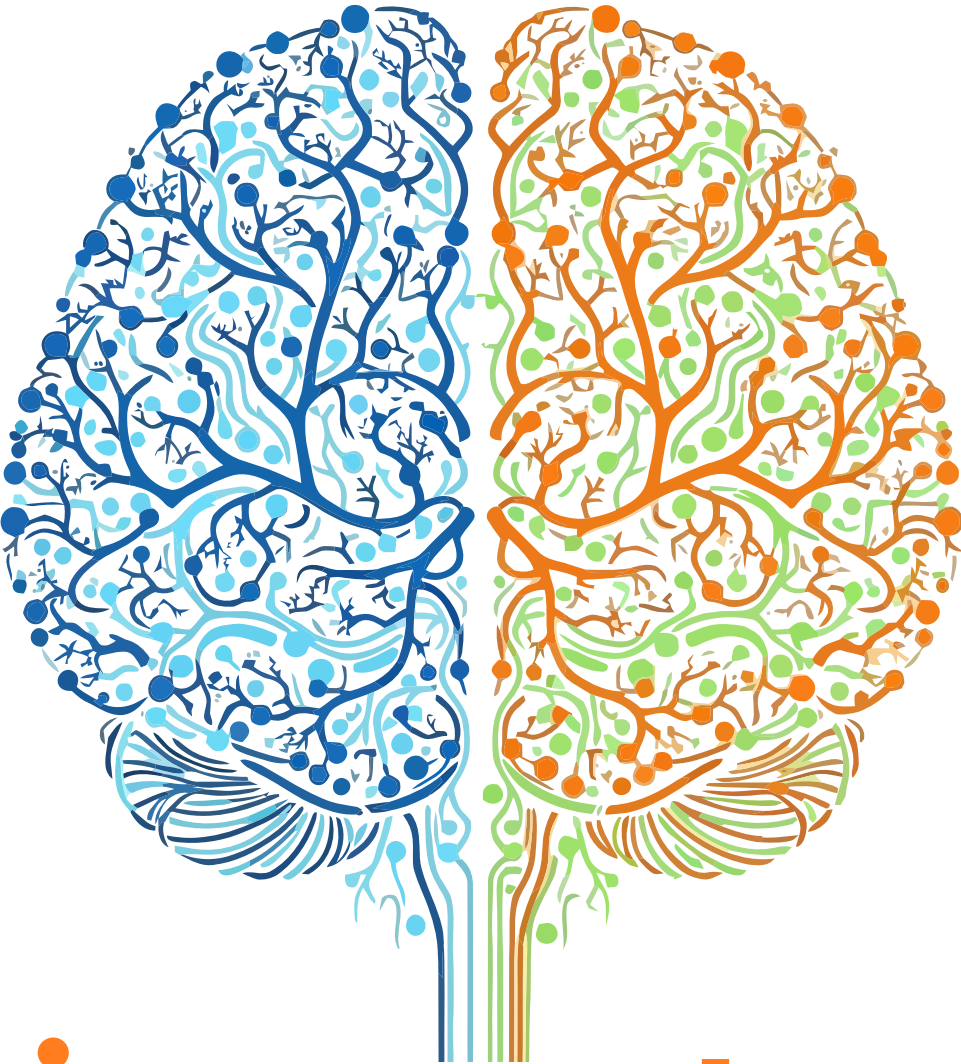


congressquarterly

WINTER 2026



Environment + Neuroscience

Adapting to
Environmental Change



CNS

6 Neurosurgery in Natural
Disasters

12 Human Health is the Lived
Experience of Climate Change

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EDITOR'S NOTE



Theresa Williamson
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Julie L. Chan
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Environmental change is increasingly shaping neurological disease, neurosurgical practice, and professional responsibility. From climate-driven disasters and pollution-related cerebrovascular risk to sustainability within our own institutions, neurosurgeons are encountering the effects of environmental forces in both clinical care and health system operations. This issue explores how the neurosurgical community is responding through preparedness, innovation, research, and leadership.

We begin by examining sustainability efforts within organized neurosurgery. **Khoi Than** and **Akash Patel** highlight initiatives undertaken at the CNS Annual Meeting to reduce environmental impact while modeling climate-conscious practices at a national professional level. The issue then turns to neurosurgery's role during environmental crises, exploring the responsibilities and challenges of delivering care during national disasters. These themes are brought to life through firsthand perspectives from **Garni Barkhoudarian**, who recounts preparedness, uncertainty, and resilience during the Palisades Fire, and from **Scott Wait** and **Rich Lytle**, who share experiences as neurosurgical first responders on the front lines of emergency care.

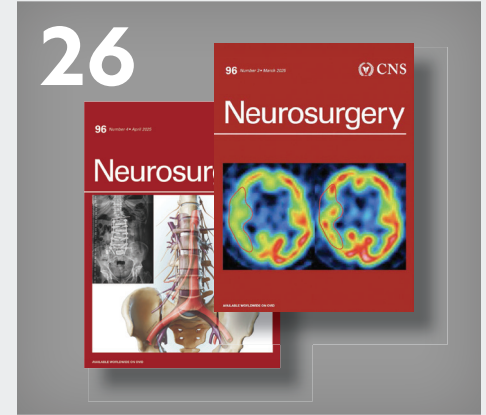
Proactive engagement with climate action and public health is further explored through a practical examination of hospital-based sustainability efforts by Ann Christine Duhaime, who addresses the feasibility, value, and impact of "greening" healthcare systems. Expanding the lens beyond institutions, **Vanessa Kerry** and **Olivia Paulo** emphasize that climate change represents a lived health experience for patients and communities, with direct and growing implications for neurological disease and care delivery.

This issue also highlights emerging scientific evidence linking environmental exposures to brain health. **Michael Lawton** and **Tomoki Hashimoto** examine the evolving data surrounding microplastics as a potential neurological threat, underscoring critical gaps in knowledge and the need for continued investigation. Complementing this work, **Robert Rennert**, **Ramesh Grandhi**, **Alexander A. Khalessi**, **William T. Couldwell**, and **Samuel A. Tenhove** explore the impact of air pollution on cerebrovascular disease, reinforcing air quality as a modifiable risk factor.

A forward-looking perspective is offered by **Theresa Williamson** through a discussion on neuroscience, resilience, and action in the context of the climate crisis, highlighting opportunities for leadership and advocacy within the field. The issue concludes with key updates from across the CNS community, including a the CNS Foundation, Neurosurgery Publications and the Washington Committee.

Together, these contributions underscore the expanding role of neurosurgeons—not only as clinicians and scientists, but also as educators, leaders, and advocates at the intersection of environment and brain health. We hope this issue encourages reflection, dialogue, and action as neurosurgery continues to adapt to a changing world.

CONTENTS



Editor's Note

Theresa Williamson, Julie Chan

President's Message

Martina Stippler

CNS ANNUAL MEETING

4 CNS Annual Meeting Green Initiatives

Khoi D. Than, Akash Patel

6 Neurosurgery in Natural Disasters

The Palisades Fire:
A Story of Preparedness, Community,
Uncertainty, Resilience and
Perseverance

Garni Barkhoudarian

Neurosurgical First Responder
Experience with Hurricane Helene
Scott Wait, Rich Lytle

10 "Greening" Your Hospital and Other Climate Action: Can You Do It? Is It Worth It?

Ann Christine Duhaime

12 Human Health is the Lived Experience of Climate Change

Vanessa Kerry, Olivia Paulo

16 Microplastics and the Brain: An Emerging Threat We Can No Longer Ignore

Michael Lawton, Tomoki
Hashimoto

18 Impact of Air Pollution on Cerebrovascular Disease: An Evolving Paradigm

Robert Rennert, Ramesh Grandhi,
Alexander A. Khalessi, William T.
Couldwell, Samuel A. Tenhoeve

20 From Climate Crisis to Brain Health: Dr. Burcin Ikiz on Neuroscience, Resilience, and Action

Theresa Williamson

FOUNDATION UPDATE

22 Foundation Update

Lola B. Chambless

24 Neurosurgery Publications Feature: The Research Environment

Douglas Kondziolka

INSIDE THE CNS

26 Washington Committee Update

Alex Khalessi, Charlotte Pineda

CNSQ INSIDE BACK COVER

Images in Neurosurgery

PRESIDENT'S MESSAGE



Martina Stippler, MD, FCNS
President, Congress of Neurological Surgeons

Dear Colleagues,

I am excited to address you for the first time as President of the Congress of Neurological Surgeons (CNS). As I look toward the months ahead, I am grateful for the opportunity to serve an organization that has played a critical role in my professional life, and energized by the challenges we will tackle and the milestones we will undoubtedly achieve together.

My primary commitment for the coming year is to foster a renewed sense of belonging and connection for every member of our organization. The strength and impact of the CNS comes from our membership. Whether you are a resident navigating the rigors of training, a mid-career surgeon balancing clinical practice, with leadership opportunities and family, or an established thought leader sharing decades of wisdom, you are the heartbeat of this organization. We are at our best when we are connected—learning from one another, supporting one another, and drawing strength from our shared mission to care of our patients.

As a forward-thinking organization, the CNS continues to inspire and facilitate the scientific discovery that defines the modern era of neurosurgery. However, clinical excellence is only one facet of our responsibility. The CNS is uniquely positioned to bring together thought leaders in neurosurgery to collaborate around the challenges facing our specialty. Innovation does not happen in a vacuum; it requires a deliberate intersection of diverse perspectives and a willingness to confront uncomfortable truths. By driving the innovations that move the field forward, we ensure that neurosurgery does not merely react to the future, but actively shapes it.

This brings us to the theme of this issue of *Congress Quarterly*, at the intersection of neurosurgery and climate change.

At first glance, some may wonder how a global environmental phenomenon relates to the precision work of the operating room. Yet, as the articles in this issue demonstrate, the impact of climate change on our field is becoming impossible to ignore. We are seeing a shift in the epidemiology of neurological diseases, from the expansion of vector-borne illnesses affecting the central nervous system to the documented rise in stroke and neurodegenerative diseases linked to extreme heat and deteriorating air quality.

Furthermore, the logistical realities of our practice are being tested. Climate change is no longer a theoretical threat; it is a clinical and operational one. Extreme weather events—hurricanes, wildfires, and unprecedented flooding—frequently disrupt the fragile supply chains that provide us with the surgical tools we require. These events strain the infrastructure of our trauma centers and force us to reconsider how we provide emergent neurosurgical care when the power grid fails or a city is evacuated.

This issue of *Congress Quarterly* highlights these systemic impacts, but it also shines a light on the extraordinary leaders within our membership who have risen to the challenge during recent climate emergencies. You will read accounts of colleagues who have maintained life-saving services in the wake of natural disasters, showing a level of resilience and ingenuity that defines the neurosurgical spirit. Their stories are a testament to the fact that while we cannot always control the environment around us, we can control our readiness and our response.

In addition to disaster response, this issue explores the concept of “sustainable neurosurgery.” As surgeons, we are stewards of immense resources. The operating room is one of the most resource-

We owe it to our patients to be informed, and we owe it to the next generation of neurosurgeons to ensure the field is prepared for the environmental realities of the 21st century.

intensive environments in the hospital setting. By examining our carbon footprint and identifying ways to reduce waste without compromising patient safety, we can lead the way in creating a more sustainable healthcare model.

The CNS has always been an organization that looks over the horizon. Just as we led the way in digital education, we must now lead the way in understanding how a changing planet affects the health of the patients we serve. We owe it to our patients to be informed, and we owe it to the next generation of neurosurgeons to ensure the field is prepared for the environmental realities of the 21st century.

I want to thank the contributors to this issue for their willingness to tackle such a complex, timely topic. Their work reminds us that our duty to our patients extends beyond the doors of the clinic and the walls of the OR.

As we move forward into this year, I invite you to engage deeply with the CNS. Attend our live courses, tune into our podcasts and connect with your colleagues at essential networking events, including the CNS Annual Meeting. Let us use this year to strengthen the bonds of our community and to drive the innovations that will define the future of neurosurgery.

I am honored to be on this journey with you. Thank you for your membership, your dedication, and your tireless commitment to excellence. 🇺🇸

Sincerely,
Martina Stippler, MD, FCNS
President, Congress of Neurological Surgeons

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Khoi D. Than, MD,
FCNS



Akash Patel, MD,
FCNS

Advancing Sustainability at the CNS Annual Meeting

Across medicine, sustainability has become an increasingly urgent priority, and professional societies are no exception. As neurosurgeons, we recognize the environmental impact of our clinical practices, our research, and the meetings that bring our community together. In recent years, the Congress of Neurological Surgeons (CNS) has made meaningful strides to reduce the environmental footprint of its Annual Meeting. These initiatives span nearly every operational domain, from signage and food service to transportation and technology. While each measure may appear modest in isolation, collectively they represent a deliberate and growing commitment to responsible stewardship.

This article outlines the key green initiatives implemented at the CNS Annual Meeting and highlights how these efforts align with broader sustainability goals shared across the health care ecosystem.

Reducing Waste Through Smarter Paper Use and Signage

Printed materials and signage have traditionally been major contributors to event waste. The CNS has taken a multi-tiered approach to address this challenge.

The meeting now reuses name badge holders and lanyards, significantly reducing the volume of plastic that historically ended up as single-use waste. In addition, single-use rigid graphics are printed on recyclable substrates, which are then donated to local art schools for creative reuse. This partnership keeps materials out of landfills while supporting local arts education.

To further reduce landfill impact, expo aisle signs are printed on recyclable paper, and all printed signs are designed with longevity in mind so they can be repurposed across meeting years whenever practicable. No inks containing volatile organic compounds are used in produced graphics, reducing the release of harmful emissions during printing and disposal.



These steps help ensure that necessary visual communication at the Annual Meeting does not come at the expense of environmental responsibility.

Sustainable Food and Beverage Practices

Food service represents another area where thoughtful planning can produce sizable sustainability gains. The CNS Annual Meeting's approach prioritizes waste reduction, responsible material use, and community support.

Refillable water stations have eliminated the need for individual plastic water bottles, a small behavioral shift with a substantial cumulative impact given the size of the meeting. Whenever possible, food is served using china, glassware, and metal cutlery, sharply reducing the volume of single-use serveware. Where disposables remain necessary, CNS has selected environmentally preferable alternatives, including compostable PLA-based clear plastics, sugarcane-pulp plates, and cornstarch-based cutlery. In addition, self-serve food stations allow attendees to customize portion sizes, reducing both food waste and reliance on single-use packaging. Finally, the CNS partners with local charities and community kitchens to donate excess food, ensuring that surplus resources serve community needs rather than contributing to waste.

High-Efficiency Transportation Solutions

Transportation has an outsized influence on the overall carbon footprint of large events. To mitigate this, the Annual Meeting uses high-efficiency motorcoaches for mass attendee transport. These vehicles deliver **184 to 240 passenger miles per gallon**, making them **84% more fuel efficient** than a single passenger traveling in a hybrid car. By consolidating attendee movement into fewer, more efficient vehicles, the CNS reduces fuel consumption and emissions while simplifying logistics.

Technology as a Tool for Sustainability

Digital tools play a growing role in reducing the need for printed

materials. The CNS Meeting App continues to expand in functionality, reducing or eliminating the printing of traditional pocket guides and other paper-based meeting resources.

The meeting also makes extensive use of digital signage, minimizing the number of meter boards and printed signs required. This shift decreases material waste and improves flexibility, enabling real-time updates without the need for reprinting.

Environmentally Conscious Convention Center Operations

Sustainability initiatives extend behind the scenes as well. The convention center supporting the Annual Meeting implements energy-efficient practices that complement CNS efforts.

These include the use of Energy Star-rated electronic equipment when available and routinely powering down electronics each night to conserve energy. The facility also employs greener logistics, with **97%** of over-the-road shipping conducted through EPA SmartWay-certified carriers that meet strict emissions and fuel-efficiency standards.

On the equipment side, heavy machinery is fueled by electricity or propane unless facility requirements dictate otherwise. In addition, the convention center prioritizes local sourcing of materials and labor, reducing transportation emissions and supporting regional economies.

Eco-Friendly Décor and Materials

Even the decorative and structural elements of the meeting environment reflect the CNS's commitment to sustainability. The expo aisle carpet contains **24% to 50%** post-industrial recycled content, reducing demand for virgin materials. The soy-based carpet padding is manufactured from recycled content, designed for durability and reuse, and is **100% recyclable** after its service life.

Such choices demonstrate that environmentally responsible options can meet high standards for durability and aesthetic quality.

A Continuing Commitment

The CNS Annual Meeting's sustainability initiatives illustrate that environmental responsibility is not an abstract ideal but a practical, achievable goal. By integrating green practices across all aspects of meeting planning and execution, the CNS reduces waste, conserves resources, and demonstrates leadership consistent with the values of the neurosurgical community.

As sustainability becomes an increasingly central concern within health care, these efforts serve not only the immediate needs of the meeting but also the broader mission of ensuring a healthier future for our patients and our planet. The CNS will continue to evaluate and refine its practices, seeking new opportunities to reduce environmental impact while preserving the high-quality meeting experience members expect.

If you have suggestions or would like to contribute to future sustainability efforts at the Annual Meeting, the CNS welcomes your input as we advance this shared and ongoing responsibility. 



Garni Barkhoudarian,
MD, FCNS

NEUROSURGERY IN NATURAL DISASTERS:

The Palisades Fire:

A Story of Preparedness, Community, Uncertainty, Resilience and Perseverance

Thinking back to January 2025, the fire seems like a distant memory. However, many are still reeling from its effects nearly a year later. Having grown up in Los Angeles, wildfires are a common occurrence with our fire season ironically not occurring during summer, but rather in the dry months of late fall. We are blessed with the semi-arid climate of Southern California with periods of rain. The lush vegetation from these rains results in fuel for impending fires after scorching hot summers. Just a couple of weeks earlier, the Franklin Fire in Malibu burned a number of acres near Pepperdine University. That was quickly extinguished by our courageous Los Angeles and California Fire Departments. We thought that was it for the season....

However, in January, the forecast was ominous. With the Santa Ana winds forecast at unprecedented levels of 60-80 mph—reaching 100 mph in the coastal areas—high-risk fire advisories had been announced. Hence, it was not surprising to hear about the fire in the Palisades that Tuesday evening. It seemed like another typical fire that one would expect in such a dry and windy climate. Alas, we were sorely mistaken. Later thought to have been reignited from a prior fire in the same region, the Palisades Fire quickly consumed the dry vegetation in the Santa Monica mountains, just above the Pacific Palisades community. Despite a swift response by the fire departments and first responders, nightfall interfered and due to high winds, fixed-wing and helicopter water and flame retardant resources were grounded. The fire grew exponentially. By the morning, the fire had grown to thousands of acres ultimately scorching 23,448 acres and destroying 6,837 homes and buildings. The amazing dedication and expertise of the first responders evacuated 105,000 citizens in the first hours of the disaster with only 12 ultimate fatalities. A truly heroic effort.

Nevertheless, many of us returned to work and quickly completed our scheduled operations. But by the afternoon, it was clear that this fire was going to define the next few days differently. The hospitals in the region including Santa Monica UCLA hospital and St. John's Health Center of Providence St. Joseph's Health—where I work—quickly canceled any remaining elective cases and effectively

remained on alert in a triage state expecting to treat burn victims or other fire related casualties.

Many of us were caught up with the fire directly. In this period of confusion, where information was conflicting and people were being prohibited from returning to their homes, we had little sense if any of our friends' or colleagues' health or if their homes had survived. One colleague of mine returned to his home the morning after the fires started on the edge of the fire boundary to assess damage and retrieve a car. Initially, all seemed fine but within a few hours the hillside below his house erupted in flames engulfing trees and brush with strong winds pushing the flames and embers onto his house and multiple adjacent homes. He quickly summoned support from a team of firefighters on an adjacent street, and they created a camp at his house and were able to save multiple homes in that part of the Palisades.

The wildfire broke all rules and marched up the coast, destroying 780 beachfront homes. On that fateful day, after completing two endonasal skull-base operations with Dr. Daniel Kelly, Dr. Chester Griffiths returned to his home, driving through the fire to join his neighbor who was left alone and found that there were no fire resources in the region and the fire was completely encircling their homes. However, Chester had been through numerous fires in his time living in Malibu and had completed Community Emergency Response Team (CERT) training and acquired firefighting equipment with repetitive simulation trainings with his neighbor and college-age son. With the CAL Fire resources spread thin and his neighborhood in jeopardy, they quickly got to work.

As they had trained, they connected multiple fire hoses to the nearby fire hydrants, applied "Barricade Fire Retardant", set up all emergency equipment and followed strict communication-engagement protocols and exit strategies. This effort resulted in saving his house, five neighbors' homes, and a commercial building over the following five days—fighting the flames, inhaling smoke and communicating with fire command as part of a larger team. That saved neighborhood is now called the "Malibu Island." Unfortunately, many were not as fortunate to be prepared or be available to protect their homes.



It did not help that during this challenging time of two major fires in Los Angeles County, the Palisades fire and the Eaton fire near the Jet Propulsion Laboratories (JPL), that at least four other fires were lit by arsonists, each burning hundreds of acres and drawing fire department resources away from fighting these larger fires. To add insult to injury, looters took advantage of the situation, vandalizing and stealing from the abandoned homes due to evacuation orders. On day three of the firefight, Dr Griffiths, his neighbor and son encountered a group of three masked looters in a van. They dissuaded them with appropriate threats to leave the street. This and similar looting events prompted the National Guard to arrive and to help restore security to the areas at risk.

I distinctly remember driving home and seeing numerous looters in our neighborhood, running through the trees and at least two individuals with gas cans throwing them into the shrubs in our community, one of which started a fire again requiring fire resources to extinguish. In a sense of irony, we needed to rely on the national guard and the local police to have continual presence in our communities to protect them from arsonists and looters. I never would have thought that I would relish having a soldier in fatigues, armed with automatic weapons in front of my community. However, it was a welcome sight to see these volunteers there keeping us safe for the following few months.

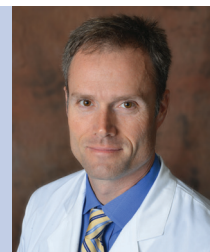
Today, the aftermath of the fires persists. Nearly half of all the properties in Pacific Palisades, Malibu, Altadena and Pasadena were lost (16,235 structures destroyed). Many have permanently relocated outside the state. To date, many evacuees still have not returned to their surviving properties due to safety or structural concerns. These fires exposed our fragile insurance system, overwhelmed by such massive catastrophes. The long-term ramifications will certainly affect the remaining population, property values and the possibilities

of rebuilding in the area. Between all the fires in the area, 32 people had perished, with potentially over 400 others from fire-related health issues. An estimated \$100 billion of property was lost or damaged. Thousands of families have been displaced. Of the 50% of the population that had to evacuate, it is thought that only 1/3 to half will actually return to their homes to rebuild.

Throughout all the pandemonium however, some good has come as well. Our communities bonded to protect our property and our loved ones. I was taking on-call patrol shifts, reminding me of my residency days. Work never stopped beyond the first two days and we continue to come in and take care of those that were displaced or affected by the fires. People were able to look past their differences whether political, ideological or otherwise and the city residents bonded in solidarity against both natural and domestic challenges.

There are lessons to be learned from the aftermath of this fire. Much like in our M&M sessions, the fire department continues to learn key lessons including resource management, high-risk fire conditions, command structures, and financial support. A number of homes did survive in areas that were otherwise decimated, pointing to key architectural differences. That will certainly lead to structural codes that will be applied to new structures during reconstruction. "Watch Duty" has become a necessary app on our smart phones, alerting us to any new fires or other challenges earlier than one would expect. Dr. Griffiths suggests we all should apply the "Emergency Preparedness Culture" we practice in our professional lives to our personal community-neighborhood lives by engaging our community with CERT training, knowing who our neighbors are and their vulnerabilities, obtaining appropriate equipment and supplies, training, simulating and teaching each other as we do professionally. It is not "if" a disaster will occur, it is "when."

Certainly, the fires were a life-altering event for many Angelenos. One would hope this would be a generational event, though these massive wildfires are happening at an increasing frequency. We have learned to always be prepared, to learn to rely on our neighbors and our loved ones. I have yet to meet a physician who plans to leave Los Angeles due to these fires. That is the epitome of grit and resilience among our healthcare professionals to lead emergency preparedness at "Home." ❌



Scott Wait, MD, FCNS,



Rich Lytle, MD, FCNS

Neurosurgical First Responder Experience with Hurricane Helene

Hurricane Helene made landfall in the Florida Panhandle at 3:10 a.m. on September 27, 2024, as a Category 3 storm with 120 mph sustained winds, but its deadliest impacts came from extreme inland rainfall and flooding across the southern Appalachians, especially western North Carolina (NC). Across all affected states, Helene caused roughly 250 deaths.

In western North Carolina, rainfall pushed rivers and streams beyond historic levels. The French Broad River crested above its record 1916 flood mark. More than 2,000 high-water marks were documented across North Carolina, Tennessee, and Virginia—approximately 2,500 square miles experienced rainfall typical of a 1-in-1,000-year event. One western NC weather station recorded over 30 inches of rain in under four days. North Carolina suffered the highest toll, with around 107 confirmed deaths statewide, including 43 in Buncombe County (Asheville's county) alone. Local residents stated that the death toll was much higher.

On Friday, September 27, 2024, at 4:37 p.m., the text message came through: "Hey Scott, it's Rich. Sorry to contact you in a situation like this. We have a three-year-old who has a brainstem tumor and had a biopsy at 'outside institution' about two weeks ago. She is becoming more lethargic, probably needs a shunt. Doesn't look like she is crashing, but I think she probably needs a shunt in the next one to two days. As you know, we got nailed by the remnants of the hurricane yesterday. I cannot even look at her films. The OR has no sterile water and is only doing emergency cases. We are running on backup power. I don't think it makes sense to just put in an EVD, and I think she is safe enough to travel."

What we found out later was that as she was declining at home, her local roads were washed out, and there was no conventional way to transport her to Mission. Her parents describe a dramatic "water rescue" to get her to Mission Hospital, only to learn that the hospital was essentially shut down. In total, it took 36 hours to get from her home to Charlotte Levine Children's Hospital, a two-hour trip by car

under normal circumstances. When she arrived, she needed urgent intervention. We performed an Endoscopic Third Ventriculostomy (ETV) and palliated her hydrocephalus.

Mission Hospital in Asheville is licensed for approximately 815 beds and functions as the region's only Level II Trauma Center and comprehensive stroke center, with a children's hospital and "Level III NICU." Mission Health serves the 18 westernmost counties of North Carolina through multiple hospitals and air and ground transfer networks; its MAMA helicopters routinely transport patients from 18 WNC counties, as well as parts of eastern Tennessee, northeast Georgia, and northern South Carolina. Western North Carolina's 18 counties are home to roughly one million people, in a region whose population is older, poorer, and more rural than the state as a whole.

The water source for Asheville and Mission Hospital was buried under a landslide. This left the hospital without city water for more than two months, forcing reliance on trucked-in water for handwashing, sterilization, dialysis, and basic operations.¹ Mission survived on trucked-in water until a new well was drilled on the hospital campus. The hospital had no running water for over a week. Nearly all neurosurgical work ceased for three weeks.

Hospitals across western NC spent days on backup generators, with widespread water system failures and disrupted communications. Blackhawk helicopters were deployed to airdrop food and water into subdivisions in Asheville and the surrounding region where road access had been washed away. Over 90 percent of the Asheville region lost phone and internet access, making it nearly impossible to communicate outside of Mission Hospital. NC Health News described the situation as "managed chaos."

On Monday, September 30, 2024, at 7:00 a.m., my team inherited the neurotrauma service at Atrium Health Carolinas Medical Center (CMC) in Charlotte. I became aware of an early-thirties male who had just arrived at our facility with a three-column, unstable thoracic spine fracture. As I was talking with him, he described being swept

down the mountain in a mudslide on Friday morning, September 27, while trying to flee to safety in his car. He was trapped in the vehicle for over 48 hours prior to rescue, and it took an additional day to get him to CMC. We operated on him that day.

There were multiple facets to the problem. Access and staffing were significant challenges. Impassable roads and landslides limited staff and patient travel; some workers stayed on site for days at a time. Staff themselves had lost homes, cars, or family members, yet were still caring for a surge of storm-related trauma, strokes, and medical emergencies.¹ Mission's status as the dominant acute-care provider and the only Level II Trauma Center in the region meant that when its capability was constrained, there was no regional alternative.

For neurosurgery, this translated into both local delays in definitive care and a sudden need to redistribute complex patients across North Carolina and neighboring states. This redistribution process resulted in significant delays in patient transfer.

Comprehensive statewide transfer data for the Mission catchment area after Helene have not been published. However, reports from Advocate Health indicate that Atrium's Regional Operations Center and Capacity Command Center facilitated 296 patient transfers (all diagnoses) and 104 consults from western North Carolina in the first two weeks after the storm, while the deployment of the MED-1 mobile hospital in Tryon cared for 116 patients and coordinated additional transfers to nearby centers.² State officials report that 145 healthcare facilities across western North Carolina were evacuated, implying substantial redistribution of inpatients, many of whom would ordinarily have remained within Mission's referral network.

Public reports do not provide a specialty-specific map of where neurosurgical patients from Mission's 18-county catchment ultimately went after Helene. However, the state's coordination system and health-system reports indicate that Atrium Health's Level I Trauma Center at Carolinas Medical Center in Charlotte and its sister Level I center at Wake Forest Baptist in Winston-Salem functioned as the primary adult tertiary destinations for evacuated patients from western North Carolina, with Levine Children's Hospital receiving complex pediatric cases.³ When those centers approached capacity, the Triangle systems—Duke University Hospital, UNC Medical Center, and WakeMed Raleigh—acted as backup Level I/II referral centers, and the statewide transfer platform allowed patients to be sent as far east as ECU Health Medical Center in Greenville when necessary.³ For counties on the far western edge, some Mission-catchment patients may have been routed into Tennessee's tertiary network when local Tennessee hospitals were incapacitated. Johnson City Medical Center (Ballad

Health), Johnson City, Tennessee, received all evacuated patients from Unicoi County Hospital, located approximately 50 miles north of Asheville, after Helene flooding destroyed that facility.¹⁰

Helene taught us that neurosurgery in western NC, despite being high quality, is a single-failure-vulnerable system. When Mission suffered, the entire neurotrauma structure for one million people hinged on the ability of Charlotte, Winston-Salem, and the Triangle to absorb the load. Many of those hospitals routinely operate beyond capacity and are frequently "closed" to transfer.

The good news is that our spine patient has fully recovered, has no restrictions, is back to work, and is enjoying the outdoor activities that the mountain region of North Carolina has to offer. Even better, the three-year-old ultimately underwent an orbitozygomatic craniotomy to remove her focal brainstem pilocytic astrocytoma, is neurologically intact, and will likely avoid a lifetime of chemotherapy and radiation effects—serendipity, and a silver lining in what was a record-setting cloud for her, her family, and the entire region.

Helene was not just a natural-disaster story. It was a systems failure and recovery playing out in real time in the real world. It exposed the reality that neurosurgical care across western North Carolina—like much of America—runs through a single center. This situation could occur in many locations across the United States outside of major metropolitan areas. When Mission went down, every downstream center worked harder, longer, and more efficiently to absorb the patients. It is the same story at all of these centers: staffing shortages (that is, chronic leadership insufficiency), space limitations, and inefficiencies of the electronic medical record platform. It is difficult to know whether our systems prevented all the morbidity and mortality associated with this catastrophic event. We suspect that we saved many—but not all. ❏

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“Greening” Your Hospital and Other Climate Action: **Can You Do It? Is It Worth It?**

During their training in medical decision-making, neurosurgeons are taught to consider the specific future of the individual patients they treat. Our pediatric neurosurgical patients have lifespans that (hopefully) stretch well beyond that of their physicians; the accelerating problem of climate change will affect them more than it will affect us.

Until the 1950s, atmospheric carbon dioxide remained under 300 parts per million for at least the past 800,000 years, throughout humanity’s roughly 300,000 year-long existence. Swings in average temperature reflecting various geologic and biologic forces occurred very slowly, over tens of thousands of years. This allowed for migration and adaptation of most species, including humans, who were much smaller in number. Human population only reached one billion in the 1800s and has ballooned to over 8 billion today, reflecting our enormous ability to adapt and thrive in many environments, but also the pressures our large numbers and advanced technologies and economies place on the planet. Due primarily to fossil fuel combustion, a process which takes highly concentrated carbon compounds sequestered and compressed underground over millions of years and releases their carbon byproducts into the air all at once, atmospheric CO² has risen with unprecedented rapidity, leading to a dramatic rise in average temperature and major worldwide destabilization of the climate and ecosystems on which we depend. Because atmospheric CO² lasts for hundreds of years while climate effects lag behind its accumulation, even if we were to stop all emissions tomorrow, warming would still progress. However, every step we take to reduce our emissions today can blunt these effects and mitigate the suffering already accelerating around the world – an obvious goal for those who are dedicated to promoting human health.

My own engagement with this problem was prompted by a 1998 series in the *Atlantic* by environmental writer and activist Bill McKibben called “A Special Moment in History.”¹ In this series

McKibben clearly and efficiently laid out the nature of the problem, helping me to understand that the challenge was not “over there” for someone else to solve, but rested here with us, in the wealthier, more technologically advanced parts of the world. It also prompted me to think about climate change from the point of view of the brain. My undergraduate reward system research and later clinical and lab observations of brain development and plasticity had prompted me to question how our evolutionarily shaped brains made this existential crisis so hard for us to process and solve. Despite the intensely gratifying and rewarding job of caring for patients, I could not ignore my own inaction on the increasing problem that was threatening the future of all children, not just the few that crossed my path. I took a sabbatical, went back to school, and delved into the problem from the brain point of view.

What did I learn? That climate change is hard for us to perceive (evolution didn’t need to include CO² sensors in our nervous system design!), easy for us to ignore, and not very rewarding, in the conventional sense, for us to address. It’s a solvable problem—we have the technology and the resources to fix it today, but, so far, not the will. Everybody can play a role, at the individual and collective level, but getting hospital administrators to see it as part of their health-related mission, and not as just one more social cause, can be a challenge. And while conditions will worsen, our actions still meaningfully shape the outcome. The result of my journey was a book, “Minding the Climate,”² and the beginnings of a transition in the focus of my time, energies, and career path.

So what action can a busy neurosurgeon take in response to this distressing crisis? Some feel this is not their area of expertise or that it’s not really a significant problem. Others want to do something but don’t know where to start or what actions have what impact. Some take steps to improve their personal carbon footprint (you can start by looking up “carbon calculator”) and others work through their hospital, while a few get involved in local, national, or global advocacy or research.

As part of my exploration, I set up a “test case”, to see if I could encourage my hospital to undertake a specific ambitious pro-environmental action—building a prototype “green” children’s hospital—by aligning this goal with what I assessed were the rewards valued by hospital leaders and decision-makers: cost savings, being “first” at something, new philanthropy streams. But at that time a new children’s hospital was not anywhere near the top of my institution’s priority list. We learned, though, that when several climate-concerned clinicians joined forces, we were more successful, establishing a Center for the Environment and Health at our hospital which opened lines of communication across hospital departments and operations. This helped to move the needle towards a more sustainable building project the administration already was planning—a new cardiovascular and cancer tower, which was considered a better financial return on investment. By combining bottom-up (physician/practitioner) with top-down efforts, we’ve been able to implement programs to change anesthetic gases, move from disposable to reusable supplies in selected cases, decrease plastic packaging and waste, participate in food waste composting, study and initiate a sustainable lab certification process in our research institutes,³ and collaborate with other local institutions on renewable energy projects. Some steps, such as improved energy efficiency and renewable energy preferences, already had been instituted by the hospital before we clinicians got involved, based primarily on financial favorability.

We designed our Center to align with the pillars of the hospital’s mission—delivery of care/operations, research, education, and advocacy. Each pillar of the Center is led by a clinician along with a hospital administration partner. The operations pillar works with building engineering, energy, waste, and clinical protocols to find opportunities to do these tasks more sustainably, and now the medical center assesses and reports its carbon emissions as part of the international Carbon Disclosure Project (CDP). In the research pillar we focus on improving sustainability in our research enterprise but also on facilitating research projects that investigate environmental and health issues. The education pillar works to educate our workforce and our patients and communities in climate change and other environmental issues of concern; one recent effort created an educational module for professional staff that was tied to a financial incentive to participate as part of a standard quality improvement program.⁴ Advocacy works with local and national organizations to support climate and pollution legislation and other initiatives; this has led to connections that help us magnify our impact by partnering with like-minded community and professional leaders.

Healthcare institutions are under pressure from many directions, including cuts in grant funding and indirect support and financial strains from decreases in reimbursement and increasing costs. We have found that when environmental benefits also align with cost savings, which is often (but not always) the case, we are more likely to have buy-in from institutional leadership. We also have observed that other institutions vary in the level of focus and support they provide for such efforts. Some include a degree of financial support for the time spent by clinicians on these initiatives, while others do not, and instead the work is done in a volunteer capacity. Some are willing to invest financial resources in initiatives that they assess will “pay off”, while others will approve only initiatives that cost nothing and garner savings. Some utilize seed grant mechanisms or extend research administration services to support faculty who apply for external grant funding.

Many resources exist to help clinicians get involved. [Practice Greenhealth](#), the [National Academy of Medicine](#), and other organizations offer resources for healthcare sustainability. The [Medical Society Consortium on Climate and Health](#) focuses on physician advocacy, including voting. [Physicians for Social Responsibility](#), the [Planetary Health Alliance](#), and [Climate Health Society](#) offer opportunities for global action.

The best advice I’ve learned gets back to reward. While tackling climate change won’t feel anywhere near as satisfying as fixing your patient, it’s still important for that patient’s health – not to mention all future generations. Because social rewards are powerful, finding one other like-minded colleague and joining forces will help you take some action together, in some sphere of influence, while there’s still time. ❖

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Human Health is the Lived Experience of Climate Change.

Climate crisis is a health crisis.

Already, climate change is directly contributing to the incidence of disease globally, accelerating infectious diseases, heat-related illnesses, non-communicable diseases, adverse pregnancy outcomes, and malnutrition. The World Economic Forum estimates there will be an additional 14.5 million deaths by 2050 as a result of climate effects.¹ These future risks are not abstract. Today, more than 84 percent of heatwaves to which people were exposed on average annually between 2020 and 2024 would not have been expected to occur without climate change.²

Beyond these direct impacts, climate change indirectly fuels a vicious cycle of poor health by increasing poverty, threatening food security, and compromising sanitation. These burdens are felt most deeply by those already more vulnerable (**Figure 1**).

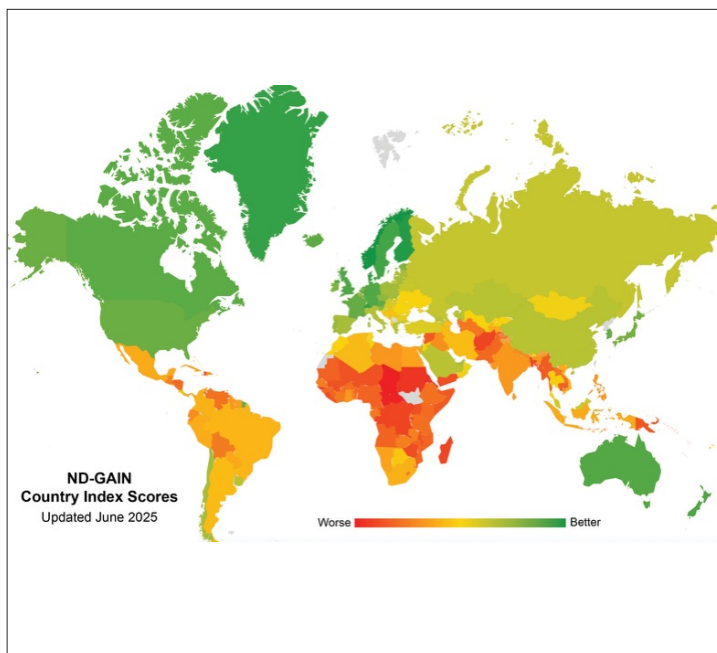


Figure 1: Global Map of Climate Vulnerability

*Figure from the ND-GAIN project, showing the measures of a country's vulnerability to climate change and its preparedness to adapt.⁵

Climate change indirectly fuels a vicious cycle of poor health by increasing poverty, threatening food security, and compromising sanitation. These burdens are felt most deeply by those already more vulnerable.

According to the World Bank, an additional 44 million people will be driven into poverty by 2030 from the health consequences of climate change. Migration will accelerate, in ways that increases the risk of disease transmission, disrupts access to health services and overwhelms health facilities already under-resourced and overburdened.⁶ These risks are compounding existing diseases and epidemics including HIV, TB, malaria, growing burdens of non-communicable disease, and preventable maternal deaths that still occur in pockets around the world.

These diseases cost in dollars as well as morbidity and mortality; the costs of growing disease burdens are mounting. The five leading causes of non-communicable disease burdens cost an average of \$2 trillion a year;⁷ annually, cardiovascular diseases alone cost the U.S. health care system \$233.3 billion and cause up to \$184.6 billion in lost productivity.⁸

As climate change accelerates all disease burdens, it also threatens to overwhelm our ability to respond. The COVID pandemic revealed important cracks in our health systems which remain vulnerable in the context of climate change. Over 90% of countries saw disruptions of health services as ill-prepared and under-resourced health systems splintered under the demand for services, the toll on health workers, the disruptions of supply chains, and the vaccine apartheid that left health workers and citizens in the world's poorest countries at disproportionate risk.

These lessons, though, point to solutions. We need to build health systems that can deliver services and withstand shocks—whether COVID or the growing burdens from climate change.

These resilient and responsive health systems are centered on prevention, surveillance, early intervention, and strong referral chains. They require moving from an approach of investing in disease silos to one that invests in the core building blocks of health systems

with attention to mitigation of greenhouse gases, adapting to the changes we are already feeling and resilience to the shocks that climate change increasingly brings (**Box 1**).

Box 1: Core Definitions of Climate Response

Mitigation:

- **Definition:** Efforts to reduce or prevent the emission of greenhouse gases, the root cause of climate change.
- **Goal:** Limit damage from climate change

Adaptation:

- **Definition:** Adjusting to current or expected future climate impacts to minimize harm.
- **Goal:** Reduce vulnerability and cope with the unavoidable consequences of climate change

Resilience:

- **Definition:** The ability of individuals, communities, or ecosystems to withstand, adapt to, and recover from climate-related shocks and stresses.
- **Goal:** Build the capacity to bounce back from climate-related disasters while adapting to changing conditions.

The World Health Organization (WHO) outlines the critical components of climate-resilient health systems. These include: climate-transformative leadership and governance; climate-smart health workforce; assessment of climate and health risks and GHG emissions; integrated risks monitoring, early warning, and GHG

emissions tracking; health and climate research; climate-resilient and low-carbon infrastructures, technologies, and supply chain; management of environmental determinants of health; climate-informed health programs; climate-related emergency preparedness and management (**Box 2**).

Box2: Operational Framework for Climate-Resilient Health Systems

Climate-transformative leadership and governance to integrate health and climate policy and promote cross-sector collaboration.

Climate-smart health workforce to identify, manage, and mitigate the health impacts of climate change.

Assessment of climate and health risks and greenhouse gas emissions to inform effective policies and mitigation measures for sectors with high GHG emissions.

Integrated risks monitoring, early warning, and greenhouse gas emissions tracking to strengthen early warning systems, improve infectious disease control and response time and

inform a sustainable approach to energy use, procurement, and manufacturing.

Health and climate research to guide effective policies, innovative solutions, and combat misinformation and mistrust.

Climate-resilient and low carbon infrastructures and technologies to reduce healthcare's significant impact on GHG as well as durable infrastructure and supply chains that can withstand climate risks.

Cross-sectoral management of environmental determinants of health to implement effective preventative measures, jointly monitor environmental exposures and health outcomes, and define regulatory standards.

Climate-informed health programs to address climate-sensitive health risks, preparedness, and response to extreme weather events and crises.

Climate-related emergency preparedness and management based on proactive planning, responsive systems, and community engagement.

Sustainable climate and health financing which recognizes that those most vulnerable to climate change often have the least financial flexibility for adaptation and mitigation measures and which is aligned with their national health plans.

Adapted from WHO, 2023⁹



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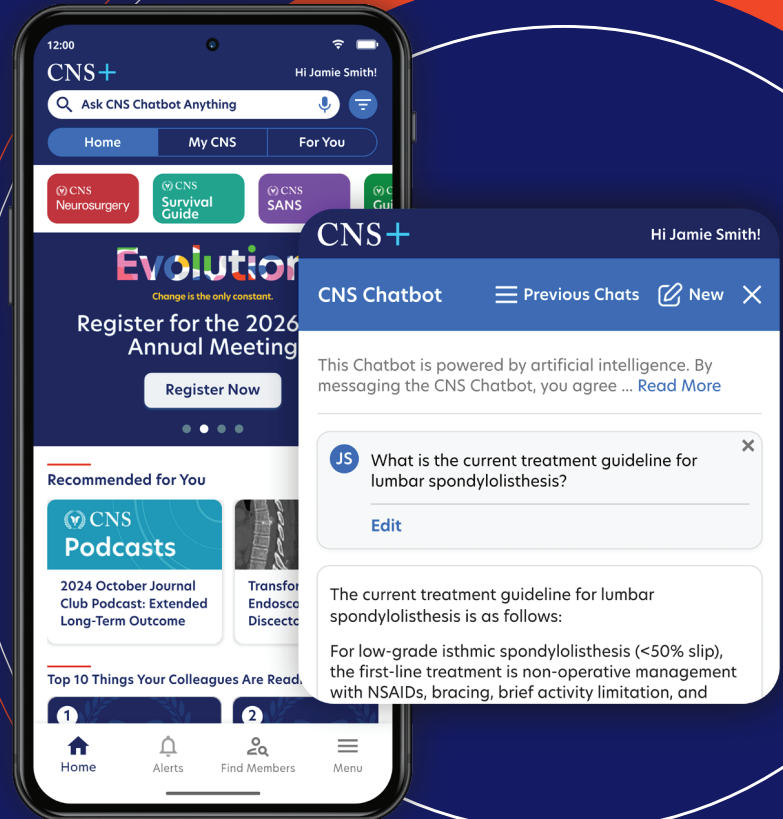
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Several pillars stand out.

The first critical priority is mitigating the health sector's significant contributions to climate change. The sector is responsible for 5% of all greenhouse gas emissions globally and 10% of all greenhouse gas emissions in the United States. While a significant contribution of the sector comes from pharmaceutical development and production, almost 50% of emissions arise from the patient care pathway. For example, while essential, surgical suites are three to six times more energy intensive than the rest of the hospital. Strategies to reduce this footprint include avoiding the use of certain inhaled anesthetics, scaling renewable energy sources, optimizing reusable or non-disposable resources, reducing waste and recycling materials when possible. There are efficiencies to be gained without compromising patient care. Further, placing a primacy on prevention, early intervention and effective disease management is key to reducing the demand side of the equation.

The second priority is the need to ensure strong data management and surveillance of risks and outcomes. Systems must integrate climate data, health risks and air pollution and greenhouse gas monitoring, leveraging early warning systems for climate-sensitive diseases and emergencies. The WHO and World Meteorological Organization have a joint office for Climate and Health which spearheads a new [Global Heat Health Information Network](#) for example. Early detection and assessment of risks will help to prevent diseases, ensure early intervention and protection of supply chains, infrastructure and resources.

Third, too often overlooked and underfinanced, is advancing the size and capacity of the health workforce. Today there is a critical shortage of 11 million health workers, 6 million of whom are in sub-Saharan Africa where the impacts of climate change are being felt most acutely. Yet, health workers are the frontline of any health system response. Through our work at Seed Global Health (Seed), we have seen firsthand the power of this investment. Health workers are our greatest tool for protecting vulnerable populations from

the increasing impacts of climate change and building sustainable health systems.

Our work in Uganda provides a case study. In partnership with the Government of Uganda, Seed has helped to build the country's first national emergency medicine training program. In the country of 55 million, over half the deaths are from a failure of emergency and triage services. Climate change is making the risk of infectious diseases like Ebola Virus Disease (EVD) higher in Uganda and elsewhere as environmental disruptions caused by climate change, such as droughts and wildfires, push wildlife into human areas and increase the risk of disease outbreaks. In January 2025, Uganda declared an outbreak of the Sudan strain of EVD. There is no vaccine available for this strain leaving health workers as the main line of defense to educate, triage and care for patients. Through our partnership with the government, we helped train over 4,000 health workers in EVD protocols, supporting the health worker cadres that carried out surveillance and case identification, performed triage protocols, and ambulance decontamination. When the outbreak subsided, these same health workers applied their enhanced skills to routine emergencies, reducing trauma and stroke fatality by 8% and improving maternal emergency management enough to cut the institutional maternal mortality ratio by 25% in the facilities where we work.

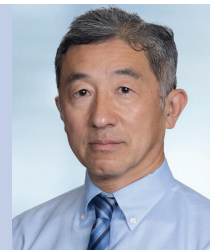
Our response to the growing challenges at the nexus of climate and health is embedded in building resilient health systems that can help mitigate carbon emissions, withstand challenges to infrastructure and core resources and tackle the growing burdens of disease with quality and access. It will require enhanced understanding of the importance of health for stable communities, scaling of financing to increase health-centered investments, and leadership at every level to enhance prevention, reduce waste and optimize care.

In the end, climate change is not best measured in terms of degrees Celsius, but in lives lost or saved. Climate resilient and responsive health systems are the frontline of that metric. 

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See *Human Health is the Lived Experience of Climate Change* continued on [page 28](#)



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Microplastics and the Brain: An Emerging Threat We Can No Longer Ignore

Plastics are integral to nearly every aspect of modern life. Many technological and medical breakthroughs would not have been possible without them.¹ Over the past century, however, plastic production has skyrocketed—nearly 40% of all plastics are now made for single-use items.¹ The consequence has been an exponential rise in plastic waste. Current global waste-management practices are inadequate, allowing massive “leakage” of plastics into aquatic, terrestrial and even atmospheric environments.¹ Once released, plastics fragment and degrade into microplastics and nanoplastics. Collectively known as microplastics (or MNPs, for micro- and nanoplastics), these particles have now been detected in drinking water, food and air—providing multiple routes for human exposure.

Ingestion of contaminated food and water is thought to be the primary source of exposure, with daily intake estimates ranging from 200 to 100,000 particles depending on diet and environment.¹ After absorption from the digestive tract, microplastics can enter the lymphatic and circulatory systems and disseminate to virtually every organ, including the liver, vasculature, and brain.¹

Research into the biological and health effects of microplastics remains in its infancy. Cell studies show that microplastics can induce oxidative stress, inflammation and apoptosis.¹ Most existing in vivo data come from aquatic species, with only limited information available for mammals and even fewer data for humans. Since the early 2000s, several reports have documented the presence of microplastics in human tissues—including the liver, spleen, placenta, and, more recently, the brain.²⁻⁴ These findings have raised legitimate concerns that microplastics may pose real risks to human health. Yet accurately quantifying exposure in humans remains technically challenging, hampering large-scale epidemiological studies that could link exposure to disease.

A 2024 multicenter study offered an innovative approach by examining patients with significant carotid atherosclerotic



stenosis—a group at high risk for vascular events.⁵ Researchers analyzed excised carotid plaques for 11 types of environmental microplastics. Polyethylene was most frequently detected, present in 58% of 304 patients, followed by polyvinyl chloride in 12%. Those with microplastics in their plaques had a 4.5-fold higher risk of adverse cardiovascular or cerebrovascular outcomes over a 34-month follow-up.⁵ These findings suggest that microplastic accumulation could exacerbate vascular injury

and worsen recovery after stroke or other vascular events,⁵ and this study exemplifies a new era of microplastic research that bridges environmental exposure to clinically relevant brain and cerebrovascular diseases.

Given that microplastics disrupt cellular homeostasis and accumulate in multiple organs, it is plausible that they contribute to the onset and progression of various brain and cerebrovascular disorders. To fully assess their health impact, we urgently need rigorous clinical and epidemiological studies capable of capturing both exposure and accumulation levels in humans. Such efforts will require technological advances in the detection and quantification of microplastics in human tissues. We must also recognize that apparent associations may be confounded by co-pollutants or socioeconomic factors. Moving from correlation to causation will require preclinical models that accurately reproduce human exposure and disease mechanisms.

If plastics are now unavoidable in modern life, what can we realistically do? Some may argue that the damage is already done—that our bodies have accumulated microplastics beyond repair. This fatalistic view echoes early skepticism about air-pollution control or tobacco regulation. Yet history shows that collective efforts can yield transformative benefits for future

generations once scientific evidence compels action. Such transgenerational benefits are not limited to the mitigation of environmental or toxic exposure.

Cholesterol-lowering strategies, for example, are largely ineffective in reversing advanced atherosclerosis in those who have long consumed toxic levels of cholesterol, but they have proven crucial in preventing disease when instituted before the critical level of exposure. Their benefits were not fully realized in the generation that first developed anti-cholesterol therapies.

Thus, our efforts to understand and mitigate the effects of microplastic exposure may not immediately benefit the current generation. However, as with many environmental and medical advances, their true value may emerge over decades—safeguarding the health of generations to come. As physicians and citizens alike, we have a responsibility to future generations. By identifying risks, establishing causal mechanisms, and developing interventions, we can begin to mitigate the harms of microplastic exposure. Evidence and advocacy have changed the course of other public health crises and they can do so again. The challenge is immense, but so is our capacity for innovation and collective resolve. ■

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Impact of Air Pollution on Cerebrovascular Disease: An Evolving Paradigm

Introduction

Hemorrhagic and ischemic strokes can occur as a result of a variety of underlying pathologies and are associated with significant morbidity and mortality. In the acute setting, the focus in ischemic stroke is primarily on revascularization, whereas, in hemorrhagic stroke, the focus is on preventing secondary cerebral injury from local mass effect, increased intracranial pressures, or repeat hemorrhages. Efforts to understand and modify the risk factors for strokes depend on the pathology (i.e., lipid level correction or revascularization procedures to prevent ischemic strokes; blood pressure control to prevent hypertensive hemorrhages; treatment of high-risk aneurysms/vascular malformations to prevent lesional hemorrhages) but are largely predicated on an awareness of these risk factors in the first place. The impact of population-level environmental exposures on stroke risk is often less emphasized because they are harder to modify.

Exposure to airborne pollutants, especially smaller particulate matter able to penetrate tissues deeply (i.e., 2.5 micrometers or smaller; PM_{2.5}), can detrimentally impact a wide range of organ systems and cause respiratory, cardiovascular, and neurologic diseases.¹ Mechanistically, these effects are mediated via multiple pathways, including the induction of local and systemic inflammatory and cytokine cascades leading to DNA damage and cellular death from oxidative stress and immune toxicity.¹ Endothelial cells are particularly affected by PM_{2.5} exposure, with secondary inflammatory cascades likely to contribute to systemic atherogenesis and diminished overall vascular health. Although endothelial cell dysfunction is a key mediator of cerebrovascular disease of all types, the impact of PM_{2.5} exposure on stroke risk appears to be pathology dependent.

Impact of PM_{2.5} Exposure on Ischemic and Hemorrhagic Stroke

In a recent review of the literature, Kulick et al.² examined the published data on the risk of short- and long-term exposure to ambient air

pollution on ischemic and hemorrhagic strokes. Acknowledging the challenges of disentangling the effects of individual pollutant exposures in epidemiologic studies, as well as variations in data based on the country studied and baseline levels of pollution, they report an overall causative relationship between short- and long-term PM_{2.5} exposure and ischemic stroke risk, without a similarly clear effect by other airborne pollutants such as PM₁₀, nitrogen dioxide, and ozone.² Conversely, data linking the risk of hemorrhagic stroke to either short- or long-term PM_{2.5} (or other particulate) exposure are more variable,^{2,3} potentially reflective of the more heterogeneous etiology of hemorrhagic stroke (e.g., hypertensive, amyloid), or a more nuanced relationship between local vessel health, coexisting pathologic conditions, and exposure-related variables.

Novel Link Between PM_{2.5} Exposure and Intracranial Aneurysm Rupture

Although there is increasing evidence linking local inflammation and risk of intracranial aneurysm formation and rupture,⁴ a link between aneurysmal subarachnoid hemorrhage (aSAH) and PM_{2.5} exposures had not been found until recently.³ Leveraging cyclic PM_{2.5} fluctuations from wildfire smoke and local pollutants along Utah's Wasatch Front, Bounajem et al.⁵ performed a retrospective single-center analysis of 70 patients with aSAH over a 5-year period and reported a delayed positive association between elevated PM_{2.5} levels and aSAH risk (incident risk ratio 2.03, 95% CI 1.05–3.93, $p = 0.035$, with PM_{2.5} spikes occurring 90–180 days prior to hemorrhage spikes). This was the first reported link between PM_{2.5} exposure and risk of aSAH, and the delayed impact fits with a potentially synergistic downstream effect of systemic cytokine and inflammatory cascades initiated by PM_{2.5} exposures. These cascades may then amplify local endothelial cell inflammation and accumulation of DNA-level damage from oxidative stress and impairment of repair processes, leading to aneurysmal wall fragility and ultimately rupture. Although additional work is needed to confirm this mechanistic link, this prolonged timescale



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effect, although initially surprising, is analogous to other longer-term effects of PM_{2.5} exposures, such as an increased cancer risk that is likely a result of reactive oxygen species formation and DNA damage.¹

Implications and Future Directions

Our increasing understanding of the effects of airborne particulate exposure on cerebrovascular disease presents opportunities for both patient- and population-level action. Further defining the risk of PM_{2.5} and other particulate exposure on ischemic and hemorrhagic stroke, as well as the exact mechanisms of action are important next steps to better inform and treat patients affected by these diseases. Exposure

reduction strategies, such as staying indoors, using N95 masks outdoors, or avoiding strenuous outdoor activities during periods of high PM_{2.5} levels, could be considered, especially in at-risk patients. On a population level, physician and health-system awareness and advocacy will be critical to the success of public health measures to combat air pollution.

Conclusion

The evidence linking airborne particulate exposure to ischemic stroke, and increasingly hemorrhagic stroke, highlights a need for ongoing epidemiologic and mechanistic study, as well as opportunities for neurosurgical advocacy. 🇺🇸

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MEMBER SPOTLIGHT

W. Christopher Newman, MD, MPH, FCNS



Q: Why did you join the CNS?

A: Initially, I joined the CNS as a neurosurgery intern because it was what everyone did. I'd like to say that I joined for the ways CNS has connected me to other neurosurgeons, exposed me to excellent coursework, and kept me up to date with neurosurgical developments, but I didn't realize

those benefits until after I joined. As a resident, I learned a lot from various symposia, and I got hands-on cadaver lab experience in new techniques. When I became an attending, it made perfect sense to not only continue the membership but to become more involved, finding committees and projects that aligned with my interests.

Q: What are you most excited about this year?

A: I am most excited about continuing to work with the Pathways to Neurosurgery Program. I started volunteering when it started in 2021, and it is my favorite CNS Annual Meeting activity. Getting to talk to kids about what we do, showing them the technology and tools we use, and watching some of them have a moment where they can see themselves doing what we do is everything. Beyond that, I'm looking forward to continuing work with CNS Podcasts. It's been fun working on the Controversies podcast and creating the Leadership miniseries. It's been a fun learning experience getting to talk to leaders in our field and share their thoughts on both the medical and the business sides of what we do, especially the conversations around how some of them built programs or national agendas that shape the way we practice and learn.



Theresa Williamson,
MD, FCNS

From Climate Crisis to Brain Health: Dr. Burcin Ikiz on Neuroscience, Resilience, and Action

Recently, our editor, Dr. Theresa Williamson, sat down with world-renowned climate neuroscientist, Dr. Burcin Ikiz, a neuroscientist and global health advisor who explores how climate change and ecological crises impact brain health. Since graduating from Stanford University with a BS in Biomedical Computation and a PhD in Neurobiology from Columbia University, Dr. Ikiz has spent 20 years researching brain disorders and mental health, focusing on how environmental factors affect our brains and how these insights can be translated into tangible global health solutions. Her work has a significant impact on the work of neurosurgeons, our trainees, and most importantly, our patients. Find out more about the science, impact, and how you can get involved in the transcript of their conversation below.

Q: What is a “climate neuroscientist”? How does someone become that and what do you do?

A: My degree and training are as a neuroscientist. I'm an adjunct lecturer at Stanford University, and I am also affiliated with Columbia University as part of the Global Consortium on Climate and Health Education. I founded and chaired the Neuro Climate Working Group. This is an international network of scientists, clinicians, and policymakers, including architects, designers, and city planners. We have quite a multidisciplinary group from 52 different countries. Our goal is to understand and address how climate change affects brain health. This includes neurological health, cognition, neurodevelopment, memory, as well as mental health. We conduct research, some of which is very global, trying to expand the knowledge base and understanding of how heat, air pollution, extreme weather events and wildfires may impact our brain health, especially in the Global South. We do a lot of projects in Latin America, South Asia, and Africa. Additionally, we work on translating this knowledge into action around policy, advocacy, and community work to build the resilience of the communities that are most vulnerable to the detrimental effects of climate change.

Q: That's so cool. And how did you get into this work? Was your PhD project related? (Of note, Dr. Ikiz has two patents and a Brunie Prize for her postdoctoral and thesis research!)

A: My PhD is in brain health, which I studied for over 20 years. I focused on neurodegenerative diseases, specifically working with amyotrophic lateral sclerosis. I was working on molecular and cellular mechanisms to understand the disease. My journey to climate change came through my personal frustration with how limited our understanding of brain health was by only looking inside the brain. I realized that our environment, whether social, natural, or built, plays a significant role in shaping our brains and health. Conversely, our brains have a responsibility in shaping the world and environment around us. I have three young children, and a conversation with my oldest son, who was a kindergartner at the time, about climate change, and seeing him upset about the impact of the crisis on nature and animals, struck a chord with me. It made me realize the seriousness of the crisis and led me to want to be part of the action. I thought the most meaningful way I could contribute was to explore how brains are impacted by climate change. At that time, I couldn't find any scientists or evidence in this space, which led me to engage with fields like epidemiology, psychology, and pediatrics. I realized there were people working on this puzzle, but we needed to come together to solve it. With that, I launched the Neuro Climate Working Group in April 2024. It started with about 40 members, and now we have 312 members. We've been working tirelessly since.

Q: What are, if you're allowed to share, some of the key targets or priorities for that group?

A: Sure, it's not a secret! Our work is structured around four pillars. One is research. We try to understand how different environmental factors related to climate change impact our

brains. While exploring mechanisms, I'm interested in focusing on solutions. For example, when a wildfire occurs or communities are exposed to heat and air pollution, brains don't react the same way. Some are more vulnerable, some more resilient. I'm interested in understanding what makes some brains resilient at both individual and population levels. We hope to launch a global Resilient Brains Project to study populations, especially Indigenous populations, to learn how they adapt to heat and what social interactions and environmental factors help. We aim to understand these factors to implement solutions for vulnerable populations. Our other pillars focus on raising awareness, driving systemic change, and fostering innovation and community. Raising awareness and working with local communities and governments to bring about policy change is crucial.

Q: In terms of what neurosurgeons could advise their patients regarding having a resilient brain or avoiding the effects of climate on brain health, what are the known tips or things to do or avoid?

A: Absolutely. Preparedness is key—both disaster and healthcare preparedness. Physicians and clinicians rank high in community trust, carrying the responsibility to provide beneficial information. Preparedness includes knowing who is at most risk during extreme heat events, wildfires, or high air pollution levels. For neurosurgery, those who had strokes, early stages of dementia, or other neurological or mental health conditions are most at risk, along with pregnant women and children. It's important for neurosurgeons to ensure patients have access to cooling services or green spaces during heat events and ensure indoor air filtration during high pollution or wildfire events. Extreme weather events also carry an emotional toll, indirectly impacting neurological health. These are important messages to deliver to patients.

Q: That's super interesting and really important. It's not necessarily something we think a lot about, but it's everywhere and so important. You mentioned our brains having an impact on the environment around us. Can you say more about that?

A: Yes. Our actions shape the environment through our behaviors, consumerism, and technology creation. Daily decisions, like using electric cars or consuming plastics, impact the environment. Healthy

brains can make healthy choices, highlighting the dual relationship where we have a responsibility to the environment. While making our brains healthy, we must also maintain a healthy planet.

Q: Finally, we have many trainees who, like your son, are passionate about looking beyond the science and seeing the impact neuroscience has on the world and vice versa. For trainees interested in incorporating this research into their careers, what advice would you give?

A: That's a great question. We welcome everyone to this field. We launched a youth council focusing on youth voices, bringing new leaders into this field. It includes medical residents, PhD students, and high school students, as we believe everyone has something to add. Neurosurgery is an incredible field, and as a neuroscientist, I'm inspired by the brain's resilience and ability to hide damage until it's too late. We need new people in this field to prevent future brain disorders and neurodegenerative diseases caused by environmental factors. We welcome everyone and encourage them to reach out for support and connection with passionate, generous people in this field.

One thing we all must do is connect and talk about how our actions impact the environment and vice versa. Health connects us all, regardless of political or background differences. Clinicians have a special ability to bring people together and communicate these issues. Collective action is crucial for change, so it's important for us to come together and act.

Q: Thank you very much for your time and your contribution to the CNS Quarterly. Our members and patients will greatly appreciate your message and we hope to collaborate more in the future!

If you are interested in joining the Neuro Climate Working Group, you can register [here](#). You can also learn more about their work through Banyan Commons (<https://www.banyancommons.org/>), the organization that hosts the group. Dr. Ikiz can be reached at burcin@stanford.edu. 

FOUNDATION UPDATE



As Chair of the CNS Foundation, I would like to thank all of our donors for helping us provide an exceptional group of awards in 2025. We continue to gain momentum identifying key ways in which the Foundation can support the critical needs of the neurosurgical community, and look forward to expanded offerings in 2026. Please consider partnering with us around issues that are important to you so that we can continue our philanthropic mission to improve the lives of neurosurgical patients.



Lola B. Chambless, MD, FCNS
Chair, CNS Foundation

2026 Foundation Awards Now Open!

The CNS Foundation is accepting applications through January 30, 2026. There are 13 opportunities across the four initiatives of the CNS Foundation.

You can find more information on our awards including the application process [here-CNS Foundation Awards](#).

Donate to the CNS Foundation

The CNS Foundation relies on support from individual donors throughout the world. Join the over 1,000 donors from 15+ countries who support our mission and make a positive impact on the specialty.

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Learn more about being a CNS donor, including the CNS Foundation's Lifetime Giving Circle and Annual Donor Recognition [here](#)



Foundation.cns.org

CNS Guidelines Initiative

The CNS Foundation Guidelines Initiative supports the CNS infrastructure in developing and disseminating of high-quality, evidence-based, clinical practice guidelines. Donations to the CNS Foundation help maintain the exceptional infrastructure and impeccable methodology unique to the CNS, the only neurosurgical organization with the volunteer and staff resources to develop clinical guidelines, which it disseminates online and through the CNS+ app, increasing their accessibility and impact.

International Philanthropy

The CNS Foundation International Philanthropy Initiative provides funding that supports opportunities for young neurosurgeons from low- and middle-income countries to take part in observership and visitorship programs within the United States where they will receive mentorship and learn practices that they can return home with to help improve patient care globally.

Community, Culture, & Engagement

The CNS Foundation Community, Culture, and Engagement Initiative supports programs that address healthcare disparities by developing inclusive practices, leading to structural changes in the neurosurgery workforce and patient care.

Through donations, the CNS Foundation is able to support projects and programs that concentrate on the enhancement of inclusivity and equitability by improving practices in the medical field.

Clinical Scientist Career Development

The CNS Foundation Clinical Scientist Career Development Initiative offers early-career neurosurgeons' recognition, networking, and research support to help advance the medical research and careers of up-and-coming clinicians and leaders in the field of neurosurgery. 

Neurosurgery Feature: The Research Environment



Douglas Kondziolka,
MD, MSc, FCNS

This issue of **CNSQ** focuses on the environment. The research environment is one that we live in and rely on. The “climate” in which that research exists is always changing. There is a research ecosystem composed of a network of interconnected parties. Ashutosh Ghildiyal at Integra describes this network as consisting of researchers, institutions, publishers, funders, and the public, whose actions continuously influence each other. Any break in the chain can cause problems and lead and can lead to issues in trust. As noted above, all of these groups face major pressures. And of course, they all exist in

their own “knowledge silos,” limiting real interaction between scientific disciplines. I have written about this before.¹ Even though I care for patients with vestibular schwannomas almost every day, I am not an otologist and do not routinely subscribe to otology journals (where much of the new science related to hearing is published). It takes real effort to keep up. Of course, there are ways around this, including having information pushed to me, instead of waiting for me to do all the pulling.

The public wants physicians and scientists to solve problems, to improve their health care expectations, and to do it quickly. At the same time, they expect fair and equitable access, and to be able to afford whatever medical or technical innovations come their way. Any assault on our research institutions slows this down. Restrictions on our regulatory processes slow this down as well. Typically, these are not election issues.

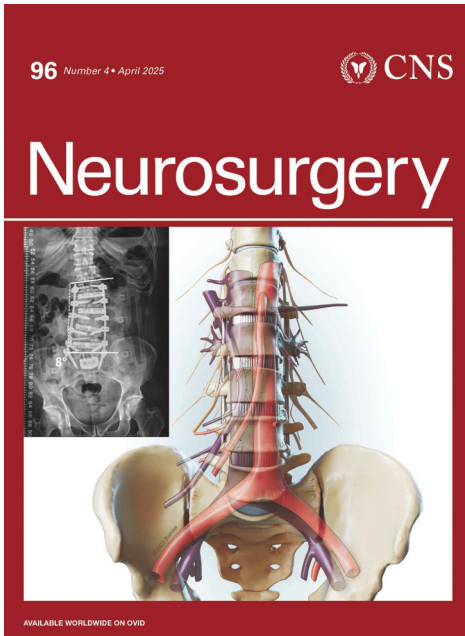
At the same time, researchers face increasing pressures to publish more and to do so visibly. Publishers need to maintain their business models in the face of increasing competition, particularly from

predatory publishers, where “pay to play” is the norm. How did so many of those publishers even get my email address, when I find it nearly impossible to find a listserv of U.S. neurosurgeons? Why would some organization in China want to invite me to contribute an article in dermatology or bioengineering and nanotechnology? Does anyone actually respond to these requests?

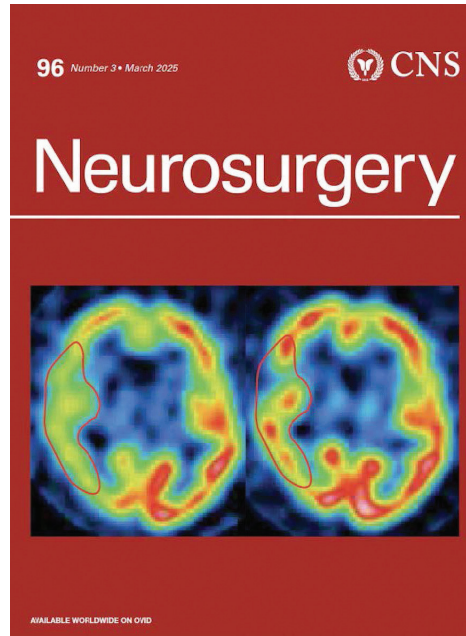
The public wants science that they can trust, and that addresses the challenges they face. Trust is a big issue. Despite a robust peer-review process, mistakes can be made. Editors cannot visit a laboratory or go through the actual case files.

An interesting disconnect between research and society is the limited publication of negative results. Researchers have less motivation to publish null findings or work that is replicative, and yet these can be some of the most meaningful findings. Koch’s postulates are the basis for the reproducibility of science. One randomized trial is interesting, of course, but it does not make dogma. The real fear relates to flawed research that drives change until the flaws are pointed out or corrected—or

The public wants physicians and scientists to solve problems, to improve their health care expectations, and to do it quickly.



to research that should be done but is not done, often under the rubric of “Don’t ask the question if you do not want to know



the answer.” That theme is explored in the recent book by Gardiner Harris relating to Big Pharma.²

There are numerous articles that discuss research quality and how to maintain high standards. The research environment is indeed changing. A few decades ago, few were calling for the changes necessary to maintain quality. For our own field, some of these include randomization; reduction and acknowledgment of bias; use of multicenter studies with different investigators; prospective data collection; use of large-scale registries; use of independent or external validators; proper disclosures; and use of validated tests specific to the problem of interest. Society depends on it. Each of us has multiple roles—observer, researcher, reader, and sometimes even user. 

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MEMBER SPOTLIGHT Kimberly Hoang MD, FCNS



Q: How has the CNS contributed to success in your career?

A: Unlike some other neurosurgeons, I do not always know that exact right path to my ultimate career goals and there can be a lot of hiccups or missteps along the way, so instead of focusing on very specific positions or accomplishments, I think about building the infrastructure to be ready and successful when good opportunities arise or to create opportunities I may not have had on my radar. Specifically, the CNS has helped build that infrastructure by providing early national visibility (podcasts, committee positions, presence at national meetings), access to meaningful mentorship and sponsorship, leadership training beyond the OR, and a professional community that amplifies my academic and clinical impact over time. Mostly, I have developed great relationships, which are the cornerstone of a fulfilling career for me.

INSIDE THE CNS



Washington Committee Update



Alexander Khalessi
MD, MBA, FACS, FCNS
Chair, Washington Committee



Charlotte Pineda, MPP
Vice President, Health Policy and Advocacy

Medicare Payment Final Rule Deepens Instability

CMS finalized the CY 2026 Medicare Physician Fee Schedule (MPFS), continuing the trend of payment volatility for physician services. While the One Big Beautiful Bill Act provided a modest increase for 2026, neurosurgery and other procedural specialties remain disproportionately affected by the new “efficiency adjustment” and practice expense (PE) methodology changes. Both changes are intended to increase reimbursement for evaluation and management (E/M) services.

The “efficiency adjustment” mandates a broad-based reduction in work relative value units (RVUs) and intraservice times for nearly all non-time-based services – based on the assumption that physicians deliver care more quickly as they gain experience. In 2026, this policy triggers a 2.5% cut to work RVUs, with further reductions scheduled every three years, indefinitely. Physician contracts may be based on work or total RVUs. Reductions in these values decrease reimbursement despite no

reductions in work under this policy. This policy also further devalues global codes, which were already excluded from previous inflationary adjustments applied to E/M services in 2021 and 2023.

The Coding and Reimbursement Subcommittee, chaired by **G. Edward Vates**, MD, is actively pushing back on this policy, raising concerns over its flawed assumptions and negative downstream effects. Alongside a broad coalition, the Washington Committee [urged Congress to intervene](#), highlighting peer-reviewed data showing operative times have remained mainly flat or increased since 2019, particularly in high-acuity surgical fields. Legislation to halt this policy is expected to be introduced in early 2026.

Similarly, the new PE methodology sharply reduces the indirect cost allocation for facility-based services. CMS justified the shift citing rising physician employment and the assumption that hospitals absorb more overhead. In response, the Washington Committee joined fellow stakeholders in [calling on Congress to halt](#)

[this indiscriminate PE cut](#). The Washington Committee and other surgical organizations proposed constructive alternatives that would have enabled a more data-driven approach to address CMS’s concerns and are currently under review by bipartisan lawmakers. Among the proposals include the creation of an employed physician modifier combined with either a PE RVU adjustment factor or a third PE RVU component.

However, in a welcome development, the Washington Committee secured a key win in the final rule. CMS reversed its proposal to inappropriately reduce the value of CPT code 61624 (transcatheter permanent occlusion or embolization in the central nervous system). Following targeted advocacy by subcommittee Chair-Elect **Clemens M. Schirmer**, MD, PhD, CMS reinstated the RUC-recommended value of 20.00 work RVUs, acknowledging the immense skill and risk associated with these life-saving procedures. This success underscores the importance of CNS’s and AANS’s participation in the RUC process to ensure that the intensity and complexity

of neurosurgical work are accurately reflected in federal payment policy.

CMS Finalizes OPPTS Rule, Preserves Key Neurosurgical Codes

The [CY 2026 Hospital Outpatient Prospective Payment System \(OPPS\) rule](#) adopted several neurosurgery-backed changes to preserve reimbursement for essential services. Notably, CMS reversed its proposal to delete CPT codes 61624 and 61626 from the Comprehensive-APC, protecting payment integrity for endovascular treatment of CNS vascular malformations.

CMS also finalized a three-year phase-out of the Medicare Inpatient Only list, starting in 2026 with 271 services, including certain complex spine procedures such as posterior lumbar interbody fusions. The Washington Committee opposed it, citing increased administrative burden, higher out-of-pocket costs, and threats to patient safety and access to appropriate inpatient care.

New Blog Series Highlights Prior Authorization Challenges

Neurosurgery Blog launched a new series exploring how prior authorization (PA) policies harm patients and practices. **Krystal Tomei**, MD, a CNS Appointee to the Washington Committee, debuted the series, [sharing a powerful perspective](#) on how a well-intended system has become a costly obstacle. Upcoming posts will

highlight ongoing advocacy efforts and first-hand experiences across the country.

Mounting Pressure Prompts Revisions to CMMI's WISeR Model

Since the [Fall issue of Congress Quarterly](#) spotlighted the Wasteful and Inappropriate Service Reduction (WISeR) Model, federal scrutiny and stakeholder advocacy over the Centers for Medicare & Medicaid Innovation's (CMMI) proposal escalated.

The [six-year demonstration](#) applies PA in traditional Medicare through third-party vendor review of select "low-value" services, including spinal procedures, neurostimulator implants, and pain management interventions.

In September, bipartisan concern over algorithmic and AI-driven PA surfaced during an Energy & Commerce [hearing](#), with many lawmakers raising alarms about WISeR and misuse of PA in Medicare Advantage (MA). Following, Reps. Lois Frankel (D-FL) and Andy Harris, MD (R-MD) led an [amendment to block WISeR implementation](#) – one of the few to win full committee support in the FY 2026 health spending bill. The legislation awaits Congressional passage.

In response, CMMI announced several updates in October. Deep brain stimulation (DBS) for Parkinson's disease was removed from the targeted services list. CMMI also committed to improving transparency around clinical guidelines, developing a "gold card" program to reward appropriate use, and selecting vendors with both provider and payer clients – avoiding insurer-owned entities.

Congress and the Washington Committee responded with further action. On November 7, Reps. Suzan DelBene (D-WA) and others introduced the Seniors Deserve SMARTER Care Act ([H.R. 5940](#)) to repeal the WISeR, with [companion legislation](#) introduced by Sen. Patty Murray (D-WA). Rep. Greg Landsman (D-OH) followed with the Ban AI Denials in Medicare Act ([H.R. 6361](#)), which would prohibit Medicare pilots from using AI-based PA. The Washington Committee [led a coalition letter](#) thanking appropriators for

supporting the amendment and outlining six reforms to improve transparency and accountability. The Washington Committee also submitted a [follow-up letter](#) to CMMI pressing for a meeting to discuss operational fixes.

On December 27, CMMI responded again with [several revisions in its operations guide](#). Most notably, percutaneous image-guided lumbar decompression was delayed, and spinal arthrodesis (i.e., CPT 22585) was removed from the list. CMMI also revised its associated codes list and documentation requirements, warranting further review by surgical specialties. CMMI clarified that while only the facility claim is subject to prior authorization under WISeR, associated professional claims will not be automatically denied or held. However, physicians may face post-payment clawbacks if the facility claim is denied. This also raises questions about how this structure could affect physician eligibility for gold-carding.

As of early January, the revised program is moving forward. CMMI is also committed to launching participant electronic portals in early January, with a 72-hour turnaround time for requests sent to vendors for dates of service on or after January 15. Participants who fail to meet this may face payment penalties or other corrective actions.

In related news, the Improving Seniors' Timely Access to Care Act ([H.R. 3514/S. 1816](#)), which would modernize and increase accountability for the use of PA in MA, closed out 2025 with 243 House and 65 Senate cosponsors. This progress reflects the efforts of the Regulatory Relief Coalition (RRC), of which the Washington Committee is a founding member. Highlights of the RRC's work are available [here](#).

Synergy at AMA House of Delegates

At the AMA House of Delegates (HOD) Interim Meeting, the Neurosurgery Delegation, chaired by **Joshua Rosenow**, MD, drove coordinated advocacy across a wide range of policy issues. The delegation tracked over 70 resolutions, submitted 32 online testimonies, coauthored resolutions,



and secured key amendments supporting the Washington Committee's regulatory and legislative priorities.

In a high-profile win, the delegation's co-led resolution opposing Elevance Health's proposal to penalize facilities that use out-of-network clinicians was adopted with broad support. The policy, which would undermine key protections of the No Surprises Act, drew national media attention, including [comments](#) from AANS Alternate Delegate **Brian Gantwerker**, MD, in *Becker's Spine Review*. Prompted by the resolution, the AMA [led national engagement](#) with the AANS and CNS joining.

The delegation also played a central role in defeating a resolution that sought to direct the AMA to oppose the WISer Model. Neurosurgery helped lead a coalition of specialty societies urging referral of the resolution, citing concerns that it would jeopardize ongoing physician-led negotiations with CMMI, which the Washington Committee is spearheading.

The Specialty and Service Society Caucus overwhelmingly sided with Neurosurgery's position.

Finally, the delegation partnered with other surgical specialties to shape AMA policy on prior authorization, clinical quality, health data infrastructure, and AI oversight. **Anthony DiGiorgio**, MD, a Washington Committee member and delegate of another organization, collaborated with the neurosurgery delegation on strategy and testimony.

New Study Confirms Repealing Liability Caps Raises Costs

A new [peer-reviewed study](#) published in *Health Economics* confirms that repealing limits on non-economic damages significantly raises medical liability premiums, especially in high-risk specialties.

Conducted by researchers from RAND Corporation, Brown University, and Harvard Medical School, the study analyzed the aftermath of court decisions in Georgia

and Illinois that invalidated longstanding damage caps. Following these rulings, liability premiums increased by 20-23%.

The Health Coalition on Liability and Access, of which the AANS and CNS are members, issued a [press release](#) applauding the study, which substantiates what physicians and patients have long known and reinforces the need to preserve balanced tort reforms. 

Human Health is the Lived Experience of Climate Change continued from [page 15](#)

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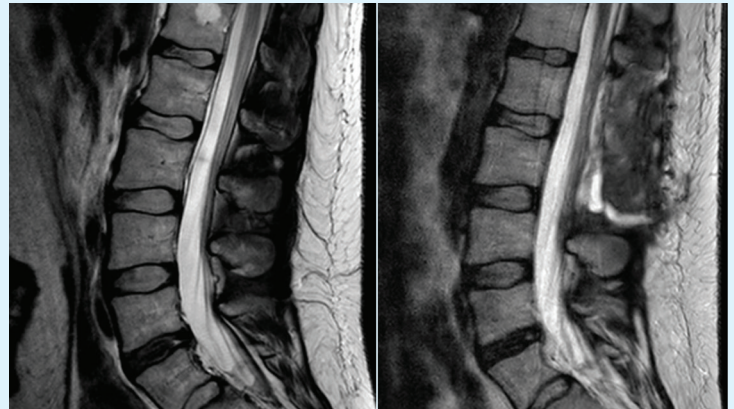
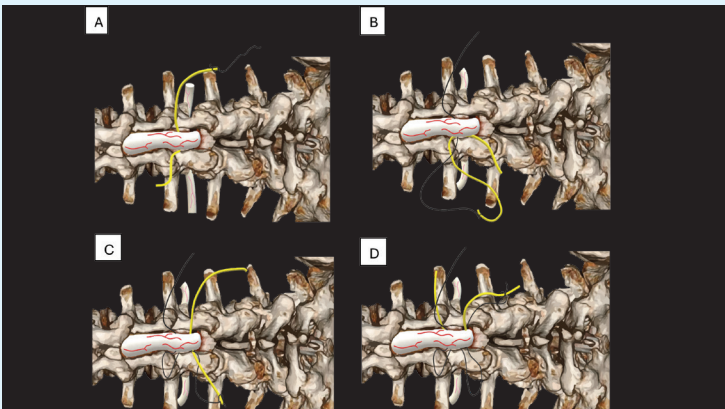
IMAGES IN NEUROSURGERY

Open Ligation of Ventral Lumbar Pseudomeningocele: Case Presentation of a Novel Treatment for a Rare Condition

Pseudomeningoceles are encapsulated extradural CSF collections that typically form as a consequence of chronic CSF leakage—classified as traumatic, idiopathic, or iatrogenic in etiology.^{1,2} Ventrally located CSF leaks pose a challenge in surgical repair given the proximity to the posterior vertebral body, necessitating mobilization and retraction of the spinal cord and thecal sac for adequate visualization and exposure of the defect.³⁻⁵ We present a case of a rare ventral lumbar pseudomeningocele, presumed secondary to epidural anesthesia, which was repaired with a novel ventral suture ligation technique.

A 33-year-old female was referred to our institution with a nearly ten-year history of positional headaches since undergoing epidural anesthesia for childbirth. Multiple epidural blood patches were performed with failure or only temporary relief of her symptoms over the course of several years. MRI neuraxis revealed CSF hypotension in the brain and a large, nearly holospinal epidural CSF collection spanning the inferior cervical to lower lumbar vertebrae. Further imaging with digital subtraction myelography and prone CT myelogram suggested a ventral CSF leak, for which she underwent an L3 laminoplasty with intention to perform a transthecal repair of the ventral leak. Intra-operatively, an organized ventral pseudomeningocele was discovered rather than an anticipated ventral leak. The procedure was aborted and she was brought back one week later for re-exploration with wide laminectomy and medial facetectomy to expose the bilateral exiting nerve roots. The pseudomeningocele was bluntly dissected from the true dura ventrally, and a silk tie was passed across the thecal sac ventrally and beneath the exiting nerve roots in order to ligate the fistulous point. Closure was confirmed by opening the pseudomeningocele sac and confirming arrest of CSF flow. Follow up MRI of the brain and spine show improvement in the epidural CSF collection and CSF hypotension.

Ventral suture ligation is a reasonable strategy for treatment of ventral pseudomeningoceles or CSF diverticula, which can present as a rare complication of percutaneous thecal puncture. 



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