Brain and Spine 3 (2023) 101746

Contents lists available at ScienceDirect

Brain and Spine

journal homepage: www.journals.elsevier.com/brain-and-spine

Characteristics of the clinical and global neurosurgical research publications from Africa: A scoping review

Mostafa Hossam El din Moawad [a,b,c], Ammar Mektebi [a,d], Ayoub Rezkallah [a,e], Taha Fayad [a,f], Mohammed Ahmed Sadeq [a,g], Ahmed Negida [a,h,i,j,*]

[a] Medical Research Group of Egypt, Cairo, Egypt
[b] Faculty of Pharmacy Clinical Department Alexandria University, Alexandria, Egypt
[c] Faculty of Medicine Suez Canal University, Ismailia, Egypt
[d] Kutahya Health Sciences University, Turkey
[e] Faculty of Medicine, University of Algiers, Algiers, Algeria
[f] Faculty of Oral and Dental Medicine, Sinai University, North Sinai, Egypt
[g] Faculty of Medicine, Misr University for Science and Technology, 6th of October City, Egypt
[h] Faculty of Medicine, Zagazig University, Zagazig, Sharkia, Egypt
[i] School of Pharmacy and Biomedical Science, University of Portsmouth, Portsmouth, United Kingdom
[j] Global Neurosurgery Initiative, Harvard Medical School, Boston, MA, USA

ARTICLE INFO

Handling Editor: Dr W Peul

Keywords:
Global neurosurgery
Africa
Operative neurosurgery
Brain
Clinical subspecialty
Spinal cord
CNS

ABSTRACT

Introduction: Scientific research has a direct, profound impact on healthcare systems worldwide. While an upward trend can be observed in the number of produced papers in the neurosurgical specialty, disparities still exist between African neurosurgeons on one side and between African neurosurgeons and neurosurgeons from high income countries, on the other.

Research question: This study aims to analyze neurosurgical research produced in Africa to identify gaps in the literature and provide recommendations for aspiring African neurosurgeons for essential research areas.

Materials and methods: Four electronic databases (PubMed, Scopus, Web of Science, and Embase) were systematically searched for relevant articles on neurosurgery published by African authors. The three main inclusion criteria were: Articles published in the Neurosurgical field, articles published by African authors (whether first authors or co-authors) and articles published in Africa. Data extracted included the study design, scope, neurosurgical subspecialty, and the authors' nationalities.

Results: A total of 982 articles were included in the analysis. Of these articles, 889 (90.6%) were primary, 48 (4.9%) secondary, and 44 (4.5%) other types of research. Global Neurosurgery papers represent 7% of African neurosurgery research output. Most common primary studies included retrospective cohort (32.4%), case reports (28.3%), and prospective cohort (13.8%) studies. The most common secondary research articles were literature reviews (4.9%), letters to the editor (1.2%), and systematic reviews and meta-analyses (0.8%). Common research areas were neuro-oncology 242 (24.7%), spinal surgery 157 (16%), and cerebrovascular (14%). The most common nationalities of the first authors were Egyptian (32.4%), Moroccan (15%), and Nigerian (14.2%).

Discussion and conclusion: This study identifies increased African authorship in neurosurgical research in recent years. Nevertheless, many countries still lack representation in the neurosurgical research scene.

Furthermore, a high percentage of the published papers is of low evidence. Therefore, we recommend that African neurosurgical researchers focus more on clinical trials and systematic reviews that directly translate to improving clinical practice. African neurosurgeons should also consider more collaboration between African authors.

* Corresponding author. Harvard Medical School, 641 Huntington Avenue, Boston, MA, USA.
E-mail addresses: mh3912214@gmail.com (M.H.E. Moawad), ammare21@gmail.com (A. Mektebi), ayoubrezkallah55@gmail.com (A. Rezkallah), tahafayad@yahoo.com (T. Fayad), mhd.a.sadeq@gmail.com (M.A. Sadeq), ahmed.said.negida@gmail.com (A. Negida).

https://doi.org/10.1016/j.bas.2023.101746
Received 29 November 2022; Received in revised form 19 April 2023; Accepted 21 April 2023
Available online 9 May 2023

Abbreviation list:

CNS	Central Nervous System
TBI	Traumatic Brain Injury
PGSSC	Program in Global Surgery and Social Change
NSOAP	National Surgical, Anesthesia, and Obstetric Plan

1. Introduction

Scientific publications play a significant role in the scientific process because they offer a key link between knowledge production and use, which helps to improve the overall quality of medical care and optimize healthcare resources. As a branch of clinical medicine, neurosurgery has made significant advancements in Evidence-Based Medicine (Liu et al., 2018). During the past few decades, both neurosurgical journals and published articles have evolved considerably (Haines, 2003). This includes African neurosurgical publications, which show a marked increase in the number of neurosurgical journals worldwide in the last two decades (2000–2022) (Akhaddar, 2019a).

Despite this increase in neurosurgical research productivity, the number of publications by African neurosurgeons is still lower than their American and European peers (Ponce and Lozano, 2010), (Waqar et al., 2019). This is attributable to many factors, including a lack of human qualifications and financial resources, the limited number of African neurosurgeons in most African countries, the limited support from seniors, the lack of reliable research skills training, and the neglected research funding (Tijssen, 2007).

No previous assessment performed on multiple databases was reported regarding neurosurgical research production originating from Africa in the first twenty years of this century. This was required to show the path of neurosurgical research output in Africa and to encourage the increase in the number of African neurosurgeons and their participation in the field of academic research.

The diversity of data on published neurosurgery research justifies a scoping review to analyze the quantity and quality of neurosurgical research concerning operative neurosurgery and global neurosurgery in Africa from the beginning of this century to this year. In addition, we also aim to estimate the countries with the highest and lowest number of publications. We also aim to estimate the publication trends, neurosurgical subspecialties and types of research articles.In the end, we want to point out gaps in the literature and make recommendations about where African neurosurgeons could concentrate their effort.

2. Materials and methods

2.1. Article selection criteria

We used the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) checklist when conducting our scooping review. The aim of this study was to find out where neurosurgical research output in Africa is going and what is needed to fill in the gaps in this field of research in Africa.

2.2. Literature search

We searched the main databases (PubMed, Scopus, Web of Science, and Embase) for research articles related to the neurosurgical field in Africa. Our scope was studies published between 2000 and 2022. The literature search was done using the following keywords as a First concept (Neurosurgery): “exp *neurosurgery”, “exp *neurosurgeon”, “Neurosurg*”, “neurological surg*”, “Neurosurgery[Mesh]”; and the name of each country as a second concept. See Table 1.

Table 1
Shows the search strategy and used Vocabulary for Embase, PubMed, Scopus and Web of Science.

Embase	PubMed	Scopus	Web of Science
First concept (Neurosurgery)			
exp *neurosurgery/ OR exp *neurosurgeon/	Neurosurg* OR neurological surg* OR Neurosurgery [Mesh]	exp *neurosurgery/ OR exp *neurosurgeon/	exp *neurosurgery/ OR exp *neurosurgeon/
Second Concept (African Countries)			
(“Algeria" or "Angola" or "Benin" or "Botswana" or "Burkina Faso" or "Burundi" or "Cameroon" or "Cape Verde" or "African" or "Chad" or "Djibouti" or "Congo" or "Egypt" or "Guinea" or "Eritrea" or "Eswatini" or "Ethiopia" or "Gabon" or "Gambia" or "Ghana" or "Guinea" or "Guinea-Bissau" or "Ivory Coast" or "Kenya" or "Lesotho" or "Liberia" or "Libya" or "Madagascar" or "Malawi" or "Mali" or "Mauritania" or "Mauritius" or "Morocco" or "Mozambique" or "Namibia" or "Niger" or "Nigeria" or "Congo" or "Reunion" or "Rwanda" or "Senegal" or "Sierra Leone" or "Somalia" or "South Africa" or "South Sudan" or "Sudan" or "Tanzania" or "Togo" or "Tunisia" or "Uganda" or "Western Sahara" or "Zambia" or "Zimbabwe" or "Africa")	("Algeria" OR "Angola" OR "Benin" OR "Botswana" OR "Burkina Faso" OR "Burundi" OR "Cameroon" OR "Cape Verde" OR "African" OR "Chad" OR "Djibouti" OR "Congo" OR "Egypt" OR "Guinea" OR "Eritrea" OR "Eswatini" OR "Ethiopia" OR "Gabon" OR "Gambia" OR "Ghana" OR "Guinea" OR "Guinea-Bissau" OR "Ivory Coast" OR "Kenya" OR "Lesotho" OR "Liberia" OR "Libya" OR "Madagascar" OR "Malawi" OR "Mali" OR "Mauritania" OR "Mauritius" OR "Morocco" OR "Mozambique" OR "Namibia" OR "Niger" OR "Nigeria" OR "Congo" OR "Reunion" OR "Rwanda" OR "Senegal" OR "Sierra Leone" OR "Somalia" OR "South Africa" OR "South Sudan" OR "Sudan" OR "Tanzania" OR "Togo" OR "Tunisia" OR "Uganda" OR "Western Sahara" OR "Zambia" OR "Zimbabwe" OR "Africa")	(("Algeria" OR "Angola" OR "Benin" OR "Botswana" OR "Burkina Faso" OR "Burundi" OR "Cameroon" OR "Cape Verde" OR "African" OR "Chad" OR "Djibouti" OR "Congo" OR "Egypt" OR "Guinea" OR "Eritrea" OR "Eswatini" OR "Ethiopia" OR "Gabon" OR "Gambia" OR "Ghana" OR "Guinea" OR "Guinea-Bissau" OR "Ivory Coast" OR "Kenya" OR "Lesotho" OR "Liberia" OR "Libya" OR "Madagascar" OR "Malawi" OR "Mali" OR "Mauritania" OR "Mauritius" OR "Morocco" OR "Mozambique" OR "Namibia" OR "Niger" OR "Nigeria" OR "Congo" OR "Reunion" OR "Rwanda" OR "Senegal" OR "Sierra Leone" OR "Somalia" OR "South Africa" OR "South Sudan" OR "Sudan" OR "Tanzania" OR "Togo" OR "Tunisia" OR "Uganda" OR "Western Sahara" OR "Zambia" OR "Zimbabwe" OR "Africa"))	ALL=("Algeria" OR "Angola" OR "Benin" OR "Botswana" OR "Burkina Faso" OR "Burundi" OR "Cameroon" OR "Cape Verde" OR "African" OR "Chad" OR "Djibouti" OR "Congo" OR "Egypt" OR "Guinea" OR "Eritrea" OR "Eswatini" OR "Ethiopia" OR "Gabon" OR "Gambia" OR "Ghana" OR "Guinea" OR "Guinea-Bissau" OR "Ivory Coast" OR "Kenya" OR "Lesotho" OR "Liberia" OR "Libya" OR "Madagascar" OR "Malawi" OR "Mali" OR "Mauritania" OR "Mauritius" OR "Morocco" OR "Mozambique" OR "Namibia" OR "Niger" OR "Nigeria" OR "Congo" OR "Reunion" OR "Rwanda" OR "Senegal" OR "Sierra Leone" OR "Somalia" OR "South Africa" OR "South Sudan" OR "Sudan" OR "Tanzania" OR "Togo" OR "Tunisia" OR "Uganda" OR "Western Sahara" OR "Zambia" OR "Zimbabwe" OR "Africa")

2.3. Eligibility criteria for screening

We selected articles based on three criteria. Included articles must: (1) discuss issues related to neurosurgery, (2) focus on, "clinical and/or operative" or global neurosurgery in Africa, and (3) be published by African neurosurgeons (at least one African author, whether first author or co-author) who currently work in Africa, we used the author affiliations to identify who to count as an African author. If the articles didn't meet any of these criteria, they were excluded.

2.4. Data extraction and subgrouping

Three authors extracted the data independently using excel sheets. We classified the studies according to their types into primary research, secondary research, or others. This included the classification based on the study design. Primary research included randomized controlled trials, retrospective cohort studies, prospective cohort studies, case-control studies, cross-sectional studies, cadaveric, case reports, and case series. Secondary studies included a literature review, scoping review, systematic review, and meta-analysis. Others included commentary, a letter to the editor, and expert opinion.

Studies were classified based on their scope into either "clinical and/or operative" or global neurosurgery. Operative and/or clinical papers refer to any studies related to the clinical neurosurgery field through treatments, diagnosis, surgical procedures, and any related clinical

interventions. Global Neurosurgery papers refer to articles that address the intersection of global health and neurosurgery, which includes studies focusing on workforce, service delivery, information management, infrastructure, governance, and financing.

Clinical and/or operative papers of neurosurgery were classified into the neurosurgical subspecialties, including spinal surgery, pediatric neurosurgery, neuro-oncology, neurotrauma (traumatic brain injury, spinal injury),neuroanatomy, cerebral palsy surgery, peripheral nervous system, CNS infection, cerebrovascular, epilepsy surgery, skull base, rare syndromes (e.g., Jael's), decompressive craniotomy, migraine surgery, cyst removal, deep brain stimulation, and aneurysm.

We classified the global neurosurgery studies into six categories: workforce, service delivery, information management, infrastructure, governance, and financing. This classification is based on modified definitions of the Harvard Program in Global Surgery, and Social Change (PGSSC)'s NSOAP health system domains (Truché et al., 2020; Ham et al., 2020; "NATIONAL SURGICAL).

The authorship pattern in the studies was classified into African authors, foreign authors, or a combination of African and foreign authors. Journals were classified according to their nationality into African and non-African journals. We also obtained the nationality of the first author depending on the affiliation and the main nationalities of all co-authors. We classified the studies according to the country where the study was carried on as well.

2.5. Statistical analysis

Data was collected and extracted as Microsoft Office Excel File (Microsoft Corporation, WA, United States). Authors submitted the classification of each article to the sheet. Figures were constructed by Jamovi (Survey Plots Package), MS Excel, and Google Sheets. We used the statistical software programs Statistical Package for the Social Sciences (SPSS) and Jamovi to calculate the percentages and frequency of each variable. Descriptive analysis was done in order to summarize the data in each included category. Tables and figures were produced by these software programs in addition to MS excel and we transformed them into written results and MS word tables.

3. Results

3.1. Literature search

The search strategy resulted in 26,635 articles. Web of science results are 8573 results, Scopus results are 6524, PubMed yielded 10,600 results, and Embase yielded 938 results. After duplicates removal, 17831 articles were available for screening, as shown in Fig. 1. These articles were uploaded to Rayyan. The net result after the screening was 982 articles that were eligible for the analysis of this study.

3.2. Types of published research articles

Of the published articles, 889 (90.6%) are primary research articles,

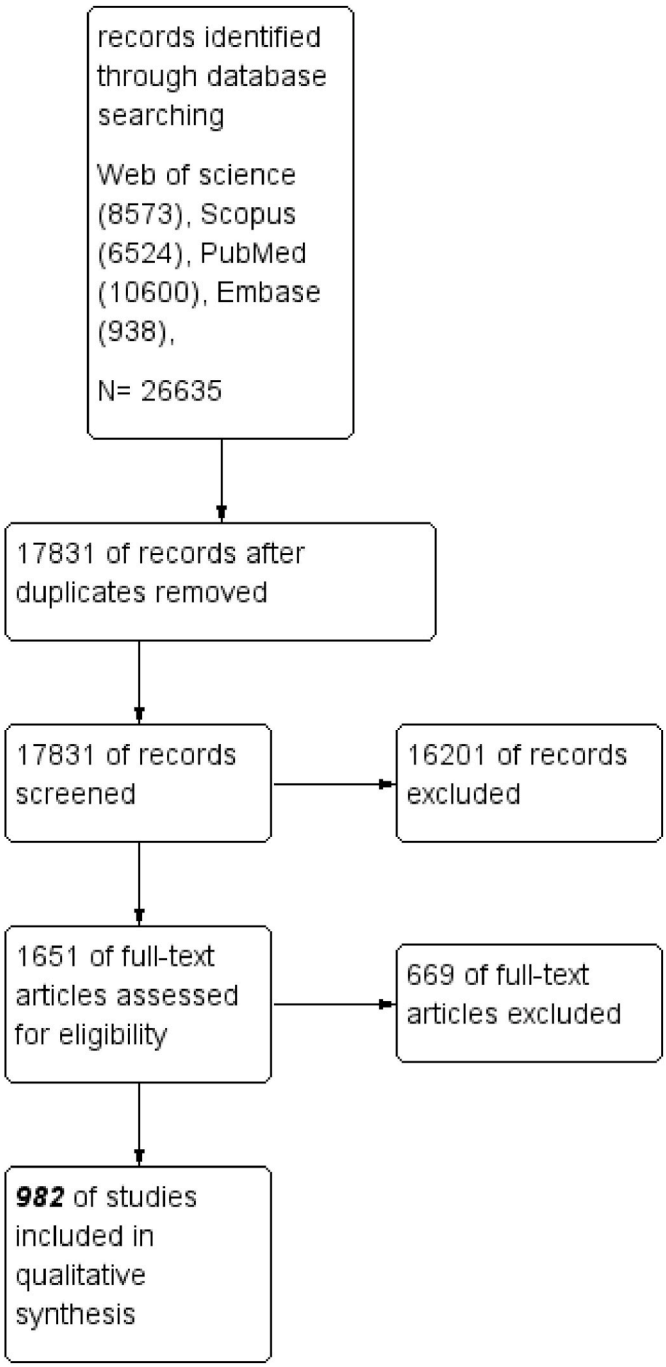

Fig. 1. Shows the PRISMA flow diagram of studies' screening and selection.

48 (4.9%) are secondary research, and 44 (4.5%) are other types of articles, as shown in Fig. 2. Of the primary research articles, 318 (32.4%) are retrospective cohort studies, 278 (28.3%) are case reports, 136 (13.9%) are prospective cohort studies, 83 (8.5%) are randomized controlled trials, 33 (3.4%) are cross-sectional studies, 24 (2.4%) are case-series, 5 (0.5%) are case-control studies, 2 (0.2%) are cadaveric studies, and 1 (0.1%) experimental study. Of the secondary research articles, 48 (4.9%) are literature reviews, 8 (0.8%) are systematic reviews and meta-analyses, and 1 (0.1%) is a scoping review. Other types included 19 (1.9%) opinions, 12 (1.2%) letters to the editor, 10 (1%)

commentaries, 2 (0.2) audits, and 1 (0.1%) editorial. This summary is shown in Table 2.

3.3. Scope of the research articles

Operative/clinical papers represented 908 (92.6%) of all articles. Global neurosurgery represented 67 (6.8%) of the papers, while 6 (0.6%) articles included both operative and global neurosurgery work, as shown in Fig. 3.

Clinical/operative neurosurgery papers included different neurosurgical subspecialties. The most common is neuro-oncology 242 (24.7%), followed by spinal surgery 157 (16%), then Cerebrovascular 138 (14%), Neurotrauma 88 (9%), Pediatric neurosurgery 59 (6%), CNS infection 58 (5.9%), skull base surgery 36 (3.7%), hydrocephalus 54 (5.5%), Peripheral nervous system 19 (1.9%), rare syndromes 19 (1.9%), epilepsy surgery 16 (1.6%), cyst removal 13 (1.3%), neuroanatomy 9 (0.9%), cerebral palsy surgery 7 (0.7%), deep brain stimulation 2 (0.2%), radiation surgery 1 (0.1%), decompressive craniectomy 1 (0.1%) and migraine surgery 1 (0.1%). as shown in Table 3.

Global neurosurgery articles included 32 (3.5%) articles related to service delivery, 23 (2.5%)

information management articles, 7 (0.8%) infrastructure articles, 7 (0.8%) workforce articles and 3 (0.3%) articles related to financing, as shown in Fig. 4.

3.4. Authorship patterns

Authorship and collaboration were divided into African authors, foreign authors, or a combination of both. 909 (92.7%) articles were published by African authors, 65 (6.6%) by foreign authors, and 7 (0.7%) were published by a combination of African and foreign authors, as shown in Fig. 5.

5. The most common nationality of the first authors was Egyptian nationality in 318 (32.4%) articles, followed by Moroccan 147 (15%), followed by Nigerian 139 (14.2%), and then South African 117 (11.9%) as shown in Table 4 and Fig. 8. The main nationality of African authors contributing to each paper was Egyptian 331 (33.7%) then, Moroccan 148 (15%), then Nigerian 143 (14.6%), and then South African 121 (12.3%) as shown in Table 5 and Fig. 9. As shown, North African countries account for the majority of publications (60%), followed by West African countries (18%), followed by South African countries (14%), then East African countries (5.5%) and Central African countries (2.5%)

Table 2
Shows the summary of the study design of published primary, secondary and other types of research articles.

Study design	N (%)
Primary studies	
Retrospective Cohort	319 (32.5%)
Case reports	278 (28.3%)
Prospective cohort	136 (13.8%)
Randomized controlled trials	83 (8.5%)
Cross-sectional	33 (3.4%)
Case series	24 (2.4%)
Case-control	5 (0.5%)
Cadaveric	2 (0.2%)
Experimental	1 (0.1%)
Secondary studies	
Literature Review	48 (4.9%)
Systematic review and meta-analysis	8 (0.8%)
Scoping review	1 (0.1%)
Others	
Opinion	19 (1.9%)
Letter to the editor	12 (1.2%)
Commentary	10 (1%)
Audit	2 (0.2%)
Editorial	1 (0.1%)

3.5. Journal trends

Journals were classified according to their nationalities into African or non-African journals. 652 (66.4%) of the articles were published in non-African journals, while 330 (34.6%) were published in African journals, as shown in Fig. 6. We reported the 5 most common journals in which African authors published their research articles. They were "World Neurosurgery", followed by "Neurochirurgie", then "Child's Nerve Cyst", "Interdisciplinary Neurosurgery: Advanced Techniques and Case Management" and "Egyptian journal of Neurology, psychiatry and neurosurgery".

3.6. Time series

Time series analysis showed that the number of Neurosurgery articles published from Africa or co-authored by African Authors are increasing in the period between 2000 and 2022, as shown in Fig. 7.

4. Discussion

Over the recent decade, the quantity of papers on African neurosurgery has increased considerably. However, there was a large difference in output between countries. Africa's research output is primarily concentrated in four countries (Egypt, Morocco, Nigeria, and South Africa), accounting for 75.23% of all publications. Egypt contributed the most of this production, accounting for 32.4% of the 982 identified neurosurgical reports over the last 22 years. The recent vitality of Egypt's neurosurgical community, as well as considerable contact with Egyptian neurosurgeons abroad, can explain the significant increase in Egyptian research papers (El Gindi, 2002). Despite having established

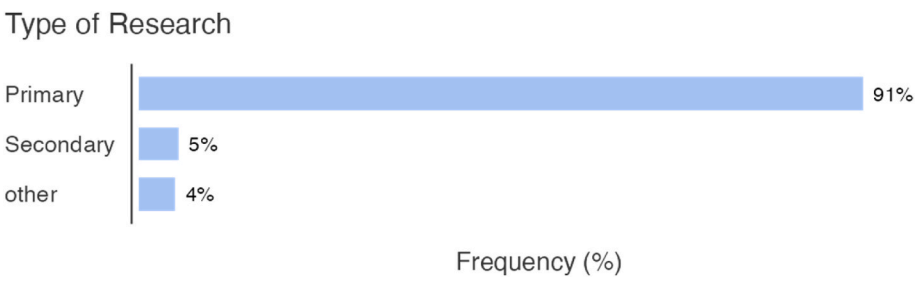

Fig. 2. Shows the percentages of the types of research articles.

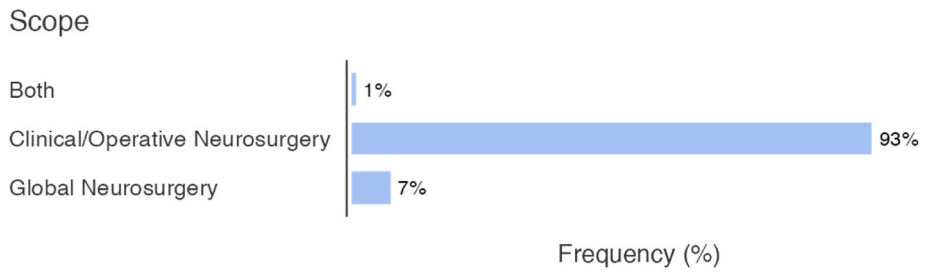

Fig. 3. Shows the percentages of the scope of published articles.

Table 3
Shows the summary of the subspecialties of neurosurgical clinical/operative research articles.

Clinical Subspecialty	N (percentage)
Neuro-oncology	242 (24.7%)
Spinal Surgery	157 (16%)
Cerebrovascular	138 (14%),
Neurotrauma	88 (9%)
Pediatric Neurosurgery	59 (6%)
CNS infection	58 (5.9%)
Skull base surgery	36 (3.7%)
Hydrocephalus	54 (5.5%)
Peripheral Nervous systems	19 (1.9%)
Rare syndromes	19 (1.9%)
Epilepsy surgery	16 (1.6%)
cyst removal	13 (1.3%)
Neuroanatomy	9 (0.9%)
Cerebral palsy surgery	7 (0.4%)
deep brain stimulation	2 (0.2%)
radiation surgery	1 (0.1%)
decompressive craniectomy	1 (0.1%)
migraine surgery	1 (0.1%).

itself as Africa's second-ranking supplier of neurosurgical research, Moroccan contributions to neurosurgical journals have been gradually falling since 2012 (Akhaddar, 2019b).

Our results showed that many Sub-Saharan African countries including Chad and Djibouti (El Khamlichi, 2005), however other countries like Benin and Mali managed to have a role in neurosurgical research.

Most of the publications (92.6%) were clinical related, with a smaller fraction (6.8%) addressing the global neurosurgery. Most of the global neurosurgery research has focused on enhancing service delivery and information management in the countries where it is conducted. More research is needed on other components of the healthcare system, such as infrastructure development, healthcare funding (economic impact, out-of-pocket expenses), and expanding research capability.

The most prevalent operative subspecialty was neuro-oncology (24.7%), followed by spinal surgery (16%) and cerebrovascular (14%). This result represents the neurosurgical illness load in Africa, where cases vary.

In terms of study types, nearly half of the papers (46.2%) focused on retrospective and prospective cohort studies, and 28% were case reports with a limited number of clinical trials (8.5%). However, the quality of evidence for cohort studies, case reports, and case series is poor, and the number of systematic reviews/meta-analysis (the highest level of evidence) from African countries is low (0.8%).

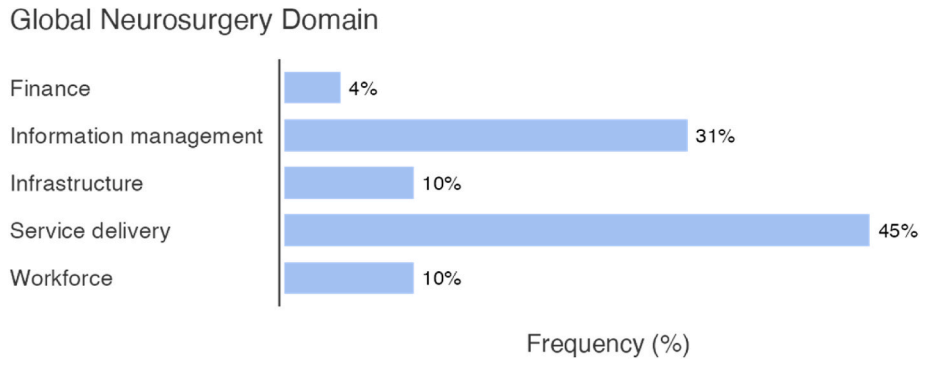

Fig. 4. Shows the percentage of NSOAP health system domains in the global neurosurgery publications from Africa.

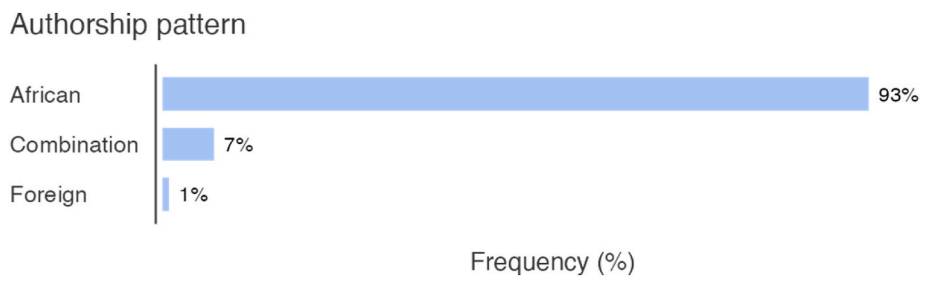

Fig. 5. Shows the percentage of the authorship patterns in Neurosurgery publications from Africa.

Table 4
Shows the summary of the nationalities of the first authors.

Nationality of the First author	N (%)
Egypt	318 (32.4%)
Morocco	147 (15%)
Nigeria	139 (14.2%)
South Africa	117 (11.9%)
Tunisia	63 (6.4%)
Sudan	16 (1.6%)
Ethiopia	15 (1.5%)
Tanzania	13 (1.3%)
USA	12 (1.2%)
Senegal	12 (1.2%)
Kenya	12 (1.2%)
Algeria	10 (1%)
Uganda	10 (1%)
Ghana	9 (0.9%)
Cameroon	9 (0.9%)
Ivory Coast	8 (0.8%)
Mauritania	4 (0.4%)
Niger	4 (0.4%)
UK	4 (0.4%)
Canada	4 (0.4%)
Rwanda	3 (0.3%)
Guinea	3 (0.3%)
Germany	3 (0.3%)
Japan	3 (0.3%)
Malawi	3 (0.3%)
Madagascar	3 (0.3%)
France	3 (0.3%)
Angola	2 (0.2%)
Zimbabwe	2 (0.2%)
Togo	2 (0.2%)
Spain	2 (0.2%)
Italy	2 (0.2%)
Australia	1 (0.1%)
Belgium	1 (0.1%)
Botswana	1 (0.1%)
Brazil	1 (0.1%)
Congo	1 (0.1%)
Burkina Faso	1 (0.1%)
Finland	1 (0.1%)
Gabon	1 (0.1%)
Libya	1 (0.1%)
Norway	1 (0.1%)
Saudi Arabia	1 (0.1%)
Portugal	1 (0.1%)
Taiwan	1 (0.1%)
Mozambique	1 (0.1%)
Netherlands	1 (0.1%)
Benin	3 (0.3%)
Mali	1 (0.1%)

Table 5
Shows the summary of the main Nationalities of the African Authors.

Main Nationality of African Authors	N (%%)
Egypt	331 (33.7%)
Morocco	148 (15%)
Nigeria	143 (14.6%)
South Africa	121 (12.3%)
Tunisia	63 (6.3%)
Sudan	16 (1.6%)
Ethiopia	17 (1.7%)
Senegal	12 (1.2%)
Kenya	13 (1.3%)
Algeria	11 (1.1%)
Uganda	13 (1.3%)
Ghana	9 (0.9%)
Ivory Coast	8 (0.8%)
Tanzania	13 (1.3%)
Cameroon	9 (0.9%)
Mauritania	4 (0.4%)
Niger	4 (0.4%)
Rwanda	4 (0.4%)
Guinea	3 (0.3%)
Malawi	3 (0.3%)
Madagascar	3 (0.3%)
Benin	3 (0.3%)
Angola	2 (0.2%)
Zimbabwe	2 (0.2%)
Togo	2 (0.2%)
Gabon	2 (0.2%)
Botswana	1 (0.1%)
Congo	1 (0.1%)
Burkina Faso	1 (0.1%)
Libya	1 (0.1%)
Mozambique	1 (0.1%)
Mali	1 (0.1%)

The typical academic neurosurgeon should specialize in "clinical care, teaching, research, and administration"; Research and development are the most vulnerable, as well as the most important parts of neurosurgery (Black, 2006). To increase the quantity and quality of neurosurgical publications published, active efforts are required. This, needs many resources. According to a recent survey, one of these is protected time for research, which was not available to the majority of African neurosurgeons and trainees (Kanmounye et al., 2021). Operations and consultations, particularly in Africa, must compensate for research time. African neurosurgeons undertake more procedures and consultations per neurosurgeon than their counterparts in more industrialized countries. This is because of the limited number of neurosurgeons in Africa (Kanmounye et al., 2020a). Furthermore, the neurosurgical illness spectrum, culture, and demographic data in African countries differ from those in other regions. This is an interesting point that should be addressed in order to motivate African neurosurgeons to report on regional variances (Akhaddar, 2019a). The focus on direct clinical activities comes at the cost of not immediately analyzing patient outcomes promptly and not researching therapeutic alternatives most suited to the local population.

Many studies explored the challenges and obstacles to research in Africa: the findings were consistent, with all focusing on the cost of publishing and the desire for English as two key barriers to publication. Having a research team was also a significant barrier for the researchers. Furthermore, a recent poll found that many African neurosurgeons are unaware of predatory publications; Some have even claimed that they would consider publishing in these journals due to their less stringent peer-review procedure (Kanmounye et al., 2020b; Conradie et al., 2018; Dhalla, Guirguis; Singh, Prasad, Shankar).

Our data suggest that the involvement of foreign researchers resulted in increased research and academic production among local neurosurgeons. According to the findings, foreigners or a combination of African and foreign authors completed (7.3%) of the reported works. The decreased collaboration can be attributed to decreased research facilities and fundings in African countries. In addition, neurosurgical research output in Africa has just started to rise in the past years so strong collaboration hasn't started yet. We also included studies done in African countries only so collaborative work may have been done in non-African countries. African neurosurgeons should continue to collaborate more with one another, with African neurosurgeons abroad, and with western facilities to increase the quality of research on the continent and raise global awareness of their work (Tijssen, 2007), (Bordons, Aparicio, Costas). As the ease and usefulness of virtual technology have been revealed, virtual methods of communication have grown in popularity. InterSurgeon (https://www.intersurgeon.org/), an independent online social network platform, has made it feasible for surgical activists from around the world with complementary needs and resources to formally join. Active HICs include the USA, Canada, France, Norway, and Sweden, whereas active LMICs include Nigeria, Uganda, Kenya, Malawi, and Senegal. Upgraded LMIC facilitators provide active HIC with essential support so they can advertise their international projects in other LMIC regions. Consider the countries that host WFNS

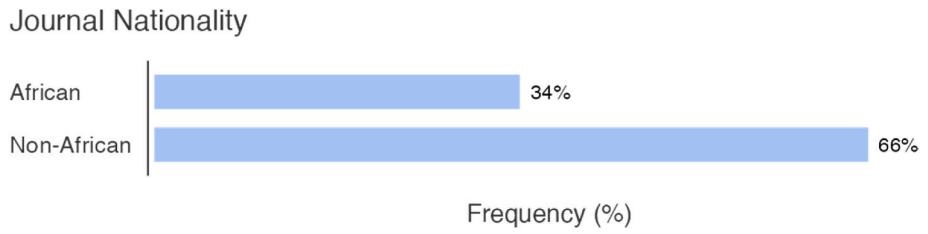

Fig. 6. Shows the percentage of the nationality of the journals where the articles were published.

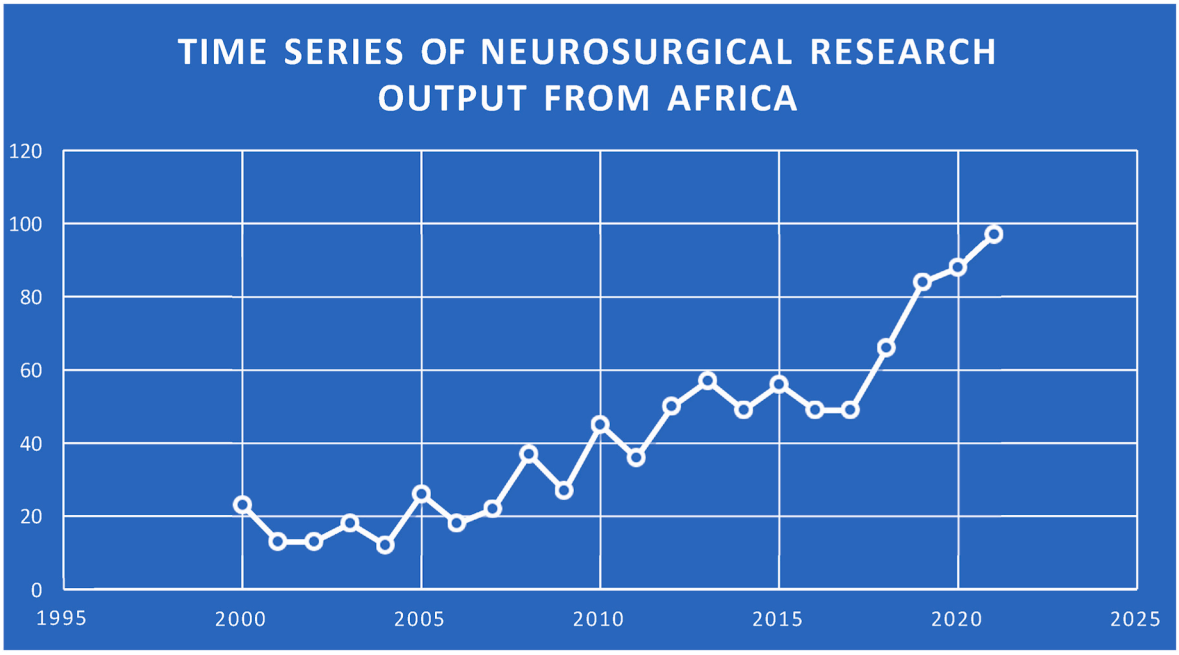

Fig. 7. Line graph showing trends of publishing research articles in Africa over the last 22 years.

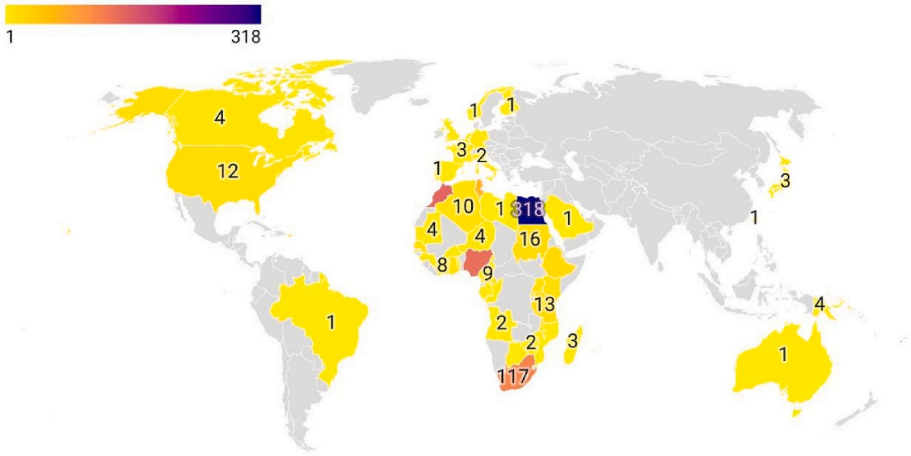

Fig. 8. Shows a worldwide map demonstrating frequency of nationalities of first authors in African Neurosurgery publications.

reference centres as an example, including Brazil, Uganda, Egypt, and Morocco. To represent the growing army of neurosurgeons and other relevant healthcare professionals working together to effect change, the Global Neurosurgery Allied Force was founded (GNAF). An important initiative to use as a model for this phase is the 2015 Lancet worldwide surgical project. The 2016 Bogota Declaration, a summit for global neurosurgical activism, was led by the International Conference for Recent Advances in Neurotraumatology (ICRAN), the international platform of the WFNS's Neurotrauma Committee (NTC). After that, in 2019, the WFNS Global Neurosurgery Committee was created.

Some activities, such as teaching medical writing and research processes to students and residents, are also required (AKHADDAR, 2011). Other suggestions could include programs to encourage academic neurosurgeons to conduct systematic reviews (since systematic reviews are inexpensive, less time-consuming, and provide the highest level of evidence). In addition to this, creating teams to support new researchers in

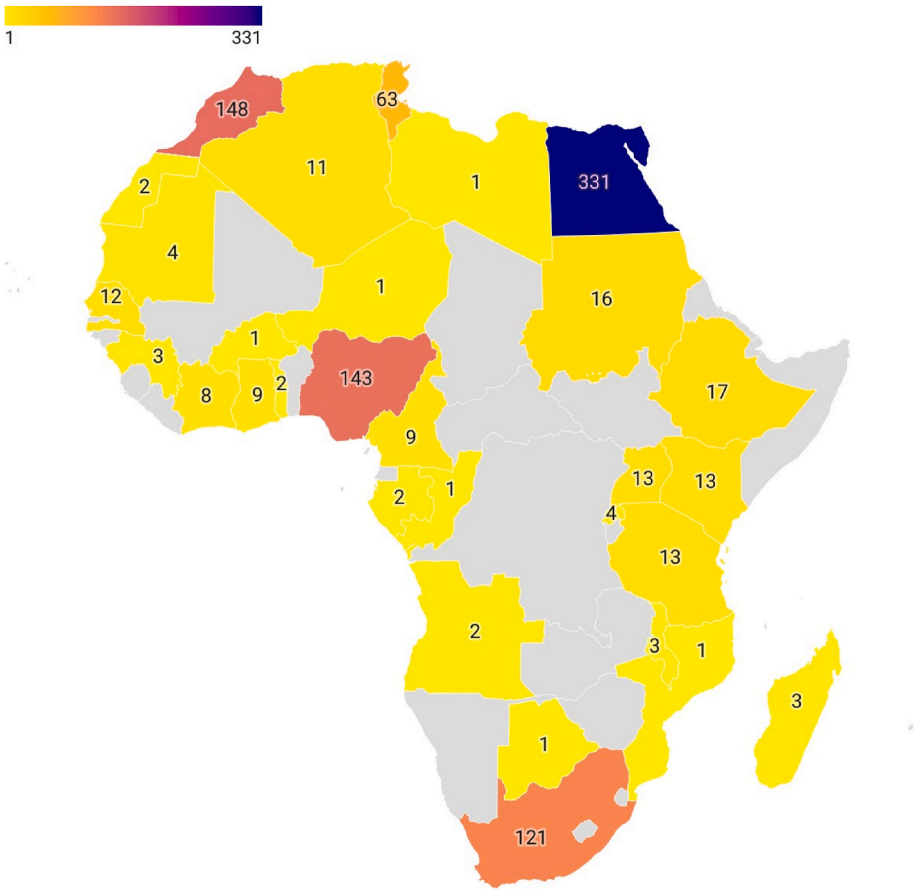

Fig. 9. Shows African continent map with the frequency of African authors' nationalities.

each task of their work will facilitate the work (Black, 2006).

The current study included significant limitations that should be addressed when interpreting the results. Papers on other areas' practices (other than clinical/operative neurosurgery and global neurosurgery) published by African neurosurgeons are not included in our definition of African neurosurgery research. These include papers published by African neurosurgeons during their residency, observership, or fellowship. As a result, our findings may not represent the whole scope of African neurosurgery research. Minor errors in some outcomes, on the other hand, were unlikely to have an impact on the conclusions.

Additionally, because there are no standard procedures for determining the authors' nationality, we chose to identify African neurosurgeons based on their affiliations. Therefore, neurosurgeons working overseas who used their foreign affiliations were underrepresented in our study.

Despite its limitations, this study provides insight into the African neurosurgery research landscape. The number of publications per year has increased over the last decade, with most articles appearing in the last seven years. It continued to increase till the current year (2022), but this year's results are only 46 publications because the search procedure was done until the middle of the year.

4.1. Authors' conclusion

Neurosurgical research output has increased in Africa in recent years, but the problem is that it is concentrated in a small number of countries and almost absent in others. This may result from several barriers to clinical research in African countries, including poverty, limited funding, unprepared infrastructures, uncooperative patients, decreased levels of education, a small number of neurosurgeons, and limited knowledge of neurosurgeons about academic research. Apart from lack of protected time for research as well as low number of neurosurgeons with large workload, lack of incentive for academic and scholarly outputs as well as poor funding for neurosurgical research are deterrents to research output on the continent.

Most studies are focused on observational designs, case reports/series, and commentaries. These types have limited evidence levels compared to randomized controlled trials, which depend on well-designed random experiments, and systematic reviews and meta-analyses, which represent the top level of evidence in the evidence pyramid.

Our recommendations include strengthening the research capacity of African neurosurgeons, soliciting funding and continental collaboration, spreading awareness, and sharing resources from the African neurosurgeons who work in academic research with their colleagues in the same or different nations.

We also recommend that neurosurgery researchers focus on clinical research studies to generate robust evidence that directly serves African patients. Global neurosurgical research collaboration that is equitable, fair, and empowering is important to advance neurosurgery research in Africa.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethics statement

No ethics approval was required since our work doesn't involve human or animal participation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Akhaddar, A., 2011. Publier dans les revues biomédicales internationales et Accroître sa visibilité.

Akhaddar, A., 2019a. African contribution to the world neurosurgical literature during the past two decades (1999-2018) using PubMed database. World Neurosurg 126, 314–321. https://doi.org/10.1016/j.wneu.2019.03.095.

Akhaddar, A., 2019b. Contribution of Moroccan neurosurgeons to the world neurosurgical data in PubMed: a bibliometric evaluation over time. World Neurosurgery 126, 59–65. https://doi.org/10.1016/j.wneu.2019.02.122.

Black, P.M., 2006. Challenges in contemporary academic neurosurgery. Neurosurgery 58 (3), 419–425. https://doi.org/10.1227/01.NEU.0000197139.61412.36.

Bordons, M., Aparicio, J., Costas, R., 2013. Heterogeneity of collaboration and its relationship with research impact in a biomedical field. Scientometrics 96 (2), 443–466. https://doi.org/10.1007/s11192-012-0890-7.

Conradie, A., Duys, R., Forget, P., Biccard, B.M., 2018. Barriers to clinical research in Africa: a quantitative and qualitative survey of clinical researchers in 27 African countries. Br. J. Anaesth. 121 (4), 813–821. https://doi.org/10.1016/j.bja.2018.06.013.

Dhalla, K.A., Guirguis, M., 2018. Barriers and incentives for conducting research amongst the ophthalmologists in Sub-Sahara Africa. PLoS One 13 (10), e0197945. https://doi.org/10.1371/journal.pone.0197945.

El Gindi, S., 2002. Neurosurgery in Egypt: past, present, and future-from pyramids to radiosurgery. Neurosurgery 51 (3), 789–795. https://doi.org/10.1097/00006123-200209000-00032. ; discussion 795-796.

El Khamlichi, A., 2005. Neurosurgery in Africa. Clin Neurosurg.

Haines, S.J., 2003. Evidence-based neurosurgery. Neurosurgery 52 (1), 36–47. https://doi.org/10.1097/00006123-200301000-00004. ; discussion 47.

Ham, E.I., et al., 2020. Cohesion between research literature and health system level efforts to address global neurosurgical inequity: a scoping review. World Neurosurgery 143, e88–e105. https://doi.org/10.1016/j.wneu.2020.06.237.

Kanmounye, U.S., et al., 2020a. Emerging trends in the neurosurgical workforce of low- and middle-income countries: a cross-sectional study. World Neurosurgery 142, e420–e433. https://doi.org/10.1016/j.wneu.2020.07.067.

Kanmounye, U.S., et al., 2020b. Barriers and facilitators of research in Cameroon (Part I) - an e- survey of physicians. PAMJ-CM 4. https://doi.org/10.11604/pamj-cm.2020.4.58.24608.

Kanmounye, U.S., et al., 2021. Hierarchy of scientific evidence and thematic analysis of african neurosurgery research – a scoping review. In: Review. preprint. https://doi.org/10.21203/rs.3.rs-564560/v1.

Liu, W., Ni, M., Jia, W., Wan, W., Tang, J., 2018. Evidence-based medicine in neurosurgery: an academic publication view. Neurosurg. Rev. 41 (1), 55–65. https://doi.org/10.1007/s10143-016-0742-7.

Ponce, F.A., Lozano, A.M., 2010. Academic impact and rankings of American and Canadian neurosurgical departments as assessed using the h index. J. Neurosurg. 113 (3), 447–457. https://doi.org/10.3171/2010.3.JNS1032.

Singh, M., Prasad, C., Shankar, A., 2021. Publication charges associated with quality open access (OA) publishing and its impact on low middle income countries (LMICs), time to reframe research policies. Asian Pac. J. Cancer Prev. APJCP 22 (9), 2743–2747. https://doi.org/10.31557/APJCP.2021.22.9.2743.

Tijssen, R.J.W., 2007. Africa's contribution to the worldwide research literature: new analytical perspectives, trends, and performance indicators. Scientometrics 71 (2), 303–327. https://doi.org/10.1007/s11192-007-1658-3.

Truché, P., et al., 2020. Globalization of national surgical, obstetric and anesthesia plans: the critical link between health policy and action in global surgery. Glob. Health 16 (1), 1. https://doi.org/10.1186/s12992-019-0531-5.

Waqar, M., et al., 2019. Academic neurosurgery in the UK: present and future directions. Postgrad. Med. 95 (1128), 524–530. https://doi.org/10.1136/postgradmedj-2019-136805.

"NATIONAL surgical, obstetric and anesthesia planning," harvard medical school, program in global surgery and social change [Online]. Available. https://www.pgssc.org/national-surgical-planning.