

Training in Neurology: Neuro Day

An Innovative Curriculum Connecting Medical Students With Patients

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Abstract

Objective

To determine whether increased patient interaction, exposure to the neurologic examination, and access to positive neurology mentors increase interest in neurology for first-year medical students.

Methods

Neuro Day was a 2-part experience for first-year medical students. The first part consisted of a flipped classroom to teach the standard neurologic examination. The second part involved patient encounters modeled off of the traditional patient rounds. Students rotated from room to room, listening to patients' experiences with different neurologic diseases and eliciting pathologic neurologic examinations. Students were surveyed before and after Neuro Day.

Results

The result of the binomial test indicated that the proportion of medical students interested in neurology significantly increased from 78% to 85% (95% confidence interval [CI] 0.79–0.92; $p = 0.034$) after participating in Neuro Day. The proportion of students' knowledge of clinical neurology increased from 45% to 63.1% (95% CI 0.54–0.72; $p < 0.0001$), comfort with performing a neurologic examination increased from 30% to 78.4% (95% CI 0.70–0.86; $p < 0.0001$), and fear of studying neurology decreased from 46% to 26% (95% CI 0.17–0.34; $p < 0.0001$) following Neuro Day. One hundred percent of students indicated that they would recommend Neuro Day to their peers.

Conclusion

Neuro Day is a feasible and effective model to incorporate into medical education. There was increased interest in and decreased fear of neurology. We anticipate that this paradigm can be used in the future to encourage students to consider a career in neurology.

In spite of the high prevalence of neurologic conditions and a corresponding need for neurologists, the number of medical students choosing a career in neurology is small. Neurophobia, a term coined by Dr. Józefowicz in 1994, may be responsible for the limited number of students selecting neurology as a future career. Neurophobia is defined as the fear of neuroscience and clinical neurology secondary to students' inability to utilize skills from the basic sciences in the clinical field of neurology.¹ Global morbidity and mortality attributed to neurologic diseases is 6.3% and 12%, respectively. Neurophobia is a widespread problem, with rates of 18%–47% throughout a variety of countries.^{2,3} Reasons for neurophobia include lack of positive mentors in the field of neurology, lack of innovative educational strategies to teach a traditionally difficult topic, and lack of exposure to neurology.⁴ Students' perception of what the field entails, including poor patient outcomes, limited treatment options, high burnout rates, complex neuroanatomy, and difficult neurologic examination, all contribute to neurophobia as well.^{4,5} Several studies have found that neurophobia actually increased following courses on basic neuroscience and clinical neurology.^{3,6}

Formal American Academy of Neurology guidelines recommend a longitudinal curriculum consisting of small group exercises in the first year, an integrated neuroanatomy and clinical skills course in the second year, a mandatory 4-week clinical rotation in the third year, and an optional subinternship in the fourth year, but many medical programs do not offer neurology in this manner.⁷ In fact, neurology is not even a required clerkship at 56% of medical schools.⁸ Although there are no validated surveys to assess neurophobia, there is a critical need to develop innovative neurologic curricula that are introduced to medical students early in their education. We propose a Neuro Day during the first year of medical school, consisting of a flipped classroom experience to teach the neurologic examination and a series of patient encounters modeled off of the traditional team rounds. The goal of Neuro Day is to effectively teach the neurologic examination, expose early trainees to neurologic patients, and instill a sense of excitement and curiosity in the field of neurology. We hypothesized that Neuro Day will lead to diminished sense of neurophobia and increase interest in the field of neurology for first-year medical students.

Program Description

This was a pilot study structured as a prospective survey study of 103 first-year medical students at West Virginia University School of Medicine in Morgantown. Neuro Day consisted of 2 parts: first, an hour-long block to teach the neurologic examination and second, a 3-hour patient encounter experience, for a half-day educational experience totaling 4 hours. The first part of Neuro Day used a flipped classroom experience to teach the neurologic examination. A week prior, students were provided with videos highlighting the neuroanatomy underlying different parts of the neurologic examination. There were a total of 9 videos, and the total running time was approximately 25

minutes. Students were instructed to watch these videos prior to attending Neuro Day. Topics included a neurologic examination for coma, coordination, eye movements, gait, hearing, mental status, neuromuscular, sensation, and smell. Each of these examination videos had interactive features where students could click on links specific to that examination topic, read about the physiology behind each of the examination techniques, and then watch videos of an examiner performing this technique on the patient. Because the medical students had already reviewed the videos at home, we were able to minimize the amount of lecture time and instead maximize the hands-on, interactive learning opportunities on Neuro Day itself. This part of Neuro Day took place in a large lecture hall and an hour was allotted for in-person instruction. The goal was to introduce basic neurologic examination techniques in a fun and interactive manner. Students had the opportunity to practice the neurologic examination techniques on each other with guidance from faculty and residents who were freely available to answer questions.

The second part of Neuro Day involved an interactive patient experience with 11 patients stationed in different rooms modeled off of traditional “patient rounds” in the hospital. Represented diseases included Parkinson disease, amyotrophic lateral sclerosis, facioscapulohumeral muscular dystrophy, multiple sclerosis, essential tremor, mesial temporal sclerosis, spinal muscular atrophy, cerebral palsy, dystonia, myotonic dystrophy, and stroke. A neurology faculty or resident was assigned to each patient and stayed in the patient's room throughout the day. The medical students were divided into groups of 10–11 students and rotated from room to room with the guidance of a facilitator. We used problem-based learning (PBL) rooms in the medical school because these rooms are already designed for small-group learning and were easily accessible for both medical students and patients. These rooms are also in close proximity to one another, which is an ideal setup for a rotational system such as the one we employed. The assigned neurology faculty or resident discussed pathophysiology pertinent to each patient. Each session lasted about 15 minutes and there were scheduled blocks of time built into the rotation schedule to allow for the patients and facilitators to have one or two 15-minute breaks between student groups. The patients had the opportunity to share their personal experience with their disease, and the students had the opportunity to ask the patients questions and practice examinations with pathologic features. For the majority of the students, this was their first encounter with real, nonstandardized patients.

Surveys were distributed to medical students immediately before (50 students participated) and immediately after Neuro Day (103 students participated). Survey participation was optional for students, which is why there was a different number of participants in the pre- and post-surveys. Surveys consisted of multiple questions using a 6-point Likert scale (0–5) to rate student level of interest in neurology, knowledge of clinical neurology, comfort performing a neurologic

examination, fear of studying neurology, and consideration of neurology as a future career option. Surveys also asked students to rate on a 4-point Likert scale what strategies would be the most effective for teaching neurology from the following options: patient encounters, lectures, clinical skills demonstrations, virtual demonstrations, neuroanatomy demonstrations, case discussions, PBL groups, and access to neurology mentors. Students also provided qualitative feedback on Neuro Day. Institutional review board approval was obtained from our institution prior to initiation of the surveys. Additional data are available upon request.

To analyze the data, student responses were separated into binary responses with 0–2 representing low interest/knowledge and 3–5 representing high interest/knowledge. A binomial test was used to calculate the differences in proportions of student interest or knowledge in each category before and after Neuro Day. The answers in the free response section were reviewed by one of the authors using thematic analysis, and subsequently organized by the themes that emerged during this analysis.

Program Assessment

The result of the binomial test indicated that the proportion of medical students interested in neurology significantly increased from 78% to 85% (95% confidence interval [CI] 0.79–0.92; $p = 0.034$) after participating in Neuro Day. Similarly, the percentage of students reporting a high level of knowledge in clinical neurology significantly increased from 45% to 63.1% (95% CI 0.54–0.72; $p < 0.0001$) and the percentage of students reporting comfort with performing a neurologic examination significantly increased from 30% to 78.4% (95% CI 0.70–0.86; $p < 0.0001$) following Neuro Day. There was a significant decrease in the proportion of students reporting fear of studying neurology following Neuro Day from 46% to 26% (95% CI 0.17–0.34; $p < 0.0001$).

There was a significant difference between the proportion of students who said “yes,” they would consider pursuing neurology as a future career, before and after Neuro Day, from 30% to 45% (95% CI 0.35–0.54; $p = 0.0006$). Importantly, 100% of the 103 students said they would recommend Neuro Day to their peers. The teaching strategy that was rated as the most useful for students was patient encounters, with 82% of students rating this as very helpful (highest score on the supplied Likert scale). The qualitative responses that we received from students were overwhelmingly positive, with requests for a Neuro Day to be continued in the future. Some specific themes that emerged in analyzing the qualitative responses submitted by the medical students included how this exercise helps with the following: to reduce burnout through patient interaction, to instill a sense of professional identity as a physician, to promote medical learning through the use of patients as teachers, and to encourage learning through personal connection (table).

Lessons Learned

Neuro Day was well received by the students, with 100% of students indicating that they would recommend Neuro Day to their peers. The proportion of students interested in neurology was significantly higher following Neuro Day, as was the proportion of students comfortable with clinical neurology knowledge and performance of a neurologic examination. The proportion of students fearful of studying neurology significantly decreased and the proportion of students considering neurology as a future career significantly increased following Neuro Day.

Neurophobia among medical students has been demonstrated at comparable levels throughout the world: the United States, China, the United Kingdom, Ireland, Sri Lanka, Nigeria, and the Caribbean found that neurology was consistently ranked as an area with one of the lowest, if not the lowest, level of interest, level of understanding, and level of confidence.⁹ The major contributing reasons across all of these studies were the complex neurologic examination, difficult neuroanatomy, and poorly taught or structured neurology curricula.⁹

For early medical trainees, there has been a shift from lecture-centric modes of teaching and more emphasis on real-life clinical application.¹⁰ Some of the pedagogical methods that have been used to minimize neurophobia include team-based learning, 3D neuroanatomy demonstrations, interactive online games, video demonstrations, flipped classroom techniques, and neurohumanities electives.¹⁰ It has become increasingly important to change the way we think about students' perception of neurology: instead of trying to minimize neurophobia, we should be trying to promote neurophilia.¹⁰ Overall, students reported less trepidation regarding neurology in programs that had greater exposure to patients, more bedside tutorials, and better access to mentors.^{5,6}

Our Neuro Day enabled students to empathize with individual patient stories, practice the clinical skills they learned from that morning on patients with real pathologic neurologic examination findings, and gain exposure to a variety of potential neurology mentors from residents and faculty. This exercise highlights the importance of using patients as educators and the value of teaching medicine through personal connections. Patient selection is important. Many of our patients were former teachers or had previous experience talking about their disease in front of groups of people, and thus were comfortable and passionate about sharing their story and having repeat examinations performed on them during a rigorous educational day with the medical students. Another consideration in the future would be to have multiple patients representing the same disease, to allow for a rotation system to relieve patients. Although the repetitive nature of the day could be seen as a daunting task for the patients and facilitators, we actually found that the intimate setting with a small group of students allowed for a more meaningful and personalized experience.

Table Selection of Qualitative Responses From Participants in the Neuro Day Course Organized by Thematic Representation

Theme	Medical student quotation
Reducing burnout through patient interaction	<p>"The clinical presentations and patient encounters were far and away the best part of this course. They helped me to not get burnt out and really made me enjoy MedNeuro, which I didn't think was possible."</p> <p>"This was the single best day of my medical school career. Please, whatever you do, do not take this away. I cannot tell you how much motivation this experience gave me to keep pushing through the remainder of first year and onto the summer. Thank you."</p> <p>"After an exhausting year of memorization and information processing, it was nice to pause for a day to remember why we are pursuing this career and who can benefit from the time we are putting in now. That reminder may seem small but it is worth so much. Each patient story was moving and educational in its own way."</p> <p>"I cannot express how much I loved this day. It was really incredible and inspiring and I think it came at a perfect time to lift our spirits. We need days like this to remind us why we're here and why we're doing all this. Don't ever change a thing, seriously. Unless it's to add more than one of them!"</p>
Development of professional identity as a physician	<p>"MedNeuro day was by far the most fun day of medical school of first year. It made everything come together for me and made me remember why I chose the field."</p> <p>"I loved seeing this live and can't wait to talk to and take care of these kinds of patients in the future. Thank you for organizing this!"</p> <p>"12/10, seriously, probably best day of learning we had all year of med school. Do not take that away. I for once actually felt like a physician that may be taking care of someone someday and not stuck in a library forever. Amazing day."</p> <p>"I especially enjoyed the Neuro Day. It was the first time I had ever considered neurology as a career path, and it now remains on my 'list.'"</p>
Refining medical knowledge by using patients as teachers	<p>"Seeing them and hearing their stories helped me remember a lot of the information later on for the exam as well."</p> <p>"Very beneficial. What made this helpful was that residents explained the basic science/path of the disease and the characteristic symptoms of the disease before allowing the patient to share their experience."</p> <p>"I loved MedNeuro Day! I learned so much about a variety of diseases, and this helped me remember these conditions during exams. I also loved being able to experience what cogwheel rigidity feels like clinically."</p> <p>"Neuro patient day was the best med school experience I've had. The questions by physicians and their explanations offered insight to aspects of diseases we wouldn't otherwise have exposure to as students. Seeing patients also inspired me to study more."</p> <p>"MedNeuro Day was my favorite day of all of MS1. It was our first real opportunity to engage with real (nonstandardized) patients and it allowed us a chance to bridge our classroom learning of diseases and injuries with the reality of disease presentation."</p> <p>"MedNeuro day 10/10 one of the coolest days of the first year...if only that was able to be all of first year. I think by the last week and the shelf I was still answering questions based off the few patients I saw that day and what they told us they dealt with and what I was able to feel and see."</p>
Value of teaching medicine through personal connections	<p>"This day was incredibly valuable. I loved the patient interaction and was so humbled by their stories."</p> <p>"I loved MedNeuro Day. Everything about MedNeuro Day was fantastic, and I really wish that we were able to do something similar in other classes. It was really awesome being able to go room to room and talk to patients who all had diseases that were unique. Since we do not get a lot of patient interaction during the first year, this was a refreshing change from being in lectures all day."</p> <p>"It was also an invaluable experience to talk with patients and learn from them how their conditions affect their day-to-day lives."</p> <p>"The Neuro Day was fantastic. I loved this. I know this may have been tough for the patients to go through their story many times, but I certainly know that the students got a lot from it."</p>

Implementing a Neuro Day at medical schools with larger class sizes may face logistical challenges. However, we noted several strategies that helped this day run smoothly, including clearly marking all entrances and patient rooms and having volunteers help direct patients to the correct area; ensuring all entranceways and patient rooms were accessible, especially for patients with limited mobility; having a pre-determined rotation schedule distributed to all participants of Neuro Day; posting volunteers in the hallway to help direct student traffic and keep track of time; and assigning a faculty chaperone to rotate with student groups to help them know where to go. It is also important to reserve rooms well in advance to ensure there are enough rooms for each patient volunteer and that these rooms are easy to travel between; the PBL rooms in the medical school served as an ideal location for this purpose. We chose to set aside 4 hours to complete our Neuro Day, but we recognize that the specific amount of time dedicated to each portion of the day may vary depending on the number of students, the number of

patient volunteers, room availability, and other features unique to individual institutions. Although there are many logistical considerations in order to implement such a day of learning, with enough advanced planning, we found that this was a very rewarding day for everyone involved.

Future Directions

The primary limitations of this study were the lack of a control group and the large difference between the number of respondents on the pre- and post-surveys. For future iterations of Neuro Day, we plan to match the pre- and post-surveys with a deidentified random number. We also plan to formally evaluate the patient volunteers as well as the neurology resident volunteers to assess how being involved in Neuro Day influences them. We also plan to survey the medical students longitudinally to determine how many students from this group end up selecting neurology for their residency training.

Overall, Neuro Day was a successful curricular intervention for first-year medical students. It is a feasible paradigm to institute a day with a flipped classroom scenario focused on the neurologic examination followed by exposure to real neurologic patients in a patient rounds format. After Neuro Day, our students had increased interest in neurology, decreased fear in studying neurology, and a trend toward more students considering neurology as a future career. With 100% of students indicating that they would recommend Neuro Day to their peers, we expect that Neuro Day will continue to be used in the future to inspire medical trainees in neurology.

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Disclosure

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Appendix Authors

Name	Location	Contribution
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Brandon Neeley, MD	Department of Neurology, West Virginia University, Morgantown	Design and conceptualization, revision of the manuscript
Amna Umer, PhD	Department of Pediatrics and Research, West Virginia University, Morgantown	Data analysis and manuscript revision

Appendix (continued)

Name	Location	Contribution
James W. Lewis, PhD	Department of Neuroscience, West Virginia University, Morgantown	Coordination of the educational intervention
Anna Lama	Department of Medical Education, West Virginia University, Morgantown	Coordination of the educational intervention and survey distribution
Gauri Pawar, MD	Department of Neurology, West Virginia University, Morgantown	Coordination and revision of the manuscript
Ann Murray, MD	Department of Neurology, West Virginia University, Morgantown	Conceptualization, coordination, and revision of the manuscript

References

- Józefowicz RF. Neurophobia: the fear of neurology among medical students. *Arch Neurol* 1994;51:328–329.
- Abushouk AI, Duc NM. Curing neurophobia in medical schools: evidence-based strategies. *Med Educ Online* 2016;21:32476.
- Shiels L, Majmundar P, Zywtot A, Sobotka J, Lau CSM, Jalonen TO. Medical student attitudes and educational interventions to prevent neurophobia: a longitudinal study. *BMC Med Educ* 2017;17:225.
- Zinchuk AV, Flanagan EP, Tubridy NJ, Miller WA, McCullough LD. Attitudes of US medical trainees towards neurology education: “neurophobia”: a global issue. *BMC Med Educ* 2010;10:49.
- Abulaban AA, Obeid TH, Algahtani HA, et al. Neurophobia among medical students. *Neurosciences* 2015;20:37–40.
- Fantaneuanu TA, Moreau K, Eady K, et al. Neurophobia inception: a study of trainees’ perceptions of neurology education. *Can J Neurol Sci* 2014;41:421–429.
- Charles PD, Scherokman B, Jozefowicz RF. How much neurology should a medical student learn? A position statement of the AAN undergraduate education subcommittee. *Acad Med* 1999;74:23–26.
- Albert DV, Yin H, Amidei C, Dixit KS, Brorson JR, Lukas RV. Structure of neuroscience clerkships in medical schools and matching in neuromedicine. *Neurology* 2015;85:172–176.
- Cuoco JA. Medical student neurophobia: a review of the current pandemic and proposed educational solutions. *Eur J Educ Sci* 2016;3:41–46.
- Shelley BP, Chacko TV, Nair BR. Preventing “neurophobia”: remodeling neurology education for 21st-century medical students through effective pedagogical strategies for “neurophilia.” *Ann Indian Acad Neurol* 2018;21:9–18.

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