



## Global Neurosurgery in the Context of Global Public Health Practice—A Literature Review of Case Studies

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### Key words

- Global health
- Global surgery
- Health policy
- Neurosurgery
- Public health
- Surgery

### Abbreviations and Acronyms

**CHYSR:** Comprehensive Policy Recommendations for the Management of Spina Bifida and Hydrocephalus in Low-and-Middle-Income Countries  
**DALY:** Disability-adjusted life-year  
**HIC:** High-income country  
**LMIC:** Low- and middle-income country  
**NSOAP:** National Surgical, Obstetrics and Anesthesia Plan  
**NTD:** Neural tube defect  
**RTA:** Road traffic accident  
**SDG:** Sustainable Development Goal  
**TBI:** Traumatic brain injury  
**UHC:** Universal health coverage  
**UN:** United Nations  
**WFNS:** World Federation of Neurosurgical Societies  
**WHO:** World Health Organization

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Neurosurgical conditions are a substantial contributor to surgical burden worldwide, with low- and middle-income countries carrying a disproportionately large part. Policy initiatives such as the National Surgical, Obstetrics and Anesthesia Plans and Comprehensive Policy Recommendations for the Management of Spina Bifida and Hydrocephalus in Low-and-Middle-Income countries have highlighted the need for an intersectoral approach, not just at the hospital level but on a large scale encompassing national public health strategies. This article aims to show through case studies how addressing this surgical burden is not limited to the clinical context but extends to public health strategies as well.

For example, vitamin B<sub>12</sub> and folic acid are micronutrients that, if not at adequate levels, can result in debilitating neurosurgical conditions. In Ethiopia, through coalesced efforts between neurosurgeons and policy makers, the government has made strides in implementing food fortification programs at a national level to address the neurosurgical burden. Traumatic brain injuries (TBIs) are another neurosurgical burden that unevenly affects LMICs. Countries such as Colombia and India have shown the importance of legislation and enforcement, coupled with robust data collection and auditing systems; strong academic advocacy of neurosurgeons can drastically reduce TBIs.

Despite the importance of public health efforts in addressing neurosurgical conditions, there is a lack of neurosurgeon involvement in public health and lack of integration of neurosurgical burden in national health planning systems. It is imperative that neurosurgeons advocate for and are included in aspects of public health policy. Neurosurgery does not stop within the bounds of the hospital, and neither should the role of a neurosurgeon.

### INTRODUCTION

In recent years, many efforts have been made to improve access to surgical care in low- and middle-income countries (LMICs), an example being the country-driven National Surgical, Obstetrics and Anesthesia Plans.<sup>1</sup> This policy was also observed when the United Nations (UN) made a commitment to ensure safe and affordable access to health care for every person in the world through the 3rd Sustainable Development Goal (SDG3), established in 2015.<sup>2</sup> Furthermore, the World Health Organization (WHO) has recognized the essential role of quality surgical and anesthesia care in global and national efforts to achieve universal health coverage

(UHC) by 2030.<sup>3</sup> However, despite these efforts, it is apparent that too little attention has been given to neurosurgery. Neurosurgical diseases remain a major contributor to the global burden of death and disability.<sup>4</sup> Diseases such as traumatic brain injury (TBI), hydrocephalus, and spina bifida affect millions of children and adults worldwide.<sup>5</sup> Therefore, it is clear that UHC cannot be achieved if neurosurgical care is not integrated and prioritized through health policies and programs to strengthen national health systems.

A 2016 report found that neurologic disorders are the leading cause of disability-adjusted life-years (DALYs) lost and the second leading cause of death worldwide.<sup>4</sup> Annually, an average of 22.6 million individuals worldwide require

neurologic care due to diseases such as TBI, stroke, brain tumor, and epilepsy, and 13.8 million of these individuals require surgical intervention.<sup>6</sup> For example, TBIs are common worldwide, with a prevalence between 55 and 69 million, but disproportionately affect individuals in LMICs.<sup>7</sup> Each year, 5 million people in LMICs require neurosurgical intervention but do not receive it because of limited capacity and resources, necessitating an additional 23,000 neurosurgeons to meet population demands.<sup>6</sup> This situation has led to expansion of the field of neurosurgery globally in recent years.

Global neurosurgery is “the clinical and public health practice of neurosurgery with the purpose of ensuring timely, safe and affordable neurosurgical care to all who need it.”<sup>8</sup> The role of neurosurgeons in achieving this aim has been well described in the literature.<sup>9</sup> However, achieving UHC goes beyond the role of neurosurgeons and it is crucial to approach it cohesively as a public health practice involving policy makers, global health advocates, and local governments.

This article aims to present a series of case studies on key topics within global neurosurgery and to discuss the potential benefits that these strategies can bring to health care systems worldwide. We also aim to address the integral roles that policy makers, global health leaders, local governments, and neurosurgeons can play in alleviating the burden of neurosurgical diseases and making global neurosurgery a public health practice.

## VITAMIN B<sub>12</sub> AND FOLIC ACID FORTIFICATION

### Burden of Vitamin B<sub>12</sub> and Folic Acid Fortification in LMICs

Vitamin B<sub>12</sub> and folic acid are key micronutrients within neurosurgery. Lack of adequate intake of vitamin B<sub>12</sub> and folic acid in pregnant women has been associated with congenital neurologic conditions such as neural tube defects (NTDs), anencephaly, and spina bifida.<sup>10,11</sup> In high-income countries (HICs) such as the United Kingdom, folic acid supplementation is recommended for all pregnant women to take from before pregnancy until 12 weeks gestation.<sup>12</sup> However, in

LMICs, the lack of nationalized food fortification programs, access to funding and research, and provision of primary care services have resulted in a high burden of pediatric neurologic conditions as a result of these micronutrient deficiencies.<sup>13</sup> The burden of such neurosurgical conditions is around 2 times higher in LMICs than in HICs,<sup>13</sup> with estimates suggesting around 190,000 live births with NTDs annually in LMICs.<sup>4</sup> The burden becomes higher when stillbirths are taken into account.<sup>13</sup>

These neurologic conditions carry not only an emotional and mental burden for patients and their families but also an immense financial burden for patients and the national economy.<sup>13-15</sup> Estimates have shown that the lifetime cost for patients with spina bifida is around \$600,000, which is largely a result of additional medical treatment and health care costs, special education and development services, and other indirect costs such as loss of paid work time on behalf of caregivers. This economic burden results in extreme inequality in health care outcomes observed in LMICs compared with HICs and further compounds the poor financial state of patients resulting from catastrophic health expenditure.<sup>13,16,17</sup> Moreover, spina bifida also carries a burden to society, with micronutrient deficiencies causing LMICs around \$20–\$30 billion annually.<sup>15</sup> Vitamin B and folate deficiency also increases the neurosurgical burden within a country, with a study estimating that such neurologic conditions in Ethiopia require 37,800 hours of neurosurgical care per year, which is equivalent to 19 full-time neurosurgeons.<sup>14</sup> Addressing these modifiable risk factors, and thus, this burden will enable neurosurgeons to focus on other neurosurgical conditions observed in LMICs, hence improving the overall efficiency of the limited workforce.

### Examples of Public Health Campaigns Led by Neurosurgeons on Food Fortification

Public health campaigns such as food fortification campaigns have been shown to significantly reduce the burden of conditions such as spina bifida and anencephaly.<sup>10,11</sup> Mass fortification of staple foods, such as rice and wheat, or condiments, such as salt, can improve the health standards of large populations

and drastically reduce the burden of micronutrient deficiencies.<sup>10,15</sup> Although more than 59 countries have committed to mandatory fortification programs, many LMICs have yet to effectively implement similar policies into practice.<sup>13</sup>

### National Efforts to Implement Food Fortification

Neurosurgeons play an important role in advocating and implementing these fortification programs. We cite 4 examples. First, the International Society for Pediatric Neurosurgery has recently produced a resolution on mandatory folic acid fortification of staple foods to decrease NTD-associated disability and child mortality. Second, the Comprehensive Policy Recommendations for the Management of Spina Bifida and Hydrocephalus in Low-and-Middle-Income countries group, coordinated by the Program in Global Surgery and Social Change in Harvard Medical School, has published a set of comprehensive policy recommendations for the management of hydrocephalus and spina bifida in LMICs.<sup>18</sup> Third, the [Global Alliance for Prevention of Spina Bifida F](#) is a coalition of pediatricians, neurosurgeons, researchers, advocates, and organizations united in a passion to prevent folic acid–preventable spina bifida. The [Global Alliance for Prevention of Spina Bifida F](#) is working to introduce a World Health Assembly Resolution on folate fortification to prevent spinal dysraphism in children.

Countries such as Costa Rica and Ethiopia have seen strong advocacy efforts from neurosurgeons and other organizations translate into national public health strategies and policies. At a national level, Ethiopia stands as an exemplary country that prioritizes the importance of food fortification in reducing the burden of NTDs and associated neurologic conditions.<sup>14</sup> In 2020, the Ethiopian government made fortification of wheat flour and cooking oils mandatory by investing in building capacity and resources for the industry, with the aim to implement the policy by 2025.<sup>14</sup> To take such strides in food fortification, Ethiopian neurosurgeons had a large role to play.<sup>14</sup> Through advocacy efforts for prevention of NTDs at a national and institutional level, and through academic efforts that contributed to building a robust evidence

base for the Ethiopian population, neurosurgeons were able to encourage the government to develop public health policies while the neurosurgery workforce was being increased in parallel.<sup>14</sup> With neurosurgical capacity building and government's implementation of public health policies occurring synergistically, it is estimated that the neurosurgical burden of vitamin B and folate deficiencies will be met in Ethiopia with adequate neurosurgeons by 2028.<sup>14</sup>

These advances by the Ethiopian government highlight the role that neurosurgeons can play beyond their clinical work. In line with the targets laid out by the Lancet Commission on Global Surgery of offering 100% protection against catastrophic expenditure by 2030, it is important that policy makers and governments emulate the efforts of those seen in Ethiopia to reduce the burden of neurologic conditions caused by vitamin B and folate deficiency in their country, if fortification programs have yet to be established.<sup>17</sup> Likewise, neurosurgeons should proactively advocate for public health campaigns and be given the opportunity to work with local governments to craft policies that have the potential to reduce the neurosurgical burden within their country. Tackling micronutrient deficiencies would be a step in the right direction for countries to achieve the UN SDGs of ensuring healthy life and well-being, reducing inequality, ending poverty, and ensuring sustainable economic growth.<sup>16</sup>

## NEUROTRAUMA AND PUBLIC HEALTH ROAD TRAFFIC SAFETY CAMPAIGNS

### State of TBI and Neurotrauma

The global epidemic of TBI is a major public health concern. In 2018, it was estimated that 69 million individuals sustain TBI each year globally and that TBI accounts for 6,160,814 patients requiring neurosurgical operation, with between 25% and 56% of cases resulting from road traffic accidents (RTAs).<sup>5</sup> Improvements in road safety are critical to reducing the 5 million case deficit in neurosurgical capacity in LMICs.<sup>6</sup> According to the Lancet's 2019 Global Burden of Disease study,<sup>2</sup> RTAs were responsible for 2.9% global DALYs in 2019, and were the

leading cause of DALYs in the 10–24 years and 25–49 years age-groups. The issue of road safety is most critical in LMICs, where the RTA-related death rate is 3.5 times higher than in HICs, despite lower rates of vehicle ownership.<sup>19</sup>

Thus, the neurosurgical need is clear for a global-scale public health focus on road and traffic safety. In 2015, the UN SDGs recognized road safety issues. SDG 3.6 aims by 2020 to “halve the number of global deaths and injuries from road traffic accidents,” and SDG 11.2 by 2030 to “provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.”<sup>16</sup> Later, after the UN General Assembly in 2017, member states reached consensus on 12 global road safety performance targets, which include points relating to technical road standards, vehicle safety standards, speed limits, helmet-wearing, safety belts, alcohol and substance use, mobile telephones, driving time, and provision of emergency care.<sup>19</sup> However, the 2018 WHO Global Status Report on Road Safety noted the lack of improvements in any low-income country regarding road traffic death rates.<sup>19</sup> It is therefore apparent that the UN road safety targets will not be reached without careful analysis of the problem and concerted public health efforts. We highlight a selection of important strategies.

A key UN performance target regarding neurosurgery is target 7, “By 2030 to increase the proportion of motorcycle riders correctly using standard helmets to close to 100%.”<sup>19</sup> Cochrane reviews have found that helmets reduce the risk of head and brain injury and severe TBI by 63%–88% in bicyclists<sup>20,21</sup> and of head injury and death in motorcyclists by 69% and 42%, respectively.<sup>22</sup> Moreover, research has shown that legislation is effective in increasing helmet use and decreasing head injuries and fatalities among both bicyclists and motorcyclists<sup>21</sup> in LMICs and HICs. Recent statistics show that only 49 countries worldwide (36%) have helmet laws meeting best practice, and only 6% of these countries are LMICs despite the rapidly increasing prevalence

of motorcycle use in low-income settings.<sup>18</sup>

### Academic Push for Addressing TBI

Many academic institutions worldwide have been instrumental in highlighting the need for evidence-based public health strategies in addressing the burden of TBI. Countries such as India, Zambia, Ethiopia, Pakistan, and Tanzania have shown a strong academic push to recognize and address the burden of TBI through collaborative research efforts.<sup>23</sup> In India, for example, the neurosurgical community of Andhra Medical College, Visakhapatnam<sup>24</sup> has played a key role in the establishment of TBI registries and providing localized information on the health burden of RTAs to empower advocates and inform public health policy. Academic institutions in HICs have also supported this academic trend. For example, the Harvard University Program in Global Surgery and Social Change has coordinated the development of policy recommendations for head and spine injuries in LMICs that encompass infrastructure, governance, financing, workforce, service delivery, and information management.<sup>25</sup> Other academic institutions such as Cambridge University and Oregon Health and Sciences University have supported large-scale multicentered international studies looking into neurotrauma.<sup>26,27</sup>

### National Strategies for Road Safety and Their Impact on Neurotrauma

Although the data on helmet legislation are motivating, experience has shown the power of multifaceted approaches to road safety intervention. Sweden is a global leader in road safety performance. Through commitment to Vision Zero, a strategic framework for road safety adopted by many countries, Sweden achieved a record of 221 road fatalities in 2019, halved from 440 in 2007.<sup>28</sup> A similarly strategic approach was initiated in France in 2002, with varied interventions including the introduction of automated speed cameras, probationary license, stricter alcohol penalties, and formation of the National Council for Road Safety.<sup>29</sup> According to a comprehensive registry in the Rhone Department of France, road traffic casualties were reduced by 25% and TBI casualties by 42% in the 5-year

period after 2002.<sup>30</sup> These data endorse the implementation of national policies to tackle public health issues. Globally, stakeholders include neurosurgical teams, who should play a key role in advocating for similar initiatives in their countries.

There has been a scarcity of literature on the implementation of national road safety campaigns in LMICs. Although there are widely applicable lessons to be learned from HICs, such as Sweden and France, it would not be appropriate to extrapolate directly from the available data, without consideration of epidemiologic, economical, political, and social differences among countries. The 2018 WHO report showed major differences among regions in the distribution of road fatalities by road user. In Europe, the highest proportion (48%) of fatalities affects occupants of 4-wheeled vehicles, whereas in South-East Asia, this is observed by occupants of motorized 2-wheelers or 3-wheelers (43%); in Africa, pedestrians are the victims of 40% of fatalities, substantially more than in any other continent.<sup>19</sup> Strategic approaches to road safety should recognize these differences, as well as more detailed national and subnational level data. Also, helmet legislation was less impactful in LMICs, such as Kenya and Vietnam, than in HICs,<sup>28</sup> highlighting the importance of appropriate attention to enforcement strategies and continuous audit of compliance. The city of Bogotá in Colombia provides an exemplary approach. Bogotá uses Vision Zero, facilitated by the city's robust data bank on road safety incidents. Through an agreement with the public transport police, all road incidents were reported and coded to build an openly accessible data bank, thus providing a resource for continuous local audit and planning. Consequently, Bogotá reduced traffic fatalities by 50% between 1996 and 2006.<sup>19,29,31</sup>

## SOCIOECONOMIC DISPARITIES IN NEUROSURGICAL CARE

### Current State of Socioeconomic Disparities

The global burden of neurosurgical disease is largely concentrated in LMICs.<sup>6,31</sup>

Approximately 17.6 million patients annually require neurosurgical consultation in LMICs, relative to 4.3 million in HICs.<sup>6,32</sup> However, 5 million essential neurosurgical cases are unmet yearly occur in LMICs because of factors such as an inadequate neurosurgical workforce, insufficient funding, and insufficient infrastructure.<sup>6,32</sup> Individual factors, including an inability to fund medical care or transportation costs, need to make trade-offs between medical care and other expenses, or the opportunity cost of missing work to attend medical appointments, magnify this disparity. These factors are most prominent in rural areas.<sup>33</sup> In turn, the concentration of neurosurgical disease in LMICs leads to greater economic burden in these countries. Economic losses from neurosurgical diseases disproportionately affect LMICs as discussed in the case studies earlier, amounting to 0.54%–0.60% losses in gross domestic product, and are estimated to promote \$4.4 trillion in gross domestic product losses during 2015–2030.<sup>34</sup>

### Role of Neurosurgeons

Neurosurgeons bear the important responsibility of increasing awareness of socioeconomic considerations in the delivery and receipt of neurosurgical care and developing scalable and sustainable strategies to increase access to affordable neurosurgical care. However, neurosurgeons must understand the role of these considerations themselves. The proportion of neurosurgeons with adequate knowledge regarding socioeconomic dimensions is low. Neurosurgery residents in the United States largely lack socioeconomic proficiency despite a validated curriculum.<sup>35</sup> Generally, economic considerations fall into the realms of macroeconomics, aiming to describe the behavior of the economy on a large scale, or microeconomics, delineating the driving factors and effects of the actions of individual people or firms on consumption, resource allocation, or exchange.<sup>36</sup> Cost analysis is an important economic investigation framework to apply to underline the importance of expanding neurosurgical care globally.<sup>36</sup> Although high-quality studies are necessary to provide useful evidence in support of this effort, studies regarding the cost-

effectiveness of cranial and spinal neurosurgery frequently involve knowledge gaps.<sup>37–39</sup> Markov models represent a useful approach to model cost-effectiveness.<sup>40</sup> Key aspects of cost analyses include describing the type of evaluation performed, how benefits and costs are assessed, the type of cost assessed, the source of the cost data, the perspective that the cost analysis is provided from, and the timeframe.<sup>37–39</sup>

### Economic Considerations in Neurosurgical Public Health

In addition, understanding the influence of key economic considerations in the policy-making process is essential. First, policy makers become incentivized to enact policy change if the problem itself is economically and politically viable.<sup>41</sup> Neurosurgeons should emphasize the economic losses resulting from unmet neurosurgical procedures. Second, proposed policy solutions must be cost-effective. Previous studies have determined that expanding access to surgical care is cost-effective, although data regarding neurosurgical care in particular remain limited.<sup>42</sup> Thus, researchers should assess the cost-effectiveness of expanding neurosurgical care in LMICs, so neurosurgeons and policy makers can use evidence-based recommendations about the economic feasibility of this endeavor. Third, economic impacts of policy must be grounded in the local health system, relevant social and political considerations, and culture. Context-specific evaluations and solutions provide the greatest impetus for policy action.

### EFFECTIVE ADVOCACY STRATEGIES: WHAT CAN NEUROSURGEONS DO?

#### Integration of Global Neurosurgery in Global Surgery Movement

In 2015, the Lancet Commission on Global Surgery created a common language for the global surgery community to address the global burden of surgical conditions. Since then, the unanimous passage of World Health Assembly Resolution WHA68.15 further reinforced the importance of surgical care and anesthesia as key components of UHC and health systems strengthening.<sup>43</sup> It is imperative that neurosurgeons and the nascent field of



global neurosurgery become integrated into the goals of UHC and national surgical planning process, because its integration will have benefits to the strengthening of health systems. This theory is further supported by Barthélemy et al.,<sup>44</sup> who highlight the relevance of neurosurgery to 14 of the 17 SDGs.

At least 3 neurosurgeons are actively involved in the global surgery movement. Dr. Walter Johnson served as the Lead for the Surgical Care Programme at WHO from 2016 to 2019 and continues to be a influential figure in the field, Dr. Gail Rosseau is on the Board of the G4 Alliance, an advocacy organization comprising 70 organizations, and Dr. Kee Park is the Director of Policy and Advocacy at the Harvard Program in Global Surgery and Social Change. The neurosurgery profession is well integrated into the global surgery movement.

#### LMIC Neurosurgical Training

There is a need for the training of new neurosurgeons in LMICs. Short-term neurosurgical missions, although a good adjunct to neurosurgical care delivery, are not sustainable in the long-term. There are various examples of initiatives geared toward training new LMIC neurosurgeons. For example, HIC–LMIC collaboration between Duke University Department of Neurosurgery in the United States and Mulago Hospital Department of Neurosurgery in Uganda has increased the neurosurgical workforce and capacity.<sup>45</sup> Another example is the establishment of the first neurosurgical residency program in Haiti, created through collaboration between the University of Miami and the Haitian Ministry of Health and National Medical School, where a general surgeon has become trained in neurosurgery through the incorporation of Web-based learning modules, online assessments, teleconferences, and visiting professorships. Furthermore, collaborative partnerships and opportunities with the Foundation for International Education in Neurological Surgery are examples of education-focused initiatives to help develop neurosurgical capacity/workforce abroad.<sup>46,47</sup> Given the increasing interest in global neurosurgery as a discipline, the potential for future collaborative partnership between LMICs and HICs to create long-term training programs is on

the horizon. In addition, it is crucial to acknowledge the importance of south–south research collaborations or partnerships.<sup>48</sup>

One of the targets of the *Global Action Plan (2019–2021)* of the World Federation of Neurosurgical Societies (WFNS) Global Neurosurgery Committee was to “Initiate 3 new Local Neurosurgery Training Programs.” Afghanistan, Sudan, and Tanzania have all signed memoranda of understanding to start the process. Such a model can already be seen in places such as Rabat, Nairobi, Alger, and Dakar, where WFNS regional centers have contributed to neurosurgical training. The WFNS Rabat Training Center alone has trained 69 neurosurgeons from 17 sub-Saharan countries.<sup>49,50</sup> This model has proved to be cost-effective and sustainable and has contributed to increased neurosurgical capacity in sub-Saharan African countries. We should also encourage neurosurgical training programs in LMICs to increase the number of training positions accepted each year. Collaboration with HICs is essential to develop and implement neurosurgical subspecialties in LMICs in need, such as pediatric, oncology, and vascular epilepsy, which comprise a substantial burden on public health systems.

#### Involvement of Neurosurgeons in National Surgical, Obstetrics and Anesthesia Plans

Neurosurgical diseases, including TBI and spinal cord injury, are a major contributor to death and disability globally. However, little attention has been given to the importance of neurosurgeons in managing these diseases in the global conversation. With increasing efforts to address timely and safe access to surgical care worldwide, especially with the incorporation of National Surgical, Obstetrics and Anesthesia Plans, it is important for neurosurgeons to become stakeholders in these processes. The involvement of neurosurgeons, both domestically and internationally, will be beneficial to strengthening surgical priorities, infrastructure, and care delivery.

The *Global Action Plan (2019–2021)* of the WFNS Global Neurosurgery Committee included the target “Participation by Neurosurgeons in the National Surgical Strengthening Process” and neurosurgeons were involved in national surgical processes in Fiji, Rwanda, Ethiopia,

Tanzania, Zambia, Nepal, India, and Pakistan.

#### Incorporating the “Decolonizing Global Health” Movement in Global Neurosurgery

However, accordingly, a relatively new movement to “decolonize global health” has sought to address neocolonial patterns of relations in medicine.<sup>51–54</sup> Scholars and activists argue that decolonizing global health will move us closer to “removing all forms of supremacy within the global health practice within countries, between countries, and at the global level.”<sup>54</sup> Doing so is critical for shifting power relations and promoting social and cultural consciousness inquiry within privileged institutions, organizations, and systems, most often based in HICs, that drive the overall global health and global surgery/neurosurgery discourse, funding, and policies. However, extricating global surgery/global neurosurgery from colonial legacies will be a long and arduous process that will require a concerted effort from all stakeholders in global surgery.

Using a decolonial lens will be critical for neurosurgeons to “use historical hindsight to explain patterns of power that shape our intellectual, political, economic, and social world.” This strategy means acknowledging that within global health, surgical efforts in global medicine either can be cooperative and empowering or they can recreate exploitative dynamics that benefit communities in some ways and harm them in others. By anchoring our efforts in a decolonial critical approach, surgical communities can better align their efforts with the highest ethical standards and disrupt hierarchic modes of understanding and relating to practitioners, institutions, and systems in formerly colonized and historically marginalized communities.

Instead, practitioners who are well versed in decolonial thinking and possess a critical understanding of how privilege and power shape social relations can begin to spot areas of improvement and begin creating truly equitable collaborations that see both our colleagues and patients from low-income countries as equal partners who deserve respect, dignity, and equitable access to professional opportunities and medical resources.

Building nondiscriminatory, bilateral, sustainable partnerships with marginalized communities and, most importantly, centering principles of equity in justice at all levels of humanitarian medicine (interpersonally, socially, institutionally, and systemically) has the power not only to transform how we conduct global neurosurgery work in our profession but also to amplify the impact that this work has on local hosts and their home communities. Promoting decolonial thinking in global public health, including global surgery/neurosurgery, will require existing practitioners, as well as future participants, to invest time and resources in educating themselves about how the field is implicated in oppressive practices that our generation has inherited. Furthermore, it demands a shift of the existing imbalance of power and persisting inequitable structures and practices between practitioners and institutions in HICs and LMICs. The Global Neurosurgery Committee (2021–2023) of the WFNS has a designated Decolonization Lead to oversee the transition toward a more equitable relationship between HIC and LMIC actors.

#### Action Points for Effective Advocacy by Neurosurgeons

Neurosurgeons have a responsibility for promoting and developing their specialty outside the hospital. To do so, neurosurgeons, should be in a position to influence policy makers and health actors. Neurosurgeons are to be encouraged to:

- organize themselves into larger professional groups such as national societies or associations, which become more influencing than individual actors
- organize health education campaigns in their countries, focusing on regions in which there are few or no neurosurgeons to increase awareness of neurosurgical diseases within the population and among policy makers.
- organize epidemiologic and economic studies and surveys at national level on the major neurosurgical diseases that are a public health problem and use these data to convince health system actors to modify their strategy to reduce the burden of these diseases

- create and participate in nonprofit foundations dedicated to neurosurgical diseases with the aim to improve neurosurgical capacity in the country; in Morocco, this strategy, with support from the government, has been successful in promoting neurosurgery at national and international levels<sup>55</sup>
- contribute to political actions and participate in the administrative management of hospitals and medical care institutions.

#### CONCLUSIONS

The case studies presented in this article highlight key issues that contribute to the unmet burden of neurosurgical diseases in LMICs. Moreover, the case studies also present public health strategies, which if developed and implemented by policy makers, can directly address a country's neurosurgical burden. There is also an apparent lack of training for neurosurgeons in aspects of public health, global health, and advocacy such as cost analysis, national health planning, and decoloniality. Increasing access and building infrastructure for better neurosurgical training and education and increasing the neurosurgical workforce can only take us so far. Equitable global neurosurgery should be achieved through cooperation and collaboration of not only neurosurgeons but also governments, policy makers, and stakeholders in ensuring that the public are provided with the education and resources required to reduce the incidence of neurosurgical diseases. Neurosurgeons should be equipped with the skills and knowledge of public health and advocacy and provided with the opportunity to work alongside global health actors and leaders to address their country's neurosurgical burden. Similarly, governments, policy makers, and stakeholders should encourage intranational, international, and cross-continental collaborations and learn from leading countries of their policies in achieving a quality robust health coverage for their people. We therefore recommend all members of the public health workforce mentioned earlier to consider the case studies provided in our article and emulate them accordingly in their countries as a step in the right direction to achieving equitable health for all worldwide.

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