Diversity in Neurosurgery  

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INTRODUCTION

Neurosurgery has experienced tremendous growth over the past century since its beginning as a new specialty.1 Its history is filled with pioneers who have expanded and diversified the field in a multitude of directions, harnessing advancements in scientific knowledge and technology to devise innovative solutions and treatments for neurosurgical conditions. The wide breadth of subspecialties that have emerged within the field—from pediatric neurosurgery to neuro-oncology, functional neurosurgery, endovascular surgery, peripheral nerve surgery, traumatology, skull base surgery, and spine surgery—reflects the great diversity with which neurosurgical practice has evolved over time. The neurosurgical workforce is also progressing toward diversification, as individuals with increasingly heterogeneous backgrounds and identities are entering the field. In this article, we recognize some of the underrepresented groups in neurosurgery and highlight individuals from these groups who have excelled in the field despite structural barriers and discrimination. We demonstrate data from the basic sciences, economics, business, and other disciplines that illustrate that diversity is not only just but also the most rational pursuit for positive growth and advancement. Diversity is needed to enrich the specialty and augment its capacity to serve the heterogeneous population of patients that reflect our society. To promote equity and diversity in the field, ongoing deliberate, organized, and systematic efforts to change the status quo and make the field more inclusive are needed.

Key words

- Biodiversity
- Diversity
- Equity
- Gender
- Inclusion
- Race

Abbreviations and Acronyms

AANS: American Association of Neurological Surgeons  
ABNS: American Board of Neurological Surgery  
BIPOC: Black, Indigenous, People of Color  
EANS: European Association of Neurosurgical Societies  
WINS: Women In Neurosurgery  
WFNS: World Federation of Neurosurgical Societies

Over the past century, the field of neurosurgery has evolved and expanded in various directions. Neurosurgeons have continuously pushed the boundaries of the specialty with scientific discovery and innovation. A diverse array of neurosurgical techniques, treatments, and new areas of study have emerged within the field. Meanwhile, the neurosurgical workforce has stayed demographically homogeneous throughout time. Certain groups remain underrepresented owing to systemic barriers based on social identifications and categorizations, including gender, race, ability status, and others. In this article, we highlight some of the underrepresented groups in neurosurgery and chronicle the important contributions and achievements that individuals from these groups have made in the field despite structural barriers and discrimination. We present evidence from the basic sciences, economics, business, and other disciplines that illustrate that diversity is not only just but also the most rational pursuit for positive growth and advancement. Diversity is needed to enrich the specialty and augment its capacity to serve the heterogeneous population of patients that reflect our society. To promote equity and diversity in the field, ongoing deliberate, organized, and systematic efforts to change the status quo and make the field more inclusive are needed.
Neurosurgery at the Ibn Sina Hospital in Rabat, Morocco, since 1990.8 Not only have women made significant contributions to the field of neurosurgery as leading scientists and surgeons, but they have also been active champions for gender equity. In North America, Women In Neurosurgery (WINS) has advocated for systemic efforts to promote recruitment and retention of women in the field since 1989.9 The Women In Neurosurgery Committee of the World Federation of Neurosurgical Societies (WFNS) has mobilized a global network of women neurosurgeons for advocacy and empowerment.10 The European Association of Neurosurgical Societies (EANS) has recently established a Task Force on Diversity, spearheaded by Silvia Hernandez, which works to address gender diversity in neurosurgery in Europe.11 Along with these global efforts, there has been an increasing representation of women in leadership positions in the field. In 2005, Karin Muraszko was appointed Professor and Chair of the Department of Neurosurgery at the University of Michigan, becoming the first woman to head a neurosurgery department in the United States. Shelley D. Timmons was elected President of the AANS in 2018. Linda Liau (Figure 2), who chairs the Department of Neurosurgery at University of California, Los Angeles, and is the first Asian American woman to hold this position, was inducted into the National Academy of Medicine in 2018.12 Black, Indigenous, People of Color (BIPOC)13 are vastly underrepresented in the neurosurgical workforce. It is worth recognizing the handful of individuals who did succeed as neurosurgeons despite structural racism. In 1953, Clarence S. Greene, Jr., became the first African American certified by the American Board of Neurological Surgery (ABNS), followed by Jesse Barber and Lloyd Dayes in 1963 and 1967, respectively.14 In 1981, Alexa Canady (Figure 3) became the first African American woman neurosurgeon and successfully practiced pediatric neurosurgery for many decades.15-16 Deborrah Hyde (Figure 4) was the second African American woman to be board-certified in neurosurgery in 1985. She was also a philanthropist, who was devoted to improving education opportunities for African American students.16 In 2017, Odette Harris (Figure 5) became the first Black woman to be appointed Professor of Neurosurgery at Stanford University.17 The Society of Black Academic Surgeons was established in 1989 in the United States to foster the careers of African American surgeons.18 Recently, Physicians for Criminal Justice Reform published a statement signed by 82 Black neurosurgeons that declared systemic racism and state-sanctioned violence against Black communities to be a public health crisis.19 Neurosurgeons of diverse ethnic origins and nationalities have further enriched the field. Many successful neurosurgeons were immigrants or so-called geographic transplants not native to their country of practice. Gazi Yasargil, a world-renowned neurosurgeon who pioneered micro-neurosurgical techniques, was born in Turkey.20 He held the position of Professor and Chair of Department of Neurosurgery at the University of Zurich in Switzerland for 20 years before coming to the United States in 1994. Roberto Heros, a world-class expert in cerebrovascular neurosurgery and recipient of the 2010 Cushing Medal, was born in Cuba but left the country for exile in the United States.21 Renowned surgeons of the Barrow Neurological Institute, Robert Spetzler and Volker Sonntag, emigrated as children to the United States from Germany.22-23 Nelson Oyesiku, the current Editor-in-Chief of Neurosurgery, is from Nigeria.24 Alfredo Quinones-Hinojosa went from crossing the Mexico–United States border to work at a farm to becoming Professor of Neurosurgery and Oncology at Johns Hopkins University and Chair of Neurosurgery at the Mayo Clinic in Jacksonville, Florida.25 Other notable geographic transplants in neurosurgery include Jacques Morcos (Lebanon), Raymond Sawaya (Syria, Lebanon), Ossama Al-Mefty (Syria, Saudi Arabia),...
and many more. Perhaps the great success of these individuals is a reflection of the resilience, strength, and adaptability that they have built through their lived experiences as immigrants.

One area of diversity that is not very often discussed in medicine, especially in technical disciplines such as surgery, is the ability status of individuals in these professions. Strict technical standards constructed in the culture and system of surgical training can limit individuals with certain disabilities from pursuing surgery. One of the very few practicing neurosurgeons who have a documented disability is Karin Muraszko. She lives with spina bifida and was the first neurosurgery resident in the United States to complete training with a physical disability. She has been professor and chair of the Department of Neurosurgery at the University of Michigan since 2005 and the first woman chair of neurosurgery in the United States. Muraszko’s achievements serve as a reminder that, with the opportunity for training and institutional support, individuals with disabilities are perfectly capable of becoming excellent neurosurgeons with great technical and clinical skills. In her words, “… their ability to see me as capable instead of handicapped has permeated my life. Rather than emphasizing what I couldn’t do, I was encouraged to maximize what I could do.” Disabilities are not uncommon; >57 million Americans—20% of the U.S. population—are currently living with disability. However, only an estimated 2% of practicing physicians have a disability, making this one of the most underrepresented groups in medicine. Physicians most commonly acquire disabilities after completion of training. There is a lack of policy and structure for accommodating the needs of physicians and surgeons with disabilities in professional practice and for protecting them from stigma and discrimination.

The success stories of neurosurgeons from backgrounds that have historically been underrepresented in the field are important to highlight, not only in celebration of their trailblazing achievements but also in acknowledgment of the systemic barriers and discrimination they have had to overcome throughout their careers. The representation of these groups in the neurosurgery field has paved a way for others from similar backgrounds as well as stimulated new conversations on diversity, equity, and inclusion within the field. The large diversity gap in the neurological workforce persists. The number of neurosurgeons in certain gender and racial groups remains low. Women make up more than half of graduating medical classes each year in the United States, yet only 6% of ARNS-certified practicing neurosurgeons are women. Less than 4% of all neurosurgeons in the United States are Black/African American. The intersection of gender and race leads to more compounded forms of inequity. There are 33 neurosurgeons who identify as African American and female, making up 0.6% of the neurological workforce in the United States. The global situation appears to be similar. Neurosurgeons of various other gender identities and neurosurgeons who have disabilities are so poorly represented in the field that statistics regarding these groups are unknown.

Structural racism, implicit bias, and other systemic inequalities form “leaky pipelines” and hinder the progress of individuals in underrepresented groups at every stage of their neurological careers. A significant pay gap based on gender and race exists across all of academic medicine; neurosurgery is no exception. Implicit biases put underrepresented groups at a disadvantage in academic promotions, hires for leadership positions, evaluations, and institutional research support. Sexual harassment and discrimination of all forms are pervasive issues that are often unaddressed. The socioeconomic
While we acknowledge the particularity of diversity in the field of neurosurgery, it is worthwhile to consider efforts that have been made in other domains to promote diversity. In this section, we draw attention to military, business, politics, and the arts and the lessons these 4 nonmedical fields can provide on diversity.

Lessons Learned from Other Professions

Military. In 1948, President Truman issued Executive Order 9981, which outlawed racial discrimination in the U.S. military and declared “that there will be equality of treatment and opportunity for all persons in the armed forces [of the United States] regardless of race, color, religion or national origin.” According to their diversity roadmap, the military intends to become the “national leader in embracing the strengths of diverse people in an inclusive environment.” Indeed, the share of BIPOC in the U.S. military increased from 35% in 1990 to 40% in 2015. Black representation in the U.S. military now exceeds the percentage of Black Americans in the U.S. population. However, the institution fails to achieve the same level of diversity in terms of leadership roles. For example, while the percentage of Hispanic people enrolled in the U.S. military corresponds to the overall percentage of the Hispanic population in the country (both 18%), Hispanic officers represent <10% of the officer corps and only 2% of general officers.

Although the U.S. military as an institution is not a perfect example of workforce diversity and equity, it is worthwhile to examine its diversity agenda and its efforts to promote it. First, the U.S. military has acknowledged that to serve the United States as a nation and protect its interests, it must recruit and retain a workforce that “mirrors the demographic composition of the nation as a whole.” This principle is also relevant to the institution of medicine, which is tasked to provide equitable health care to all individuals in society. The U.S. military has also shown that to improve diversity, political will at the highest level of an institution is crucial. President Trump’s executive order was a catalyst to initiate the process and to the continued efforts of the U.S. Congress to improve representation of diverse groups both at the global and at executive levels of the U.S. Army. It demonstrated that efforts for diversity and inclusion do not stop at the “membership” level but must also reach leadership. Representation matters; experts believe that when enlisted soldiers see people of the same cultural and ethnic origin as them at the executive level, this encourages them to pursue a military career. Finally, the wide range of army commissions and divisions working on diversity reminds us that promoting systemic change for equity and diversity requires consistent efforts and a dedicated organization as a whole.

Business. In business, the notion of diversity and inclusion has emerged naturally with continuous cultural and demographic shifts in companies and consumers in the era of globalization. One of the most valued effects of diversity is its problem-solving advantage. According to a Harvard Business Review study, a group of people with different backgrounds and cultural perspectives tends to come up with more innovative and creative solutions to new situations. In addition, gender and racial diversity in the workforce has been associated with corporate profitability. Global studies by McKinsey & Company found that companies in the top quartile for racial and ethnic diversity are likely to have financial returns 15%–35% higher than the median of their national industry. Research done by the Boston Consulting Group showed that companies with substantial diversity among the leadership and management teams were associated with 19% higher revenue owing to innovation. Major companies such as Bain and Booz Allen Hamilton now showcase their commitment for diversity and spearhead conscious efforts to promote diversity and inclusion in company culture. Booz Allen Hamilton now boasts 67% representation of ethnic and gender minorities in its Board of Directors. In addition, ageism is detrimental to business; in fact, the encore careers movement championed by Bill Gates and Michael Bloomberg, among others, has led to stimulating and
productive engagement for individuals and corporations alike.\textsuperscript{57}

Although completely different fields, business and neurosurgery are disciplines that are both driven by teamwork. Qualities such as flexibility and effective problem-solving skills are valued. Cultural competency and humility are also key, especially in effective and equitable provision of health care. Business models clearly illustrate that diverse environments can best foster these qualities.

Politics. The importance of diversity in the world of politics was recently showcased through the 2019 novel coronavirus disease (COVID-19) pandemic. It has been observed that countries led by woman leaders tended to orchestrate the most effective and successful responses to this urgent health crisis.\textsuperscript{58-59} In fact, the United Nations has launched an all women-led initiative to mobilize funds to support global response to and recovery from COVID-19.\textsuperscript{56} However, this phenomenon is not new: multiple examples illustrate that when women are elected into political positions, they bring to the table critical issues that are otherwise neglected.\textsuperscript{60} The United Nations has found that at a global level, women representation in local governments has led to increased childcare coverage, access to water and sanitation, and policies to address gender-based violence.\textsuperscript{61} In addition, studies show that women in politics simply get more work done than men. Female legislators and congressional members sponsor more bills related to women’s health. On average, they also pass twice as many bills compared with their male colleagues.\textsuperscript{62} Iceland provides an example of how gender diversity in governance leads to better policies for all. After Vigdis Finnbogadottir was elected president of Iceland in 1980, women’s political participation increased drastically, and now the country boasts the most gender-equal parliament in the world. Having women in leadership has led to radical changes in policy that has improved the lives of women and families.\textsuperscript{62} For instance, in 2018, Iceland became the first country in the world to legally enforce equal pay.\textsuperscript{63} It has consistently ranked the most gender-equal country in the world by the World Economic Forum.\textsuperscript{62}

The promotion of gender equity by women in leadership shows that representation of diverse individuals in politics can elicit progressive policy change that will serve not only the dominant group but also groups that are less privileged or have less power in society. Likewise, diversification of leadership in neurosurgery can better address the needs of neurosurgeons of all backgrounds and identities and can help improve the neurosurgical training and practice environment for all.

Benefits of Diversity: Biological and Economic Perspectives

But divide your investments among many places, for you do not know what risks might lie ahead.

—Ecclesiastes 11:2\textsuperscript{64}

In nature there’s no blemish but the mind. None can be called deformed but the unkind.

—Twelfth Night, William Shakespeare\textsuperscript{65}
An increasing interest in the critical role of diversity is not unique to medicine or neurosurgery and originates far from the field. In fact, references to the importance of diversity can be found in the Bible, Torah, Talmud, Quran, Vedas, Tripitaka, and Shakespeare. More recently, work in the vastly different domains of ecology and economic theory has become strongly rooted in diversity.

For decades (though most prolifically in the late 1960s), ecologists have pondered and debated the value of biodiversity. Is it merely chance that there are estimated to be at least 5.3 million species of life on earth? Or is there some Darwinian advantage conferred to nature by the presence of such diversity? Countless studies completed via observation, modeling, and experimental conditions consistently supported the following 3 key findings:

1. Biodiversity improves the average level of performance of a system.
2. Biodiversity enhances productivity and stability of a system.
3. Biodiversity improves resilience to negative change and lowers the risk of negative outcomes when a system is threatened.

The field of economics also relies on diversification to achieve better outcomes. Economist Harry Markowitz was awarded the 1990 Nobel Prize in Economic Sciences for his work developing the modern theory of diversification.

The 20th-century economist Benjamin Graham, the father of value investing, described the theory of portfolio diversification as follows: “As the number of such commitments is increased, the more certain does it become that the aggregate of the profits will exceed the aggregate of the losses.”

Graham’s student, John Templeton, was another tremendously successful investor and follower of the theory of diversification. He advanced the market with globally diversified mutual funds, which further expanded investment options.

CONCLUSIONS

Over the past century, the field of neurosurgery has evolved, expanded, and diversified in numerous directions. There is more work to be done to improve diversity within its workforce and augment its capacity to serve the heterogeneous population of patients that reflect our society. Lessons can be learned from other disciplines that illustrate the essential role of diversity in improving performance, stimulating growth, and promoting equity. The case for diversity is rooted in justice, but it is also the most rational pursuit, as its benefits are evidenced in biologic and economic contexts. For the field of neurosurgery to continue to advance, it must move into the future with the team best equipped for success. A key to this success is diversity.

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