

Tanzania Stroke Project: Developing mechanical thrombectomy in resource limited settings

Karol P Budohoski, MD, PhD,¹ Sarah Nguyen, MD,¹ Sarah Matuja, MD,² Eric Mbuguye, MD,³
Frank Minja, MD,⁴ Martin Mutonga,⁵ Faheem Sherif, MD^{6,7}, Alpha Kinghomella, MD,⁸

¹Department of Neurosurgery, University of Utah, Salt Lake City, UT, USA. ²Department of Neurology, Catholic University of Health and Allied Sciences–Weill Bugando, Tanzania.

³Department of Radiology, Muhimbili National Hospital, Tanzania. ⁴Department of Radiology and Imaging Sciences, Emory University, GA, USA. ⁵Department of Radiology, Yale-New Haven Hospital, CT, USA. ⁶Department of Neurology, Texas Tech University Health Sciences Center, El Paso, TX, USA. ⁷Neuroendovascular Associates, Corpus Christi Medical Center, TX, USA. ⁸Neurosurgery, Muhimbili Orthopedic Institute, Tanzania

The Global Burden of Disease study estimated that in 2016 there were 5.5 M deaths and 116.4 M DALYs (Disability-Adjusted Life Years) lost due to stroke, the second most common cause of death worldwide.¹ Due to its burden, stroke has been designated a priority by the World Health Organization.² While from 1990 to 2016 the global incidence of stroke decreased, in sub-Saharan Africa and Asia the incidence has increased.¹ Furthermore, 87% of DALYs lost due to stroke and 86% of stroke-related mortality occurs in lower- and middle-income countries (LMICs).³ A survey of 17 African countries found that there were only 5 stroke units and 2 designated stroke centers and only 5% of all acute cases receive either thrombolysis or mechanical thrombectomy.³

Large vessel occlusion (LVO) accounts for 15 – 40% of all stroke, or 24 cases/100 000 population or 80 000 cases/year in the US alone.⁴ LVO stroke increases the odds of death by 4.5 fold.⁵ RCTs evaluating mechanical thrombectomy for stroke demonstrated uniform benefit,^{6–10} and cost-effectiveness,^{11,12} with the number needed to treat (NNT) to prevent 1 death or disability of 2.6.¹³ The American Heart Association guidelines recognize mechanical thrombectomy as the first line treatment for stroke within 24 hours of onset.¹⁴ The pioneering Mechanical Thrombectomy Global Access For Stroke (MT-GLASS) study,¹⁵ demonstrated that globally access to mechanical thrombectomy is <3% of the demand, and <1% in most LMICs (Fig 1).¹⁵ Indeed, in the majority of studied sub-Saharan countries there is no access to this lifesaving treatment.

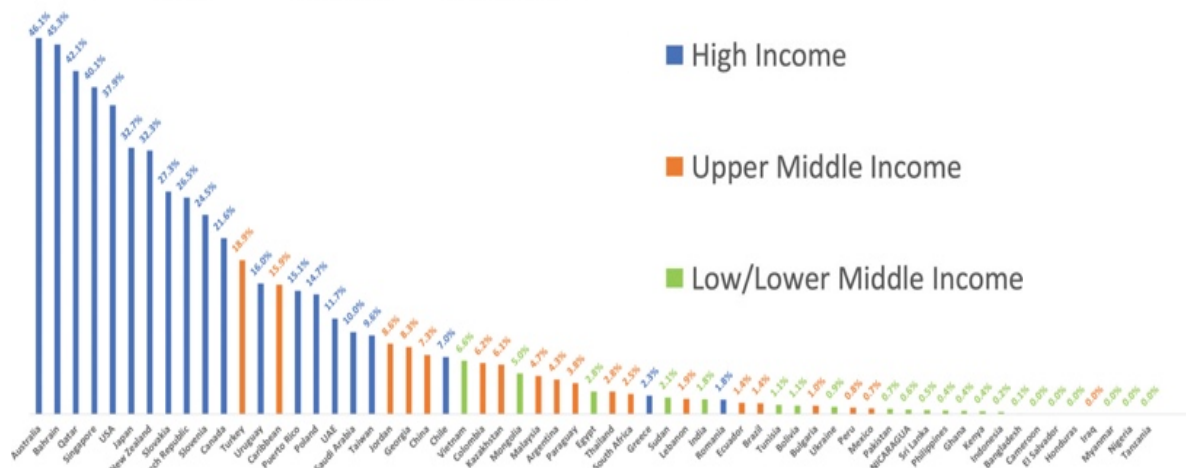


Figure 1 Global distribution of mechanical thrombectomy access rates by country and by income level. Tanzania seen in far right of graph. Asif et al. 2023¹⁵

The recent implementation of stroke registries in major referral hospitals in Tanzania provides epidemiological data on patients with stroke.^{16–19} The 1-year mortality of patients with stroke has been reported as high as 40%,^{18,19} with 97% of survivors unable to resume work.¹⁹ Furthermore, retrospective data from Tanzania suggests that up to 39% of first time stroke is due to LVO, which carries a significantly higher mortality rate of up to 80%.¹⁸ However, based on the available studies it is not possible to determine how many patients would be candidates for mechanical thrombectomy due to the lack of data on other qualifiers, such as stroke severity and time from symptom onset. Registry data from 566 patients admitted with stroke to a referral hospital in Tanzania demonstrates that at least 51% of patients are admitted with a delay from symptom onset of 2–6 days and only 19% are within 24 hours of onset (Matuja et al. unpublished data). These results point at the need to develop services to provide rapid diagnosis and treatment, and that there may be a significant number of patients presenting with LVO stroke who could benefit from modern treatments. The specific factors contributing to the delays in diagnosis and admission remain unclear. Data from traumatic brain injury (TBI) and spinal cord injury demonstrated that the lack of public awareness of symptom and available treatment, lack of emergency services, and lack of rapid, affordable access to imaging play significant roles.^{20–22}

Many recommendations and guidelines for treatment of acutely ill patients, which have been developed in high-resource countries, may not be applicable in resource limited settings. This Essential Emergency and Critical Care (EECC) study recognized this in 2021 and published an expert consensus on the minimal requirements for critical care.²³ EECC is defined as the care that should be provided to all critically ill patients of all ages in all hospitals in the world. This concept can be extrapolated to other domains of treatment to define the essential requirements to provide a particular service. Defining of essential components required for a sustainable and effective mechanical thrombectomy can be useful in guiding policymakers and healthcare system officials as to the required capital expenditure and personnel training.

A barrier to developing mechanical thrombectomy services in many healthcare systems is the lack of trained providers, specialized equipment for diagnosis and treatment, and post-operative care.^{15,24} Various organizations have aimed to provide a blueprint for training in endovascular procedures. The World Federation for Interventional Stroke Treatment (WIST) has formulated multi-specialty training guidelines.²⁴ Mission Thrombectomy (<https://missionthrombectomy.org>) published a white paper describing the steps required to build a thrombectomy capable center.²⁵ However, improvement in capacity remains slow and training providers in LMICs is challenging. Road to IR (<https://www.road2ir.org/training-model>) was developed to bring a sustainable training curriculum of peripheral intervention radiology to Tanzania (with multiple on-line education sessions and serial hands-on training sessions).²⁶ They have shown successful training of multiple fellows during a 5 year period.

We developed the Tanzania Stroke Project (<https://www.tanzaniastrokeproject.com>) to establish mechanical thrombectomy as a treatment in Tanzania and serve as a guideline for future development in the East African region. Our approach is based on the MT-GLASS study, guidelines established by Mission Thrombectomy, the WIST training curriculum, and the encouraging results of the Road to IR program. We established a collaboration between the Muhimbili National

Hospital in Dar es Salaam, the Department of Neurosurgery at the University of Utah and Road to IR to deliver a project focusing on three essential components required to establish a mechanical thrombectomy service for acute ischemic stroke patients due to LVO in Dar es Salaam:

Aim 1: *Establish the incidence patients presenting with acute ischemic stroke who are eligible for mechanical thrombectomy treatment*

We established a registry to prospectively collect data on all patients presenting with LVO stroke to 3 District Hospitals and the Muhimbili National Hospital. We will include data on progression of care through hierarchical structure within the healthcare system. We aim to identify the epidemiology of LVO stroke and addressable barriers to patient flow and care progression (Fig 2).



Figure 2 Map of the referral network for acute patients in Dar es Salaam metro area. Hospitals in BLUE designate District Hospitals; Hospitals in RED designate the National Referral Hospitals (Muhimbili National Hospital, 2 campuses)

Aim 2: *Establish an international consensus on the essential requirements for providing mechanical thrombectomy which can be utilized in low resource setting*

We have utilized Delphi methodology to develop a set of generally agreed upon guidelines for the essential requirements for a self-sustaining mechanical thrombectomy service. We have disseminated questionnaires and surveys through international organizations such as Mission Thrombectomy, World Stroke Organization, Society for Neurointerventional Surgery and personal contacts to reach endovascular providers with expertise in mechanical thrombectomy who practice in resource limited settings (manuscript in submission). Using this methodology we have developed a set of recommendations, which can be utilized by healthcare systems working on establishing mechanical thrombectomy as an available treatment for stroke (Fig 3).

Aim 3: *Develop a self-sustaining training curriculum and program for training physicians to perform mechanical thrombectomy for stroke and ultimately the whole breadth of neuroendovascular interventions culminating in a Master of Science of Neuro-Endovascular Intervention*

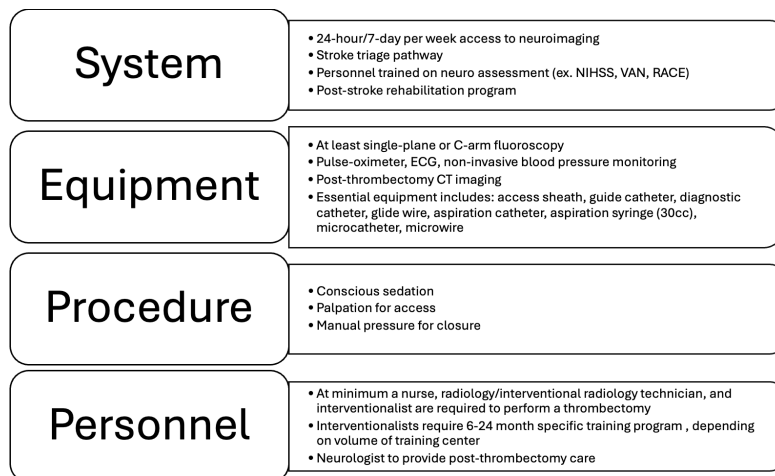


Figure 3 Diagram describing the recommendations for essential components required to develop a mechanical thrombectomy service. Delphi methodology was used achieving a consensus of 28 endovascular providers from 18 countries.

We propose to establish an international consortium of physicians, nurses, technologists, and trainees to work together with physicians in Dar es Salaam to bring minimally invasive, image guided neuroendovascular procedures to the Muhimbili National Hospital and Muhimbili Orthopedic Institute. Alongside hands-on training, together with our partners we aim to develop a formalized curriculum leading to a Master’s degree in neuroendovascular intervention. We have now completed 2 readiness assessment visits to determine the strengths and weakness of the current healthcare set up, as well as to identify the opportunities for growth. We have performed a number of endovascular procedures, demonstrating feasibility for the program.²⁷ Using this approach, we aim to formulate a blueprint for developing neurointerventional training programs in East Africa and improve capacity for interdisciplinary research in the field of stroke (Fig 4).

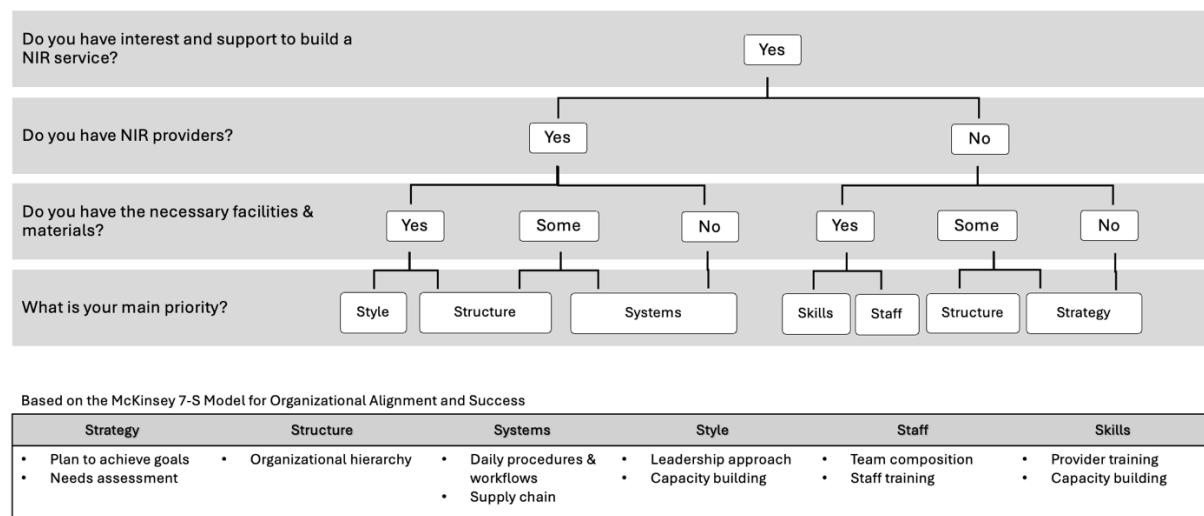


Figure 4 Diagram demonstrating a checklist used for readiness assessment and needs determination for healthcare systems wishing to pursue development of mechanical thrombectomy capable stroke programs (Nguyen et al. unpublished data).

We believe the above goals will establish an epidemiological basis for a cost-effectiveness analysis of mechanical thrombectomy in Dar es Salaam and ultimately in large urban centers in Tanzania; the background for informing policy makers as to the required capital investment and subsequent on-going funding; and ultimately lead developing a self-sustaining model for training the next generation of physicians with expertise in neuro-endovascular intervention.

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