

Knowledge, attitudes, and exposure to neurocritical care among neurosurgical providers in sub-Saharan Africa: A cross-sectional survey of physicians

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Abstract

OBJECTIVE

Neurosurgical emergencies, including traumatic brain injury, intracranial hemorrhage, brain tumors, and CNS infections, impose a heavy burden of mortality and disability worldwide. In sub-Saharan Africa (SSA), constrained access to specialized neurocritical care exacerbates preventable complications. Understanding neurosurgical providers' knowledge, attitudes, and training exposure is critical to inform targeted capacity-building interventions.

METHODS

We conducted a cross-sectional online survey from April to July 2025 among neurosurgical trainees and specialists affiliated with WACS, COSECSA, and SSA medical institutions. Participants reported their neurocritical care knowledge, attitudes, practices, and clinical exposure. Data was analyzed using descriptive statistics, correlation analyses, regression modeling, and geographic mapping to assess disparities in ICU and Neuro-ICU access.

RESULTS

Of 52 participants, dedicated Neuro-ICU exposure was limited (median 2–4 weeks), despite high theoretical knowledge (97% satisfactory). Attitudes and self-reported practices were positive, reflecting strong motivation to apply neurocritical care principles. Regression analyses identified no significant predictors of knowledge, while geographic mapping revealed marked inequities in Neuro-ICU availability and training opportunities across SSA.

CONCLUSION

The contrast between robust theoretical knowledge and limited practical Neuro-ICU experience underscores critical training gaps. Competency-based rotations, simulation-driven learning, and regional mentorship networks are strategic interventions to enhance clinical skills, strengthen neurocritical care delivery, and improve outcomes for critically ill neurological patients in resource-limited settings.

Introduction

Neurosurgical disorders contribute substantially to the global burden of disease and are a major cause of mortality and long-term disability. Conditions such as traumatic brain injury (TBI), intracranial hemorrhage, brain tumors, and central nervous system infections often require urgent neurosurgical intervention and specialized perioperative care¹. Access to neurosurgical services remains highly

unequal, particularly in low- and middle-income countries (LMICs), where limited surgical access contributes to preventable neurological morbidity and mortality².

TBI is one of the most common neurosurgical emergencies worldwide, affecting approximately 69 million people annually, with most cases occurring in LMICs³. Patients with severe neurological injury are vulnerable to secondary brain injury from intracranial hypertension, cerebral edema, hypoxia, and systemic instability, requiring timely recognition and critical care interventions⁴.

Neurocritical care has emerged as a specialized field for managing life-threatening neurological conditions. Integrating neurology, neurosurgery, anesthesiology, and intensive care medicine, dedicated neurocritical care units allow continuous monitoring, early detection of deterioration, and protocol-based management of complex neurological emergencies⁵. Evidence suggests that care in dedicated units staffed by trained specialists improves survival and functional outcomes^{5,6}. In high-income countries, structured fellowship programs provide advanced training in neuromonitoring, ventilatory support, hemodynamic optimization, and prevention of secondary brain injury⁷.

Sub-Saharan Africa faces substantial challenges in neurosurgical service delivery, including limited workforce capacity and restricted geographic access to specialized care^{1,8}. A global analysis demonstrated that only about 25% of the population in SSA lives within two hours of a center capable of providing neurosurgical care, highlighting major disparities in access to treatment⁸. These gaps exacerbate the burden of neurosurgical disease and limit timely access to life-saving interventions.

Over the past two decades, neurosurgical training programs across Africa have expanded through regional initiatives⁹. However, access to dedicated neurocritical care units and structured neurocritical care education remains limited. In many hospitals, neurosurgical providers including both residents and fully trained specialists, often manage critically ill neurological patients due to shortages of trained intensivists, with variable exposure to neurocritical care principles¹⁰.

Understanding the knowledge, attitudes, and exposure to neurocritical care among neurosurgical providers is essential to identify gaps in training and guide educational improvements. Strengthening neurocritical care competencies may enhance perioperative management and improve outcomes for patients with severe neurological conditions in resource-limited settings. This study aimed to assess these factors among neurosurgical providers in SSA through a cross-sectional survey, providing evidence to guide curriculum development and training strategies to strengthen perioperative and neurocritical care capacity.

Methods

Study design and setting

This study was a cross-sectional survey conducted via an online questionnaire among neurosurgical trainees and specialists affiliated with the West African College of Surgeons (WACS), COSECSA programs, and other medical universities offering postgraduate neurosurgery training across sub-Saharan Africa.

Study participants and recruitment

This study included neurosurgical residents, fellows, and specialist neurosurgeons from selected colleges, medical schools, and health facilities who provided informed consent to participate. To maximize coverage, invitations to participate were disseminated through WACS and COSECSA country representatives, neurosurgical program directors or coordinators, and the COSECSA Education Office in Arusha. Multiple social media platforms commonly used by trainees and specialists were also employed to encourage participation. At each participating institution or country, a senior neurosurgical faculty member (country representative, division head, or training program director) was contacted by phone or email, and the purpose of the study was explained. The senior faculty member then circulated the Qualtrics survey via email to trainees, faculty, and house staff.

Data collection procedures and instrument

This cross-sectional study was conducted between April and July 2025 using a structured, self-administered online questionnaire distributed via Qualtrics (Provo, UT, USA). The survey targeted neurosurgical trainees and faculty across SSA and was disseminated through email and professional social media networks. The questionnaire was developed by the study team using a knowledge-attitudes-practices (KAP) framework adapted for neurocritical care. It comprised three domains: knowledge (10 items), attitudes (5 items), and practices (5 items). Knowledge items assessed core neurocritical and general critical care principles, including management of intracranial pressure, stroke, status epilepticus, meningitis, sepsis, and airway management. Attitude items evaluated perceptions regarding the relevance of neurocritical care, the need for dedicated training, and self-reported confidence in managing neurocritical and general critical care conditions. Practice items assessed the frequency of involvement in neurocritical care delivery, procedural experience, and competency in tasks such as neuroimaging interpretation and intracranial pressure monitoring. The complete questionnaire is provided in the Table 1. Content validity was assessed by two independent reviewers, and the instrument was pilot tested among 10 general surgery residents at Mbarara University of Science and Technology; these responses were excluded from the final analysis. Electronic informed consent was obtained from all participants before survey completion. Knowledge responses were scored dichotomously (correct: 1, incorrect or “I do not know”: 0), with total scores ranging from 0 to 10. Knowledge levels were categorized as satisfactory when more than 50% of items were answered correctly and unsatisfactory otherwise. Additional variables collected included age, sex, professional level (trainee or faculty), and exposure to intensive care unit (ICU) and neurocritical care rotations (Tables 2 and Fig. 1), allowing assessment of associations between training background and neurocritical care competencies.

Table 1
Neurocritical care and general critical care knowledge, attitude and practice assessment

No.	Item
Knowledge	
1	Preferred agent for management of increased intracranial pressure in traumatic brain injury
2	Vasogenic edema due to a brain tumor should be treated with corticosteroids
3	Recommended systolic blood pressure target in hemorrhagic stroke
4	Decompressive craniectomy can be lifesaving in malignant middle cerebral artery infarction
5	First-line treatment for status epilepticus
6	Initial management of suspected community-acquired bacterial meningitis should include corticosteroids
7	Standard reference level for zeroing an external ventricular drain
8	Suspected sepsis requires administration of intravenous antibiotics and fluids within 3 hours irrespective of culture results
9	Effect of increasing respiratory rate on PaCO ₂ and intracranial pressure
10	Indications for endotracheal intubation in trauma patients
Attitudes	
1	Dedicated neurocritical care training would improve my ability to manage patients effectively
2	Neurocritical care requires a distinct set of knowledge and skills beyond standard neurosurgical training
3	Neurocritical care is not relevant or useful in low-resource settings
4	I am confident in managing acute neurocritical care conditions (e.g., raised intracranial pressure, seizures, meningitis, encephalitis, and external ventricular drains)
5	I am confident in my general critical care management skills
Practice	
1	I serve as the primary provider for patients with neurological emergencies (e.g., stroke, traumatic brain injury)
2	I manage patients requiring neurological procedures or devices (e.g., external ventricular drains, intracranial pressure monitoring, electroencephalography)
3	I manage patients requiring critical care interventions (e.g., endotracheal intubation, mechanical ventilation, tracheostomy, central venous access)
4	I am able to interpret basic trauma-related neuroimaging
5	I am able to insert an intracranial pressure monitoring device

Table 2
Demographic and training exposure characteristics of respondents (N: 52)

Characteristic	Trainees	Faculty	Total
Demographic characteristics			
Mean Age (years), mean $\pm$ SD	36.1 $\pm$ 5.1	41.6 $\pm$ 9.3	38.3 $\pm$ 7.5
Sex, n (%)			
Female	11 (35.5%)	3 (14.3%)	14 (26.9%)
Male	20 (64.5%)	18 (85.7%)	38 (73.1%)
Mean Years of Training/Practice $\pm$ SD	4.37 $\pm$ 2.48	10.38 $\pm$ 8.76	-
Median Total Years Experience	4 (3–5)	10 (3–18)	-
Neurosurgical ICU Involvement, n (%)	30 (96.8%)	21 (100%)	51 (98.1%)
Training exposure characteristics			
Total years of training/practice, median (IQR)	4 (3–6)	10 (8–14)	6 (4–10)
ICU rotation duration (weeks), median (IQR)	8 (4–12)	12 (8–16)	10 (6–14)
Neuro-ICU rotation duration (weeks), median (IQR)	2 (0–4)	4 (2–8)	3 (0–6)
Formal neurocritical care curriculum exposure	Limited	Limited	Majority reported no structured curriculum
Perceived training adequate	10 (47.6%)	4 (28.6%)	14 (40.0%)
Perceived training inadequate	11 (52.4%)	10 (71.4%)	21 (60.0%)

Data processing and analysis

The survey data were exported from Qualtrics in Microsoft Excel format and imported into STATA version 15 (StataCorp, College Station, TX, USA) for preliminary cleaning and organization. Subsequent analyses were conducted in R software. Continuous variables including age, years of training or practice, ICU and Neuro-ICU rotation durations, and composite knowledge, attitude, and practice scores were summarized as means with standard deviations or medians with interquartile ranges, depending on data distribution, while categorical variables were tabulated as frequencies and percentages.

To evaluate relationships among knowledge, attitudes, practices, and training exposure, Spearman correlation coefficients were calculated for ordinal and non-normally distributed data. Differences in knowledge scores by clinician role were tested using Fisher's exact test. Predictors of satisfactory knowledge were modeled using logistic regression with bias-reduction techniques to mitigate quasi-complete separation, while linear regression was applied to assess associations with continuous knowledge scores. Patterns of association were visualized with a correlation heatmap, and multivariable logistic regression results were summarized in a forest plot.

Subgroup analyses compared KAP characteristics between trainees and faculty and across geographic regions. Statistical significance was set at a two-sided p-value < 0.05. Finally, geographic visualizations were created to map ICU and Neuro-ICU exposure, providing actionable insight into regional variability in neurocritical care training and infrastructure across Sub-Saharan Africa. All analyses were designed to be descriptive and exploratory, guiding interpretation and identifying areas for targeted improvement.

Results

Participant demographics

Among the 52 neurosurgical providers surveyed, 31 (60%) were identified as trainees and 21 (40%) as faculty. The mean age was 36.1 ± 5.1 years for trainees and 41.6 ± 9.3 years for faculty. Females accounted for 35.5% of trainees and 14.3% of faculty, resulting in an overall female representation of 26.9%. Nearly all participants (98.1%) reported ICU experience, while exposure to dedicated Neuro-ICU rotations remained limited (Table 2). The distribution of trainees and faculty across Sub-Saharan African countries and their reported ICU and Neuro-ICU exposure is presented in Fig. 1.

Dedicated Neuro-ICU experience was limited, particularly among trainees. Median ICU rotation duration was 8 weeks for trainees and 12 weeks for faculty, while Neuro-ICU rotations were 2 and 4 weeks, respectively. Exposure to a formal neurocritical care curriculum was limited, and fewer than half of respondents (40.0%) considered their training adequate (Table 2).

From a systems perspective, neurocritical care is predominantly delivered within general ICU settings, as dedicated Neuro-ICU units remain uncommon. Access to advanced neuromonitoring technologies is limited, and multidisciplinary neurocritical care teams are inconsistently available (Table 3).

Table 3
Institutional capacity for neurocritical care

Category	Availability	Notes
Dedicated Neuro-ICU	Rare	Most institutions rely on general ICU
General ICU access	Widely available	Primary care location for neurocritical patients
ICP monitoring devices	Limited	Not universally available
External Ventricular Drain (EVD) capability	Available in tertiary centers	Variable access
Mechanical ventilation	Widely available	Standard in ICU settings
Advanced neuromonitoring (brain tissue oxygen, multimodal monitoring)	Rare	Largely unavailable
Multidisciplinary neurocritical team	Inconsistent	Often neurosurgeon-led without intensivist specialization

Knowledge

Knowledge scores were uniformly high, with 97% of participants achieving satisfactory performance. There was no statistically significant difference in knowledge scores by role (Fisher's exact test, $p = 0.4$) (Table 4). Performance was lower on specific questions: Q38 (49%), Q41 (43%), and Q45 (62%) (Fig. 2).

Table 4
Neurocritical care knowledge, attitudes and self-reported practices of respondents

Variable	Trainees	Faculty	Total (N: 35)
Knowledge			
Knowledge Score (0–10) Median (IQR)	8 (7–9)	9 (8–9)	8 (7–9)
Knowledge Score (0–10)	4–10	7–10	4–10
Satisfactory Knowledge	20 (95%)	14 (100%)	34 (97%)
Score Distribution Pattern	Clustered at 7–9	Greater concentration at 9	High clustering at 7–9
Attitudes toward neurocritical care			
Total Attitude Score (5–25) Median (IQR)	21 (19–23)	20 (19–22)	21 (19–22)
Total Attitude Score (5–25)	High clustering	High clustering	
Overall Attitude Interpretation	Positive	Positive	Positive
Dominant Response Pattern	Majority “Agree”	Majority “Agree”	Majority “Agree”
Neutral Responses	Low frequency	Low frequency	Low
Self-reported neurocritical care practices			
Median Practice Score (IQR)	17 (15–19)	17 (16–19)	Median Practice Score (IQR)
Range	12–20	13–20	Range
Highest Frequency Item	prac4 (70%)	prac4 (70%)	Highest Frequency Item
Lowest Frequency Item	prac5 (20%)	prac5 (20%)	Lowest Frequency Item
Association with Knowledge	Not significant	Not significant	Association with Knowledge

Attitudes and Practices

Attitude and practice scores were generally positive and high among participants. The median total attitude score was 21 (IQR 19–23) for trainees and 20 (IQR 19–22) for faculty (Table 4). Self-reported practice scores were similarly high, with a median practice score of 17 (IQR 15–19) for trainees and 17

(IQR 16–19) for faculty (Table 4). Most participants reported frequent use of recommended practices, though practice 5 was reported at the lowest frequency (20%) across both groups (Fig. 3).

Multivariable Associations

None of the examined factors including attitude score, practice score, clinical experience (years), ICU or neuro-ICU rotation time, role (Consultant vs Resident), or self-perceived adequacy of training show any meaningful association with having a “satisfactory” knowledge score. All adjusted odds ratios are approximately 1.0, indicating that no association with satisfactory knowledge (Table 5, Fig. 4–5).

Table 5
Multivariable associations with satisfactory neurocritical care knowledge

Predictor Variable	Adjusted OR (95% CI)	p-value
Attitude score (continuous)	1.05 (0.44–2.47)	> 0.90
Practice score (continuous)	0.92 (0.40–2.13)	0.90
Total years of training/practice	1.06 (0.60–1.89)	0.80
ICU rotation duration (weeks)	1.01 (0.59–1.72)	> 0.90
Neuro-ICU rotation duration (weeks)	0.99 (0.90–1.10)	> 0.90
Consultant vs Trainee	1.03 (0.04–29.4)	> 0.90
Perceived adequacy of training (Yes vs No)	0.85 (0.02–37.1)	> 0.90

Discussion

This study demonstrates that neurosurgical providers in Sub-Saharan Africa generally demonstrate high theoretical knowledge of neurocritical care, yet structured exposure to dedicated Neuro ICU training remains limited. While most participants reported experience in general ICUs, formal Neuro ICU rotations and structured curricula were uncommon, particularly among trainees. Attitudes toward neurocritical care were positive, and self-reported practices broadly aligned with core principles. Despite this, knowledge scores were only weakly correlated with practice behaviors, and regression analyses did not identify significant predictors of performance. Geographic mapping revealed that ICU and Neuro ICU exposure exists across multiple countries, but availability and intensity vary considerably, suggesting inequities in experiential opportunities.

Neurosurgical disorders including traumatic brain injury (TBI), intracranial hemorrhage, brain tumors, and central nervous system infections contribute substantially to global mortality and long-term disability and often require urgent surgical and specialized perioperative care^{1,8}. Access to neurosurgical services in low- and middle-income countries remains highly unequal, which contributes to preventable

neurological morbidity and mortality^{3,8}. In Sub-Saharan Africa, geographic barriers and limited specialized care capacity further constrain timely access to life-saving interventions⁸.

Neurocritical care has emerged as a distinct subspecialty that integrates neurology, neurosurgery, and intensive care to optimize outcomes among critically ill neurological patients⁶. Landmark multicenter studies and meta-analyses have demonstrated that neurocritical care services staffed by specialists or delivered in dedicated Neuro ICUs are associated with improved survival and functional outcomes. For instance, a systematic review and meta-analysis of over 55,000 adults with acute brain injury found that specialized neurocritical care was associated with a 17% relative reduction in mortality and unfavorable functional outcomes compared with general ICU care¹¹. The PRINCE study further documented worldwide variability in neurocritical care organization but confirmed the feasibility of international collaboration to characterize neurocritical practice and improve outcomes globally¹².

In the African context, studies highlight both the burden of critical neurological illness and opportunities for targeted capacity building. A retrospective audit from a South African Neuro ICU reported a high incidence of complications among critically ill neurological patients, emphasizing the need for structured training and quality improvement initiatives¹³. Similarly, an online neurocritical care course evaluation among African healthcare workers showed significant improvement in provider confidence and competence in managing neurological emergencies, demonstrating the feasibility of remote capacity-building interventions¹⁴. These regional findings reinforce the need for contextually relevant, structured neurocritical care education across Sub-Saharan Africa.

The gap between high theoretical knowledge and limited structured Neuro ICU exposure has direct clinical consequences^{15,16}. Providers with strong theoretical understanding but limited hands-on training may be less prepared to manage complex physiological derangements, such as intracranial hypertension, cerebral edema, and systemic instability, which contribute to secondary brain injury³. Without dedicated Neuro ICU experience, early recognition and timely interventions may be delayed or inconsistently applied.

Positive attitudes toward neurocritical care suggest a strong motivation to integrate best practices, providing an opportunity for educational and system-level interventions¹⁰. However, the weak correlation between knowledge and practice behaviors indicates that didactic learning alone is insufficient for clinical competence. Evidence from global and African studies supports this conclusion: supervised hands-on practice and mentorship improve guideline adherence and clinical decision-making more effectively than theoretical knowledge alone^{14,17}. Geographic disparities in ICU and Neuro ICU exposure further highlight inequities in practical training that may affect patient outcomes.

To address these gaps, neurosurgical training programs should integrate dedicated Neuro ICU rotations with structured supervision and clearly defined competencies. Training should include intracranial pressure monitoring, cerebral perfusion optimization, multimodal neuromonitoring, advanced ventilatory

strategies, and early recognition of neurologic deterioration⁶. Competency-based rotations embedded within residency curricula ensure repeated supervised exposure and skill consolidation.

Simulation-based training and structured case discussions can supplement clinical exposure, especially where dedicated Neuro ICU resources are limited. Simulation has been shown to enhance clinical performance, knowledge retention, and provider confidence^{17,18}. Regional hub-and-spoke training networks may allow trainees from under-resourced centers to rotate through well-equipped Neuro ICUs, while tele-mentoring can extend expert supervision to remote sites. Prospective adaptation of neurocritical care protocols to local resources and patient populations is essential to ensure feasibility and sustainability^{10,13}. Continuous professional development programs, including refresher courses and competency assessments, will support long-term maintenance and growth of clinical skills.

Although this study included a relatively modest cohort of neurosurgical providers, it captures a diverse, multicountry sample across Sub-Saharan Africa, encompassing both trainees and fully qualified specialists. This breadth provides valuable insight into neurocritical care knowledge, attitudes, and practices across varied healthcare settings, highlighting specific gaps in structured training, hands-on experience, and regional accessibility. Such findings offer actionable guidance for the development of targeted educational interventions and health system strengthening initiatives.

The limited sample size may constrain the generalizability of the results and reduce statistical power for detecting subtle associations. In addition, the cross-sectional design does not permit causal inference, and reliance on self-reported practices introduces the potential for reporting bias. Direct assessment of clinical performance or patient outcomes was not conducted, leaving the practical impact of training gaps unmeasured. Furthermore, institutional and contextual factors such as staffing models, local policies, and resource availability were not comprehensively captured.

Despite these limitations, the study provides robust, contextually relevant evidence in a region where data on neurocritical care capacity are scarce. By identifying critical areas for improvement, these findings form a foundation for strategic educational and system-level interventions aimed at enhancing neurocritical care delivery in resource-limited settings.

Conclusion

Neurosurgical providers in Sub-Saharan Africa possess strong theoretical knowledge of neurocritical care, yet structured exposure to dedicated Neuro ICU training remains limited and inconsistently available. While positive attitudes and self-reported practices suggest motivation to apply neurocritical care principles, gaps between knowledge and practical experience persist. Implementing competency-based rotations, simulation-based learning, and regional mentorship networks can bridge these gaps, enhance clinical skills, and improve outcomes for critically ill neurological patients. This study identifies clear targets for educational and system-level interventions to strengthen neurocritical care capacity in resource-limited settings.

Abbreviations

CI (Confidence Interval); COSECSA (College of Surgeons of East, Central and Southern Africa); IQR (Interquartile Range); ICU (Intensive Care Unit); KAP (Knowledge, Attitudes, and Practices); LMICs (Low- and Middle-Income Countries); MUST (Mbarara University of Science and Technology); Neuro-ICU (Neurocritical Care Intensive Care Unit); OR (Odds Ratio); SD (Standard Deviation); TBI (Traumatic Brain Injury); WACS (West African College of Surgeons).

Declarations

Ethics approval and consent to participate

Ethical clearance for the survey was obtained from the COSECSA Research and Ethics Committee (Ref. No. COSECSA/REC/2025/01). Permission to access medical schools and/or health facilities was obtained from all relevant local health authorities and the leadership of regional bodies under WACS and COSECSA. All participants provided informed consent electronically prior to completing the online survey. Participation was entirely voluntary, and no patient data were collected directly.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analysed during the current study are available from the corresponding author upon reasonable request.

Competing interests

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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Authors' contributions

FKS, EA and AAM contributed to the study's conception and design, conducted the literature search, and drafted the manuscript. TL did statistical analysis. HML, SB, DS, LKK, SJM, SST, RB, BT, JN, IE, LC, MJY, AB, PK, MMH and DK participated in the literature search and reviewed the manuscript. All authors read and approved the final version of the manuscript.

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References

1. Weiss HK, Garcia RM, Omiye JA, et al. A Systematic Review of Neurosurgical Care in Low-Income Countries. *World Neurosurg* X Jan. 2020;5:100068. 10.1016/j.wnsx.2019.100068.
2. Alkire BC, Raykar NP, Shrimel MG, et al. Global access to surgical care: a modelling study. *Lancet Glob Health* Jun. 2015;3(6):e316–23. 10.1016/s2214-109x(15)70115-4.
3. Dewan MC, Rattani A, Gupta S, et al. Estimating the global incidence of traumatic brain injury. *J Neurosurg* Apr. 2019;1(4):1080–97. 10.3171/2017.10.Jns17352.
4. McNamara R, Meka S, Anstey J, et al. Development of Traumatic Brain Injury Associated Intracranial Hypertension Prediction Algorithms: A Narrative Review. *J Neurotrauma* Mar. 2023;40(5–6):416–34. 10.1089/neu.2022.0201.
5. Kuroda Y. Neurocritical care update. *J Intensive Care*. 2016;4:36. 10.1186/s40560-016-0141-8.
6. Busl KM, Bleck TP, Varelas PN. Neurocritical Care Outcomes, Research, and Technology: A Review. *JAMA Neurol* May. 2019;1(5):612–8. 10.1001/jamaneurol.2018.4407.
7. Sheth KN, Drogan O, Manno E, Geocadin RG, Ziai W. Neurocritical care education during neurology residency: AAN survey of US program directors. *Neurology* May. 2012;29(22):1793–6. 10.1212/WNL.0b013e3182583034.
8. Punchak M, Mukhopadhyay S, Sachdev S, et al. Neurosurgical Care: Availability and Access in Low-Income and Middle-Income Countries. *World Neurosurg* Apr. 2018;112:e240–54. 10.1016/j.wneu.2018.01.029.
9. Dada OE, Karekezi C, Mbangtang CB, et al. State of Neurosurgical Education in Africa: A Narrative Review. *World Neurosurg* Jul. 2021;151:172–81. 10.1016/j.wneu.2021.05.086.
10. Prust ML, Mbonde A, Rubinos C, et al. Providing Neurocritical Care in Resource-Limited Settings: Challenges and Opportunities. *Neurocrit Care* Oct. 2022;37(2):583–92. 10.1007/s12028-022-01568-2.
11. Pham X, Ray J, Neto AS, et al. Association of Neurocritical Care Services With Mortality and Functional Outcomes for Adults With Brain Injury: A Systematic Review and Meta-analysis. *JAMA Neurol*. Oct 2022;1(10):1049–58. 10.1001/jamaneurol.2022.2456.
12. Suarez JI, Martin RH, Bauza C, et al. Worldwide Organization of Neurocritical Care: Results from the PRINCE Study Part 1. *Neurocrit Care* Feb. 2020;32(1):172–9. 10.1007/s12028-019-00750-3.
13. Kgaodi BA, Arnold-Day C, Linde S, Semple PL. Evaluating complications in a South African neurocritical care unit: A 1-year retrospective audit. *South Afr J Crit Care*. 2025;41(2):e1896.

10.7196/SAJCC.2025.v412.1896.

14. Tihamiyu K, Suarez JI, Komolafe MA, Kwasa JK, Saylor D. Effectiveness, relevance, and feasibility of an online neurocritical care course for African healthcare workers. *J Neurol Sci Dec.* 2021;15:431:120045. 10.1016/j.jns.2021.120045.
15. Rubin MA, Lewis A, Creutzfeldt CJ, et al. Equity in Clinical Care and Research Involving Persons with Disorders of Consciousness. *Neurocrit Care Oct.* 2024;41(2):345–56. 10.1007/s12028-024-02012-3.
16. Lewis A, Claassen J, Illes J, et al. Ethics Priorities of the Curing Coma Campaign: An Empirical Survey. *Neurocrit Care Aug.* 2022;37(1):12–21. 10.1007/s12028-022-01506-2.
17. Beal MD, Kinnear J, Anderson CR, Martin TD, Wamboldt R, Hooper L. The Effectiveness of Medical Simulation in Teaching Medical Students Critical Care Medicine: A Systematic Review and Meta-Analysis. *Simul Healthc Apr.* 2017;12(2):104–16. 10.1097/sih.0000000000000189.
18. Cheng A, Lang TR, Starr SR, Pusic M, Cook DA. Technology-enhanced simulation and pediatric education: a meta-analysis. *Pediatrics May.* 2014;133(5):e1313–23. 10.1542/peds.2013-2139.

Figures

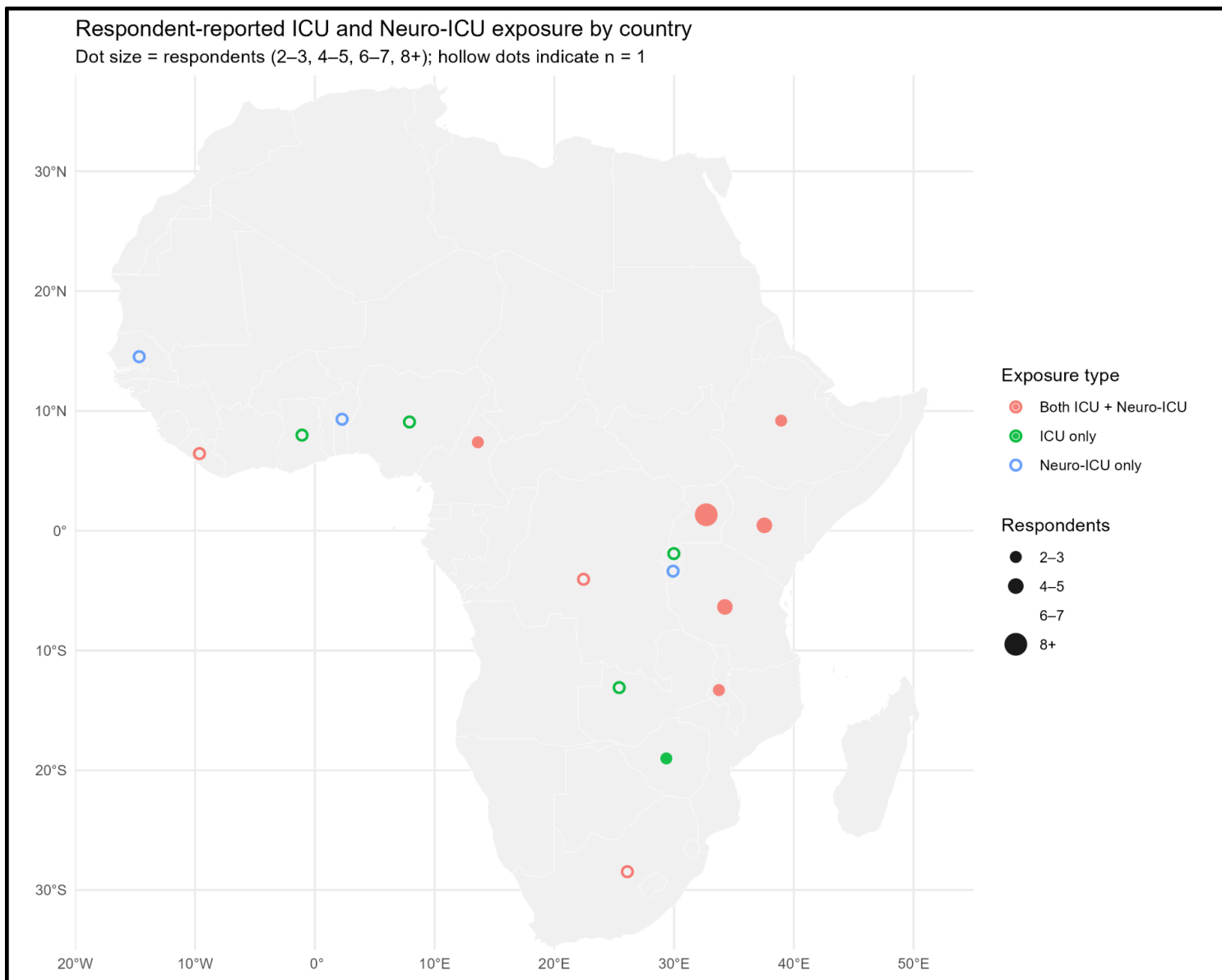


Figure 1

Participants reporting ICU or Neuro-ICU exposure across SSA country

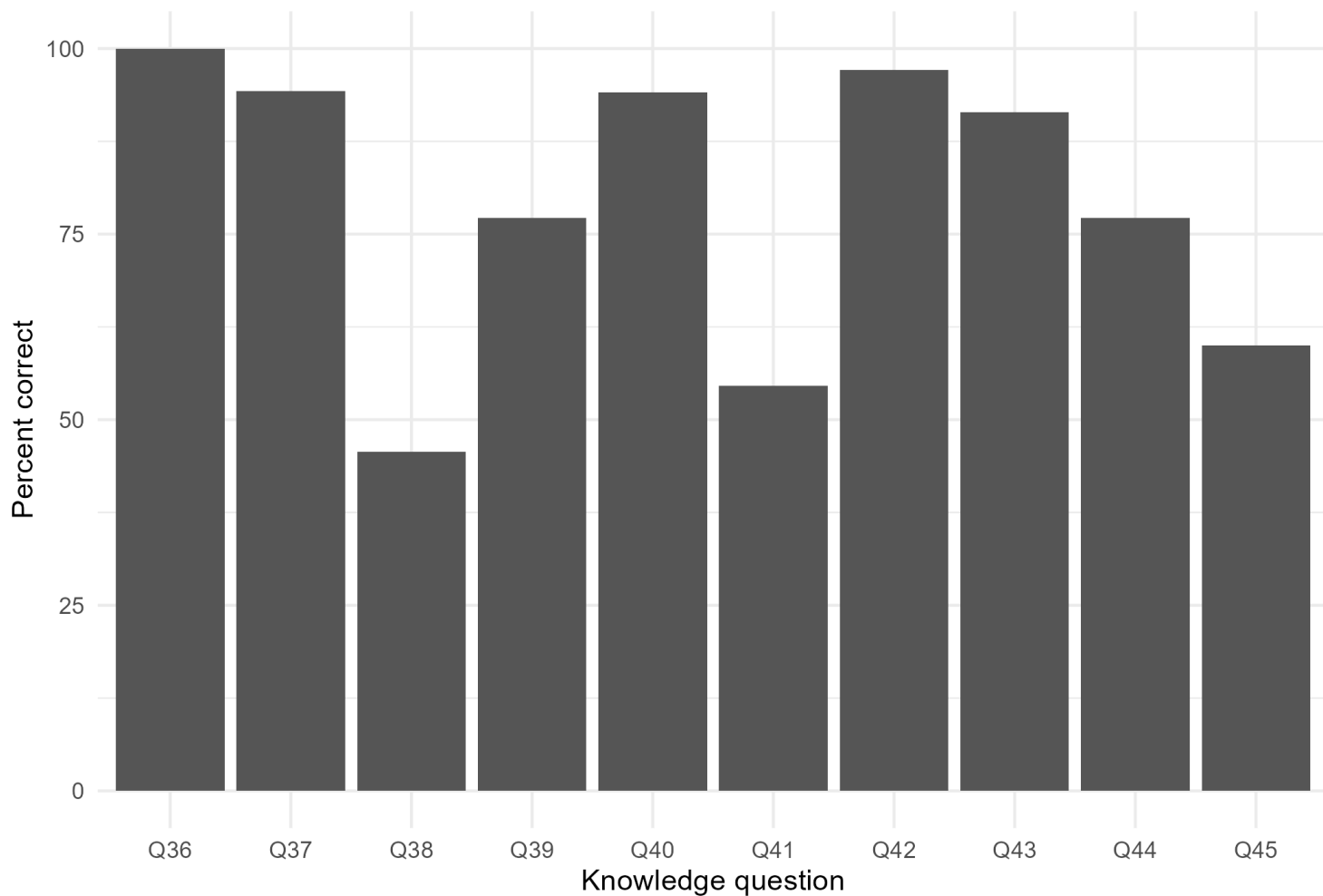


Figure 2

Items of knowledge Toward Neurocritical Care. Note that Q36-45: are equal to questions or items number 1 to 10 of knowledge

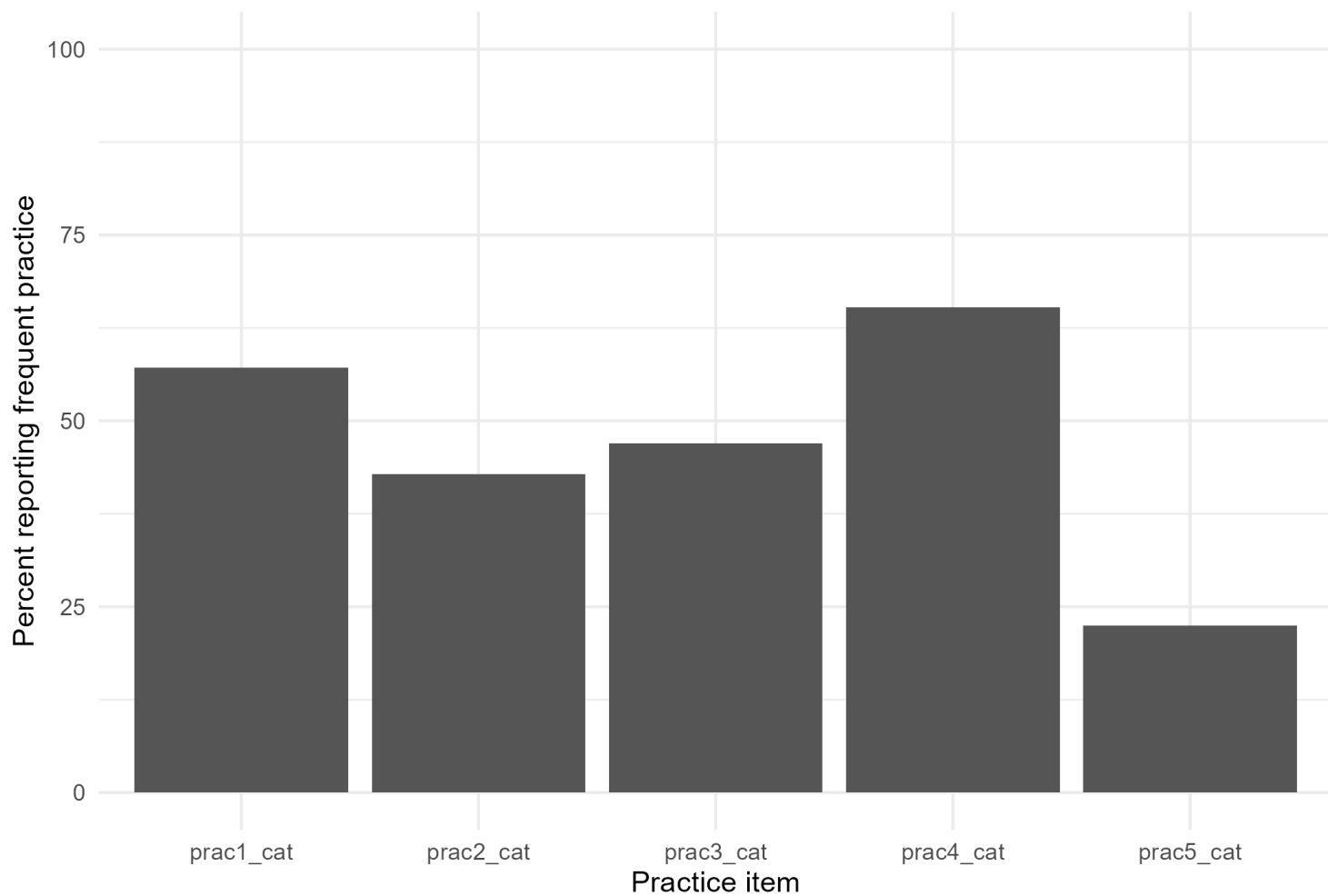


Figure 3

Item-Level of Practice Frequency across participants. Noted that: prac1-cat: practice item 1; prac2-cat: practice item 2 ; prac3-cat : practice item 3; prac4-cat : practice item 4; prac5-cat: practice item 5



Figure 4

Heatmap of associations with Satisfactory Neurocritical Care Knowledge

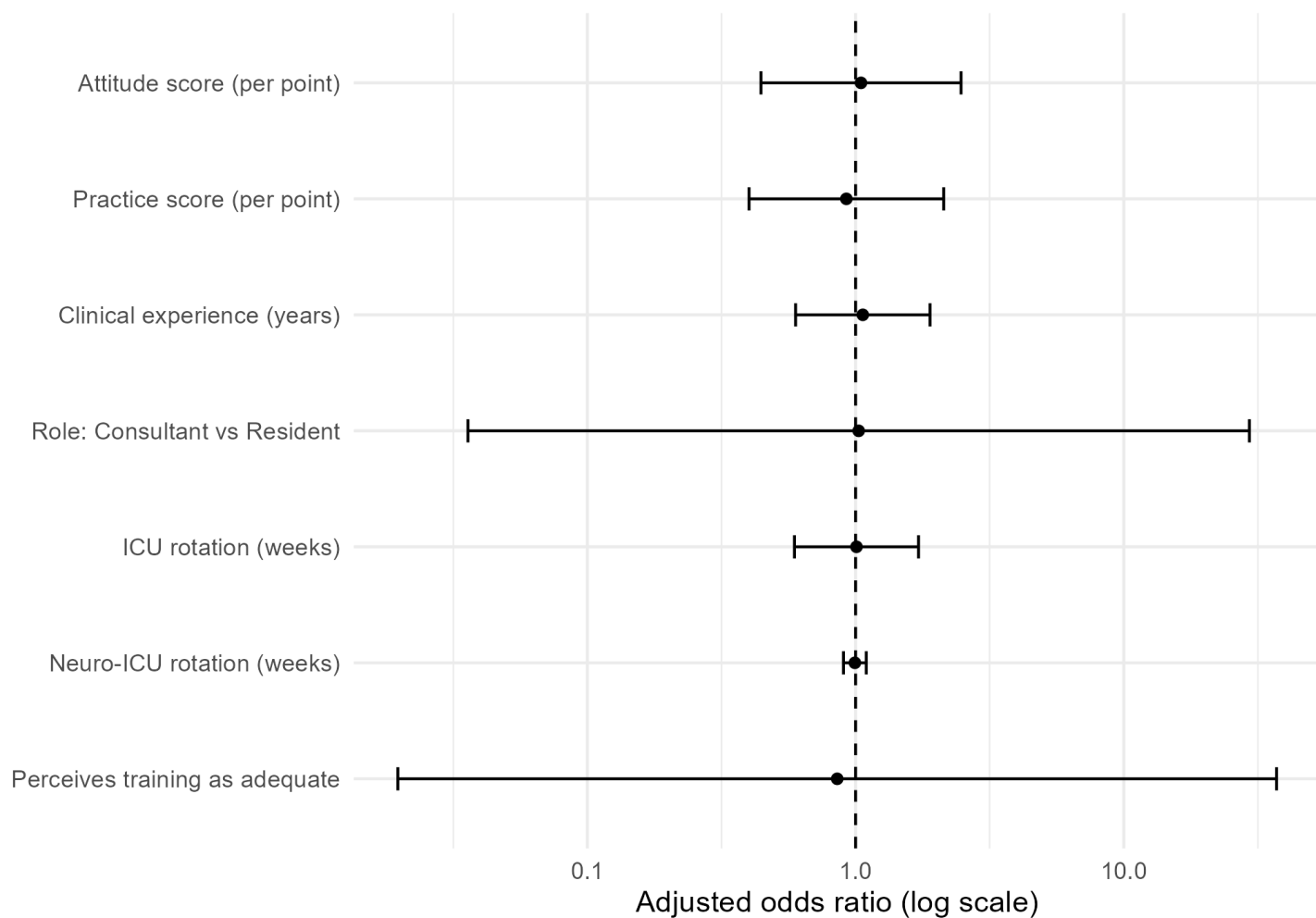


Figure 5

Logistic regression forest plot of predictors of satisfactory neurocritical care knowledge