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Needs, Roles, and Challenges of Young Latin American and Caribbean Neurosurgeons

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■ **BACKGROUND:** Barriers to neurosurgery training and practice in Latin American and Caribbean countries (LACs) have been scarcely documented. The World Federation of Neurosurgical Societies Young Neurosurgeons Forum survey sought to identify young neurosurgeons' needs, roles, and challenges. We present the results focused on Latin America and the Caribbean.

■ **METHODS:** In this cross-sectional study, we analyzed the Young Neurosurgeons Forum survey responses from LACs, following online survey dissemination through personal contacts, social media, and neurosurgical societies' e-mailing lists between April and November 2018. Data analysis was performed using Jamovi version 2.0 and STATA version 16.

■ **RESULTS:** There were 91 respondents from LACs. Three (3.3%) respondents practiced in high-income countries, 77 (84.6%) in upper middle-income countries, 10 (11%) in lower middle-income countries, and 1 (1.1%) in an unclassified country. The majority (77, or 84.6%) of respondents were male, and 71 (90.2%) were younger than 40. Access to basic imaging modalities was high, with access

to computed tomography scan universal among the survey respondents. However, only 25 (27.5%) of respondents reported having access to imaging guidance systems (navigation), and 73 (80.2%) reported having access to high-speed drills. A high GDP per capita was associated with increased availability of high-speed drills and more time dedicated to educational endeavors in neurosurgery, such as didactic teaching and topic presentation ($P < 0.05$).

■ **CONCLUSIONS:** This survey found that neurosurgery trainees and practitioners of Latin America and the Caribbean face many barriers to practice. These include inadequate state-of-the-art neurosurgical equipment, a lack of standardized training curricula, few research opportunities, and long working hours.

INTRODUCTION

Surgery has historically been overlooked in advocacy for global health initiatives.¹ The unmet need for surgical care in low- and middle-income countries (LMICs) is immense.

Key words

- Barriers
- Education
- Global neurosurgery
- Latin America
- Low-and middle-income countries
- Neurosurgical capacity
- Research

Abbreviations and Acronyms

- HICs:** High-income countries
ICU: Intensive care unit
LAC: Latin American and Caribbean countries
LMICs: Low- and middle-income countries
U-MICs: Upper-middle-income countries
WFNS: World federation of neurosurgeons
YNF: Young neurosurgeons forum

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In 2015, the Lancet Commission on Global Surgery reported that approximately 5 of 7 people in the world lack access to safe, timely, and affordable surgical care. Moreover, most of the affected populations reside in LMICs.² More than 13 million of the 20 million patients suffering from neurologic disorders yearly require neurosurgical treatment. However, more than 5 million people requiring essential neurosurgical operations remain burdened by disease due to the lack of nearly 23,000 additional neurosurgeons in LMICs.³ In recent years, the field of global neurosurgery, which aims to advance health equity for all people suffering from neurosurgical disorders, has been gaining international recognition as advocacy for the improvement of neurosurgical care in LMICs has been increasing.^{4,4-6}

Neurosurgical training and practice in LMICs, such as in most Latin American and Caribbean countries (LACs), are heavily affected by barriers to health care delivery, such as inadequacy of requisite equipment and personnel.⁷ LACs are home to >658 million people in this region of the Americas, where nations span the entire economic spectrum of World Bank income groups.⁸ Moreover, the 6637 neurosurgeons in this region are inequitably distributed, as the density of neurosurgeons per 100,000 population ranges from 0 in Suriname to 3.3 in Bolivia.⁹ Recent research has demonstrated the neurosurgeon density in at least 12 countries of the region is below the minimum requirement workforce to provide adequate neurotrauma care—0.47 neurosurgeons per 100,000 population.⁹⁻¹¹

While neurosurgical education and professional opportunities are expanding in most LACs, young neurosurgeons in these nations face many challenges in their daily practice. Most training programs in LACs are centralized in urban centers, and most practicing neurosurgeons and critical care facilities are also located in metropolitan hubs. The disparity in the distribution of neurosurgical centers between urban and rural areas causes significant delays in access to care, resulting in worse outcomes for patients living in rural areas far from essential health care facilities.^{7,9} Furthermore, the absence of universal health coverage in a setting of high and persistent socioeconomic inequalities (i.e., high Gini indices) worsens the disparity in access to neurosurgical care across socioeconomic echelons.^{12,13}

In an effort to elucidate the needs, roles, and challenges of young neurosurgeons, the Young Neurosurgeons Forum of the World Federation of Neurosurgeons (WFNS) conducted a worldwide survey.¹⁴ The survey results pertinent to young neurosurgeons in Africa and the global workforce have been recently published.¹⁴⁻¹⁶ This study aimed to analyze the responses from neurosurgeons practicing in LACs in order to highlight the most pressing needs of Young Latin American and Caribbean trainees and practitioners and inform future academic and policy changes that can improve the state of neurosurgical care for all people.

METHODS

Survey Design, Distribution, and Study Variables

This cross-sectional study was based on a self-administered web-based survey consisting of 30 multiple-choice and free-text questions (Appendix 1). The survey was designed by The World Federation of Neurosurgical Societies Young Neurosurgeons

Forum (WFNS-YNF) and pilot-tested before dissemination.^{14,15} It was directed at young neurosurgeons, which the WFNS-YNF defines as residents, fellows, and consultants (within 10 years postresidency graduation).

Questions that assessed demographics, professional characteristics, institutional profile, auxiliary resource availability, logistics of neurosurgical services, neurosurgical training, and the needs and interests of neurosurgery residents and consultants were included in the survey. CHERRIES (Checklist for Reporting Results of Internet E-Surveys) was used to authenticate and improve the quality of the web survey.¹⁷ The survey was administered via Qualtrics (Qualtrics, Provo, Utah) from April–November 2018. It was distributed through the WFNS and WFNS-YNF mailing lists, personal connections, social media websites (Twitter, Facebook, WhatsApp), and regional societies. This study focuses on questions pertinent to the needs of young neurosurgeons in LACs and the challenges they endure in their daily neurosurgical practice. Further details of the methodology have been previously published.^{14,15}

Data Analysis

Data were analyzed using Jamovi version 2.0 (The Jamovi Project, Sydney, Australia) and STATA version 16 (StataCorp, College Station, Texas, USA). Responses were categorized according to World Bank income classifications of high-income countries (HICs), upper-middle-income countries (U-MICs), lower-middle-income countries, and low-income countries. Frequency and percentages were reported for categorical variables. Descriptive statistical tests, followed by chi-square tests and logit econometric modeling, were used for analysis. All tests were 2-sided, with statistical significance defined as $P < 0.05$.

RESULTS

Demographic and Professional Characteristics

There were 91 complete responses representing 15 LACs. The response rate could not be calculated due to wide dissemination of the survey across multiple online platforms. Most respondents practiced in South America (61.6%). By World Bank income level, 3.3% of respondents practiced in HICs, 85% in U-MICs, and 11% in lower-middle-income countries (Figure 1). The majority of respondents were between the ages of 30 and 35 (37; 40.7%), followed by 36–40 years old (34; 37.4%). Most respondents were male (77; 84.6%), with 14 females accounting for 15.4% of respondents (Table 1).

Regarding neurosurgical career length, 24 (26.4%) respondents reported being consultants with less than 5 years postresidency graduation. Resident categories were broken down into residents having graduated >5 years ago from medical school (14; 15.4%) and residents who graduated <5 years ago from medical school (16; 17.6%) at the time of survey participation. A total of 48 (52.7%) respondents practiced in locations with populations exceeding 1.5 million, followed by 21 (23%) neurosurgeons who practiced in settings with a population ranging between 500,000 and 1.5 million. Most respondents were paid for clinical work (72; 79.1%), followed by clinical and research responsibilities (18; 19.8%), and a single respondent was paid exclusively for research work (Table 1).

Table 1. Demographic and Professional Characteristics

| Characteristic | Number of Respondents (n, %) N = 91 |
|---|-------------------------------------|
| Sex | |
| Female | 14 (15.4%) |
| Age (years) | |
| < 30 | 11 (12.1) |
| 30–35 | 37 (40.7) |
| 36–40 | 34 (37.4) |
| > 41 | 9 (9.9) |
| Profession and career length | |
| Resident (<5 years postmedical school graduation) | 16 (17.6) |
| Resident (≥5 years postmedical school graduation) | 14 (15.4) |
| Fellow | 6 (6.6) |
| Consultant <5 years postresidency | 24 (26.4) |
| Other | 2 (2.2) |
| Population size of respondents' location | |
| < 50,000 | 3 (3.3) |
| 50,000–200,000 | 10 (11.0) |
| 200,000–500,000 | 9 (9.9) |
| 500,000–1.5 million | 21 (23.1) |
| >1.5 million | 48 (52.7) |
| Paid activities | |
| Clinical | 72 (79.1) |
| Research | 1 (1.1) |
| Clinical and research | 18 (19.8) |

Table 2. Institutional Characteristics and Resource Availability

| Institutional Resources | Number of Respondents (n, %) N = 91 |
|---|-------------------------------------|
| Institution type | |
| Mixed public and private | 34 (37.4) |
| Nonteaching public | 19 (20.9) |
| Private | 10 (11.0) |
| University teaching | 28 (30.8) |
| Bed capacity | |
| < 500 | 61 (67.0) |
| 500–1000 | 22 (24.2) |
| > 1000 | 8 (8.8) |
| Neurosurgical ward beds and ventilators | |
| < 25 | 45 (49.5) |
| 25–50 | 30 (33.0) |
| 50–75 | 9 (9.9) |
| 75–100 | 4 (4.4) |
| >100 | 3 (3.3) |
| Mechanical ventilators in ICU | 90 (98.9) |
| Equipment and auxiliary services | |
| Catheter angiography | 66 (72.5) |
| CT scan | 91 (100) |
| MRI | 77 (84.6) |
| Operating microscope | 84 (92.3) |
| Image guidance | 25 (27.5) |
| High-speed drill | 73 (80.2) |
| ICU beds | 90 (98.9) |
| Rehabilitation specialists | 79 (86.8) |

hands-on operating sessions without further increasing the long work hours that the respondents currently endure.

Health Care Systems and Reforms

During the second half of the 20th century, LACs experienced a rise in access to adequate nutrition, vaccination, and proper sanitation. Such developments, in turn, increased the average life expectancy of many countries, which led to a transition in health care needs.¹⁸ With an aging population, chronic diseases have become more prevalent; the vast majority of annual deaths in Latin America are due to chronic noncommunicable diseases. Additionally, a wave of advocacy for health care to be regarded as a human right has been gaining popularity since it began during the late 20th century. In response, many LACs have implemented public policies that synchronize health, social, and economic actions in order to introduce health care models that strive for universal health coverage.^{12,18,19}

Each LAC possesses an independent health care system, which might differ significantly from others in the region.¹⁸ The most

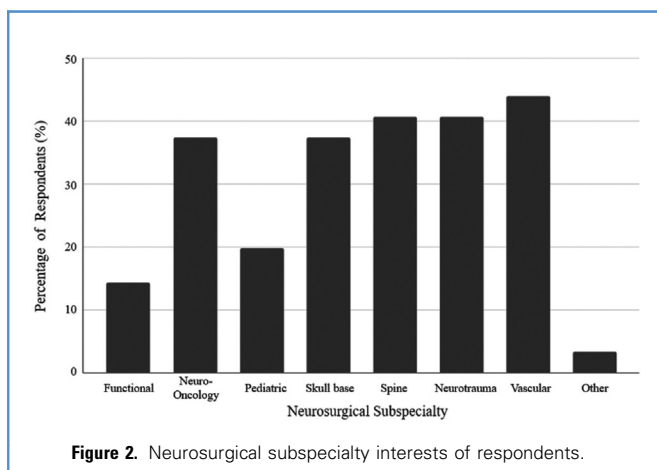
common health care model in the region is the segmented model, which is organized by population groups and, as such, divides the responsibility of each group to a different institution. In contrast, countries such as Cuba and Costa Rica maintain a unified model in which the 3 functions of health care systems (financing, delivery, and stewardship) are under 1 institution's control. Lastly, some countries like Colombia and Chile have been moving toward a structured pluralism model in which health care functions are performed for the whole population. To date, no country in Latin America or the Caribbean has adopted a purely private model. In our study, 58.3% of respondents reported being affiliated in some way with a public hospital. This result excludes those who are affiliated with teaching or university hospitals, which may be public or private, so the final number of young neurosurgeons affiliated with public institutions may be much higher.^{18,20}

As the global neurosurgery movement gains momentum, more literature regarding necessities in LMICs has emerged. All strides

Table 3. Perceived Barriers to Day-to-Day Neurosurgical Practice

| Barrier | Number of Respondents (n, %) N = 91 |
|---|--|
| Limited opportunities to do research | 52 (57.1) |
| Lack of access to organized teaching/training sessions | 49 (53.8) |
| Limited number of opportunities for hands-on operating | 48 (52.7) |
| Long hours of work | 40 (44.0) |
| Poor work/life balance | 28 (30.8) |
| Lack of a mentor | 24 (26.4) |
| Lack of regular access to the advice of experienced/senior colleagues | 22 (24.2) |
| Lack of access to neurosurgical journals | 20 (22.0) |
| Bullying and harassment issues | 14 (15.4) |
| Lack of access to neurosurgical textbooks | 10 (11.0) |
| N/A-there are no hurdles | 2 (2.2) |

toward universal health coverage are salient for the establishment of neurosurgical care within a high-quality health system.^{6,21} Previous LACs health care initiatives that provided intersectoral or universal health coverage for specific issues, such as early childhood development in Chile and Colombia, may serve as exemplary models for future endeavors that aim to alleviate the burden of neurosurgical disorders in the region.¹² In terms of neurosurgical workforce distribution, the results of recent research can serve as indicators for the workforce distribution target for LACs. Recent research indicates that over 75% of patients in low-income countries travel for more than 2 hours to seek emergency and elective neurosurgical care compared with one third of patients in HICs.²² A study by Punchak et al²³ reported that 62.3% of the population of LACs has access to basic

**Figure 2.** Neurosurgical subspecialty interests of respondents.

neurosurgical care within a 2-hour window. Yet only 27.4% of the LACs population had access to advanced microsurgery within the same time period.²³ Another study by Barthélemy et al²⁴ indicated that patients who received neurosurgical care within 4 hours post injury had a better outcome in terms of the Glasgow Outcome Scale. Thus future policies and initiatives that focus on workforce distribution in LACs may strive to ensure universal access to neurotrauma care and elective care within a 4-hour and 2-hour driving distance, respectively.

Access to Equipment and Postoperative Care

Most young neurosurgeons surveyed reported having access to basic imaging modalities like CT scans (100%) and operating tools such as high-speed drills (80.2%) and operating microscopes (92.3%), yet most respondents also reported not having access to image guidance systems (72.5%). Given the differential access to operative equipment across LACs, some have greater access to these material resources than other LMICs regionally and globally.¹⁶ The vast majority of respondents also reported having access to ICU beds with available mechanical ventilators and rehabilitation specialists. While equipping all neurosurgical centers with the latest innovations is a daunting task in settings of immense monetary need in other sectors, LACs may aim to provide all essential neurosurgical equipment across every center by partnering with large professional and nonprofit organizations such as WFNS Foundation and the Foundation for International Education in Neurological Surgery. Another potential solution is advocating for policies incentivizing the medical manufacturing industry in LACs—categorized as HICs or U-MICs—to invest in producing medical devices essential for neurosurgery.

Training and Research

The length of neurosurgical training in Latin America and the Caribbean is 5 years at most institutions (± 1 year). In our survey, the majority of respondents described their barriers to day-to-day practice to be training related (lack of opportunities to do research, lack of organized teaching/training sessions, and limited opportunities for hands-on operating). These might stem from a shorter training time compared with North American programs, which provide more opportunities to conduct research while in residency and even take research years or pursue enfolded fellowships.^{25,26} The scarcity of research opportunities may have an impact on local practices by causing a shortage of guidelines and recommendations tailored to resource-limited settings. This could lead to excessive reliance on research data from HICs, where the population characteristics may not be representative of LMICs. The absence of training standardization can also contribute to the perceived lack of organized teaching and training sessions.²⁶⁻²⁸ Potential strategies to enhance research productivity include standardization of neurosurgical training with a specific focus on protected research time and support for conference participation.²⁶ Murguía-Fuentes et al²⁶ reported only 18% of their participants had allotted research time, and 40% reported no publications during residency. Lengthening training time has been proposed in the past, but this comes with its own issues, such as heightened financial burden for residents in countries such as Colombia, where residents are required to pay tuition

during their residency years and only began receiving a salary for their work in 2020 due to a resident law passed in 2018.^{29,30} Additionally, in a region with few neurosurgeons per capita and high demand for neurosurgical care, lengthening the time of training may result in fewer neurosurgeons available for the population and discourage potential residents from choosing neurosurgery due to its training length and economic implications.⁹ Moreover, a coordinated effort to implement mentorship programs, as well as both national and international exchange rotations, may alleviate the current training and research challenges reported in this study.

Impact of COVID-19 Pandemic

This survey aimed to establish the most pressing needs young neurosurgeons in LACs face in their practice. Since the survey data were collected in 2018, the aforementioned results should be complemented with newer data. In the available literature, several other surveys have sought to characterize issues encountered by neurosurgeons during the pandemic. One of these was the Latin American Federation of Neurosurgical Societies survey, which reported that 10 of the 16 countries represented in the survey had pandemic-specific recommendations for neurosurgical practice.³¹ The same study found that neurosurgical practice in Latin American Federation of Neurosurgical Societies–affiliated countries was reduced by up to 79%. The restrictions on practice left many neurosurgeons at immense financial risk, with almost half of respondents stating their savings would last fewer than 3 months. Apart from economic hardships, neurosurgeons in LACs also faced a significant emotional impact due to the pandemic. A recent survey of spine surgeons in Latin America indicated that almost half of the surveyed participants reported depressive symptoms, with statistically significantly higher depression scores in neurosurgeons compared with orthopedic surgeons.³²

Limitations

The cross-sectional nature of the survey impedes us from assigning causation to the issues described by the survey respondents. Other limitations include a small sample size with

heterogeneous national representation and with limited participation from Caribbean-based young neurosurgeons and trainees. Additionally, the results may be subject to nonresponse bias if the demographics of individuals who did not answer the survey differ from those who did. Response bias may have occurred based on question framing. Future surveys are needed to assess further the needs, roles, and challenges of young Latin American and Caribbean neurosurgeons. Future efforts should focus on a more equitable survey distribution throughout LACs.

CONCLUSION

The overall density of neurosurgeons per 100,000 inhabitants is low across Latin America and the Caribbean, with highly variable numbers throughout the region. Although health care delivery has improved over the past decades, more efforts are needed to achieve equitable neurosurgical care in LACs. This survey found that neurosurgery trainees and practitioners in Latin American countries face many barriers to practice. These include a lack of state-of-the-art neurosurgical equipment, a lack of standardized training curriculums, few research opportunities, and long working hours. Possible solutions for these issues are the inclusion of protected research time during neurosurgical residency, encouragement in congress participation, and partnership with international organizations and industry. More studies are needed to evaluate the needs, roles, and challenges of young Latin American and Caribbean Neurosurgeons, especially after the COVID-19 pandemic.

CRedit AUTHORSHIP CONTRIBUTION STATEMENT

Conception and design: IE, EJB. Acquisition and analysis of data: DPC, AV, EH. Drafting the article: DPC, ZKA, SJ, NS, FR.

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APPENDIX

WFNS YN Survey

Dear Colleagues, If you are a young neurosurgeon (i.e. in training or within 10 years after the end of residency), we would like to hear from you. This online survey aims to document, for the first time, the demographics and needs of young neurosurgeons worldwide but also their views on improving neurosurgical care for all those who need it. The survey should not take you more than 10 minutes to complete and we would be grateful if you could forward it to as many of your young neurosurgical colleagues as possible. With many thanks and best wishes, Angelos Koliass (UK), Amro Al-Habib (KSA), Tsegazeab Laeke (Ethiopia), Luis Rafael Moscote-Salazar (Colombia), and Kerry Vaughan (USA) on behalf of the WFNS Young Neurosurgeons committee Franco Servadei (WFNS President)

Q1 Name: (Optional)

Q2 Email address if you want to be notified about the committee's activities: (Optional)

Q3 Age

- < 30 (1)
- 30-35 (2)
- 36-40 (3)
- 41 or more (4)

Q4 Gender

- Male (1)
- Female (2)

Q5 In which country do you currently reside?

▼ Afghanistan (1), Zimbabwe (1357)

Q6 What is the size of the town/city in which you work? (Optional)

- > 1.5 million (1)
- 500 000–1.5 million (2)
- 200 000–500,000 (3)
- 50 000–200,000 (4)
- < 50,000 (5)

Q7 Level of practice:

- Resident (<5 years after graduating from medical school) (1)
- Resident (5 years or more after graduating from medical school) (2)
- Fellow (defined as additional training near the end or after the end of residency) (3)
- Consultant <5 years after finishing residency (4)
- Consultant 5 years or more after finishing residency (5)

Other (6) _____

Q8 What is your main subspecialty (for residents, which subspecialty are you interested in)?

- Cerebrovascular Surgery (1)
- Functional Neurosurgery (2)
- Neuro-endoscopy (3)
- Neuro-oncology (4)
- Neurotrauma (5)
- Paediatric Neurosurgery (6)
- Skull Base Surgery (7)
- Spinal Surgery (8)
- Other (9) _____

Q9 Is your appointment (job) purely clinical or are you also paid by your employer to do research?

- Clinical (1)
- Clinical and I am paid to do research (2)
- Research only (3)

Q10 How would you describe your main place of work?

- University/Teaching Hospital (1)
- Other Public Hospital (2)
- Private Hospital (3)
- Mixed Public and Private Hospital (4)

Q11 Number of hospital beds:

- 500 or less beds (1)
- 500 to 1000 beds (2)
- More than 1000 beds (3)

Q12 Are there dedicated neurosurgical wards in your hospital? (This does not include high dependency or intensive care unit beds)

- Yes (1)
- No (i.e. we share wards with other specialties) (2)

Q13 Number of neurosurgical beds (Including beds in wards, high dependency unit, and intensive care unit, if applicable):

- < 25 (1)
- 25-50 (2)
- 50-75 (3)
- 75-100 (4)
- > 100 (5)

Q14 Which of these imaging modalities do you have access to?

- CT scan (1)
- MRI (2)
- Catheter Angiography (3)

Q15 Do you have an operating microscope?

- Yes (1)
- No (2)

Q16 Do you have an image guidance system (navigation)?

- Yes (1)
- No (2)

Q17 Do you have a high-speed drill?

- Yes (1)
- No (2)

Q18 Do you have access to Intensive Care Unit (ICU) Beds?

- Yes (1)
- No (2)

Q19 Do you have access to mechanical ventilators in the ICU?

- Yes (1)
- No (2)

Q20 Do you have access to specialists in rehabilitation?

- Yes (1)
- No (2)

Q21 Do you have time dedicated for neurosurgical education (didactic teaching, topic presentations etc) during the week?

- Yes (1)
- No (2)

Q22 Does your department hold a journal club?

- Yes (1)
- No (2)

Q23 Do you have access to regular hands-on cadaver training courses in your department?

- Yes (1)
- No (2)

Q24 In your view, what are the biggest hurdles that are not letting your neurosurgical service (i.e. the hospital you are working at) provide neurosurgical care that can satisfy the needs of your local population in its entirety (you can select >1)?

- N/A - the neurosurgical care needs of my local population are perfectly covered (1)
- Inadequate or no insurance coverage for significant number of people (2)
- The limited number of trained neurosurgeons (3)
- The limited number of neurosurgical beds (4)
- The limited number of ICU beds (5)
- Lack of access to equipment necessary for microsurgery (e.g. microscope, drill, bipolar) (6)
- Lack of regular/consistent access to CT (7)
- Lack of regular access to MRI (8)
- Lack of organised primary care (9)
- Lack of organised pre-hospital/emergency hospital care (10)
- Lack of organised rehabilitation care (11)
- Other (12) _____

Q25 In your view, what are the biggest hurdles in your own personal day-to-day practice (you can select >1)?

- N/A-there are no hurdles (12)
- Lack of access to organised teaching/training sessions (1)
- Limited number of opportunities for hands-on operating (2)
- Long hours of work (3)
- Poor work/life balance (4)
- Bullying and harassment issues (5)
- Lack of regular access to the advice of experienced/senior colleagues (6)
- Lack of a mentor (7)
- Lack of access to neurosurgical journals (8)
- Lack of access to neurosurgical textbooks (9)
- Limited opportunities to do research (10)
- Other _____ (11)

Q26 Are you a member of a national neurosurgical society?

- Yes (1)
- No (2)

Q27 If yes, which one?

Q28 Have you attended a WFNS conference or a WFNS supported meeting before?

- Never (1)
- Once (2)
- Twice (3)
- More than 2 times (4)

Q29 Please list three areas you would like the WFNS help you in your personal goals and the goals of your neurosurgical service (e.g. education, research etc)? (Optional)

- Area 1 (1) _____
- Area 2 (2) _____
- Area 3 (3) _____

Q30 Assuming that you are interested in attending education/training provided by the WFNS, which of these formats suit you?

- Web-based lectures (1)
- Personal attendance in a course or a conference (2)
- Hands-on course (3)