timely and appropriate neurosurgical interventions.

The result also reveals that insufficient funding allocated to neurosurgical care further exacerbates the existing challenges [2, 11]. Limited financial resources hinder the development and maintenance of essential infrastructure, the training and retention of skilled personnel, and the provision of affordable services [2, 11]. This financial constraint perpetuates disparities in access to care and limits the potential for expanding neurosurgical services to underserved populations. Additionally, the Nigerian health system's vulnerability to shocks and disruptions, such as disease outbreaks and political instability, poses a significant threat to the continuity of neurosurgical care [33]. This vulnerability impresses the need for policies that prioritize health system strengthening and resilience to ensure uninterrupted access to essential services, including neurosurgical interventions, during crises.

Discussion

Accessing cerebrovascular neurosurgical care in Nigeria is hindered by multiple entrenched barriers within the health system and sociocultural landscape. A significant challenge is the acute shortage of neurosurgeons, primarily concentrated in urban centers, which limits access to specialized care, especially in rural areas [1,2,8,10]. Proposed solutions like task-shifting and task-sharing, intended to alleviate workforce burdens, are often insufficient for meeting the specialized needs of cerebrovascular patients due to the advanced expertise required for optimal care [2,8]. This situation necessitates a dual approach of expanding the neurosurgical workforce while enhancing the capacity of non-specialist providers. The infrastructure for neurosurgical care is also inadequate, with a glaring lack of specialized centers equipped with modern technology and essential medications, hindering the capacity for timely and effective treatment [2,8,11].

Moreover, the high cost of neurosurgical procedures, often unaffordable for many Nigerians, poses another formidable barrier. Most patients face significant challenges due to the dominance of out-of-pocket payments and limited health insurance coverage [2,11]. Proposals to integrate neurosurgical care into national health insurance schemes and explore innovative financing options have yet to be proven in Nigeria's constrained resource setting. Geographical disparities exacerbate access issues, with services predominantly located in urban areas. Although telemedicine has been suggested as a remedy, logistical and infrastructural challenges, such as limited internet connectivity and inadequate power supply, impede its implementation. Lastly, a general lack of public awareness about cerebrovascular diseases delays early diagnosis and treatment [7]. Effective public awareness campaigns, combined with targeted education for healthcare

providers and community engagement, are essential to improve health literacy and promote timely medical intervention.

The analysis of existing national health policies in Nigeria reveals a significant disconnect between the recognized importance of surgical care and the lack of specific provisions for cerebrovascular neurosurgery [2, 11, 22]. While overarching documents like the National Health Act acknowledge the need for surgical services, they lack detailed guidelines on workforce development, infrastructure planning, financing mechanisms, and quality assurance for neurosurgical care [22]. This policy gap creates ambiguity and hinders the systematic integration of neurosurgical care into the broader health system.

Moreover, the fragmented nature of the Nigerian health system, characterized by poor coordination between different levels of care and a lack of integration between primary care and specialized services, poses a significant challenge [33]. This fragmentation results in disjointed care pathways, delays in diagnosis and treatment, and suboptimal outcomes for patients with cerebrovascular diseases. The limited funding allocated to neurosurgical care further exacerbates the existing policy gaps [2, 11]. While Nigeria has made strides in expanding healthcare coverage through initiatives like the National Health Insurance Scheme, neurosurgical services remain largely underfunded [35]. This financial constraint not only limits access to care but also hampers the development of a skilled workforce and the establishment of adequate infrastructure.

Evidence-Based Policy Recommendations and Implementation Strategies

Based on the findings of this study, and the synthesis of literature relevant to the integration of cerebrovascular neurosurgery in Nigerian healthcare sector, this study proposes evidence-based policy recommendations and strategies designed as a Systems Integration framework for Cerebrovascular Neurosurgery (SIF-CN). These recommendations focus on expanding the neurosurgical workforce, strengthening infrastructure, integrating neurosurgical care into national health policies, improving health financing, and enhancing public awareness and engagement.

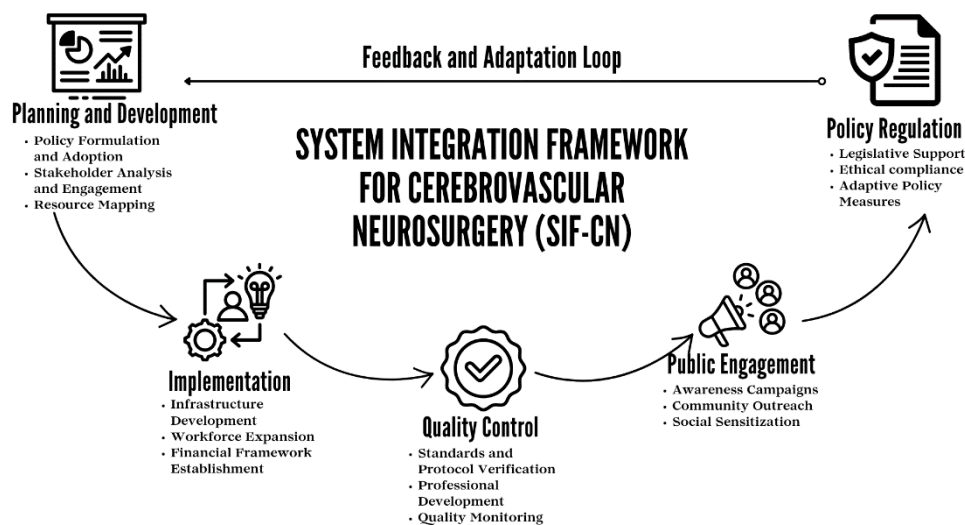


Fig 1: The SIF-CN Framework for improving policy recommendations for LMICs

The study avers that expanding and retaining the neurosurgical workforce is critical; hence, establishing training programs at major universities and teaching hospitals can increase the number of qualified neurosurgeons [36,37]. Moreover, offering competitive salaries, career development opportunities, and improved working conditions can help retain these professionals within Nigeria. Additionally, implementing task-shifting strategies by training nurse practitioners and physician assistants in basic neurosurgical care can alleviate the pressure on neurosurgeons and extend care to underserved areas [38].

Strengthening neurosurgical infrastructure involves investing in the construction and equipping of regional neurosurgical centers with modern technology. Establishing a reliable supply chain for essential neurosurgical medications and supplies ensures availability across all regions, which is crucial for timely and effective care. Integrating neurosurgical care into national health policies requires developing specific health policy provisions that detail guidelines for workforce development, infrastructure, and quality assurance [39,40,41]. Advocating for the inclusion of neurosurgical procedures in national health insurance coverage can significantly reduce the financial burden on patients, making essential care more accessible. Improving health financing through public-private partnerships can provide necessary funds for neurosurgical care facilities and training programs [42]. Exploring innovative financing models such as crowdfunding, diaspora funding, and international aid can supplement traditional healthcare financing, providing a more robust financial base for neurosurgical initiatives [30].

Enhancing public awareness and engagement is also vital. Launching national public awareness campaigns can educate the public about the signs and symptoms of cerebrovascular diseases and available treatment options. Initiating community

outreach programs, especially in rural and underserved areas, can improve health literacy and facilitate early detection and treatment of neurosurgical conditions [43,44]. The implementation of these policies requires collaborative governance involving a multisector task force that includes health officials, neurosurgeons, educators, and community leaders [43,44,45]. This collaboration ensures the alignment of goals and resources and addresses emerging challenges effectively. A robust monitoring and evaluation system is essential to track the progress of policy implementation and its impact on health outcomes [44]. This system should utilize data-driven feedback to continually refine and improve policy measures, ensuring they remain effective and responsive to the population's needs [46]. Additionally, leveraging telemedicine technologies can extend neurosurgical consultations and follow-up care to remote areas, thus overcoming geographic barriers and expanding access to essential neurosurgical services [45].

Integrating SIF-CN into Nigeria's national health policies implies significant potential for transformative impacts across health, economic, and social features. These proposed policies not only aim to enhance the immediate clinical outcomes for patients but also contribute to broader societal and economic benefits.

SIF-CN can improve health outcomes of CVDs patients by increasing the availability of trained neurosurgeons and improving access to equipped facilities, mortality rates from cerebrovascular incidents like strokes are likely to decrease. Additionally, the reduction in delayed diagnoses and treatments can significantly minimize long-term disabilities, thereby improving the quality of life for survivors and reducing the overall disease burden on the healthcare system [36,39]. Economically, the enhancements in neurosurgical care can lead to considerable savings by decreasing the long-term healthcare costs associated with stroke management and rehabilitation. Increasing the efficiency and effectiveness of neurosurgical interventions can contribute to a healthier workforce, thus boosting productivity and stimulating economic growth. Furthermore, developing neurosurgical infrastructure can create job opportunities, not only within the healthcare sector but also in ancillary services that support medical facilities.

Socially, the proposed policies are poised to promote greater equity in healthcare access. By decentralizing neurosurgical services and integrating care into the national health insurance scheme, the disparities in access between urban and rural populations can be addressed [16,39]. This inclusivity fosters social cohesion and builds trust in the healthcare system. Additionally, the emphasis on public awareness and education about cerebrovascular diseases can empower individuals to seek care early, which is crucial for effective treatment outcomes. In terms of sustainability, the policies must include ongoing training for healthcare professionals, continuous infrastructural maintenance, and consistent funding. Establishing partnerships with private sectors and international health organizations can provide a steady influx of resources and innovations [38]. Regular monitoring and evaluations, coupled with adaptive

management strategies, will ensure that the neurosurgical services remain responsive to the evolving healthcare needs of Nigeria's population, thereby maintaining their efficacy and relevance over time [38].

5. Conclusion

This study has meticulously outlined the profound and multifaceted challenges hindering access to cerebrovascular neurosurgical care in Nigeria, emphasizing the critical need for strategic interventions at both policy and practice levels. The barriers identified—ranging from severe workforce shortages to infrastructural deficiencies, and from economic constraints to geographical and educational disparities—highlight the urgency of adopting the Systems Integration Framework for Cerebrovascular Neurosurgery (SIF-CN).

Given the evidence and analyses presented, it is clear that implementing the SIF-CN, a comprehensive overhaul of the existing framework, is necessary. Policymakers, healthcare providers, and stakeholders must come together to forge a robust national policy framework that not only prioritizes neurosurgical care but also commits to substantial investments in workforce development and infrastructure. Ensuring equitable access to care and bolstering the resilience of the health system are paramount to addressing the current deficiencies effectively. Such reforms will pave the way for a future where timely, affordable, and high-quality neurosurgical care is not a privilege but a norm accessible to all Nigerians, regardless of their geographic or socioeconomic status. Implementing these changes will substantially decrease the burden of cerebrovascular diseases across the country and enhance the overall health and well-being of the Nigerian population.

The findings of this study emphasize the necessity of immediate and sustained efforts to adopt and implement the SIF-CN framework through a collaborative, well-resourced, and strategically focused approach to foster significant improvement in the Nigerian healthcare outcomes.

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