Stroke care in Africa: a systematic review of the literature

Cover title: Practice for stroke care in Africa

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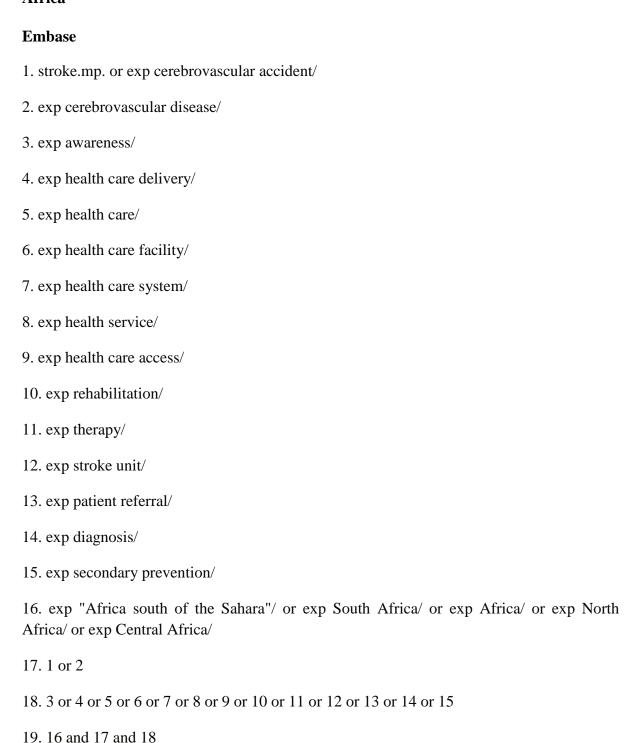
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SUPPLEMENTARY FILES FOR ONLINE ONLY PUBLICATION

Online supplement Search strategies S1: Details for search strategies for stroke care in Africa

Embase

1. stroke.mp. or exp cerebrovascular accident/

2. exp cerebrovascular disease/

3. exp awareness/

4. exp health care delivery/

5. exp health care/

6. exp health care facility/

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9. exp health care access/

10. exp rehabilitation/

11. exp therapy/

12. exp stroke unit/

13. exp patient referral/

14. exp diagnosis/

15. exp secondary prevention/

16. exp "Africa south of the Sahara"/ or exp South Africa/ or exp Africa/ or exp North Africa/ or exp Central Africa/

17. 1 or 2

18. 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15

19. 16 and 17 and 18

20. limit 19 to (full text and yr="2006 - 2017")

Ovid Medline

1. exp Stroke/

2. exp Cerebrovascular Disorders/

3. exp Awareness/

4. exp "Delivery of Health Care"/

5. exp Health Services Accessibility/

6. exp Rehabilitation/

7. exp Therapeutics/

8. stroke unit.mp.

9. (referral and consultation).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

10. exp Diagnosis/

11. exp Secondary Prevention/

12. exp Africa, Western/ or exp Africa, Central/ or exp "Africa South of the Sahara"/ or exp Africa/ or exp Africa, Northern/ or exp South Africa/ or exp Africa, Eastern/ or exp Africa, Southern/

13. 1 or 2

14. 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11

15. 12 and 13 and 14

16. limit 15 to (full text and yr="2006 - 2017")

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1. exp stroke/

2. exp Cerebrovascular disorders/

3. exp Cerebrovascular accident/

4. exp Awareness/

5. exp "Delivery of health care"/

6. exp Health facilities/

7. exp Health services accessibility/

8. exp Rehabilitation/

9. exp therapeutics/

10. exp Therapy/

11. stroke unit.mp.

12. exp Diagnosis/

13. (referral and consultation).mp. [mp=abstract, heading words, title]

14. secondary prevention.mp.

15. exp Africa/

16. 1 or 2 or 3

17. 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14

18. 15 and 16 and 17

19. limit 18 to yr="2006 - 2017"

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Online supplement Table S1: Stroke care in Africa

Country and study reference	Publication year	Study setting type	Study design	Sample	Key element(s) investigated	Main results
					Systems for stroke recognition and response	
Nigeria[16]	2008	Urban hospital	Cross-sectional survey	225 patients with hypertension or diabetes	Knowledge of stroke signs and symptoms	The commonest sign identified was sudden unilateral limb weakness (24.4%), and 136 (60.4%) of the participants had no knowledge of any warning sign. Male sex and higher education level were independently associated with better knowledge
Uganda[17]	2015	Rural and urban community	Cross-sectional survey	377 adult people	Knowledge of stroke signs and symptoms	Paralysis (18.3%) was the most commonly identified warning sign of stroke, and 215 (57%) had no knowledge of any warning sign. Urban residence and knowing that stroke is preventable were independently associated with better awareness of stroke warning signs.
SA[18]	2015	Four urban emergency stations	Cross-sectional survey	40 Ambulance personnel	Ability to recognize stroke signs and symptoms and identify stroke	The combined sensitivity and specificity were 91.5% and 92.0% respectively.
Benin[19]	2012	Urban community	Cross-sectional survey	15155 people aged ≥15 years	Knowledge of stroke signs and symptoms and perception of adequate response	The most often cited warning signs were paralysis and hemiplegia (34.4%). A proportion of 27.2% were unable to cite any stroke symptom. A proportion of 94.1% of subjects reported that they would go to a hospital if one of their relatives experienced stroke symptoms while 3.5% said they would wait and let the patient rest. Older age (>40 years), family history of stroke, higher education level, having hypertension, overweight or obesity were independently associated with better knowledge and better reaction to stroke symptoms.
Ghana[20]	2014	Urban Community	Cross-sectional survey	693 people between 18 and 60 years	Knowledge of stroke signs and symptoms and perception of adequate response	Numbness on one side (44%) was the commonest warning sign cited by the participants, and 22% of the participants had no knowledge of any warning sign. The majority (77%) of the participants believed that stroke requires emergency treatment.
Nigeria[21]	2009	Urban hospital	Cross-sectional survey	370 hospital workers	Knowledge of stroke signs and symptoms and perception of adequate response	Weakness on one side (61.9%) was the most commonly identified warning symptom, and 8.6% of the participants could not identify a single warning symptom. Hospital treatment (61.1%) was the most preferred option while 13% of the participants preferred spiritual healing. Higher level of education was significantly associated with better stroke knowledge and perception.

Table S1: Stroke care in Africa   *Continued*

Nigeria[22]	2014	Urban university	Cross-sectional survey	994 (500 students and 494 staff)	Knowledge of stroke signs and symptoms and perception of adequate response	Weakness (66.2%) was the most commonly identified warning sign, and 12.2% of the participants had no knowledge of any warning sign. Predictors for adequate awareness were being female, younger age (< 40 years), and higher education level. Four hundred ninety-three (49.6%) participants indicated that they would take the person to the hospital while 3.2% would seek spiritual attention if a stroke happens near them.
Nigeria[23]	2015	Urban secondary schools (n=4)	Cross-sectional survey	703 (589 students and 114 teachers)	Knowledge of stroke signs and symptoms and perception of adequate response	Weakness (51.9%) was the most commonly identified warning sign of stroke, but 23.7% of the teachers had no knowledge of any warning sign. Better awareness of warning signs was associated with having had stroke in the family and being hypertensive. Four hundred ninety-three (41.4%) participants indicated that they would take the person to the hospital while 20 (2.8%) participants indicated that they would seek spiritual attention if a stroke happens near them.
Egypt[24]	2016	Urban Cairo University Hospitals	Cross-sectional survey	111 hospital workers	Knowledge of stroke signs and symptoms and perception of adequate response	The most common identified stroke symptoms were slurring of speech (38.5%) and elevated blood pressure (38.5%), but 12% of the participants did not know any symptom. The most frequent response to an attack of stroke was transferring the patients to a hospital (59.8%) while 1.1% preferred calling a religious person. Clinical workers were more likely to identify the stroke symptoms compared with nonclinical workers.
Tanzania[25]	2008	Rural & urban community	Qualitative in-depth interviews	80 people	Perception of adequate response to stroke signs and symptoms	In rural area (Hai) where stroke was believed to come from natural causes, hospital treatment was the first option while in urban area (Dar-es-Salaam) where stroke was widely believed to emanate from supernatural causes the first option was traditional healers.
Benin[26]	2012	Urban hospitals (n=2)	N/A	2 hospitals	Availability and accessibility of stroke care services	There were 2 neurologic departments only in Benin (one in Cotonou and the other in Parakou) for a population of 9 million. There were 3 CT scanners, but no MRI facilities and none of 2 existing neurologic departments could conduct vascular sequences. In Parakou as example, there was also shortage of staff in all healthcare domains, and the costs for diagnostic exams such as CT scan ($100 USD) was high, and awareness of early stroke symptoms was very poor. For improvement, evidence-based accessible multidisciplinary care pathways for stroke management were set up, and there were public campaigns related to stroke awareness.

Table S1: Stroke care in Africa *Continued*

Uganda[27]	2012	Urban hospital	N/A	1 hospital	Availability and accessibility of stroke care services	Patients were brought to the emergency room by family members. Many patients presented to hospital several days or more after stroke onset and travelled long distances by public transportation. There was only one government health facility in the whole country that had a CT scanner, but there was no MRI unit or equipment for contrast angiography. The cost for a brain CT was approximately $60 USD. For those who could afford a CT scan, additional diagnostic tests (EKG, carotid ultrasound, echocardiogram) were usually not affordable. Thrombolytics and IV heparin were not available. Neurosurgical consultation was available for emergency decompression of large intracerebral hemorrhages. Inpatient physical therapy services were very limited and basic equipment (quad canes, walkers, wheelchairs) were obtained privately by the patient. Long-term rehabilitation facilities did not exist.
SA[28]	2009	Rural hospital	Prospective follow up	1 hospital	Availability and accessibility of stroke care resources	In 2007, at Mosvold Hospital (rural), there were 13 doctors and 59 professional nurses, 4 PTs, 1 OT, 1 ST, 1 dietician and 2 social workers only for a municipality with a population of 184 049. These staff were responsible for managing 49 000 outpatients annually, and admitting 9400 patients per year, whose average stay was 7 days. Basic radiography and ultrasound were available, but no CT scanner. The nearest referral facility with a CT scanner was 3 hours' drive away.
SA[29]	2016	Nationwide	N/A	-	Initiative to support stroke unit establishment	Three different meeting sessions were organized by South African team during October 2014-October 2015, with each time with growing numbers of attendees. Stroke experts from different countries spoke at these meetings, and neurologists and neurology registrars with much experience in European stroke units led the scheduled training sessions. By December 2015, 17 new stroke units were initiated in addition to four pre-existing stroke units, and many more were expected to join later.
Ghana[30]	2011	Urban hospital	N/A	2 hospitals	Initiative to support stroke unit establishment	There was no stroke unit in Ghana, but a collaborative partnership between staff from England and Ghana was initiated to review and plan local services, and provide multidisciplinary education and training with a goal of establishing the Ghana's first stroke unit.

Table S1: Stroke care in Africa   *Continued*

Ghana[31]	2017	Hospital	Cross-sectional survey	11 major referral hospitals	Availability of stroke care services and Health policies for stroke care	One hospital had a stroke unit, but thrombolytic therapy using rtpA for ischemic stroke care was not available in any of the study hospitals. Aspirin therapy was administered in all the 11 hospitals. Although eight study sites reported having a brain CT scan, only 7 (63.6%) were functional at the time of the study. MRI scan services were also limited to only 4 (36.4%) hospitals (only functional in three). Acute stroke care by specialists, especially neurologists, was found in 36.4% (4) of the study hospitals whilst none of the study hospitals had an OT or a ST. The study participants agreed that no direct health policy support from the state or national level for stroke care, or a national stroke policy framework, or national stroke clinical guideline existed. There were some broad policies on health care improvement, non-communicable diseases and staff professional development, but these were not being implemented due to lack of funds. No national level or hospital level community stroke awareness programs were reported.
				Hyperacute stroke care		
Nigeria[32]	2014	Urban hospital	Prospective follow up	128 patients	Time from stroke onset to hospital arrival	Only 10.2% presented in 3h; 17.2% presented more than one week after stroke onset.
Nigeria[33]	2015	Urban hospital	Prospective follow up	81 patients	Time from stroke onset to hospital arrival	Only 17 (21%) of the patients arrived at the hospital within three-hours of stroke onset, while 53 (65.4%) patients arrived >24 h after symptom onset. None of the patients were brought by ambulance service. Only lack of awareness of the symptoms of stroke was independently associated with delayed presentation.
Tunisia[34]	2008	Urban hospital	Prospective follow up	203 patients	Time from stroke onset to hospital arrival and time from stroke onset to CT Scan	Only 17.3% used medical ambulance transport. Arrival to emergency time mean was 16h (median=4h), and arrival to emergency within 3h rate was 42.9%. Early arrival to emergency was associated with urban residence and having motor deficit or higher NHISS score. Stroke onset-access to CT interval mean was 19h07'(median= 8h45'), and access to CT within 3h and 24 h rate was 13.3% and 77.8% respectively. The waiting time mean for CT scan access was 3h. Early access to CT was associated with subarachnoid hemorrhage.

Table S1: Stroke care in Africa   *Continued*

Nigeria[35]	2015	Urban hospital	Retrospective	83 patients	Time from stroke onset to CT Scan	Mean presentation time for CT scan was 70 h with a median time of 24 hours. None presented for CT scan within 3 hours, and only 31.3 % and 54% presented within 12h and 24h respectively after stroke onset. Ischemic stroke was associated with higher presentation delay.
Nigeria[36]	2012	Urban hospitals (n=2)	Prospective follow up	273 patients	Time from stroke onset to hospital arrival and access to CT/MRI Scan	Only 20.1% and 28.9% of the participants presented before 3h and within 6h of stroke onset respectively. The main reasons for delay included delay referral from private hospital (49.1%), transportation problem (32.2%), prior visit to traditional homes (10.6%) and treatment at home (7%). Only 36.3% and 2.2% had CT and MRI scans respectively, and of these, only 32.3% had imaging within 24 hrs.
SA[28]	2009	Rural hospital	Prospective follow up	30 patients	Time from stroke onset to hospital arrival and access to CT scan	Mean delay of almost 2 days from symptoms onset to presentation at hospital; only 4 (13.3%) had CT brain scans
CAR[37]	2013	Urban hospital	Retrospective	1680 patients	Access to CT scan and its impact	Between 2006 and 2011, there was a significant increase in CT scan completion rate which was 5.81% in 2006 versus 93.68% in 2011 (OR: 15.4, CI: 8.2-29.4), a significant increase in cases of cerebral hemorrhage between 2006 and 2011 (OR: 5.21, CI: 2.6-17.3), and a decrease in mortality (OR: 2.41, CI: 1.4-8.2).
Burkinafaso[38]	2017	Urban hospital	Prospective follow up	227 patients	Route and time from stroke onset to hospital arrival, time from stroke onset to CT Scan, and access to thrombolysis	The time between the stroke onset and the first contact with the first health facility ranged between 30 min and 24 h with an average of 6 h and 56 min and the one between first health facility and medical emergency ranged between 15 min and two weeks. Patients spent on average 2 days (41 h 48 min) in the first health facilities, with no CT scans or neurologist there. After their arrival in medical emergency, patients spent on average 21 h and 18 min to achieve the cerebral CT scan. Thrombolysis was not available yet while 19% of patients were eligible according to the 4h30mn period.
CAR[39]	2016	Urban hospital	Prospective follow up	737 patients	Proportion of ischemic stroke patients treated with thrombolysis	Twenty six of 464 patients with ischemic stroke were eligible for IV rt-PA, but none was thrombolysed because of the high cost of rt-PA, and Congolese patients had to pay themselves before all treatment.

Congo Brazzaville[40]	2013	Urban hospital	Case report	1 patient	The first ever thrombolysis	The first ever thrombolysis with tenecteplase in Congo Brazzaville was indicated and performed by a neurologist and the CT scan performed at 24 h did not show bleeding.
Morocco[41]	2016	Urban hospital	Case series report	52 patients	Stroke onset/door-to-needle time for thrombolysis	Seventeen of 52 patients were treated within a 3 hours window of stroke onset and 35 of 52 patients were treated within 3-4.5 h. The mean door-to-needle time was 1h15 minutes while the mean onset-to treatment time was 3h32 minutes.
Acute inpatient care						
Benin[26]	2012	Urban hospitals (n=2)	Situation analysis report	122 patients	Time from stroke onset to admission	In 2011, only 17.2% of 122 patients were admitted within 3 hours of stroke onset.
Tunisia[34]	2008	Urban hospital	Prospective follow up	203 patients	Time from stroke onset to admission	Time onset-admission mean was 29h23' (median= 15h), and only 1% of patients were admitted within 3 h from stroke onset.
Mauritania[42]	2008	Urban hospital	Prospective cohort follow-up	82 patients (42 for neurology unit and 40 for internal medicine and cardiology unit)	Impact of acute admission unit	Stroke onset-CT scan interval: 3.12 for neurology unit versus 3.73 days for internal medicine and cardiology unit; stroke onset-hospitalization interval: 2.05 for neurology unit versus 1.36 days for internal medicine and cardiology unit; stroke onset-rehabilitation start interval: 9.11 for neurology unit versus 19.53 days for internal medicine and cardiology unit (p=0.0002); there was more 3-month functional independence improvement for the neurology unit admission (59.52%) than the internal medicine and cardiology unit admission (25%) (p=0.001).
CAR[39]	2016	Urban hospital	Prospective follow up	737 patients	Impact of stroke unit admission	During the first year (2004) of stroke unit admission, there was 30% mortality rate decrease compared to the previous year.
SA[43]	2009	Urban hospital	Prospective follow up	195 patients	Impact of stroke unit admission (n=101) compared to general ward admission (n=94)	Inpatient mortality decreased from 33% to 16% (P=0.005); LoS increased from a mean of 5.1 days to 6.8 days (P=0.01), referral at discharge to inpatient rehabilitation increased from 5% to19% (P=0.04). Number of CT scans performed (13% GW versus 16% SU) and the number of referrals to the tertiary academic hospital (7% GW versus 4% SU) did not increase significantly.
SA[28]	2009	Rural hospital	Prospective follow up	30 patients	Acute admission, family education, and discharge planning	Mean duration of hospital stay was 6 days. Two-thirds of all families received no stroke education before discharge. All the patients were discharged into family care as there was no stroke rehabilitation facility available to the community
Rwanda, SA & Tanzania[44]	2015	Hospitals (n=3)	Retrospective	452 patients	Time from stroke onset to admission	Time onset-admission interval was 6.8, 0.3 and 1.2 days and the length of hospital stay was 8.2, 7.38 and 12.16 days for Rwanda, SA and Tanzania respectively.

						Stroke rehabilitation
Rwanda, SA & Tanzania [44]	2015	Hospitals (n=3)	Retrospective	452 patients	Inpatient PT rehabilitation	A proportion of 40%, 68% and 98% of stroke patients in Rwanda, Tanzania and SA respectively received PT rehabilitation during acute hospital stay. The mean total number of PT rehabilitation sessions was two in both Rwanda and Tanzania and three in SA.
Nigeria [45]	2017	Urban hospital	Retrospective	783 patients	Inpatient PT rehabilitation	The mean LoS was 16.2 days. Referral rate for PT was high (75.8%) and the mean time from admission to referral for PT was three days. The majority (63.4%) of patients referred utilised PT and the mean number of PT sessions received during in-patient care was 8.7. Utilisation of in-patient PT was significantly associated with reduced LoS.
SA [46]	2009	Urban Community Health Centres (n=20)	Retrospective	100 patients	Rehabilitation services received	At two months post stroke, most participants were treated by PT (98.8%) and medical doctor (62.5%), and only 25% were treated by OT. At six months also, many participants were treated by PT (57.9%) and medical doctor (82.9%), and only 21.1% were treated by OT. Surprisingly, at both two and six months, less than 10% of the participants were treated by any of other rehabilitation team members including ST, home-based carer, nurse, social worker, dietitian, rehabilitation worker, and other rehabilitation specialists. By six months post stroke, the majority (68%) of the participants received between one and 5 physiotherapy sessions. Almost half (49%) of the participants received between one and four hours of physiotherapy.
SA [47]	2013	Urban rehabilitation centre	Retrospective	67 patients	Rehabilitation services received and outcomes	LOS was 52 days. Health professionals seen by patients were nurse (100%), doctor (98.48%), PT (98.48%), social worker (96.96%), OT (95.45%), ST (54.54%), dietitian (16.66%), psychologist (10.60%). Discharge destination was mainly home (82.08%). The mean Barthel Index scores on admission and discharge were 58.85 and 81.59 respectively (p<0.01)
SA [51]	2012	Rehabilitation facilities	Cross-sectional survey	36 facilities	Practice in return to work (RTW) intervention programmes	Seventeen clinical settings referred patients to facilities offering RTW services, and seven facilities offered RTW services. Of the seven facilities that rendered post stroke RTW services, five communicated with the employer to discuss reasonable accommodation and four did assessments for potential to RTW. The most common reasons given by the 29 facilities for not offering RTW services were that they referred patients to other therapists who offered these services, staff shortage, and the unemployed status of the patient at the time of having stroke.

Table S1: Stroke care in Africa *Continued*

SA[48]	2013	Rural hospital	Cross-sectional survey	103 patients	Rate of attendance to outpatient physiotherapy services	The majority (86%) of patients did not attend out-patient physiotherapy. The major reasons for poor attendance were lack of finances (95%), migration to other areas (36%), and living a long distance from the hospital (38%).
Nigeria[49]	2017	Urban hospitals (n=3)	Cross-sectional survey and Focus group discussion (FGD)	60 patients	Satisfaction with outpatient physiotherapy services	Nearly all the participants (98.3%) indicated one of good, very good, and excellent improvement in their clinical conditions with physiotherapy. Majority expressed satisfaction with their physiotherapy care, the modal response being very good (59.3%). However, lack of continuity (being treated by different physiotherapists) and cost of care were sources of dissatisfaction.
Secondary stroke prevention						
SA[28]	2009	Rural hospital	Prospective follow up	30 patients	Rate of adherence to secondary prevention	At three months after discharge follow up, all patients claimed to be taking their antihypertensive medication but 11 (55%) of those who had been prescribed aspirin admitted to defaulting.
Uganda[50]	2016	Urban hospitals (n=2)	Cross-sectional survey	112 patients	Rate of adherence to secondary prevention	Only 17% were highly compliant with anti-hypertensive medications. The main reasons for poor drug adherence were lack of knowledge of the chronicity of hypertension (73%), cost of the drugs (63%) and access to health care provision (15%). However, 19% of the study participants were not able to provide a reason for the poor drug adherence.
Ghana[52]	2017	Urban clinic	Retrospective	418 patients	Rates and determinants of persistent utilization of secondary prevention therapies	At one-year post stroke, 92.1% of subjects were persistent on secondary prevention medications initiated at enrollment with medication class specific rates of 97.5% for antihypertensive, 94.8% for anti-platelets, 94.1% for statins, 85.7% for anti-diabetic and 50% for anticoagulants. Abuse of alcohol was significantly associated with non-persistence, adjusted OR (95% CI) of 3.08 (1.13–8.38).
Ghana[53]	2017	Urban clinic	Retrospective	602 patients	Rates and determinants of uncontrolled systolic blood pressure (SBP)	At one-year post stroke, up to 35% of subjects had SBP above 140 mmHg during follow-up clinic visits. Predictors of uncontrolled SBP were SBP at enrollment into clinic, with an adjusted odds ratio (OR [95% confidence interval]) of 1.31 (1.17-1.47)/10 mmHg increase, and average number of antihypertensive medications prescribed, with an adjusted OR (95% CI) of 1.30 (1.06-1.60) for an increase in the number of antihypertensives prescribed.

Table S1: Stroke care in Africa *Continued*

					Longer-term stroke recovery
SA[28]	2009	Rural hospital	Prospective follow up	30 patients	Training of home-based carers (HBCs)' and patients' follow-up in community	The HBCs received no specific stroke care training. Each carer travelled about 7 km each day on foot or bicycle to conduct home visits. In three months after discharge, only 13 of 20 (65%) surviving patients were visited by home-based carers, nine patients were visited by a physiotherapist, and 2 could consult a social worker during this period.

Abbreviations: CAR, Central African Republic; CT, computerized tomography; EKG, electrocardiogram; IV, intravenous; LOS, length of hospital stay; MRI, magnetic resonance imaging; OT, occupational therapy(ist); PT, physiotherapy(ist); rtpA, recombinant tissue plasminogen activator; SA, South Africa; ST, speech therapist.