

Career Pathways, George Wittenberg, MD, PhD, FASNR

“My career has been fairly linear, but it developed out of certain core interests that I’ve had for most of my life. Pursuing and exploring these interests has led me in new directions and to many opportunities that have been more rewarding than I ever could have imagined,” reflected ASNR Past President George F.

Wittenberg, MD, PhD, FASNR. Dr. Wittenberg is Professor in the Department of Neurology at the University of Pittsburgh and Associate Director, Research for the Technology Enhancing Cognition and Health - Geriatric Research

Education and Clinical Center (TECH-GRECC) in the Veterans Affairs Pittsburgh Healthcare System. He also holds secondary appointments in Bioengineering and Physical Medicine and Rehabilitation at the University of Pittsburgh where he directs the Laboratory for Research on Arm Function and Therapy (RAFT). In addition, he is a Vascular Neurologist at UPMC and a Visiting Associate Professor at the University of Maryland, Baltimore. Dr. Wittenberg is a board-certified neurologist whose clinical and research interests include neurorehabilitation, stroke, cerebral palsy, and movement disorders. He uses transcranial magnetic stimulation, functional neuroimaging, and rehabilitation robotics to study recovery of motor function after neural injury.



Choosing a Path, Connecting with Mentors, and Gaining Experience

Dr. Wittenberg’s interest in neurology stemmed from a general interest in medicine, science, and math. As a young child, visiting the doctor for an annual check-up was an exciting event that he kept track of and enjoyed. These interests later combined with his hobby of tinkering with electronics in high school, and this evolved into a fascination with the circuitry of biological systems, particularly the brain. In addition, he volunteered at Bellevue Hospital in New York, and the one-on-one interactions with patients and clinicians left a lasting impression on him.

As an undergraduate student at Harvard University, Dr. Wittenberg earned his bachelor’s degree in Engineering and Applied Sciences. For his very first research project, Dr. Wittenberg joined the lab of Dr. Tom McMahon, a pioneer in the field of biomechanics. Working with Dr. McMahon taught him a lot about how to run a lab and do rigorous, novel research. There were several other formative moments during his time as a trainee. “I vividly remember hearing a lecture by Dr. Ron Calabrese on how a complicated pattern of activity was produced in an invertebrate animal, and he used a model with lights and a control circuit to simulate how it all worked. That was a very influential moment for me,” Dr. Wittenberg recalled.

He signed up to take a course from Dr. Calabrese and also participated in the Neural Systems and Behavior course at the Marine Biological Laboratories (MBL) in Woods Hole. The summer course at MBL solidified Dr. Wittenberg’s interest in neuroscience, and gave him an appreciation of the strong community in science and the nature of a scientific career where

researchers are always learning new things. The year he spent working in an immunology laboratory after college was another great experience that taught him a lot about the process of doing science. However, Dr. Wittenberg was also still interested in medicine. Neurology seemed like a good way to combine these two interests, though he also considered other pathways in medicine like psychiatry and ophthalmology.

As a next step, Dr. Wittenberg attended the University of California, San Diego, where he earned his PhD and MD. During his graduate studies, Dr. Wittenberg had worked out how sensory inputs inform decisions for certain types of behaviors. In doing this research, he realized that neural circuits could adapt to the temporary removal of certain pieces of the circuit, and this was relevant for recovery of function after stroke. The question that remained was, how does this adaptation occur? Finishing his medical degree, Dr. Wittenberg wasn't sure whether he wanted to focus on research or continue to pursue medicine. To keep his options as open as possible, he decided to do a residency and build a career that included clinically relevant research as well as clinical practice.

Recognizing that rehabilitation was part of his interests helped guide where Dr. Wittenberg applied for residencies. He kept rehabilitation in mind as a criterion when evaluating potential programs. This brought him to Washington University in St. Louis, where he completed a neurology residency and a fellowship in neurorehabilitation. There was a required rotation in neurorehabilitation for neurology residents, and Dr. Wittenberg had the opportunity to work alongside remarkable colleagues and mentors, including the late Dr. Alex Dromerick and Dr. Warren Lux. These individuals who helped him develop a strong grounding in neurorehabilitation. Dr. Dromerick introduced Dr. Wittenberg to ASNR, and he attended his first Annual Meeting during this fellowship. Through his subsequent fellowship, Dr. Wittenberg gained experience in spinal cord injury, acute brain injury, and stroke, further setting him on the path to pursue his career in neurorehabilitation.

Dr. Wittenberg then accepted a position as a Senior Staff Fellow at the National Institute of Neurological Disorders and Stroke (NINDS). There, he worked in the laboratory of Dr. Leonardo Cohen, a remarkable mentor who has trained many leaders in the field of neurorehabilitation who are also members of ASNR. A willingness to move to take advantage of training opportunities and work with the best mentors in his area helped Dr. Wittenberg advance his career.

Career Development and Becoming a Leader in Neurorehabilitation

After training in Massachusetts, California, Missouri, and Washington D.C., Dr. Wittenberg began his first faculty position as an Assistant Professor at Wake Forest University Baptist Medical Center in North Carolina. As a neurologist trained in neurorehabilitation, there weren't a lot of places at the time that were a good fit for his clinical and research interests, but this position at Wake Forest University Baptist Medical Center proved to be an excellent opportunity. While there, Dr. Wittenberg worked with Dr. David Good, who was a Professor of Neurology and later became Director of Rehabilitation. Dr. Good was a leader in ASNR (serving as President from 2006-2008), and he quickly got Dr. Wittenberg more involved as well. "Having a community

of people with similar interests was really, really helpful. I also obtained the Neurorehabilitation certification from ASNR when it was available, and it's been helpful to present to the group and get feedback on my work."

After six years at Wake Forest University Baptist Medical Center, he moved to the University of Maryland Baltimore and the Veterans Health Administration where he continued providing clinical care in neurology and conducting research in neurorehabilitation. During his time working in Baltimore, Dr. Wittenberg served as the President of ASNR (2014-2016). ASNR has a system where leaders rotate through each of the Executive Committee positions before becoming president. Dr. Wittenberg joined a group discussion about the Program Committee at one of ASNR's Meetings, and he was struck by the idea of helping shape the science that is shared at the ASNR Meetings. He later agreed to become the Program Chair, and this had a big impact on his subsequent years in ASNR. "When I agreed to be the Program Chair, I didn't know that this was a position on the leadership ladder towards becoming president. However, the leadership experiences have been tremendously valuable, and I've continued to use things I learned as a leader in ASNR," he remarked.

Past-Presidents imparted their wisdom before Dr. Wittenberg took office, including how to handle the Society's finances, how to organize work, how to think about when to move and when not to move, and other important lessons. In the leadership pipeline and during his time as President of ASNR, Dr. Wittenberg was involved in transitioning the Society to independent Annual Meetings. He felt strongly that having a separate meeting would help the ASNR grow, allow for more in-depth discussions and programming, and distinguish the Society from others in the field. ASNR's Annual Meetings have been highly successful and well-attended each year, and this transition to independent meetings was a major milestone for the organization.

Maintaining Balance While Advancing the Field

In 2018, Dr. Wittenberg moved to Pittsburgh upon accepting his current positions, and this move allowed him to mentor graduate students in his laboratory. He has been invested in training the next generation of neurorehabilitation scientists in addition to advancing his own research. "It is an exciting time for neurorehabilitation, and I'm excited to see the culmination of years of work on motor plasticity, the timing of rehabilitation interventions to foster recovery, and the role of genomics in personalizing rehabilitation therapies. Having a deep understanding of neural circuits will be instrumental in applying new, cutting-edge technologies in the field," he shared.

Currently, Dr. Wittenberg has ongoing work in three exciting research areas. In one, he is collaborating on multiple studies examining more invasive stimulation approaches for motor recovery after stroke, including research on epidural spinal cord stimulation and deep brain stimulation. These kinds of projects require a large team, and it is exhilarating to see these technologies with implanted electrodes become potentially viable treatment approaches. In a second area, Dr. Wittenberg is advancing studies using brain stimulation, like transcranial magnetic stimulation (TMS), to explore connections in the brain, and he is pleased to be starting a therapeutic trial this year that will investigate a unique approach to pairing TMS with movement to enhance motor recovery. A third area of research is exploring genomic factors that

may predict a person's response to therapy. This is a new research area for Dr. Wittenberg that was driven by some interesting results, and it has the potential to help make rehabilitation treatments more personalized.

"Balancing clinical and research roles across multiple institutions can be a lot, but to the extent that I can, I try to make the work that I do in one place relevant to my other roles. For example, many of the individuals who volunteer to participate in our research studies are patients who I have seen in the clinic. So, providing excellent patient care and really connecting with patients can also lead to them becoming interested in participating in research." Dr. Wittenberg also points to the value of a good system for scheduling and setting reminders, as well as blocking time for writing and eliminating activities that aren't productive.

Reflections on Lessons Learned

For early-career neurorehabilitation professionals, Dr. Wittenberg advises not to let current clinical practice be a barrier. Getting new treatments to be adopted can be daunting, but he urges researchers to partner with people who are familiar with considerations for implementation, and don't let this hurdle hinder new discoveries. Also, Dr. Wittenberg pointed out that rehabilitation has become even more interdisciplinary over the years. "You can't expect to have all of the expertise in every area needed for a successful research study. Collaborate with statisticians, psychologists, or others who have complementary skills in order to do the best possible science," he remarked.

He also urged early-career researchers in the field to consider a career in academia in addition to other industry opportunities. "There were difficult times, but overall, I've found my career to be very rewarding, and I have enjoyed the intellectual freedoms of an academic career. Ultimately, try to build a career doing the things you are interested in most," he said. Being flexible is also critical in an academic career path. Looking back on his own career, Dr. Wittenberg noted that there were several opportunities that he did not pursue because they didn't fully align with his core interests. "While you can't do everything, sometimes you should push yourself to try something new, even if you're not sure you will like it. Often, it's more important to have a good mentor than to be working on the one thing that you are most excited about. Keep an open mind and try to think about things from different perspectives," he recommended.

An important lesson about professional societies that Dr. Wittenberg has learned over the years is that your connection with the organization may change over time, and that's okay. Dr. Wittenberg has had periods of his career where he was more involved in ASNR and times when he was less involved, but he has always maintained a connection and felt welcome. "For the majority of my career, I've had some kind of role in ASNR, whether it was a leadership position, sitting on the Board of Directors, being involved with the journal *Neurorehabilitation and Neural Repair*. Whenever I go to an ASNR Annual Meeting, I never have to worry about whether people I know will be there. It's always been this community, and ASNR has kind of been a home for me."