Availability and Affordability of Therapies and Services of Multiple Sclerosis in Africa: A Continent-Wide Survey

Ali Shalash[1], Daniel Gams Massi[2], Samia Ben Sassi[3], Houyam Tibar[4], Maouly Fall [5], Yared Z. Zewde[6], Ahmed Alsiddig Ebraheem[7], Yasser Mecheri [8], Julien Razafimahefa[9], Dadah Samy [10], Gonçalves Carlos Fernando [11], Olivier kapto [12], Abdu Kisekka Musubire[13], Ahmed Omar Sheikh Mohamed[14], Massaman Camara [15], Nsengiyumva Nestor[16], Naziha Amer [17], Saara Ndinelago Neshuku-Nampala[18], Bugeme Marcellin [19], Foksouna Sakad[20], Gift Wilson Ngwende[21], Juzor Hooker[22], Yusuf Jamnagerwalla[23], Albert Akpalu [24], Deanna Saylor [25], Riaan van Coller [26], Njideka U. Okubadejo[27], Eman Hamid[1], Azza Abdelnasser Abdelaziz[1], Nouran Mohamed Salah[1]

[1] Department of Neurology, faculty of medicine, Ain Shams University, Cairo, Egypt

[2] Douala General Hospital, Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Douala, Cameroon

[3] National Institute of Neurology Mongi-Ben Hamida, Tunis, Tunisia

[4] Research Team in Neurology and Neurogenetics, Center of Genomics of Human Pathologies, Medical School and Pharmacy, University Mohammed V in Rabat, Rabat, Morocco

[5] Centre Hospitalier National de Pikine, Dakar, Senegal

[6] Addis Ababa University, College of Health Sciences, Department of Neurology, Addis Ababa, Ethiopia

[7] University of Gezira, Khartoum, Sudan

[8] Benbadis University Hospital, Constantine, Algeria.

[9] University of Antananarivo Faculty of Medicine, neurology Antananarivo, Madagascar

[10] Centre Hospitalier des specialites, Nouakchott, Mauritania

[11] Maputo Central Hospital, Maputo, Mozambique

[12] Polyclinique notre Dame de la Paix, Ouagadougou, Burkina Faso

[13] Kiruddu National Referral Hospital, Kampala, Uganda

[14] Madina hospital, Mogadishu, Somalia

[15] Public hospital of kati, Bamako, Mali.

[16] Tanganyika Hospital, Bujumbura, Burundi

[17] Benghazi medical center, Benghazi, Libya

[18] Intermediate Hospital Katutura, Windhoek, Namibia

[19] Cliniques Universitaires De Lubumbashi, Lubumbashi, Democratic Republic of The Congo

[20] University Hospital Center of National Reference, N'djamena, Chad

[21]University of Zimbabwe , Harare, Zimbabwe

[22] Aga Khan University Hospital, Nairobi, Kenya

[23] Saifee Hospital Tanzania, Dar Es Salaam, Tanzania

[24] Korle Bu Teaching Hospital, Accra, Ghana

[25] University Teaching Hospital, Lusaka, Zambia

[26] Department of Neurology, Faculty of Health Sciences, University of Pretoria, Pretoria, South Africa

[27] Neurology Unit, Department of Medicine, College of Medicine, University of Lagos, Lagos State, Nigeria

Ali Shalash, PhD, MD

ali_neuro@yahoo.com

Department of Neurology, faculty of medicine, Ain Shams University, Cairo, Egypt

Daniel Gams Massi, MD

danny.gamsmassi@gmail.com

Douala General Hospital, Faculty of Health Sciences, University of Buea, Buea, Cameroon

Samia Ben Sassi, MD

bensassisam@yahoo.fr

National Institute of Neurology Mongi-Ben Hamida, Tunis, Tunisia

Houyam Tibar, MD

tibarhouyam@gmail.com

Regional Hospital of Guelmim, Guelmim, Morocco

Bugeme Marcellin, MD

Cliniques Universitaires De Lubumbashi, Lubumbashi, Democratic Republic of The Congo

Yared Z. Zewde, MD

yaredzene121@gmail.com

Addis Ababa University, Department of Neurology, Addis Ababa, Ethiopia

Ahmed Alsiddig Ebraheem, MD

Dr.alkenani@gmail.com

Assistant professor of internal medicine and neurology, faculty of medicine, University of Gezira, Sudan

Yasser Mecheri, MD

mecheriyasser@outlook.com

Dr Benbadis University Hospital, Constantine, Algeria.

Julien Razafimahefa, MSc

julien.smne@gmail.com

Faculté de Médecine Université d'Antananarivo/ Unité de Soin, de formation et de Recherche de neurologie, Centre Hospitalier Universitaire Joseph Raseta Befelatanana, Antananarivo Madagascar

Dadah Samy, MD

Centre Hospitalier des specialites, Nouakchott, Mauritania

Gonçalves Carlos Fernando, MD

Maputo Central Hospital, Maputo, Mozambique

Olivier kapto, MD

olivierkapto@gmail.com

Polyclinique notre Dame de la Paix, Ouagadougou, Burkina Faso

Abdu Kisekka Musubire, MD

amusubire@yahoo.com

Kiruddu National Referral Hospital, Kampala, Uganda

Ahmed Omar Sheikh Mohamed, MD

profka252@gmail.com

Madina hospital, Mogadishu, Somalia

Camara Massaman, PhD

Pulblic hospital of kati, Bamako, Mali

Nsengiyumva Nestor, MD

nsengstor@gmail.com

Tanganyika Hospital, Bujumbura, Burundi

Naziha Amer, MD

mrshamoda@gmail.com

Benghazi medical center, Benghazi, Libya

Saara Ndinelago Neshuku-Nampala, MMED

sneshuku@gmail.com

Intermediate Hospital Katutura, Windhoek, Namibia

Maouly Fall, MD

fall.maouly@gmail.com

Centre Hospitalier National de Pikine, Dakar, Senegal

Foksouna Sakad, MD

fokasaka@gmail.com

University Hospital Center of National Reference, N'djamena, Chad

Gift Wilson Ngwende, MD

giftngwende@yahoo.co.uk

University of Zimbabwe,, Harare, Zimbabwe

Juzor Hooker, FCP

juzar@neuroclinicke.com

Aga Khan University Hospital, Nairobi, Kenya

Yusuf Jamnagerwalla, MD, M.Med, M.Sc

yusufsjamnagerwalla@gmail.com

Saifee Hospital Tanzania, Dar Es Salaam, Tanzania

Albert Akpalu,MBBS

a_akpalu@yahoo.com

Korle Bu Teaching Hospital, Accra, Ghana

Deanna Saylor, MD

dcettom1@jhmi.edu

University Teaching Hospital, Lusaka, Zambia

Riaan van Coller, PhD

riaan.vancoller@up.ac.za
Department of Neurology, Faculty of Health Sciences, University of Pretoria, Pretoria, South Africa

Njideka U. Okubadejo, MBChB, FMCP
njideokubadejo@yahoo.com
Neurology Unit, Department of Medicine, College of Medicine, University of Lagos, Lagos State, Nigeria
Eman Hamid, MD
Eman.abdeldayem84@gmail.com
Department of Neurology, faculty of medicine, Ain Shams University, Cairo, Egypt
Abbassyia, Faculty of Medicine, 11566, Cairo, Egypt
Azza Abdelnasser Abdelaziz, MD
Department of Neurology, faculty of medicine, Ain Shams University, Cairo, Egypt

Nouran Mohamed Salah, MD
nouranm49@gmail.com
Department of Neurology, faculty of medicine, Ain Shams University, Cairo, Egypt

Corresponding author:
Ali Shalash, PhD, MD,
Professor of Neurology, Department of Neurology, Ain Shams University Faculty of Medicine
Address: 168 Elnozha St, Saint Fatima Square, Heliopolis, Cairo, Egypt
Email: ali_neuro@yahoo.com, drali shalash@med.asu.edu.eg
Tel: +002 27757457, 00201111124815
Fax: +0020224346742
Running title: Availability and affordability of services of Multiple Sclerosis in Africa

Keywords: Multiple Sclerosis, Africa, therapies, availability, affordability

Manuscript: 4982

Abstract: 200

Tables: 4

Supplementary tables: 4

Figures 1

Conflicts of interests: none for all authors

Funding: none

ABSTRACT

Background

Limited data is available about the availability of multiple sclerosis (MS) therapies and services in Africa.

Objective

We aimed to investigate the availability, affordability, frequency of usage, and insurance coverage of MS therapies and services across Africa.

Methods

A comprehensive web-based survey was constructed and distributed to neurologists from different African countries. The survey addresses availability, affordability, frequency of use and insurance coverage of different therapies and services of MS.

Results

Respondents represented 27 African countries. Intravenous methylprednisolone was always available in most countries (88.9%), while Interferons were completely or partially available in 13 countries (48.1%). The most available disease-modifying therapies (DMTs) were rituximab (22 countries, 81%), followed by interferon beta 1a intramuscular type (12, 44.4%). Availability of other DMTs was variable, while specific MS services were limited. Affordability is limited in most countries, and the use of DMTs was related to insurance coverage. Most associated therapies and investigations were more available and affordable, but less insured. Neurologists were the main healthcare providers, but traditional healers had a role in 14.8 % of countries.

Conclusion

Significant challenges characterize MS care in Africa. MS therapies, particularly DMTs and services, are inaccessible and unaffordable in most African countries.

Introduction

Multiple sclerosis (MS) is an immune-mediated disorder characterized by demyelination of the central nervous system, most commonly affecting individuals between the ages of 20 and 40. It can lead to a variety of symptoms, including physical disabilities, cognitive impairments, and psychiatric disturbances, causing functional disability.[1,2]

Previous studies reported a low incidence of MS in Africa, which was attributed to assumed lack of genetic and environmental risk factors, along with limited access to diagnostic tools like magnetic resonance imaging (MRI). Although the estimated prevalence remains relatively low, about one to two per 1,000 people, this number is rising across several African countries.[3, 4] Recent estimates indicate that sub-Saharan Africa (SSA) has approximately 49,000 cases, with around 2,800 new cases diagnosed annually.[5] Challenges with availability and affordability have been documented in different world regions, particularly Low- and Middle-Income Countries (LMICs), with an increasing need for more data from the African context.[6]

Effective management of MS across the continent is hindered by several challenges, as low disease awareness, limited access to diagnostic resources and treatment options, and a shortage

of specialized care services. In addition, there is a notable scarcity of research focusing on the epidemiology, disease progression, treatment outcomes, and drug development related to MS in Africa.[7, 8] Addressing these challenges is essential to improving outcomes and ensuring a better care for individuals living with MS in Africa. [3, 8, 9]

To expand the available data and better understand the current state of MS therapies and healthcare services across African countries, we conducted a survey aimed at investigating the availability, affordability, frequency of use, and insurance coverage of MS treatments and related services.

Methods

A structured questionnaire was designed to assess the availability, affordability, frequency of use and insurance coverage of therapies and health care services for MS in Africa, following a similar approach to our previous study.[10] The questionnaire was adapted from the previous questionnaire to ensure alignment with MS treatments and services. The initial draft was then reviewed and revised by the research team to confirm the clarity of the questions, terminology, and wording. The final version was distributed online via Google Forms and consisted of closed-ended questions with multiple-choice options, structured on a unidimensional Likert-type scale.

Neurologists with an interest in MS were invited to participate through personal contacts, , and the African Academy of Neurology, and were contacted to request participation. Participants were asked to answer accurate responses and sources required data if needed to report the situation within each country.

Availability of therapies was defined as the consistent presence of a medication throughout the year. It was categorized as *always available* (no shortage during the year), *sometimes available* (available for four to eight months), or *not available*. Affordability was defined as the capacity of low-income patients to cover the monthly costs of medications and investigations.[11]

Frequency of use was assessed as either continuously prescribed or not prescribed. Insurance coverage was also evaluated, and categorized as complete, partial, or none. Medications (generic or brand) were grouped into those used for the treatment of relapses and disease-modifying therapies (DMTs) (Table 1). Additional drugs for associated symptoms, including both motor and non-motor manifestations, were also examined. Furthermore, different healthcare services and diagnostic investigations required for MS were assessed.

Data clarification and analysis

All survey responses were reviewed to identify incomplete submissions. When gaps were detected, country representatives were contacted to confirm or clarify their responses. The dataset was then processed, and descriptive analyses were conducted using SPSS® version 25 (IBM Corp., Armonk, NY, USA).

Results

We received 27 responses from 27 African countries. Countries represented all regions of Africa; North Africa (Egypt, Sudan, Algeria, Tunisia, Morocco, Libya), Central Africa (Cameroon, Democratic Republic of the Congo, Chad), East Africa (Ethiopia, Tanzania, Uganda, Kenya, Mozambique, Madagascar, Zambia, Somalia, Zimbabwe, Burundi), West Africa (Nigeria, Ghana, Mali, Burkina Faso, Senegal, Mauritania) and South Africa (South Africa and Namibia).

Availability of multiple sclerosis therapies in Africa:

Regarding acute relapse therapies, intravenous methylprednisolone was always 24 (88.9%) or sometimes 3 (11.1%) available in all recruited countries but was available in all country regions in only 15 countries (55.6%). Intravenous immunoglobulins and plasma exchange were available in 24 (88.9%) and 18 (66.7%) countries, respectively, mostly in only some country regions (83.3% and 88.9%, respectively) (Table 1, Figure 1).

The most available DMT was rituximab 22 countries (81%), followed by interferon beta 1a intramuscular type (12, 44.4%). Interferon beta 1a subcutaneous type and fingolimod were available in 10 (37%) countries, whereas natalizumab and ocrelizumab were available in only 9 countries (33.3%), including North Africa countries, South Africa and a few SSA countries. Interferon beta 1b, dimethyl fumarate and glatiramer acetate were present in only 8 countries (29.6%). Any type of Interferons was completely or partially available in 13 countries (48.1%), completely in North Africa countries and South Africa and partially in SSA countries e.g., Nigeria, Tanzania, Kenya and Somalia. Other DMTs were available in fewer than 5 African countries (18.5%). Alemtuzumab was present in only South Africa, Siponimod was present in only two countries (Egypt and South Africa), whereas ponesimod was available in Egypt only. All DMTs were mostly available in some regions (Table 1, Figure 1).

Table 1: is here

Affordability of multiple sclerosis therapies in Africa:

Intravenous methylprednisolone was completely affordable in less than 50% of the countries (44.4%) and totally insured in 9 countries (33.3%), while plasma exchange and intravenous

immunoglobulins were completely affordable in only 1 (5.6%) and 3 (12.5%) countries, respectively and partially affordable in 7 (38.9%) and 5 (20.8%) countries, respectively. They were totally insured in 7 (38.9%) and 6 (25 %) countries, respectively (table 2).

DMTs were non-affordable in most countries (40-100%). Commonly affordable DMTs were subcutaneous interferon beta 1a as it was totally affordable in 3 countries (30%), intramuscular interferon beta 1a was partially affordable in 3 countries (25%), teriflunomide was partially affordable in 4 countries (57.1%), and fingolimod was partially affordable in 5 countries (50%). On the other hand, ponesimod, ofatumumab, alemtuzumab and cladribine were not affordable at all when available. Also, natalizumab and ocrelizumab were not affordable in 77% and 66% of the countries, respectively, where they are available.

When available, first-line DMTs were insured completely or partially in about two-thirds of countries, except ponesimod (100% insured). Fingolimod and rituximab were totally insured in 5 countries (50% and 22,7%, respectively). Natalizumab and ocrelizumab were totally insured in 4 countries (44%), when available (Table 2).

Table 2: is here

Frequency of usage and types of available MS therapies in Africa

The most prescribed therapy for acute relapse was methylprednisolone in 24 countries (88.9%), whereas intravenous immunoglobulins and plasma exchange were sometimes prescribed in 19 countries (79.2%) and 15 countries (83.3%), respectively. Interferons were mostly continuously prescribed first-line DMTs. When available, other DMTs such as teriflunomide and dimethyl fumarate were less frequently prescribed (3 countries (42.9% and 37.5, respectively)),

Fingolimod, ofatumumab and natalizumab were sometimes prescribed in 8 (80%), 2 (100%) and 4 (44%) countries, respectively. Ocrelizumab, cladribine and alemtuzumab were all sometimes prescribed in the available countries, whereas rituximab was continuously prescribed in 4 countries (18.2%) and sometimes prescribed in 18 countries (81.8%).

Most DMTs were available mainly as brand, while teriflunomide, dimethyl fumarate, fingolimod, and rituximab were offered in few countries in both generic and brand forms (Supplementary Table 1).

Availability and frequency of use of therapies of associated manifestations of MS

Dalfampridine was sometimes available in 4 countries only (14.8%). Muscle relaxants were always available in 19 (70.4%) countries, whereas botulinum toxin and baclofen pumps were sometimes available in 33.3% and 22.2%, respectively. Medications for associated symptoms such as psychiatric disorders, cognitive impairment, constipation, and fatigability were present in most of the recruited countries (Table 3, Supplementary document).

Table 3: is here

Affordability and Insurance coverage of therapies for the associated manifestations of MS

Most drugs for psychiatric manifestations, sleep and spasticity were either completely or partially affordable among most countries, but SNRI and modafinil weren't affordable in 6 countries (22.2% and 31.6%, respectively). Also, botulinum toxin and baclofen pumps weren't affordable in 9 (52.9%) and 7 (63.6%) countries, respectively. Antidepressants and antipsychotics insurance coverage was variable among countries, with 40.7% totally insured for tricyclic antidepressants

and SSRIs and 33.3% totally insured for typical antipsychotics (Supplementary Table 2, Supplementary document).

Availability and frequency of usage of other therapies and services for MS in Africa

General physiotherapy was available in all the recruited countries, but specific MS programs were always available in 22.2% of the countries. Specific speech programs were sometimes available in only 7 countries (25.9%). Specialized MS clinics and nurses were sometimes available in 18.5% and 25.9% of the countries, respectively. The MS supportive groups were sometimes available in 25.9% of the countries (Table 4, Supplementary document).

Affordability of other therapies and services for MS in Africa

Physiotherapy and speech therapies were partially affordable in many countries (70.4% and 73.9%, respectively), together with specialized MS clinics and nurses, telemedicine calls and psychiatric consultation. These services weren't affordable at all in less than 4 countries. Physiotherapy and speech therapy were partially insured in 37% of the countries, and not insured at all in 29.6% of the countries. Telemedicine services were insured in only one country. Other conjugated services, psychiatric and cognitive rehabilitation were partially insured in most of the countries (53.8%, 38.5%, and 50%, respectively) (Supplementary Table 3).

Availability and frequency of use of investigations of MS in Africa

MRI was always available in 81.5% and frequently requested in 77.8% of the countries. cerebrospinal fluid (CSF) analysis for oligoclonal bands was always available in 51.9% of the countries and requested in 13 (61.9%) of them. Visual evoked potential and optic coherence

tomography (OCT) were always available in 37% and 59.3% of the countries, respectively, and they were requested in most of them. All investigations were either completely or partially affordable within the recruited countries.(Table 4). Insurance coverage of most investigations was either partial or total but not in all countries (Supplementary Table 3, Supplementary document).

Table 4: is here

Neurologists were the common healthcare providers in 18 countries (66.7%), followed by neurosurgeons, Internists, and traditional healers (14.8%, 14.8% and 11.1%, respectively). Specific recommendations of surveyed physicians were asked through open questions. Most of the respondents confirmed the need for more affordable and available therapies, specialized MS centers, national recommendations, education programs and research, and the lack of access to other therapies (e.g., speech and occupational therapies) (Supplementary Table 4).

Discussion:

The current study comprehensively investigated the contemporary state of MS services in Africa, stressing the widespread unavailability and unaffordability of MS therapies, diagnostic and monitoring investigations, and specialized services, particularly in SSA. The most available DMTs were rituximab, followed by interferon beta 1a intramuscular type, subcutaneous interferon and fingolimod. Most other DMTs remained largely unavailable and unaffordable. Moreover, access to specialized MS programs and trained neurologists was limited. Availability of generics and insurance coverage in some countries helped improve accessibility and affordability. Moreover.

the study highlights major disparities in access to both standard and advanced MS therapies across the continent.

Similarly, a previous study reported that interferon beta was initially the most prescribed MS therapy (33.8%), followed by rituximab (20.97%) at the Aga Khan University Hospital in Nairobi, Kenya. However, a review of their treatment registry showed that rituximab has since become the most frequently used therapy at the institution. This shift is attributed to rituximab's consistent availability, relative affordability, and practicality as a treatment option for many patients.[12] Moreover, more than half of patients with RRMS had never received DMTs, with a delay of up to 2 years from diagnosis to start DMTs.[12] Another studies reported the unavailability of DMTs in Sudan.[13].[14]

Previous reports on MS therapies in west Africa are sparse and limited to single institution's experiences. Okubadejo et al reported that DMTs were used by 3 out of 5 patients, in a preliminary clinc-based report from Lagos, Nigeria. These DMTs were paid out of pocket and specially imported, incurring a high annual cost.[15]. Despite the access to some DMTs, barriers and challenges to accessing DMTs were reported in North African countries, including access to some treatments, high costs, access to monitoring investigations and continuation of DMTs. The use of off-label drugs, e.g., rituximab, was also reported[14]

The high cost of DMTs is a major barrier to accessibility for these therapies, causing a huge economic burden on patients and health care systems, particularly in LMICs.[6] This burden increases with increasing disease severity, escalating the negative impact. Although the cost

drivers varied more as EDSS increased, relapse treatments and DMTs remained the most dominant cost drivers, followed by home care costs and rehabilitation.[16]

Expectedly, DMTs' availability is much higher in high-income countries. According to the 2021 MS atlas, availability of DMTs was lower in low-income countries (30%), and highest in high-income countries (97-100%). [6, 17] Noteworthy, the current study showed more challenges and less access to DMTs than other world regions, including Latin America.[18]

The widespread availability and use of rituximab in Africa are in line with real-world practice, particularly in LMICs. A retrospective study showed that the anti-B cell therapy with rituximab was safe, effective, available, and affordable in developing countries,[19] recommending its use in resource-limited countries such as African countries.[20] Additionally, retrospective studies from developed countries showed similar findings, however, prospective studies are required to confirm its long-term efficacy, safety, and impact on patients' disability.[21, 22]

MS diagnosis and management rely on the findings of MRI, CSF biomarkers and OCT, while other laboratory tests are essential for monitoring of DMTs. In this survey, these investigations were not available in most countries and either partially or fully affordable and mostly not insured. Consistently, a cohort study in Kenya reported an average five-year delay in diagnosis due to limited MRI availability and the shortage of neurologists.[12] Substantial diagnostic delays were likewise reported in Nigeria and Zambia, largely attributed to limited resources and services.[15, 23] Accessibility to MRI in several African regions is hindered by the high cost of equipment, scarcity of MRI devices, and the limited number of radiologists. [9, 10] The proposed 2024 revised diagnostic criteria for MS place greater emphasis on novel MRI, OCT and laboratory markers as a key

component for diagnosis.[24] This shift raises critical questions about the feasibility of implementing these criteria in many African countries.

Our survey showed that specific MS programs, physiotherapy, speech therapy, and specialized MS clinics or trained nurses are inconsistently available and limited across the continent, with some countries reporting only occasional access. Services such as physiotherapy, speech therapy, psychiatric support, and telemedicine are often only partially affordable or insured , if at all. The lack of structured supportive care contributes to limited disease management, reduced quality of life and increased disease burden, highlighting a significant gap in comprehensive MS care in Africa.[9] In developed countries, support groups play a vital role in MS care by offering patients a platform to connect with others facing similar challenges, exchange information, and receive emotional and psychological support and improve the overall quality of care.[9]

The current study found that while neurologists are the primary healthcare providers for MS in most countries, a substantial number still rely on neurosurgeons or internists, indicating a shortage of specialized care. Interestingly, traditional healers were sought in 14.8% of African countries, resulting in delayed diagnosis and treatment of African MS patients and implying the need for more awareness of African populations. Additionally, stigma and widespread misinformation surrounding MS can further hinder access to appropriate care.[25] Also, some MS patients may turn to traditional and complementary therapies, often influenced by cultural misconceptions and economic burden.[26] Consequently, the non-neurological consultation and misdiagnosis result in delay of diagnosis and increased disease disability.[27]

Remarkably, the current study also showed the variable availability of MS therapies and services across regions within the same country, implying worse scenarios in some regions. Approximately half of Africa's population resides in rural areas. In these rural regions, healthcare infrastructure remains severely underdeveloped, resulting in limited access to neurologists and medical services and significant delays in accurate diagnosis and treatment.[28] Additionally, ongoing conflicts and wars in various African countries disrupt healthcare infrastructure, particularly affecting the management of chronic diseases such as MS.[29]

One limitation of the study is the inability to include all African countries, a situation due to non-response from contacts or limited neurological workforce. It is however likely that the reality in these countries share similarities with the surveyed countries in terms of health systems are either not significantly different, or in fact worse. This survey relied on physicians' perspectives as the prescribers and those anticipated to have greater insight into medication utilization. We invited physicians who are recognized national experts, actively engaged in African neurology networks, and provided guidance to gather and verify data from reliable sources.

With the rising prevalence of MS in Africa, integrating MS care into national health strategies has become more critical than ever.[9] The current study highlights the substantial challenges that hinder the diagnosis and management of MS in Africa. MS therapies, particularly DMTs, experts, diagnostic tools and services are non-accessible and unaffordable in most countries. Implementing cost-reduction measures as expanding government insurance coverage, supporting the local production of effective generics , and partnering with international organizations for funding and treatment donations—is essential.

Equipping healthcare providers with the knowledge and tools to diagnose and manage MS at an early stage is also vital to reducing disability and easing the overall disease burden. Collaboration with international organizations, such can facilitate education, training, and knowledge exchange, enabling local providers to adopt global best practices.

Equipping healthcare providers with the knowledge and tools to diagnose and manage MS at an early stage is also vital to reducing disability and easing the overall disease burden. Collaboration with international organizations, such can facilitate education, research, training, and knowledge exchange, enabling local providers to adopt global best practices. Furthermore, encouraging research that addresses the unique barriers and healthcare challenges within African contexts is crucial.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding: none

Disclosure

N.O. receives institutional research grant funding (not MS related) from the Michael J Fox Foundation for Parkinson's Research and the National Institute for Health and Care Research (United Kingdom). Other authors have nothing to disclose

Data availability statement

Anonymized data not published within this article will be made available by request from corresponding author

Abbreviations:

BZD: benzodiazepine,

CSF: cerebrospinal fluid

DMTs: disease-modifying therapies

ER: extended release,

IR: immediate release,

IgG: immunoglobulin G

IM: intramuscular,

JC virus: john Cunningham virus

LMICs: Low- and Middle-Income Countries

MRI: magnetic resonance imaging

MS: multiple sclerosis

OCT: optic coherence tomography

RLS: restless leg syndrome

SSA : sub-Saharan Africa

SC: subcutaneous,

SPMS: secondary progressive multiple sclerosis

SSRI: selective serotonin reuptake inhibitor,

SNRI: serotonin norepinephrine reuptake inhibitor

SDMT: symbol digit modalities test

VEP: visual evoked potential

References:

1. Filippi M, Bar-Or A, Piehl F, et al. Multiple sclerosis. *Nat Rev Dis Primers* 2018; 4: 43. 2018/11/10. DOI: 10.1038/s41572-018-0041-4.
2. Baecher-Allan C, Kaskow BJ and Weiner HL. Multiple Sclerosis: Mechanisms and Immunotherapy. *Neuron* 2018; 97: 742-768. 2018/02/23. DOI: 10.1016/j.neuron.2018.01.021.
3. Heine M, Maartens D, Hanekom S, et al. Multiple Sclerosis in sub-Saharan Africa - a scoping review. *Mult Scler Relat Disord* 2020; 42: 102133. 2020/05/08. DOI: 10.1016/j.msard.2020.102133.
4. Yamout BI, Assaad W, Tamim H, et al. Epidemiology and phenotypes of multiple sclerosis in the Middle East North Africa (MENA) region. *Mult Scler J Exp Transl Clin* 2020; 6: 2055217319841881. 2020/01/28. DOI: 10.1177/2055217319841881.
5. Qian Z, Li Y, Guan Z, et al. Global, regional, and national burden of multiple sclerosis from 1990 to 2019: Findings of global burden of disease study 2019. *Front Public Health* 2023; 11: 1073278. 2023/03/07. DOI: 10.3389/fpubh.2023.1073278.
6. World Health Organization. *Improving access to medicines for neurological disorders.* . 2024. Geneva.
7. Multiple Sclerosis Advisory Committee of the Neurological Association of South A. Guideline for the use of beta-interferons in patients with multiple sclerosis--a South African proposal. *S Afr Med J* 2004; 94: 917-921. 2004/12/14.
8. Aderinto N, Muili AO and Opanike J. Navigating the journey of multiple sclerosis management in Africa, overcoming hurdles and harnessing opportunities: a review. *Ann Med Surg (Lond)* 2023; 85: 1774-1779. 2023/05/25. DOI: 10.1097/MS9.0000000000000560.
9. Aderinto N. Current Practices, Challenges, and Future Directions in Multiple Sclerosis Management in Sub-Saharan Africa. *Int J MS Care* 2024; 27: T13-T16. 2025/04/17. DOI: 10.7224/1537-2073.2024-080.
10. Hamid E, Ayele BA, Massi DG, et al. Availability of Therapies and Services for Parkinson's Disease in Africa: A Continent-Wide Survey. *Mov Disord* 2021; 36: 2393-2407. 2021/06/04. DOI: 10.1002/mds.28669.

11. Ewen M, Zweekhorst M, Regeer B, et al. Baseline assessment of WHO's target for both availability and affordability of essential medicines to treat non-communicable diseases. *PloS one* 2017; 12: 1-13. DOI: 10.1371/journal.pone.0171284.
12. Jamal I, Shah J, Mativo P, et al. Multiple sclerosis in Kenya: Demographic and clinical characteristics of a registry cohort. *Mult Scler J Exp Transl Clin* 2021; 7: 20552173211022782. 2021/07/01. DOI: 10.1177/20552173211022782.
13. Idris MN, Sokrab TE, Ibrahim EA, et al. Multiple sclerosis in Sudan: a prospective study of clinical presentation and outcome. *Mult Scler* 2009; 15: 1537-1538. 2009/12/19. DOI: 10.1177/1352458509345913.
14. Zeineddine M, Al-Hajje A, Salameh P, et al. Barriers to accessing multiple sclerosis disease-modifying therapies in the Middle East and North Africa region: A regional survey-based study. *Mult Scler Relat Disord* 2023; 79: 104959. 2023/09/01. DOI: 10.1016/j.msard.2023.104959.
15. Okubadejo N, Oluwadamilola O, Temitope L, et al. Unveiling Multiple Sclerosis in Nigeria: The Conundrum of Diagnosis and Access to Disease Modifying Therapies *Neurology* 2014; 82: P5.152.
16. de Seze J, Zephir H, Hautecoeur P, et al. Pathologic laughing and intractable hiccups can occur early in multiple sclerosis. *Neurology* 2006; 67: 1684-1686. 2006/11/15. DOI: 10.1212/01.wnl.0000242625.75753.69.
17. MS International Federation w. *Atlas of MS*. 2021.
18. Rocha V and Navas C. Multiple Sclerosis Care in Latin America. *Int J MS Care* 2024; 27: T7-T12. 2025/03/13. DOI: 10.7224/1537-2073.2024-085.
19. Mathew T, John SK, Kamath V, et al. Efficacy and safety of rituximab in multiple sclerosis: Experience from a developing country. *Mult Scler Relat Disord* 2020; 43: 102210. 2020/06/03. DOI: 10.1016/j.msard.2020.102210.
20. Piehl F and Mathew T. Low-dose rituximab should be used for treating MS in resource-limited settings: Yes. *Mult Scler* 2022; 28: 1028-1029. 2022/04/20. DOI: 10.1177/13524585221089890.
21. Zecca C, Bovis F, Novi G, et al. Treatment of multiple sclerosis with rituximab: A multicentric Italian-Swiss experience. *Mult Scler* 2020; 26: 1519-1531. 2019/10/02. DOI: 10.1177/1352458519872889.
22. Filippini G, Kruja J and Del Giovane C. Rituximab for people with multiple sclerosis. *Cochrane Database Syst Rev* 2025; 3: CD013874. 2025/03/12. DOI: 10.1002/14651858.CD013874.pub3.
23. Sahu M, Chomba M, Mortel D, et al. Factors associated with delay to diagnosis of multiple sclerosis in Zambia. *Mult Scler* 2025; 31: 1039-1050. 2025/06/18. DOI: 10.1177/13524585251344832.
24. Klotz L, Saraste M, Airas L, et al. Multiple sclerosis: 2024 update. *Free Neuropathol* 2025; 6: 14. 2025/07/10. DOI: 10.17879/freeneuropathology-2025-6762.
25. Batran RA, Kamel M, Bahr A, et al. Multiple sclerosis: economic burden, therapeutic advances, and future forecasts in the Middle East and North Africa region. *Expert Rev Pharmacoecon Outcomes Res* 2024; 24: 873-882. 2024/06/04. DOI: 10.1080/14737167.2024.2364832.
26. Lotfi R, Chikhaoui M, Elmourid A, et al. The Use of Traditional and Complementary Medicine Among Patients With Multiple Sclerosis in Morocco. *Int J MS Care* 2024; 26: 140-143. 2024/06/14. DOI: 10.7224/1537-2073.2022-116.
27. Khedr EM, El Malky I, Hussein HB, et al. Multiple sclerosis diagnostic delay and its associated factors in Upper Egyptian patients. *Sci Rep* 2023; 13: 2249. 2023/02/09. DOI: 10.1038/s41598-023-28864-x.

28. Georgi F and Hall P. Studies on multiple sclerosis frequency in Switzerland and East Africa. *Acta Psychiatr Scand Suppl* 1960; 35: 75-84. 1960/01/01. DOI: 10.1111/j.1600-0447.1960.tb08666.x.
29. Nasreldin M, Shaweno T, Dereje N, et al. Humanitarian strategies for tackling public health crises in conflict zones in Africa. *J Public Health Afr* 2024; 15: 824. 2024/12/09. DOI: 10.4102/jphia.v15i1.824.

Figure legend

Figure 1: Availability of multiple sclerosis therapies in Africa

Tables

Table 1: Availability of multiple sclerosis therapies in Africa

	Availability			Number of countries with available treatment	Regional Availability		
	Always available	Sometimes available	Not available at all		Available in different regions	Available only in some regions	I don't know
Treatment of relapses							
Intravenous Methylprednisolone	24 (88.9%)	3 (11.1%)	0 (0%)	27/27	15 (55.6%)	11 (40.7%)	1 (3.7%)
Plasma Exchange	8 (29.6%)	10 (37%)	9 (33.3%)	18/27	1 (5.6%)	16 (88.9%)	1 (5.6%)
Intravenous Immunoglobulins	7 (25.9%)	17 (63%)	3 (11.1%)	24/27	4 (16.7%)	20 (83.3%)	0 (0%)
Disease Modifying Therapies							
First line DMTs							
Interferons	7 (25.9%)	6 (22.2%)	14 (51.9%)	13/27	4 (30.7%)	8 (61.5%)	1 (7.6%)
Interferon Beta 1A (SC)	7 (25.9%)	3 (11.1%)	17 (63%)	10/27	4 (40%)	6 (60%)	0 (0%)
interferon Beta 1A (IM)	7 (25.9%)	5 (18.5)	15 (55.6%)	12/27	4 (33.3%)	8 (66.7%)	0 (0%)
Interferon Beta 1B	6 (22.2%)	2 (7.4%)	19 (70.4%)	8/27	4 (50%)	4 (50%)	0 (0%)
Pegylated Interferon 1A	3 (11.1%)	3 (11.1%)	21 (77.8%)	6/27	1 (16.7%)	4 (66.7%)	1 (16.7%)
Glatiramer acetate	4 (14.8%)	4 (14.8%)	19 (70.4%)	8/27	3 (37.5%)	4 (50%)	1 (12.5%)
Teriflunomide	4 (14.8%)	3 (11.1%)	20 (74.1%)	7/27	3 (42.9%)	2 (28.6%)	2 (28.6%)
Dimethyl fumarate	5 (18.5)	3 (11.1%)	19 (70.4%)	8/27	3 (37.5%)	5 (62.5%)	0 (0%)
Ponesimod	1 (3.7%)	0 (0%)	26 (96.3%)	1/27	0 (0%)	1 (100%)	0 (0%)
Second line DMTs							
Fingolimod	6 (22.2%)	4 (14.8%)	17 (63%)	10/27	4 (40%)	6 (60%)	0 (0%)
Natalizumab	5 (18.5%)	4 (14.8%)	18 (66.6%)	9/27	2 (22.2%)	7 (77.7%)	0 (0%)
Ofatumumab	1 (3.7%)	1 (3.7%)	25 (92.5%)	2/27	0 (0%)	2 (100%)	0 (0%)
Induction DMTs							
Ocrelizumab	7 (25.9%)	2 (7.4%)	18 (66.6%)	9/27	2 (22.2%)	7 (77.7%)	0 (0%)
Alemtuzumab	1 (3.7%)	0 (0%)	26 (96.3%)	1/27	0 (0%)	1 (100%)	0 (0%)
Cladribine	3 (11.1%)	3 (11.1%)	21 (77.8%)	6/27	0 (0%)	6 (100%)	0 (0%)
DMTs for SPMS							
Siponimod	1 (3.7%)	1 (3.7%)	25 (92.6%)	2/27	0 (0%)	2 (100%)	0 (0%)
Rituximab	12 (44.4%)	10 (37%)	5 (18.5)	22/27	3 (13.6%)	19 (86.4%)	0 (0%)

DMTs; disease modifying therapies, SC: subcutaneous, IM: intramuscular, SPMS: secondary progressive multiple sclerosis

Table 2: Affordability and insurance coverage of multiple sclerosis therapies in Africa

	Number of countries with available treatment	Affordability			Insurance Coverage			
		Completely affordable	Partially affordable	Not affordable at all	Total Insurance coverage	Partial insurance coverage	No insurance coverage	I don't know
Treatment of relapses								
Intravenous Methylprednisolone	27/27	12 (44.4%)	12 (44.4%)	3 (11.1%)	9 (33.3%)	5 (18.5%)	7 (25.9%)	2 (7.4%)
Plasma Exchange	18/27	1 (5.6%)	7 (38.9%)	10 (55.6%)	7 (38.9%)	3 (16.7%)	8 (44.4%)	4 (22.2%)
Intravenous Immunoglobulins	24/27	3 (12.5%)	5 (20.8%)	16 (66.7%)	6 (25%)	5 (20.8%)	11 (45.8%)	4 (16.7%)
Disease Modifying Therapies								
First line DMTs								
Interferons	13/27	3 (23%)	5 (38.4%)	5 (38.4%)	5 (38.4%)	4 (30.7%)	4 (30.7%)	0 (0%)
Interferon Beta 1A (SC)	10/27	3 (30%)	2 (20%)	5 (50%)	4 (40%)	2 (20%)	4 (40%)	0 (0%)
Interferon Beta 1A (IM)	12/27	2 (16.7%)	3 (25%)	7 (58.3%)	5 (41.7%)	3 (25%)	4 (33.3%)	0 (0%)
Interferon Beta 1B	8/27	2 (25%)	1 (12.5%)	5 (62.5%)	5 (62.5%)	1 (12.5%)	2 (25%)	0 (0%)
Pegylated Interferon 1A	6/27	0 (0%)	2 (33.3%)	4 (66.7%)	2 (33.3%)	2 (33.3%)	2 (33.3%)	0 (0%)
Glatiramer acetate	8/27	1 (12.5%)	3 (37.5%)	4 (50%)	3 (37.5%)	2 (25%)	3 (37.5%)	0 (0%)
Teriflunomide	7/27	0 (0%)	4 (57.1%)	3 (42.9%)	4 (57.1%)	1 (14.3%)	2 (28.6%)	0 (0%)
Dimethyl fumarate	8/27	2 (25%)	1 (12.5%)	5 (62.5%)	4 (50%)	2 (25%)	2 (25%)	0 (0%)
Ponesimod	1/27	0 (0%)	0 (0%)	1(100%)	1(100%)	0 (0%)	0 (0%)	0 (0%)
Second line DMTs								
Fingolimod	10/27	1 (10%)	5 (50%)	4 (40%)	5 (50%)	3 (30%)	2 (20%)	0 (0%)
Ofatumumab	2/27	0 (0%)	0 (0%)	2 (100%)	1 (50%)	1 (50%)	0 (0%)	0 (0%)
Natalizumab	9/27	0 (0%)	2 (22.2%)	7 (77.7%)	4 (44.4%)	1 (11.1%)	4 (44.4%)	0 (0%)
Induction DMTs								
Ocrelizumab	9/27	0 (0%)	3 (33.3%)	6 (66.6%)	4 (44.4%)	1 (11.1%)	4 (44.4%)	0 (0%)
Alemtuzumab	1/27	0 (0%)	0 (0%)	1 (100%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)
Cladribine	6/27	0 (0%)	0 (0%)	6 (100%)	2 (33.3%)	2 (33.3%)	2 (33.3%)	0 (0%)
DMTs for SPMS								
Siponimod	2/27	0 (0%)	1(50%)	1(50%)	1 (50%)	1 (50%)	0 (0%)	0 (0%)
Rituximab	22/27	0 (0%)	12 (54.5%)	10 (45.5%)	5 (22.7%)	8 (36.4%)	8 (36.4%)	1 (4.5%)

DMTs; disease modifying therapies, SC: subcutaneous, IM: intramuscular, SPMS: secondary progressive multiple sclerosis

Table 3: Availability and frequency of usage of therapies of associated manifestations of multiple sclerosis in Africa

	Availability			Number of countries with available treatment	Frequency of usage		
	Always available	Sometimes available	Not available at all		Continuously prescribed/ used	Sometimes prescribed/ used	Not prescribed/ used at all
Drugs for gait dysfunction, spasticity, and dystonia							
Dalfampridine	1 (3.7%)	4 (14.8%)	22 (81.5%)	5/27	1 (20%)	3 (60%)	1 (20%)
Botulinum toxin	8 (29.6%)	9 (33.3%)	10 (37%)	17/27	1 (5.9%)	12 (70.6%)	4 (23.5%)
Muscle relaxants including centrally acting ones	19 (70.4%)	5 (18.5%)	3 (11.1%)	24/27	13 (54.2%)	9 (37.5%)	2 (8.3%)
Baclofen pump	5 (18.5%)	6 (22.2%)	16 (59.3%)	11/27	2 (18.2%)	6 (54.5%)	3 (27.3%)
Anticholinergic for dystonia	21 (77.8%)	5 (18.5%)	1 (3.7%)	26/27	9 (34.6%)	16 (61.5%)	1 (3.8%)
Drugs for depression, fatigue, sleep and cognitive impairment							
Tricyclic Antidepressants	26 (96.3%)	1 (3.7%)	0 (0%)	27/27	17 (63%)	10 (37%)	0 (0%)
SSRI	25 (92.6%)	2 (7.4%)	0 (0%)	27/27	15 (55.6%)	12 (44.4%)	0 (0%)
SNRI	18 (66.7%)	9 (33.3%)	0 (0%)	27/27	9 (33.3%)	16 (59.3%)	2 (7.4%)
Mirtazapine and other antidepressants	17 (63%)	7 (25.9%)	3 (11.1%)	24/27	6 (25%)	18 (75%)	0 (0%)
Typical antipsychotic; haloperidol, Sulpride	26 (96.3%)	1 (3.7%)	0 (0%)	27/27	9 (33.3%)	16 (59.3%)	2 (7.4%)
Atypical and other antipsychotics	23 (85.2%)	3 (11.1%)	1 (3.7%)	26/27	9 (34.6%)	17 (65.4%)	0 (0%)
Medications for cognitive impairment (Memantine, Donepezil, Rivastigmine)	18 (66.7%)	8 (29.6%)	1 (3.7%)	26/27	7 (26.9%)	15 (57.7%)	4 (15.4%)
Modafinil	11 (40.7%)	8 (29.6%)	8 (29.6%)	19/27	3 (15.8%)	13 (68.4%)	3 (15.8%)
Amantadine (IR and/ or ER)	9 (33.3%)	9 (33.3%)	9 (33.3%)	18/27	5 (27.8%)	12 (66.7%)	1 (5.6%)
Melatonin	20 (74.1%)	5 (18.5%)	2 (7.4%)	25/27	7 (28%)	14 (56%)	4 (16%)
Benzodiazepine and non-BZD hypnotics	24 (88.9%)	3 (11.1%)	0 (0%)	27/27	10 (37%)	15 (55.6%)	2 (7.4%)
Pramipexol for RLS	10 (37%)	12 (44.4%)	5 (18.5%)	22/27	1 (4.5%)	16 (72.7%)	5 (22.7%)
Therapies for autonomic and neuropathic pain							
Medication for hypotension (Domperidone, Fludrocortisone and midodrine)]	15 (55.6%)	11 (40.7%)	1 (3.7%)	26/27	3 (11.5%)	20 (76.9%)	3 (11.5%)

Laxatives	26 (96.3%)	0 (0%)	1 (3.7%)	26/27	15 (57.7%)	11 (42.3%)	0 (0%)
Drugs for overactive bladder as Solifenacin	16 (59.3%)	7 (25.9%)	4 (14.8%)	23/27	8 (34.8%)	14 (60.9%)	1 (4.3%)
Sildenafil	22 (81.5%)	3 (11.1%)	2 (7.4%)	25/27	6 (24%)	18 (72%)	1 (4%)
Medications for neuropathic pain (as gabapentin, carbamazepine)	26 (96.3%)	1 (3.7%)	0 (0%)	27/27	18 (66.7%)	9 (33.3%)	0 (0%)

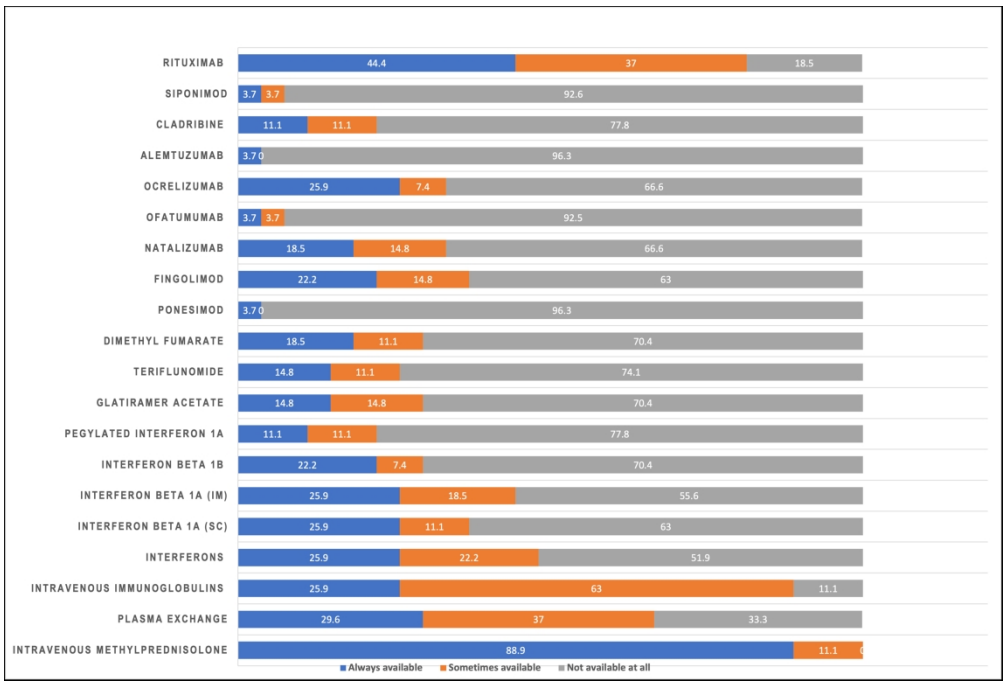
SSRI: selective serotonin reuptake inhibitor, SNRI: serotonin norepinephrine reuptake inhibitor, IR: immediate release, ER: extended release, BZD: benzodiazepine, RLS: restless leg syndrome

Table 4: Availability and frequency of usage of other therapies, services and investigations of multiple sclerosis in Africa

	Availability			Number of countries with available service	Frequency of usage		
	Always available	Sometimes available	Not available at all		Frequently prescribed/ used	Sometimes prescribed/ used	Not prescribed/ used at all
Therapies and services							
Physiotherapy (general)	23 (85.2%)	4 (14.8%)	0 (0%)	27/27	18 (66.7%)	9 (33.3%)	0 (0%)
Physiotherapy (MS specific programs)	6 (22.2%)	5 (18.5%)	16 (59.3%)	11/27	5 (45.5%)	4 (36.4%)	2 (18.2)
Speech therapy	14 (51.9%)	9 (33.3%)	4 (14.8%)	23/27	8 (34.8%)	14 (60.9%)	1 (4.3%)
Speech therapy (MS specific programs)	1 (3.7%)	7 (25.9%)	19 (70.4%)	8/27	0 (0%)	6 (75%)	2 (25%)
Specialized MS clinic	4 (14.8%)	5 (18.5%)	18 (66.7%)	9/27	1 (11.1%)	7 (77.8%)	1 (11.1%)
Specialized MS nurse	2 (7.4%)	7 (25.9%)	18 (66.7%)	9/27	1 (11.1%)	4 (44.4%)	4 (44.4%)
Supportive MS group	6 (22.2%)	7 (25.9%)	14 (51.9%)	13/27	5 (38.5%)	5 (38.5%)	3 (23.1%)
Telemedicine (asynchronous; WhatsApp calls)	6 (22.2%)	6 (22.2%)	15 (55.6%)	12/27	3 (25%)	8 (66.7%)	1 (8.3%)
Telemedicine (synchronous; virtual visits)	4 (14.8%)	7 (25.9%)	16 (59.3%)	11/27	1 (9.1%)	9 (81.8%)	1 (9.1%)
Services conjugated with other clinics as urology and nutrition	5 (18.5%)	8 (29.6%)	14 (51.9%)	13/27	2 (15.4%)	9 (69.2%)	2 (15.4%)
Psychiatric consultation	21 (77.8%)	5 (18.5%)	1 (3.7%)	26/27	8 (30.8%)	18 69.3%)	0 (0%)
Cognitive rehabilitation	9 (33.3%)	13 (48.1%)	5 (18.5%)	22/27	6 (27.3%)	14 (63.6%)	2 (9.1%)
Transcranial magnetic stimulation	1 (3.7%)	3 (11.1%)	23 (85.2%)	4/27	1(25%)	0 (0%)	3 (75%)
Investigations							
MRI	22 (81.5%)	5 (18.5%)	0 (0%)	27/27	21 (77.8%)	6 (22.2%)	0 (0%)
CSF examination for oligoclonal bands and IgG index	14 (51.9%)	7 (25.9%)	6 (22.2%)	21/27	13 (61.9%)	7 (33.3%)	1 (4.7%)
VEP	10 (37%)	9 (33.3%)	8 (29.6%)	19/27	6 (31.5%)	11(57.9%)	2 (10.5%)
OCT	16 (59.3%)	8 (29.6%)	3 (11.1%)	24/27	8 (33.3%)	13 (54.1%)	3 (12.5%)
SDMT	8 (29.6%)	10 (37%)	9 (33.3%)	18/27	6 (33.33%)	9 (50%)	3 (16.6%)

Complete blood count	24 (88.9%)	0 (0%)	3 (11.1%)	24/27	22 (91.6%)	2 (8.3%)	0 (0%)
Liver function	25 (92.6%)	0 (0%)	2 (7.4%)	25/27	22 (88%)	3 (12%)	0 (0%)
thyroid function	23 (85.2%)	2 (7.4%)	2 (7.4%)	25/27	21 (84%)	4 (16%)	0 (0%)
Varicella zoster virus antibodies	14 (51.9%)	9 (33.3%)	4 (14.8%)	23/27	6 (26%)	13 (56.5%)	4 (17.39%)
JC virus	10 (37%)	9 (33.3%)	8 (29.6%)	19/27	5 (26.3%)	9 (47.36%)	5 (26.3%)
Collagen battery (basic)	8 (29.6%)	10 (37%)	9 (33.3%)	18/27	5 (27.77%)	8 (44.44%)	5 (27.77%)
Echocardiogram	25 (92.6%)	2 (7.4%)	0 (0%)	27/27	14 (51.9%)	12 (44.4%)	1 (3.7%)
Electrocardiography	26 (96.3%)	1 (3.7%)	0 (0%)	27/27	17 (63%)	9 (33.3%)	1 (3.7%)

MS: multiple sclerosis, MRI: magnetic resonance imaging, CSF: cerebrospinal fluid, VEP: visual evoked potential, OCT: optic coherence tomography, SDMT: symbol digit modalities test, JC virus: john Cunningham virus, IgG: immunoglobulin G



Availability of multiple sclerosis therapies in Africa

295x199mm (300 x 300 DPI)

Supplementary Results

Availability and frequency of use of therapies of associated manifestations of MS (continue)

Medications for cognitive impairment (memantine, donepezil and rivastigmine) were available in 26 countries and always present in 66.7%. Melatonin, benzodiazepine and non-benzodiazepine hypnotics were always available (20 countries (74.1%) and 24 countries (88.9%), respectively). Amantadine (for fatigue) and pramipexol (for RLS) were sometimes available in 9 (33.3%) and 12 (44.4%) countries, respectively. Medication for hypotension and laxatives were always available in 15 (55.6%) and 26 countries (96.3%), respectively. Drugs for overactive bladder, sildenafil and medications for neuropathic pain were always available in 16 (59.3%), 22 (81.5%) and 26 (96.3%) countries, respectively (Table 3).

Tricyclic antidepressants and SSRI were continuously prescribed by 17 (63%) and 15 countries (55.6%), respectively, whereas SNRI, mirtazapine and other antidepressants were sometimes prescribed. Typical and atypical antipsychotics were also sometimes used within when available (59.3% and 65.4, respectively). It was noticed that laxatives, medications for neuropathic pain and muscle relaxants were the most frequently prescribed medications for non-motor symptoms, with percentages of 57.7%, 66.7%, and 54.2%, respectively, among countries, where they are available. (Table 3).

Affordability and Insurance coverage of therapies for the associated manifestations of MS (continue)

Medications for cognitive impairment and sleep disorders are either partially or totally insured in most countries when available. On the other hand, some of these weren't insured at all as amantadine was not insured in 33.3% and modafinil in 31.6% of the countries. Medications for hypotension, laxatives and medications for neuropathic pain were totally or partially insured within most countries. Meanwhile, botulinum toxin and baclofen pumps weren't insured in most of the countries (58.8% and 81.8%, respectively) (Supplementary Table 2).

Availability and frequency of usage of other therapies and services for MS in Africa (continue)

Telemedicine calls and virtual visits were sometimes available in about a quarter of countries (22.2%- 25.9%). Other conjugated services, such as psychiatric and cognitive rehabilitation were frequently present in 77.8% and 33.3% of the countries, respectively .

Physiotherapy was more frequently prescribed in 66.7% of the countries, but specific MS programs were only prescribed in 5 countries. Specific MS speech programs were sometimes prescribed in 6 countries (75%). Telemedicine calls and visits were also sometimes prescribed in 66.7% and 81.8% of the countries. Psychiatric consultation was also sometimes prescribed in many countries (69.3%) together with cognitive rehabilitation (Table 4).

Availability and frequency of use of investigations of MS in Africa (continue)

Tests for cognitive functions were always available in 8 countries (29.6%), while they were requested in a third of countries when available. Complete blood count, liver, and thyroid functions were available and continuously requested in all except 2-3 countries, and they were requested in all of them, where they are available. Varicella zoster virus antibodies were always available in 14 countries (51.9%) and requested in all except 4 countries (17.39%), when available. JC virus titre was always available in 10 countries (37%) and frequently requested in 5 (26.3%) of them. Collagen batteries were always available in 8 (29.6%) and frequently requested in 5 (27.77%) of them. Echocardiography and Electrocardiogram were available and requested by most countries (Table 4).

SUPPLEMENTARY TABLES

Supplementary Table 1: frequency of use and types of available MS therapies:

	Number of countries with available treatment	Type of drug available			Frequency of usage		
		Brand	Generic	Both	Continuously prescribed/used	Sometimes prescribed /used	Not prescribed/ used at all
Treatment of relapses							
Intravenous Methylprednisolone	27/27				24 (88.9%)	3 (11.1%)	0 (0%)
Plasma Pheresis	18/27				1 (5.6%)	15 (83.3%)	2 (11.1%)
Intravenous Immunoglobulins (IVIG)	24/27				1 (4.2%)	19 (79.2%)	4 (16.7%)
Disease Modifying Therapies							
First line DMTs							
Interferons	13/27	8 (61.5%)	1 (7.6%)	4 (30.7%)	7 (70%)	6 (30%)	0 (0%)
Interferon Beta 1A (SC)	10/27	9 (90%)	0 (0%)	1 (10%)	7 (70%)	3 (30%)	0 (0%)
Interferon Beta 1A (IM)	12/27	9 (75%)	1 (8.3%)	2 (16.7%)	6 (50%)	6 (50%)	0 (0%)
Interferon Beta 1B	8/27	7 (87.5%)	0 (0%)	1 (12.5%)	5 (62.5%)	3 (37.5%)	0 (0%)
Pegylated Interferon 1A	6/27	4 (66.7%)	0 (0%)	2 (33.3%)	1 (16.7%)	3 (50%)	2 (33.3%)
Glatiramer acetate	8/27	2 (25%)	3 (37.5%)	3 (37.5%)	1 (12.5%)	7 (87.5%)	0 (0%)
Teriflunomide	7/27	2 (28.6%)	1 (14.3%)	4 (57.1%)	3 (42.9%)	2 (28.6%)	2 (28.6%)
Dimethyl fumarate	8/27	3 (37.5%)	3 (37.5%)	2 (25%)	3 (37.5%)	4 (50%)	1 (12.5%)
Ponesimod	1/27	1(100%)	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)
Second line DMTs							
Fingolimod	10/27	2 (20%)	5 (50%)	3 (30%)	2 (20%)	8 (80%)	0 (0%)
Ofatumumab	2/27	1 (50%)	1 (50%)	0 (0%)	0 (0%)	2 (100%)	0 (0%)
Natalizumab	9/27	7 (77.7%)	1 (11.1%)	1 (11.1%)	4 (44.4%)	4 (44.4%)	1 (11.1%)
Induction DMTs							

Ocrelizumab	9/27	8 (88.8%)	1 (11.1%)	0 (0%)	3 (33.3%)	6 (66.6%)	0 (0%)
Alemtuzumab	1/27	1(100%)	0 (0%)	0 (0%)	0 (0%)	1(100%)	0 (0%)
Cladribine	6/27	6 (100%)	0 (0%)	0 (0%)	0 (0%)	6 (100%)	0 (0%)
DMTs for SPMS							
Siponimod	2/27	2 (100%)	0 (0%)	0 (0%)	1 (50%)	1 (50%)	0 (0%)
Rituximab	22/27	4 (18.2%)	6 (27.3%)	12 (54.5%)	4 (18.2%)	18 (81.8%)	0 (0%)

DMTs; disease modifying therapies, SC: subcutaneous, IM: intramuscular, SPMS: secondary progressive multiple sclerosis

Supplementary Table 2: affordability and insurance coverage of treatment of associated manifestations in MS

	Number of countries with available treatment	**Affordability**			**Insurance Coverage**			
		Completely affordable	**Partially affordable**	**Not affordable at all**	**Total Insurance coverage**	**Partial insurance coverage**	**No insurance coverage**	**I don't know**
Treatment of relapses								
Intravenous Methylprednisolone	27/27	12 (44.4%)	12 (44.4%)	3 (11.1%)	9 (33.3%)	5 (18.5%)	11 (40.7%)	2 (7.4%)
Plasma exchange	18/27	1 (5.6%)	7 (38.9%)	10 (55.6%)	7 (38.9%)	3 (16.7%)	8 (44.4%)	0 (0%)
Intravenous Immunoglobulins	24/27	3 (12.5%)	5 (20.8%)	16 (66.7%)	6 (25%)	5 (20.8%)	11 (45.8%)	2 (8.4%)
Disease Modifying Therapies								
First line DMTs								
Interferons	13/27	3 (23%)	5 (38.4%)	5 (38.4%)	5 (38.4%)	4 (30.7%)	4 (30.7%)	0 (0%)
Interferon Beta 1A (SC)	10/27	3 (30%)	2 (20%)	5 (50%)	4 (40%)	2 (20%)	4 (40%)	0 (0%)
Interferon Beta 1A (IM)	12/27	2 (16.7%)	3 (25%)	7 (58.3%)	5 (41.7%)	3 (25%)	4 (33.3%)	0 (0%)
Interferon Beta 1B	8/27	2 (25%)	1 (12.5%)	5 (62.5%)	5 (62.5%)	1 (12.5%)	2 (25%)	0 (0%)
Pegylated Interferon 1A	6/27	0 (0%)	2 (33.3%)	4 (66.7%)	2 (33.3%)	2 (33.3%)	2 (33.3%)	0 (0%)
Glatiramer acetate	8/27	1 (12.5%)	3 (37.5%)	4 (50%)	3 (37.5%)	2 (25%)	3 (37.5%)	0 (0%)
Teriflunomide	7/27	0 (0%)	4 (57.1%)	3 (42.9%)	4 (57.1%)	1 (14.3%)	2 (28.6%)	0 (0%)
Dimethyl fumarate	8/27	2 (25%)	1 (12.5%)	5 (62.5%)	4 (50%)	2 (25%)	2 (25%)	0 (0%)
Ponesimod	1/27	0 (0%)	0 (0%)	1(100%)	1(100%)	0 (0%)	0 (0%)	0 (0%)
Second line DMTs								

Fingolimod	10/27	1 (10%)	5 (50%)	4 (40%)	5 (50%)	3 (30%)	2 (20%)	0 (0%)
Ofatumumab	2/27	0 (0%)	0 (0%)	2 (100%)	1 (50%)	1 (50%)	0 (0%)	0 (0%)
Natalizumab	9/27	0 (0%)	2 (22.2%)	7 (77.7%)	4 (44.4%)	1 (11.1%)	4 (44.4%)	0 (0%)
Induction DMTs								
Ocrelizumab	9/27	0 (0%)	3 (33.3%)	6 (66.6%)	4 (44.4%)	1 (11.1%)	4 (44.4%)	0 (0%)
Alemtuzumab	1/27	0 (0%)	0 (0%)	1 (100%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)
Cladribine	6/27	0 (0%)	0 (0%)	6 (100%)	2 (33.3%)	2 (33.3%)	2 (33.3%)	0 (0%)
DMTs for SPMS								
Siponimod	2/27	0 (0%)	1(50%)	1(50%)	1 (50%)	1 (50%)	0 (0%)	0 (0%)
Rituximab	22/27	0 (0%)	12 (54.5%)	10 (45.5%)	5 (22.7%)	8 (36.4%)	8 (36.4%)	1 (4.5%)

DMTs; disease modifying therapies, SC: subcutaneous, IM: intramuscular, SPMS: secondary progressive multiple sclerosis

Supplementary Table 3: Affordability and insurance coverage of other therapies, services and investigations of MS in Africa

	Number of countries with available service	Affordability			Insurance Coverage			
		Completely affordable	Partially affordable	Not affordable at all	Total Insurance coverage	Partial insurance coverage	No insurance coverage	I don't know
Transcranial magnetic stimulation	4/27	0 (0%)	2 (25%)	2 (25%)	1 (25%)	0 (0%)	3 (75%)	0 (0%)
Physiotherapy (general)	27/27	4 (14.8%)	19 (70.4%)	4 (14.8%)	7 (25.9%)	10 (37%)	8 (29.6%)	2 (7.4%)
Speech therapy	23/27	2 (8.7%)	17 (73.9%)	4 (17.4%)	6 (26.1%)	10 (43.5%)	7 (30.4%)	0 (0%)
Specialized MS clinic	9/27	1 (11.1%)	5 (55.6%)	3 (33.3%)				
Specialized nurse	9/27	1 (11.1%)	7 (77.8%)	1 (11.1%)				
Telemedicine (asynchronous; WhatsApp calls	12/27	2 (16.7%)	9 (75%)	1 (8.3%)	1 (8.3%)	3 (25%)	8 (66.7%)	0 (0%)
Services conjugated with other clinics as urology and nutrition	13/27	5 (38.5%)	6 (46.2%)	2 (15.4%)	3 (23.1%)	7 (53.8%)	3 (23.1%)	0 (0%)
Psychiatric consultation	26/27	9 (34.6%)	16 (61.5%)	1 (3.8%)	7 (26.9%)	10 (38.5%)	8 (30.8%)	1 (3.8%)
Cognitive rehabilitation	22/27	5 (22.7%)	13 (59.1%)	4 (18.2%)	3 (13.6%)	11 (50%)	7 (31.8%)	1 (4.5%)
Investigations								

Magnetic Resonance imaging (MRI)	27/27	22 (81.5%)	5 (18.5%)	0 (0%)	10 (37%)	5 (18.5%)	10 (37%)	2 (7.5%)
CSF examination for oligoclonal bands and IgG index	21/27	14 (66.7%)	7 (33.3%)	0 (0%)	5 (23.8%)	9 (42.85%)	6 (28.6%)	1 (4.76%)
Visual evoked potential (VEP)	19/27	10 (52.6%)	9 (47.4%)	0 (0%)	5 (26.3%)	4 (21%)	8 (42.1%)	3 (15.7%)
Optical Coherence tomography (OCT)	24/27	16 (66.7%)	8 (33.3%)	0 (0%)	5 (20.8%)	5 (20.8%)	12 (50%)	2 (8.33%)
Tests for Cognitive functions as symbol digit modalities test (SDMT)	18/27	8 (44.4%)	10 (55.6%)	0 (0%)	5 (27.7%)	4 (22.2%)	9 (50%)	0 (0%)
Complete blood count	24/27	24 (100%)	0 (0%)	0 (0%)	11 (45.83%)	7 (29.16%)	5 (20.83%)	1 (4.16%)
Liver function	25/27	25 (100%)	0 (0%)	0 (0%)	12 (48%)	6 (24%)	6 (24%)	1 (4%)
Thyroid Function	25/27	23 (92%)	2 (8%)	0 (0%)	11 (44%)	7 (28%)	6 (24%)	1 (4%)
Varicella zoster virus antibodies	23/27	14 (60.9%)	9 (39.1%)	0 (0%)	5 (21.73%)	7 (30.43%)	6 (26%)	5 (21.7%)
JC virus	19/27	10 (52.6%)	9 (47.4%)	0 (0%)	7 (36.84%)	4 (21.1%)	8 (42.1%)	0 (0%)
collagen battery (basic)	18/27	8 (44.4%)	10 (55.6%)	0 (0%)	6 (33.3%)	7 (38.8%)	5 (27.7%)	0 (0%)
Echocardiogram	27/27	25 (92.6%)	2 (7.4%)	0 (0%)	9 (33.3%)	8 (29.6%)	9 (33.3%)	1 (3.7%)
Electrocardiography	27/27	26 (96.3%)	1 (3.7%)	0 (0%)	11 (40.7%)	6 (22.2%)	9 (33.3%)	1 (3.7%)

MS: multiple sclerosis, MRI: magnetic resonance imaging, CSF: cerebrospinal fluid, VEP: visual evoked potential, OCT: optic coherence tomography, SDMT: symbol digit modalities test, JC virus: john Cunningham virus, IgG: immunoglobulin G

Supplementary Table 4: Please rank the common health care provider and treating physician for MS patients:

	1	**2**	**3**	**4**	**5**	**Not applicable**
Neurology	18 (66.7%)	0 (0%)	0 (0%)	2 (7.4%)	7 (25.9%)	0 (0%)
Neurosurgeon	4 (14.8%)	6 (22.2%)	5 (18.5%)	3 (11.1%)	1 (3.7%)	8 (29.6%)
Internist	3 (11.1%)	12 (44.4%)	8 (29.6%)	1 (3.7%)	1 (3.7%)	2 (7.4%)
General practitioner	1 (3.7%)	8 (29.6%)	5 (18.5%)	5 (18.5%)	3 (11.1%)	5 (18.5%)
Traditional healer	4 (14.8%)	0 (0%)	5 (18.5%)	2 (7.4%)	5 (18.5%)	11 (40.7%)