Course Summary

Scope of the Problem: Neurophobia and the Challenges of Recruiting US Graduates into Neurology
Imran Ali, University of Toledo

Dr. Ali's presentation focused on the following topics:
1. Need for neurologists in the future neurology workforce.
2. "Neurophobia" as a factor in career choice
3. Best practices in medical school training and its impact on career choices.

The demand for neurologists is expected to exceed supply by more than 20% in most southern, Midwestern and western states, while the northeast (except Maine and New Hampshire) are expected to have greater supply than demand. The number of US medical graduates continues to increase with the increase in US medical schools from 125 to 154 in the past 15 years, producing an estimated 23,000 graduates annually by 2025. In the 2020 match, there were 946 neurology residency positions offered with 1068 total applicants, of whom 471 were US grads. All but 13 of the US grads matched into Neurology residencies. By contrast, for Neurosurgery there were 232 positions offered and 383 applicants, of which 270 were US grads. Of the US applicants, 203 matched and 67 did not, with only 29 positions going to foreign medical graduates. 97.2 % of US grads going into Neurology matched into a program, and the probability of matching approaches 100% with a USMLE step 1 score of 230 or above. The number of neurology PGY1 resident positions has increased steadily since 2007, largely due to conversion from advanced to categorical (4 year) residencies, with a relatively steady proportion of US to foreign medical graduates (about 4 :3). For Neurosurgery, the number of PGY1 residency has increased only slightly over the same period, and the proportion of foreign medical graduates has also remained relatively constant at about 10%.

The term "Neurophobia" was coined by by Dr. Ralph Jozefowicz at University of Rochester (Arch Neurol 51;328-9:1994) and refers to the perceived difficulty of neurology, which was thought to be due to lack of knowledge of the specialty (lowest ratings of all specialties), the lack of basic/clinical science integration, and poor quality of teaching. Zinchuk et al. surveyed 152 third and fourth year medical students at UConn Health Center in 2010 (BMC Med Education, 2010 Jun 23;10:49) who reported that Neurology was the medical specialty in which they had the least knowledge and was the most difficult. "Reasons for perceived difficulties with neurology were the complexity of neuroanatomy, limited patient exposure and insufficient teaching. Transition from pre-clinical to clinical medicine led to a doubling of "poor" ratings for neurological teaching. Over 80% of the respondents felt that neurology teaching could be improved through greater exposure to patients and more bedside tutorials" as well as enhanced integration of basic and clinical neurosciences.

More recently, Jordan et al. (Neurology. 2020 Aug 25;95(8):e1080-e1090) conducted focus groups of 27 medical students and 15 residents in 2017 to determine what factors attracted students to a career in Neurology. They found that four themes emerged: "(1) early and broad clinical exposure allows students to "try on" neurology and experience the variety of career options; (2) preclerkship experiences and a strong neuroscience curriculum lay the foundation for interest in the field; (3) personal interactions with neurology providers may attract or deter students from considering the specialty; and (4) persistent stereotypes about neurologists, neurology patients, and treatment options harm student perceptions of neurology."

Strategies to address neurophobia thus include 1) Integrate basic and clinic neurology, 2) Strong leadership or participation in the basic neuroscience curriculum by neurologists 3) Introduce clinical neurology early, 4) Focus on common neurological disorders, 5) Emphasize and enhance student engagement, 6) provide mentorship to those with neuroscience interests, and 7) ensure high quality of teaching.

Gutmann et al. (Neurology 2019 Apr 23;92(17):e2051-e2063) used AAMC data to assess factors associated with choosing Neurology as a career. "Of the 51,816 students with complete data, 1,456 (2.8%) indicated an intent to enter a neurology residency. Factors associated with an increased likelihood of entering neurology were a student's rating of excellent for their basic neuroscience course and neurology clerkship, participation in an MD/PhD program, majoring in neuroscience or psychology as an undergraduate, … and indicating interest in neurology. Factors associated with a decreased likelihood of entering neurology were a higher-priority … for salary, work/life balance, and personal fit of the specialty."

At the University of Toledo, the percent of medical students selecting neurology as a career increased from about 1% to about 5% in 2010, associated with moving the clerkship from the 4th to the 3rd year of medical school. Students who experience neurology in the 3rd year have greater enthusiasm for the field and view neurology more favorably as a possible career (Dewey and Agostini, Arch Neurol 2010 67(5): 548-551). In 2019, the percentage at UT going into neurology decreased to about 3%, possibly due to a shift of the major teaching site to a large community hospital.

In summary, there is need for more neurologists in most regions of the country. The number of US seniors matching has remained unchanged at 2.8-3.0%. The number of US graduates going into neurology can be increased by adopting best practices including strong teaching, early exposure to clinical neurology, and having the clerkship in the 3rd year.

How do Medical Students Make Decisions about Neurology?

Rachel Gottlieb-Smith and Douglas Gelb, University of Michigan

Dr. Ali's talk demonstrated the increasing need for neurologists, and the deficit in recruiting US graduates to our field. However, one could argue that we should not be directing students toward neurology or any particular specialty. Medical students are grown-ups who know what they like, and can decide for themselves if neurology is a good fit. Moreover, every medical specialty does good, and no medical specialty openly states that there are too many practitioners. Based on this logic, we should inform students about neurology as a career, but not necessarily promote it. However, interviews with students reveal that in fact they know very little about what different subspecialty careers are like, and the bases for their decisions are often unclear. Hence, it makes sense to promote our own specialty while we inform them about it.

Drs. Gottlieb-Smith and Gelb studied first year medical students from early after matriculation until the end of their second year of training, using ssemi-structured interviews with 15 University of Michigan medical students regarding their career intentions, factors influencing career choice, perceptions of neurology, and how these ideas change after their preclinical neuroscience course and over time. This project is part of Dr. Gottlieb-Smith's research for the Master of Health Professions Education program at the University of Michigan.

Of the 15 students interviewed, 10 were female. Nine were neutral toward neurology, 2 were inclined toward neurology and 2 inclined against it. In interview 2, there was a shift of one student from inclined toward neurology to neutral, and one of the disinclined students became neutral, increasing the number of neutral students to 11. Key factors influencing their decision making included lifestyle (27%), personal interest (20%), relationships with patients (11%), impact of the specialty (9%), and patient population (8%). Factors with smaller contributions included the ability to "fix" or "cure" the problem (7%), research in the topic (7%), the "personality" of the specialty (6%) and the ability to perform procedures (5%). "Lifestyle" appeared to mean time for family, child bearing / parental leave, work hours and flexibility, and did not equate with salary. Most had little idea of the lifestyle of a neurologist. They had the sense that it might be easier than surgical specialties with greater ability to balance family life with career. Personal interest translated as "intellectual stimulation," "passion" or "excitement." This appears to increase in importance as students progress through the preclinical curriculum. There was a sense that neurology was innovative and changing, a good field for people interested in being creative to solve problems. On the other hand, it also seemed scary to some who felt that the workings of the brain might be too complex to be understood. Students had a sense that neurology treats conditions that can't be easily fixed, though this perception lessened in the second interview. The number of students rating Neurology as "difficult" increased from 6 in interview to 10 in interview 2. The difficulty of the preclinical neuroscience course and limited time for completion may contribute to burnout.

The information from this study leads to several suggestions: 1) Introduce role models with good work-life integration early in the preclinical years. 2) Emphasize the positive impact of Neurology, including some "fixes"/"cures". 3) Increase time in the pre-clinical neurology course. Students also suggested more clinical correlations and research opportunities.

How to Increase Medical Student Interest in Neurology – The University of Oklahoma Experience

David Gordon, MD, University of Oklahoma

The percent of US MD medical graduates matching into adult Neurology residencies increased slightly from 2016 to 2020, from 1.4 % to 1.8%, with a relatively stable 0.6 % matching into child neurology training programs. The number for D.O. graduates also hovers at 1.9% for adult neurology and 0.2% for child neurology.

General factors that affect a medical student's choice of specialty include: 1) Gender, 2) Lifestyle, 3) Specialty archetype/'personality," 4) Perceived specialty prestige, and 5) Student experiences. The four factors that may increase medical student recruitment into neurology include 1. Early and broad clinical exposure, 2. Preclerkship experiences & a strong neuroscience curriculum, 3. Positive personal interactions with neurology providers, and 4. Debunking negative stereotypes about neurologists, neurology patients, and neurology treatment options. (Jordan JT et al. Neurology 2020;95:e1080-e1090).

Clinical clerkships influence medical student career choices based on: 1) Clinical experiences, including patient type, 2) Role modeling, and 3) Perceived work conditions (Maiorova T et al., Medical Education 2008;42:554-562). Medical students are more likely to choose a career in neurology if they: 1) Attend a medical school with a required neurology clerkship (Albert DV et al. Neurology 2015;85:172-176) 2) Majored in neuroscience as an undergraduate, 3) Were interested in neurology upon medical school matriculation, or 4) Rated their basic neuroscience course or neurology clerkship as excellent on the AAMC Graduation Questionnaire (GQ) (Jordan JT et al. Neurology 2020;95:e1080-e1090).

At the University of Miami, a curriculum change in 2003 increased the number of students going into Neurology from 3 to 7 by 2005 and to 10 in 2007, doubling the mean percent from 2 to 4% over 5 years. Similarly, a curriculum change at the University of Oklahoma in 2009 increased the number of students selecting neurology or child neurology from a mean of 1% to 5%, an effect which has now been sustained for 11 years. This increase directly correlated with a dramatic increase in the rating of the second year medical school neuroscience course from 7th to 1st in quality and in the clerkship from 7th to 1st in educational quality on the graduation questionnaire. The percentage of students rating education quality as "excellent" at OU increased from 29% to around 80% and remained consistent, compared to about 40% at all LCME medical schools.

These changes were accomplished by shifting the paradigm from a neurologist who teaches to an educator who teaches neurology. Experiential learning alone is Insufficient. Yes, learners crave clinical experiences, and experience is the "best" teacher (results in optimal recall). However, as American management consultant & champion of quality improvement W. Edwards Deming (1900-1993) noted, "Experience itself teaches nothing." Similarly, Sir William Osler (1849-1919) agreed that "The value of experience is not in seeing much, but in seeing wisely."

Moreover, experiential learning alone may lead to inaccurate learning. A group at the University of Michigan reviewed patient logs of 212 neurology clerkship students from 2005-6 academic year and determined the number of patients each student saw in 5 diagnostic areas—seizure, headache,

stroke, acute mental status change, dementia. They compared the number of patients seen by each student with the student's written exam scores (including 5 diagnostic area subscores) and clinical performance scores. The more patients a student saw in a given diagnostic area, the LOWER the student's exam subscore in that area (p=0.03). The total number of patients seen did NOT correlate with total written exam score (p=0.77) or clinical performance score (p=0.23) (Poisson SN et al. Neurology 2009;72:699-704).

Hence, providing experiences without feedback does not lead to learner growth and, in fact, may lead to regression through inaccurate experience interpretation. Providing experiences without learner preparation leads to missed opportunities and increased learner anxiety/neurophobia. Testing material not covered in the didactic curriculum—such as by using an NBME shelf exam—results in: 1) Learners ignoring the didactic curriculum & clinical instructors, 2) Lack of focus and direction for the learners, and 3) Increased learner anxiety/neurophobia.

The way to prevent this is by optimizing experiential learning using the lessons of educational psychology. Experiences result in optimal learning if learners are taught in a way that corresponds to educational psychology concepts. Students must be 1) Prepared (based on the educational concept of "priming"), 2) Focused (corresponding to curriculum alignment) 3) Motivated (based on the concept of a "flow channel" for information), and 4) Provided feedback (based on the concept of deliberate practice).

Priming prepares learners for experiences. This is based on a concept promoted by Karl S Lashley in 1951. Priming is influencing learners' responses to an experience by first exposing them to a related stimulus (e.g., didactic session, case-based learning, or simulation exercise before seeing a patient). This expands the knowledge base or "experience" of the learner in preparation for an upcoming experience. It lessens anxiety and optimizes potential learning during experience. It utilizes the framing heuristic and hence guides learners appropriately. It also avoids the availability heuristic – it does not allow them to generalize based on lack of knowledge or experience.

Curriculum alignment focuses learners by "teaching to the test." It is the process of linking objectives, assessments, and learning experiences to ensure learners achieve what is expected of them. It has a positive effect on learner growth and satisfaction. In educationese, it "facilitates flow." This is based on the work of Benjamin S. Bloom (1913-1999), an educational pioneer (Bloom BS. Evaluation Comment 1968; 1(2):1-12). Objectives are the engine that drives the train, followed by assessments and then learning. As noted by George E. Miller (1918-1998), a medical education research pioneer, "Assessment drives learning" (Miller GE. Acad Med 1990;65:S63-S67.) More generally, as noted by quality improvement pioneer W. Edwards Deming (1900-1993), "You can expect what you inspect."

A "flow channel" is the state of optimal experience (enjoyment and maximal concentration) in which students are confident and content. It occurs as a result of participating in activities that one perceives as worth pursuing for their own sake. Flow channels motivate learners by providing sufficient skill to accomplish the task. It requires both learner skills matching the challenge difficulty (facilitated by priming), and goals, structure, and feedback (facilitated by curriculum alignment & deliberate practice). In a flow channel, students progress to mastery from novice to intermediate to advanced by having

sufficient skills that increase proportionately to the challenges. Too much challenge without sufficient skills produces anxiety, while too many skills without sufficient challenge produces boredom. (M Csikszentmihalyi 1990).

Deliberate practice involves providing feedback to promote learner growth. Deliberate practice is focused, repetitive practice designed by instructors to improve performance of specific tasks necessary to advance to the level of expert. Studies of master level performance suggest that 10,000 hours of deliberate practice improves learner likelihood of achieving level of expert. But this is not just practice without guidance – it requires a motivated and attentive learner (flow channel), a set of well-defined tasks and goals (priming & curriculum alignment), an appropriate level of difficulty (flow channel), informative feedback from a skilled master instructor (curriculum alignment), and opportunities for repetition & refinements (priming & flow) (modified from KA Ericsson et al. 1993; KA Ericsson 2008; WC McGaghie et al. 2011). Without deliberate practice, there is less opportunity for learner growth based on new experiences.

At the University of Oklahoma, the Didactic Curriculum Components are based on the AAN core curriculum (Gelb DJ et al. Neurology 2002; 58:849-852) and taught by select faculty, including a nurse educator. The topics include: Lesion localization, Neurologic history, Neurologic exam, Neurologic findings, Brain imaging (CT & MRI), Unconscious bias, Case summaries (SBAR), Ward-based learning (H&P), Patient-centered articles, Aphasia standardized patient (SP) and objective structured clinical Examination (OSCE), Coma SP/OSCE, Case-based learning, 10 outpatient cases, 10 emergency cases, Ethics and professionalism, and Interdisciplinary team basics. To promote curriculum alignment, the clerkship supplies all required learning material, and all tests are based on clerkship-supplied materials. The Final Exam is an internal exam—NOT the NBME Shelf exam—yet students consistently perform above the national average in neurology on USMLE Step 2. "Ward Performance" is worth only 10% of total grade and is the only component not part of the structured, didactic curriculum.

Increased student satisfaction resulting from the improved didactic curriculum improves recruitment into neurology. Student satisfaction is a surrogate outcome measure for interest in neurology. A successful medical student curricula as determined by AAMC Graduation Questionnaire results increases the likelihood of students choosing a career in neurology or child neurology. Basing a neurology clerkship's didactic curriculum on core educational psychology principles significantly affects both student satisfaction and the number of medical students who choose to pursue a career in neurology.

References:

• Albert DV, Yin H, Amidei C, et al. Structure of neuroscience clerkships in medical schools and matching in neuromedicine. Neurology 2015;85:172-176.
• Bloom BS. Learning for Mastery. Evaluation Comment 1968; 1(2):1-12.
• Csikszentmihalyi M. Flow: The Psychology of Optimal Experience. New York: Harper & Row; 1990.
• Ericsson KA, Krampe RT, Tesch-Römer C. The role of deliberate practice in the acquisition of expert performance. Psychological Review 1993;100:363-406.
• Ericsson KA. Deliberate practice and acquisition of expert performance: a general overview. Acad Emerg Med 2008;15:988-994.
• Farrow AK, Gordon DL, Prodan CI. The effect of a clerkship didactic curriculum on medical student career choice in neurology. American Academy of Neurology 69th Annual Meeting, S6.002. April 23, 2017. Boston, MA.
• Gelb DJ, Gunderson CH, Henry KA, et al. The Neurology clerkship core curriculum. Neurology 2002; 58:849-852.
• Jordan JT, Cahill C, Ostendorf T, et al. Attracting neurology's next generation. A qualitative study of specialty choice and perceptions. Neurology 2020;95:e1080-e1090.
• Lashley KS. The Problem of Serial Order in Behavior. In Jeffress LA (ed) Cerebral Mechanisms in Behavior. pp 112-131. New York: Wiley; 1951.
• Maiorova T, Stevens F, Scherpbier A, van der Zee J. The impact of clerkships on students' specialty preferences: what do undergraduates learn for their profession? Medical Education 2008;42:554-562.
• McGaghie WC, Issenberg SB, Cohen ER, et al. Does simulation-based medical education with deliberate practice yield better results than traditional clinical education? A meta-analytic comparative review of the evidence. Acad Med 2011;86:706-711.
• Miller GE. The assessment of clinical skills / competence / performance. Acad Med 1990;65:S63-S67.
• National Resident Matching Program, Results and Data: 2020 Main Residency Match®. National Matching Program, Washington, DC. 2020.
• Poisson SN, Gelb D, Oh M, Gruppen L. Experience may not be the best teacher, patient logs do not correlate with clerkship performance. Neurology 2009;72:699-704.