



Diversity in Neurosurgery

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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

COVID-19: 2019 novel coronavirus disease

EANS: European Association of Neurosurgical Societies

WINS: Women In Neurosurgery

WFNS: World Federation of Neurosurgical Societies

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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

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 identities 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 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, the military, and other fields that illustrate the universal and essential role of diversity in promoting positive growth and progress. Finally, we present evidence that both justice and excellence require the system-wide promotion of diversity, equity, and inclusion in neurosurgery.

DIVERSITY ISSUES IN NEUROSURGERY

Surgical fields have historically been structured for and dominated by White men.

Neurosurgery is no exception; throughout time and to the present day, all other genders have been underrepresented in neurosurgery. However, there are a few notable individuals who entered and excelled in the field despite gender-based barriers. Although not a neurosurgeon, Louise Eisenhardt, in the center of the photograph shown in **Figure 1**,² was a renowned neuropathologist who became the first woman president of the Harvey Cushing Society, now the American Association of Neurological Surgeons (AANS), in 1938. She also served as the first editor of the *Journal of Neurosurgery* from 1944 to 1965.^{1,3} The world's first women neurosurgeons emerged in Europe in the 1940s: Alice Rosenstein from Germany, Diana Beck from England, and Sophia Ionescu from Romania.^{4,5} These women were closely followed by Aysima Altinok in Turkey and Ruth Kerr Jacoby in the United States, who became board-certified in neurosurgery in 1959 and 1961, respectively.^{1,6} T. S. Kanaka in India became the first woman neurosurgeon in Asia in 1968.⁷ Najia El Abbadi was the first woman neurosurgeon in Africa. She has served as the Professor and Chair of



Figure 1. Attendees at the first meeting of the Harvey Cushing Society in Boston, 1932. (Used with permission from American Association of Neurological Surgeons. About the AANS. Available at: <https://www.aans.org/en/About-Us?Name=1>. Accessed July 20, 2020.²)

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, Sr., 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.^{1,15} Deborah 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 2018, 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.^{22–24} Nelson Oyesiku, the current Editor-in-Chief of Neurosurgery, is from Nigeria.²⁵ 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.²⁶ Other notable geographic transplants in neurosurgery include Jacques Morcos (Lebanon), Raymond Sawaya (Syria, Lebanon), Ossama Al-Mefty (Syria, Saudi Arabia),



Figure 2. Dr. Linda Liau. (Used with permission from Schmidt E. UCLA neurosurgeon named to National Academy of Medicine. *UCLA Newsroom*. October 15, 2018. Available at: <https://newsroom.ucla.edu/releases/linda-liau-ucla-neurosurgeon-national-academy-of-medicine#:~:text=Linda%20Liau%2C%20an%20internationally%20renowned,fields%20of%20health%20and%20medicine>. Accessed July 20, 2020.¹²)



Figure 3. Dr. Alexa Canady. (Used with permission from Shaw G. Black History Month Honors Alexa Canady, MD: First African-American Woman Neurosurgeon. Available at: <https://medicine.iu.edu/blogs/women-in-medicine/black-history-month-honors-alexa-canady-md-first-african-american-woman-neurosurgeon/#:~:text=All%20Articles-,Black%20History%20Month%20Honors%20Alexa%20Canady%2C%20MD,First%20African%2DAmerican%20Woman%20Neurosurgeon&text=Alexa%20Irene%20Canady%2C%20MD%2C%20was,the%20United%20States%20in%201981.> Accessed July 20, 2020.¹⁵)

and many more. Perhaps the great success of these individuals is a reflection of the



Figure 4. Dr. Deborrah Hyde. (Used with permission from McClelland S 3rd. M. Deborrah Hyde, MD, MS: the second African-American female neurosurgeon. *J Natl Med Assoc.* 2007;99:1193–1195.¹⁶)



Figure 5. Dr. Odette Harris. (Used with permission from Costello P. Neurosurgeon Odette Harris: A unique and rare physician. Available at: <https://scopeblog.stanford.edu/2018/06/20/neurosurgeon-odette-harris-a-unique-and-rare-physician/#:~:text=Jamaican%2Dborn%20Odette%20Harris%20was,journey%20in%20a%20new%20podcast.&text=The%20numbers%20speak%20for%20themselves,with%20an%20abundance%20of%20women.> Accessed July 20, 2020.¹⁷)

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 Murszko. She lives with spina bifida and was the first neurosurgery resident in the United States to complete training with a physical disability.²⁷ 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.²⁸ Murszko'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."²⁸ 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.²⁹ 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 neurosurgical 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 ABNS-certified practicing neurosurgeons are women.³⁰ Less than 4% of all neurosurgeons in the United States are Black/African American.³¹ 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 neurosurgical workforce in the United States.³¹ The global situation appears to be similar.^{32–34} 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 inequities form "leaky pipelines" and hinder the progress of individuals in underrepresented groups at every stage of their neurosurgical careers. A significant pay gap based on gender and race exists across all of academic medicine; neurosurgery is no exception.^{30,35–38} Implicit biases put underrepresented groups at a disadvantage in academic promotions, hires for leadership positions, evaluations, and institutional research support.^{39–41} Sexual harassment and discrimination of all forms are pervasive issues that are often unaddressed.⁴² The socioeconomic



Figure 6. Jeff Hanson, artist, at the Make-A-Wish Gala with his parents, Julie and Hal Hanson. (© 2020 All Rights Reserved Jeffrey Owen Hanson LLC.)

diversity gap also persists in the United States, with the majority of medical students still coming from the top income quintile.⁴³ Because the neurosurgical workforce has historically been homogeneous, its policies, practices, and cultural norms have been largely formed by and geared toward a specific dominant group.^{44,45} This history is known to have had a marginalizing impact on underrepresented groups. To promote diversity, equity, and inclusion in the field, ongoing deliberate, organized, and systematic efforts to change the status quo and make the field more inclusive are needed.

Lessons Learned from Other Professions

While we acknowledge the particularity of the field of neurosurgery, it is worthwhile to consider the 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.

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.”⁴⁶ According to their diversity roadmap, the military intends to become

the “national leader in embracing the strengths of diverse people in an inclusive environment.”⁴⁷ Indeed, the share of BIPOC in the U.S. military increased from 25% 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.⁴⁸ 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.⁴⁸

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 best interests, it must recruit and retain a workforce that “mirrors the demographic composition of the nation as a whole.”⁴⁸ 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 Truman’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.⁴⁹ 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.⁵⁰ 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.⁵¹ One of the most valued effects of diversity is its problem-solving advantage. According to a *Harvard Business Review* study,⁵² 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.⁵³ 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.⁵⁴ 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.^{55,56} Booz Allen Hamilton now boasts 67% representation of ethnic and gender minorities in its Board of Directors.⁵⁶ 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



Figure 7. Heart of Barcelona, by Jeff Hanson. © 2020 All Rights Reserved Jeffrey Owen Hanson LLC.

productive engagement for individuals and corporations alike.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.^{58,59} In fact, the United Nations has launched an all women-led initiative to mobilize funds to support

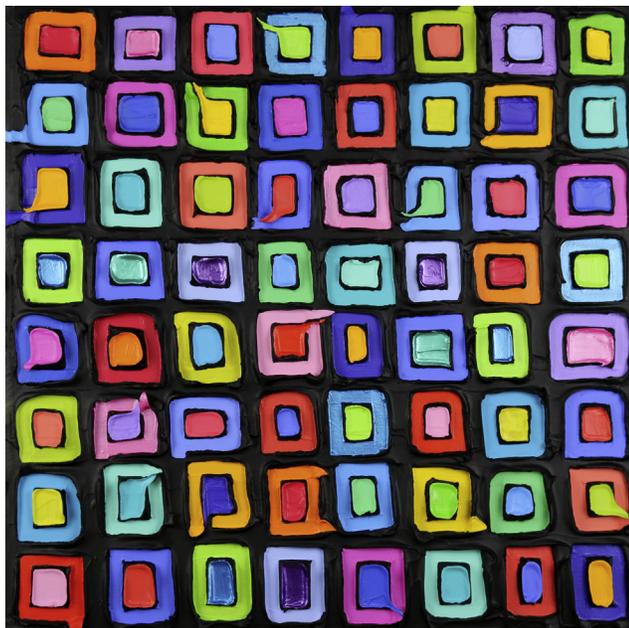


Figure 8. Belgium Chocolate Shoppe, by Jeff Hanson. © 2020 All Rights Reserved Jeffrey Owen Hanson LLC.

global response to and recovery from COVID-19.⁶⁰ 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.⁶¹ 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.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.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.⁶² For instance, in 2018, Iceland became the first country in the world to legally enforce equal pay.⁶³ It

has consistently ranked the most gender-equal country in the world by the World Economic Forum.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 11:2⁶⁴

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

—Twelfth Night, William Shakespeare⁶⁵

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 1990s), 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 conditions⁶⁶⁻⁷² 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.⁷³ 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."⁷⁴

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.⁷⁵ John Maynard Keynes, one of the most successful investors of the 20th century, also staunchly adhered to this theory. Retrospective analyses of his selection of investments have

demonstrated that his method of investing in a large collection of random, unassociated entities carried the lowest risk and highest likelihood of positive gains.⁷⁶ Modern-day investors including Warren Buffett, Jeff Bezos, and Bernard Arnault have also implemented Markowitz's model of diversification to achieve tremendous success and continue to advise it to new investors.

A common argument against diversification of the neurosurgical workforce is that this prioritization may compromise the field's standards of excellence. In an Editorial in *Acta Neurochirurgica*, Karl Schaller articulated a view held by many that excellence must be maintained as the specialty attracts gender and racial minorities in increasing numbers.³⁷ Diversification has objectively demonstrated its capacity to improve performance without jeopardizing the integrity of the system in other occupational environments, and it is logical that the outcomes will be the same in neurosurgery. It would be a false assumption that individuals who are different in terms of gender and race from individuals who have traditionally dominated the field would not be as well equipped or would lower the standards of the field. It is important to acknowledge that the underrepresentation of certain groups in neurosurgery is not due to their lack of capability or skills, but rather is due to the systemic barriers and discrimination against these groups.

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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