

'Building Your Neurology Acumen': A Flipped Classroom Approach to Strengthen Internal  
Medicine Residents' Neurological Skills

By

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## Abstract

Background/Purpose: Rotating internal medicine (IM) residents often do not feel knowledgeable about neurology, or adequately prepared to approach patients presenting with neurologic clinical issues. Limited pre-clinical exposure, uncertainty when facing neurological complaints, inadequate clinical teaching, and perceived complexity of the field contribute to this perception. We conducted a needs assessment to determine the feasibility of a novel neurology flipped classroom (FC) curriculum for internal medicine residents.

Methods: We utilized a multiple methods design and recruited participants through a combination of purposive and convenience sampling. We conducted interviews with internal medicine residents (n=12), a focus group with neurology residents, and a focus group with neurology staff. Additionally, internal medicine residents completed an entry and post-call survey while on their neurology rotation.

Results: We implemented a deductive method of analysis by organizing themes according to Kern's framework for curriculum development.

1. Problem Identification: Discomfort and perception of under-preparedness amongst IM trainees
2. Targeted Needs Assessment: What the learners (stakeholders) think they need to know vs. what their teachers want them to know vs external requirements (Royal College)
3. Goals and objectives: What content is relevant for clinical requirements vs assessments? Are they mutually exclusive?
4. Methods and setting: Didactic vs. bedside vs. on-demand

5. Implementation of the curriculum: AHD vs. Rotation
6. Evaluation and feedback: Curriculum could be evaluated with surveys, performance on rotation, and board examination result

Conclusion: Our findings illustrate the need to re-examine the way in which neurology is being taught to off-service residents.

**Dedication**

*For my loving parents who selflessly sacrificed their youth in building our family's future.*

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## **Chapter 1: Introduction and Background**

### **Shortage of neurologists**

Globally, there is a trend toward an ever-increasing burden of neurologic disease. This has been noted by the Global Burden of Disease Study and the World Health Organization (WHO).<sup>1,2</sup> In 2030, neurologic disease is expected to account for 12% of deaths worldwide and 14% of total years lost secondary to disability. These statistics combined with the documented shortage of neurologists in the coming decades will result in hospitalists and family physicians managing chronic neurologic conditions.<sup>3</sup> Thus, it is essential that these healthcare workers receive adequate training in how to approach and manage patients with neurologic symptoms. However, numerous studies have demonstrated that medical students and resident physicians find neurology to be one of the most difficult subjects within medicine.<sup>4-8</sup> In 1994, Jozefowicz described “neurophobia” as “a fear of the neural sciences and clinical neurology that is due to the students' inability to apply their knowledge of basic sciences to clinical situations.”<sup>9</sup> Other research has demonstrated that low interest and knowledge levels also contribute to neurophobia.<sup>10</sup>

### **Inadequacy of current neurological clinical exposure and curriculum**

Across Canada, neurology is a selective rotation within medical schools and for internal medicine (IM) and family medicine residents. Thus, hospitalists and primary care physicians will either receive limited or no dedicated neurologic clinical training during their careers. It is important to provide a comprehensive neurology curriculum to trainees to address their concerns and gaps in knowledge. Lazarou et al. proposed a national standardized neurology curriculum for internal medicine residents but this has not yet been adopted widely.<sup>11</sup> There is still no consensus on a standardized national neurology curriculum for internal medical residents.

### **Optimization of pedagogical approach**

Because the neurology rotation is not mandatory, we need to look at resources outside of a formal rotation. Given available time with a neurology preceptor is limited, the pedagogical approach needs to be maximized. Flipped classroom (FC) is a more active approach to learning with the learner reviewing the content at home in a self-directed manner and being prepared to discuss it with fellow students in the presence of a facilitator.<sup>12</sup> The materials can be short videos, podcasts, or even focused readings. The idea is to evaluate and analyse the information with the support of a content expert. Thus, limited time with medical preceptors can be maximized and focus can be placed on honing clinical acumen. While this method has been utilized at the level of undergraduate medical education<sup>13</sup>, its use within postgraduate training is limited. Issues include lack of buy-in from residents and faculty; residents may not engage with the content beforehand and staff can find it taxing to prepare online materials for blended learning.<sup>14</sup> Graham et al. recently studied the effects of FC curricula in an IM program and found that while it was successful in increasing knowledge acquisition and retention, 24% of residents perceived that there was not enough protected time on inpatient rotations to implement this approach.<sup>15</sup> Another paper studying the role of FC in graduate medical education found that residents “enjoyed the curricular material” but had “significant concerns about the time and motivation” required to do the pre-work.<sup>16</sup> Hence, within the right environment, the FC model has the potential to transform the current neurology curricular approach within internal medicine.

We know that the underlying issues IM residents face with neurology stem from lack of exposure, inadequate curriculum, and current pedagogical approach to neurology subject matter. The aim of our study was to conduct a needs assessment to gauge the level of

preparedness when residents start their neurology rotation, understand which topics IM residents find challenging, and gain insight into what factors would increase buy-in for a flipped class neurology curriculum for IM residents.

## **Chapter 2: Methods**

We conducted a multiple methods needs assessment using interviews, focus groups, and surveys.

### **Research team**

The research team consisted of Zoya Zaeem (Z.Z., senior neurology resident and candidate for a Master's in Health Sciences Education), Dr. Penelope Smyth (P.S., neurologist), and Dr. Vijay Daniels (V.D., general internist). In terms of background, all the investigators have a special interest in medical education. Dr. Smyth has previously served as the neurology program director and is the current Associate Dean of Professionalism for our faculty; Dr. Vijay Daniels has a master's in health Professions Education, is experienced with qualitative and quantitative research, and is the Associate Chair of Education and Faculty Development for our department.

### **Participants & Recruitment**

We recruited internal medicine residents rotating through neurology in their second year of training through a combination of purposive and convenience sampling. At the time of this study was conducted, second year IM residents completed a mandatory one-month rotation in neurology at our institution. However, this is being phased out and will currently be offered as a selective rotation. We sent out emails inviting these residents to take part in a one-on-

one interview, entry survey, and post-call survey. There were no incentives offered for participation. While most of the residents were about to start their rotation, we did recruit a few for surveys and interviews after they had completed their rotation.

To gather all perspectives around optimizing neurology curriculum for IM residents, we recruited neurology residents by email to participate in a focus group and neurologists involved in postgraduate medical education for a faculty neurologist focus group. Again, no incentives were offered for their participation.

### ***Ethics***

We received ethics approval for this project through the University of Alberta Health Research Ethics Board prior to commencement of recruitment and data collection and we obtained informed consent from all participants through signed forms (Pro00096669). Any identifiers were removed by the transcriptionist to assure confidentiality of the study. The recordings and surveys were not accessible to anyone except the research team.

### ***Data collection:***

Our institution has a dedicated neurology and stroke admitting service in addition to an inpatient consult service. Generally, IM rotators complete two weeks of stroke, one week of general, and one week of consult service. We conducted surveys and interviews with IM residents in addition to focus groups with neurology residents/staff members. This was so that we could derive information from various stakeholders and be able to collect different data from these sources. The data was subsequently used to inform what pedagogical

methods and tools would optimize residents' diagnostic reasoning, knowledge, and satisfaction.

*1. One-on-one IM Resident Interviews:*

The semi-structured interviews were all conducted by one research team member (Z.Z.) using interview guides developed by the research team. The interviews were semi-structured, lasting approximately ten minutes. Copies of the surveys and interview question script have been included in the appendices. The list of questions was created through consensus; however, we were not rigid as to the wording and sequence of the questions.<sup>17</sup> After the initial introductory questions, there were open-ended questions, followed by probing queries. For example, "how did you perceive the neurology rotation?" "What could be done to improve the neurology curriculum within the GIM residency?" "What are some of the greatest challenges you faced on the neurology rotation?" A copy of the interview guide is included in Appendix A. During the course of the interviews, an additional question was added; "how did you find your interaction with neurology staff and residents?" based on content offered spontaneously during the first interviews.

*2. Focus groups:*

The focus group with neurology residents was facilitated by ZZ (having previously taken a course in qualitative research) while the focus group with the neurology staff was facilitated by VD who has previous experience with focus group interviews. Each of these focus groups lasted for about 90 minutes. One of the investigators acted as the facilitator and field notes were recorded. The focus groups concentrated on how participants felt the neurology curriculum was currently being delivered and ideas for improvement. They also covered

perceptions around IM resident preparedness for clinical practice (a copy of the focus group questions is included in the Appendices B and C). We began with a general introduction and then moved into open-ended questions, as determined previously by the research team. Participants were allowed to join in and add their perspectives whether it was in response to the facilitator or another participant.

### *3. IM Resident Surveys:*

The internal medicine residents rotating through neurology were invited to take part in an entry survey and post-call survey. We distributed these surveys at the start of the Internal Medicine residents' neurology rotation and after their first night on call. The surveys were designed to quantify levels of comfort with neurological subject matter and likelihood of various resources for self-directed learning being adopted (Appendix D). The entry survey consisted of 13 items graded on a 5-point agreement Likert scale (strongly disagree to strongly agree) to measure their comfort/preparedness with neurology and what pedagogical modalities they would like to use in a FC approach. The post-call survey consisted of nine items graded on the same scale (Appendix E) designed to measure whether there was any shift in their comfort/preparedness with neurology after a 26-hour work shift. We did not come across any previously validated questionnaire to measure preparedness/comfort for a clinical neurology rotation or after a trainee's first night post-call. All questionnaires were designed by the team members.

### ***Data analysis***

#### ***Qualitative***

The interviews and focus groups were digitally recorded and transcribed. The surveys also had comment boxes and this data was included in the qualitative analysis. The validity of the coding process was ensured through member checking. Two participants reviewed the emerging themes, categories, and sub-categories. We followed the six-step process for thematic analysis as outlined by Kiger and Varpio to analyse interview transcripts, focus group transcripts, and survey comments.<sup>18</sup> The transcripts were reviewed independently by V.D., P.S., and Z.Z. There was >80% concordance in generation of themes amongst the investigators. The primary investigator explained and explored each phase of the analysis with team members. Disagreements about the codes and the other issues were discussed in order to reach an agreement.

### ***Quantitative***

Analysis of the survey data was completed with SPSS software (IBM Corp, 2019).<sup>19</sup> We used one-sample t-tests to compare Likert means to the neutral score of 3.0, and paired-t tests to analyse differences in means between the questions. Two-sided p-values of less than .05 were considered significant.

## **Chapter 3: Results**

### ***Qualitative analysis***

Our data was derived from the following sources:

1. *One-on-one IM Resident Interviews*
2. *Focus groups*
3. *IM Resident Survey comment boxes*

During this study, we conducted and analysed 12 interviews with IM residents and two focus groups, one with neurology residents and one with faculty each with seven participants. The



neurology residents ranged from first years to fifth years. Faculty members had four to over forty years of practice.

Fourteen IM residents completed the rotation entry survey and nine IM residents completed the post-call survey. We concluded the needs analysis at this point as we had reached saturation.

After analysis of the interviews and focus groups, our team generated themes organized within Kern's framework for curriculum development (Table 1).

Table 1- Kern Steps and Identified Themes

<b>Kern Step</b>	<b>Identified themes</b>
Step 1 Problem Identification (as discussed in introduction)	Discomfort and perception of under-preparedness amongst IM trainees
Step 2 Targeted needs assessment	What the learners (stakeholders) think they need to know vs. what their teachers want them to know vs external requirements (Royal College)
Step 3 Goals and Objectives	What content is relevant for clinical requirements vs. assessments? Are they mutually exclusive?
Step 4 Methods and Setting	Didactic vs. bedside vs virtual
Step 5 Implementation of the Curriculum	Educational days vs. ward rounds vs. scheduled rotation teaching
Step 6 Evaluation and Feedback	Curriculum could be evaluated with surveys, performance on rotation, and board examination results

### ***Step 1: Problem Identification***

Theme: Discomfort and perception of under-preparedness amongst IM trainees

The first step of Kern's framework involves identifying the underlying problem that needs to be addressed through a novel curriculum. We identified that the majority of participants had not previously had any clinical neurology exposure and felt uncomfortable with their clinical skills when first entering the rotation. Given that the neurology block is covered during junior years in medical school, there had been a significant time gap between the classroom teaching and their clinical rotations.

"Given the time that I had gone without any exposure to clinical neurology, then, you know, a lot of things I had forgotten from medical school and from third year, so, you know, doing a neuro exam, localizing, managing a first onset seizure, managing sub-acute stroke. All of those things were really not touched on very much, you know, in the last two to three years prior to the rotation, so I think those things were - I was pretty uncomfortable to start."

(13-1, IM Res)

When asked how they perceived neurology, residents brought up lack of exposure during their internal medicine rotations. This lack of exposure contributed to the feeling of being out of their depth with the subject matter.

"We are just not familiar with the neurology cases during our - like, CTU or GIM ward, we don't see a lot of neurology patients." (1-1, IM Res)

"Some of them may not have had any exposure to actual neurology on the wards until that point, so they kinda feel lost, a little, and, you know, that honestly should motivate them to

learn more, but, I mean, some might just say, like, again, ‘I’m just gonna get through this month and that’ll be it.’ (P12, Neuro Res)

### ***Step 2: Targeted Needs Assessment***

Step 2 of Kern’s framework involves conducting a needs assessment to determine learner identified gaps. Just like any other system or product, it is essential that curricula are evaluated by all the involved stakeholders. In our case, this means that we need to understand the needs of the learners (IM residents) vs. perceptions of the teachers (neurology senior residents and staff) vs. demands of board exams/clinical practice. Thus, we were able to augment what learners had to say with external sources. While there may be some disagreement as to what is important for IM residents to learn when it comes to neurology, there is certainly a great deal of concurrence. It is the overlap of these three sources that will allow us to create, implement, and deliver the most relevant and effective neurology curriculum.

Theme: Learner-centric (needs of the learners) vs. teacher-derived (perceptions of neurology senior residents and staff) vs. external (demands of board exams/clinical practice).

#### *Learner-centric*

Many of the topics that were brought up by the residents were in relation to preparedness for night calls. Thus, they would have liked more teaching around conditions with higher acuity such as seizures, strokes, and loss of consciousness. In addition, most residents put emphasis on greater teaching for localization of the condition i.e., brain

(cortical/subcortical/brainstem) vs. spinal cord vs. peripheral nervous system and observation of their physical examination while on service.

“As a general internal medicine resident, I’m more interested in, like, how do you – like, basic localization for stroke, and how do we work up stroke patients when they come into the emergency department, and what do we do for those patients?” (11-2, IM Res)

### *Teacher-derived*

From the neurology residents/staff, it was evident that they wanted to focus on bread-and-butter neurology topics which would be encountered frequently by internal medicine residents. This included placing emphasis on localization, physical examination teaching, and neurologic emergencies. They stated that exposure to rare neuromuscular or other subspecialty presentations should not be the focus of the academic half day or neurology rotation.

“When each of us is kind of enmeshed within our sub-specialty, that sometimes we lose perspective in terms of what’s relevant, and so, I think, improving the relevance of that teaching would be essential.” (PG6, Neuro Staff)

“You only have one month; I don’t expect you to see everything from, you know, all the seizure presentations, all the Guillain-Barre, all the Myasthenia Gravis and Neuromuscular junction disorder and myopathies. I just don’t think it’s possible, and so same with our teaching.” (P8, Neuro staff)

*External*

A common theme from the IM residents' comments centred on preparation for their licensing examinations. Many residents brought up topics which they felt were high yield for the Royal College.

"Everybody's always worked up about what do they have to know for the Royal College exam, and there are actually objectives for the Royal College exam for neurology, for internal medicine, that are just not publicized well enough, and if you actually had those objectives as part of the rotation, or at least the beginning of the rotations that, 'Hey, this really is important of for you; this is – these sessions that we're trying to get you to work on are actually objectives for the Royal College exam" (PG15, Neuro Res)

For reference, see Appendix F for the detailed Royal College objectives for IM residents.

***Step 3: Goal and objectives****Theme: Preparedness*

Step 3 of Kern's framework focuses on the goals and objectives of the curriculum. While developing this curriculum, the aim was for it to result in residents feeling prepared for clinical service and board examinations. During the discussion of what level and topics the neurology curriculum needed to address, it seemed to depend on the individual resident's focus.

Those that were concerned about being prepared for the rotation asked for additional supplementary materials to be provided prior to the rotations whereas those concerned about Royal College examinations wanted to be taught around high yield topics.

“Having some sessions that are sort of homework for the resident to do, beforehand, so that are these topics that lets the learner know, hey, yeah, you remember some things, but you don’t remember really as much as you think you remember, and, hey, you know, this is a headache and, you know, I should be knowing more about headache than what I remembering about headache, so that therefore you arrive on the rotation, you know, ready to go and wanting to discuss headache on that first week of the rotation.” (PG14, Neuro Res)

Residents were clear that there were certain skills needed on their first night on call which they felt were either inadequately taught or just not prioritized.

*(a) preparation for call/emergencies and (b) localization*

“My neurology call shift demanded that I have knowledge about – I remember specifically, my first call shift I needed to be fairly proficient in localizing a lesion, having an approach to weakness, and being a little familiar with headaches. These are – none of these three that I just mentioned to you came up in my academic half day. So, for my very specific kind of case-based issue, I was not exposed to any of these. I had read a little neurology textbook before I started the rotation, which helped quite a bit, but otherwise, in terms of my academic half day preparing me for the cases I was taking on call, I would say no.” (7-4, IM Res)

Neurology faculty and residents suggested gearing rotation objectives toward national board certification examinations may result in greater buy-in from IM rotators.

*(b) preparation for Royal College*

“I think tailoring the teaching and making them do a flipped classroom, and then having questions around those topics that are similar-ish to the way that they get Royal College questions, I think is the only way to make them do it because they do have a gain, then, from doing the material beforehand ‘cause, essentially, it’s them studying for Royal College.” (P18, Neuro Res)

*(c) For clinical duties*

“I know, in the back of my head, it’s probably important for me to have some approach to neuro cause I’ll probably – especially if there’s not a neurologist wherever I work, I’d probably be asked to see some of these people, so I do actually have an interest in getting a bit better at it.” (9-1, IM Res)

“It’s often that we – you know, if we find a deficit, we just – you know, we’ll consult neurology, and then we don’t really, you know, try to localize ourselves.” (12-1, IM Res)

**Step 4: Delivery**

*Theme: Classroom setting vs. on-demand vs. bedside*

Step 4 of Kern's framework is concerned with how the novel curriculum will be delivered. It was clear that depending on their preferred learning modalities, residents preferred various forms of curriculum delivery.

While some preferred a blend of didactic lectures and bedside teaching, others noted it would be useful to have video clips they could watch prior to their rotation or classroom session.

"I think there should be more and different modalities – like, the different in the sense that it should be either kind of case based, and then the case is used as a stepping stone to discuss approaches and topics, so, and, I guess, so, more a quantity, and a different style and quality, yeah." (7-2, IM Res)

"Didactic lectures are challenging to learn and retain information from. Neurology AHD sessions are very spread out. As IM residents I don't feel we have good resources for clinically important Neurology information/study material." (survey)

"[with respect to half-day] Strength: Covered most high-yield topics. Weakness: Spread in time." (survey)

"I think I would really appreciate having sort of the flip classroom model if you did do sort of the short videos to go through clinically relevant issues. I think it would be really beneficial, to be honest." (8-5, IM Res)



One commonality, however, was the importance placed on bedside/case-based teaching from IM residents and neurology colleagues.

“I find that seeing someone do an exam or seeing a pathology in real life, quote/unquote, is different from reading about ‘this is the deficiency you would see; this is dysarthria’, but really, it’s a bit hard for me to kind of visualize what it actually is, unless someone’s saying, ‘this is what you would see’ with that particular disease, yeah.” (6-2, IM Res)

“Strengths-daily patient rounds.” (survey)

“Practical management issues for newly diagnosed strokes, complications of EVT/TPA with bedside practical tips to recognize deterioration.” (survey)

### ***Step 5: Implementation***

*Theme: Setting where curriculum should be implemented*

Step 5 of Kern’s framework is involved with how to implement the new curriculum. A significant component of the study queried whether the curriculum was best delivered at AHD or the neurology rotation itself.

#### *Rotation*

Residents noted that the benefits of learning while on rotation included reading around cases and exposure to a variety of cases.

“On call, my senior has sent me a couple of things about some of the cases that we’ve seen, and I find that to be really helpful to refer back to, or even like – videos, I’m just personally less likely to watch. I’m more likely to read something, but for neuro, specifically, if there was a complementary video for whatever finding, then that would be helpful, but I like readings.” (3-2, IM Res)

“Good service volume, [would like] more formal teaching throughout the day.” (survey)

### *External to rotation*

While there are considerable barriers to implementation solely during the rotation, having a curriculum limited solely to half-day was also not noted to be an ideal option.

“It’s very piecemeal. Like, we have kind of a random neurology lecture within our half-days, or a random half-day that’s neurology focused, but you don’t really feel like you get a lot of consistency. Like, I almost wonder if it would be nice to have a month where we do our neuro half-days, and get, you know, good teaching around approaches to common presentation, as well as some resources that we can go back to when we come around to our neurology rotations.” (11-3, IM Res)

Given that not all IM residents will rotate through neurology, the curriculum will have to be delivered at AHD and on the neurology rotation (in a modified format). However, our data resoundingly demonstrates that AHD alone will not suffice for adequate neurology curriculum. The numerous barriers to implementation of curriculum while on service are listed below.

**Barriers**

Throughout the interviews and focus group, there were five key barriers to learning and teaching were identified in relation to the neurology rotation.

The interviews and focus groups identified 4 barriers to learning and teaching during the neurology rotation: *1) time and Volume of service, 2) Logistics of ward rounds, 3) Faculty perceptions, 4) Multi-level learners*

**Table 2: Barriers to learning and teaching**

Barrier	Description	Quotes
1) <i>Time and Volume of service</i>	Service requirements often took precedence over teaching.	“Stroke, for example, it was so busy, and I was left taking care of so much other stuff, I did very little focused full neuro exams on people, and so I didn’t take away a much from that as I think I could have and I wanted to cause, again, this is only a block of neuro that we do. On gen neuro it was kind of similar where the staff would go in, and the staff would be asking all the questions, and the staff would do the full physical exam, and we’re just sort of left, like, writing notes in the background.” (3-5, IM Res)
2) <i>Logistics of ward rounds</i>	Learning from week to week depended on staff and how they chose to round on the wards.	“I think it’s really staff determined because if staff sometimes run rounds in a certain way, and the way they run it doesn’t – like, they may want to examine a patient for themselves, and want to run through a patient rather quickly, and then sometimes have the time in the afternoon to go back with residents to, like, observe an exam, but then there isn’t – if there isn’t that time, then no one exams the patient for an entire week. Like, I actually only examined two patients last week.” (P6, IM Res)
3) <i>Faculty perceptions</i>	IM residents felt as though they were being treated differently than neurology residents	“I think, maybe being a medicine resident, is that, literally, my staff was like, ‘Oh, this person has a lot of red numbers on [the EMR] want to go see them’, so I was often left taking care of the more medicine patients rather than me focussing on the stroke patients – someone with interesting stroke localization findings.” (3-3, IM Res)
4) <i>Multi-level learners</i>	Challenges of teaching a group consisting of medical students, junior/senior on-service residents, and off-service residents	“I think a bit of a challenge we have in neurology is how multi-level learner it really is in our teaching sessions that we have, and especially when there’s sign over and we’re wanting to teach all levels, from a fifth-year neurology resident in the room, and in the same room there’s a third-year medical student, and the internal medicine rotators are somewhere in between there.” (P8, Neuro Staff)

**Step 6: Evaluation of curriculum**

Step 6 of Kern’s framework emphasizes evaluating the novel curriculum. Currently, there is no system in place to assess any perceived or actual improvement in neurological competence amongst IM residents (through AHD or on rotation). In terms of curriculum evaluation post-implementation, there were suggestions to distribute pre- and post-

curriculum surveys and/or neurology quizzes during residents' rotations for comparison. Some residents suggested some sort of formative assessment at the end of the neurology rotation to assess knowledge.

There were some residents who suggested evaluating the FC with surveys whereas others suggested a pre/post formative knowledge assessment.

"I think you can do questionnaires before and after; you can do evaluations before, mid-way and after, and I think those are pretty important, and that can be with an individual learner and staff person, and then somebody who, overall, at the end or the rotation review, their evaluation."(PG17, Neuro Res)

"Something not related to your evaluation for the resident, so they just gave a number of questions, like maybe twenty questions, knowledge based, about the neurology rotation. You do it in the first day or maybe couple of days prior to your starting the neurology rotation, so, and then another – at the end of the rotation, this kind or paper based, then another twenty or thirty questions, so, to see how much you did learn, and, like, this is [the] learning objective, and this kind of score is not part of your evaluation by any way." (5-3, IM Res)

#### *Quantitative results*

For the statistical comparison to the neutral Likert score of 3 for the entry survey (see Table 3), residents did not feel comfortable managing emergencies or localizing lesions. They did agree that neurology is a useful rotation for IM residents. Prior to IM half-day, most residents

would prefer watching a video or reviewing a PowerPoint in preparation. It was clear that trainees did not feel prepared for the neuro subsection on their royal college examinations. Table 4 reports the post-call survey results. Residents felt that their seniors had supported them on their call shift but that there was a lack of strong endorsement to feeling prepared for the neurology rotation. Table 5 illustrates the preferred learning modalities of residents if FC were to be adopted.

**Table 3. Entry survey for Internal Medicine Residents:**

	N	Mean	Std. Dev	P-value Significance (with test value=3)
Comfort with Neurology				
Q1. I feel comfortable with the neurology physical exam	14	3.14	0.66	.435
Q2. I feel comfortable managing neurologic emergencies	14	2.57	0.85	.082
Q3. I feel comfortable with localizing lesions	14	2.71	0.83	.218
Q4. I feel comfortable generating a ddx for common neurologic symptoms such as weakness, sensory change, altered LOC, headaches, etc.	14	3.21	0.97	.426
Q5. Neurology is a useful rotation for IM residents	14	4.14	0.53	.000
Method of Instruction				
Q6. I find the current structure of neurology lectures useful	12	3.17	0.94	.551
Prior to half-day, I would be willing to:				
Q7. Watch a short neuro video	14	3.86	1.10	.012
Q8. Read a brief neuro journal article	13	3.08	1.12	.808
Q9. Read a neuro chapter	13	3.15	1.28	.673
Q10. Review a PowerPoint presentation	14	3.71	1.07	.027
I feel prepared for my:				
Q11. I feel prepared for my U of A IM OSCE- Neuro subsection	14	2.93	0.83	.752

Q12. I feel prepared for my Royal College- Neuro subsection	14	2.36	0.63	.002
Q13. I feel prepared for my Neuro rotation	8	3.13	0.35	.351

**Table 4: Post-call table**

	N	Mean	Std. Dev	Significance (with test value=3)
Comfort with Neurology				
Q1. I feel comfortable with the neurology physical exam	9	3.56	0.53	.013
Q2. I feel comfortable managing neurologic emergencies	9	2.89	0.93	.729
Q3. I feel comfortable with localizing lesions	9	2.89	0.78	.681
Q4. I feel comfortable generating a ddx for common neurologic symptoms such as weakness, sensory change, altered LOC, headaches, etc	9	3.44	1.01	.225
Q5. Neurology is a useful rotation for GIM residents	9	4.11	0.33	.000
Preparedness for Call Shift				
Q6. I felt adequately prepared for my first call shift	9	3.11	0.93	.729
Q7. The morning teaching/orientation prepared me for my call shift	9	3.44	0.73	.104
Q8. The neurology teaching at my IM half-day prepared me for my call shift	8	3.00	0.54	.285
Q9. My senior supported me during my call shift	9	5.00	0.00	.446



**Table 5: FC modality preferences:**

Paired differences	Std Dev	P-Value
Video vs. Journal article	1.30	.054
Video vs. Textbook chapter	1.25	.069
Video vs. PowerPoint	.363	.165
Journal article vs. Neuro chapter	1.19	.819
Journal article vs. PowerPoint	1.39	.136
Neuro chapter vs. PowerPoint	1.13	.110

#### **Chapter 4: Discussion**

The purpose of our study was to conduct a needs assessment to understand the curricular needs of IM residents regarding their neurology half-day and rotation with a focus on their feeling of preparedness and their attitude to a FC approach. It is important to note that we did have a limited sample size, but our resident cohort did not endorse feeling prepared for their neurology rotation.

As discussed in the introduction, internists view neurology as a challenging and intimidating subspecialty. Our data has reiterated that IM trainees are uncomfortable with neurology subject matter. This was noted during individual interviews with participants as well as during focus groups with neurology residents and faculty. Results from the entry survey showed there was discomfort with managing neurologic emergencies and generating a differential for neurologic diagnoses. Thus, it was interesting to see that residents agreed upon neurology as a useful rotation. The entry survey also illustrated that they did not feel prepared for their neurology rotation at the onset. Interestingly, despite support from seniors the post-call survey shows that the residents still felt uncomfortable on their first night of call. To date, we do not know of any other studies where IM residents were interviewed or surveyed post-call on their neurology rotation. This is important as it gives us valuable insight into how prepared they felt for their first night on call and how supported they felt by seniors.

It was evident that residents felt uncomfortable with neuroanatomy (localization) and managing acute neurologic cases. This was in keeping with Kam et al.'s work in demonstrating that poor knowledge was associated with neurophobia. Another study surveyed 457 participants and found that reasons neurology was thought to be a difficult subject were

neuroanatomy, limited teaching, complex diagnoses, and not enough teaching.<sup>20</sup> We found that our participants echoed these sentiments, acknowledging gaps in these areas.

We found that residents would be willing to engage with a FC model via a power point or short video. Our results demonstrated that residents are eager to move away from the current didactic curriculum to a more blended format. They did stress the importance of having protected time to review the pre-work and/or to keep the preparatory material to less than ten minutes. To prepare for their rotation, there was a signal that residents preferred watching a video or reviewing a PowerPoint presentation to other modalities. In fact, there was a significant number of individuals who stated that they would rather watch a video than read a neurology journal article.

Implementation of FC at the graduate level is still a relatively novel concept with ongoing studies examining utility and satisfaction among faculty members and learners. Graham et al. reported that 30% of IM residents found that barriers to completing pre-work included: trouble accessing prework, lack of motivation, or interference of administrative clinical work.<sup>15</sup> Blair et al. also found that there were significant concerns in balancing pre-work with clinical duties.<sup>16</sup> Our participants' echoed these findings and their main concern was the time required to engage with the preparatory material (especially given their strenuous clinical schedules). However, when discussing factors that would increase chances of "buy-in", learners did agree that a ten-minute commitment to review the video, power-point, and/or lecture was reasonable. They also mentioned that it would be ideal to have protected time to review the material beforehand.

***Future Directions***

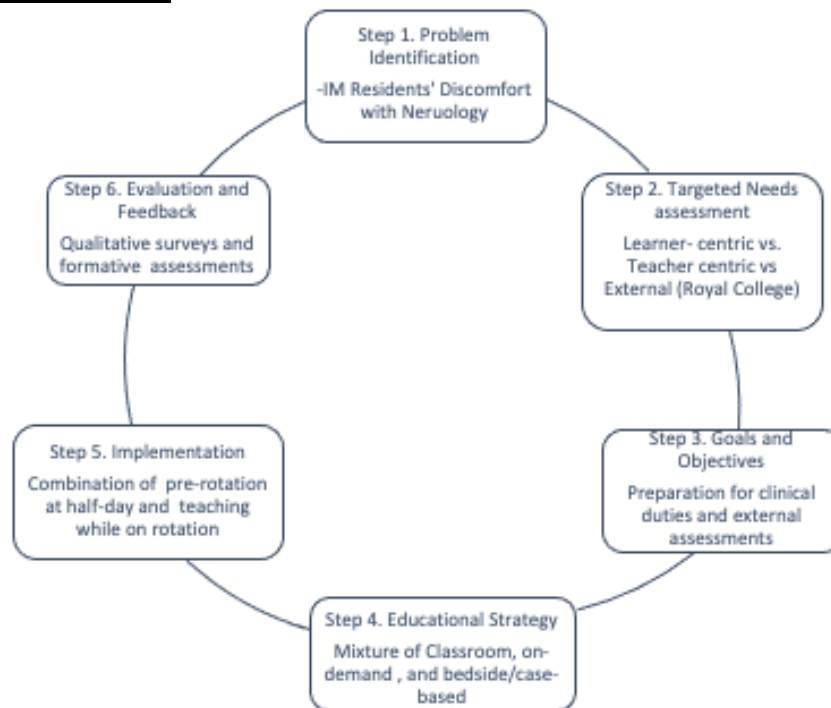
Moving forward, we hope to address these concerns with a multi-pronged approach. We will develop a library of online resources where learners can review basic neuroanatomy, presentation of common neurologic conditions, and watch videos of the physical examination components. This will be available to learners prior to their AHD lectures and also prior to their neurology rotation. AHD lectures will be replaced with an approach-based model and case-based discussion. During these sessions, there will be breakout sessions where physical examination skills can be practiced. In terms of online resources, there will be videos on localization and physical exam to review prior to half-day lectures. Also, online resources will be provided during the rotation that can be accessed for help with clinical skills, and preparedness for night-call shifts.

Neurology is now a selective rotation and there are numerous barriers to teaching on the service identified by this research (see Table 2). These include 1) time and volume of service, 2) logistics of ward rounds, 3) faculty perceptions, 4) multi-level learners. While barrier 1 may not be in our control, it is entirely possible to navigate through barriers 2-4. For example, instead of group rounding during ward rounds, staff could split off with a few members of the team while the senior resident rounds with the remaining members. Alternatively, each member of the team could perform different components of the examination during rounds. Having multi-level learners could be used as an advantage as you could have juniors demonstrate a skill and seniors could practice giving feedback. It will be essential to communicate our results to members of the neurology division to raise awareness about how some IM residents feel staff are biased toward neurology residents and to discuss how ward rounds can be made more effective to maximize teaching opportunities. At the same time, it

is important to remember that staff are tasked with the precarious role of managing their clinician and educator roles simultaneously. There is no doubt that it will be challenging to teach examination skills to 5-8 multi-level learners while also keeping patient comfort in mind.

For those who opt to complete the neurology rotation, senior residents will play a large role in bedside teaching and physical examination skills. We will propose that logbooks be completed to ensure each resident has had each component of their exam observed over the course of the month. Neurology is, by nature, a clinical field with heavy reliance on history and physical examination to generate a localization. All stakeholders agreed on greater emphasis on physical exam skills and dedicated localization sessions. Residents have stated that they feel they learn best while at the bedside.<sup>8</sup> Our data also suggest that residents highly value their physical examination skills being observed. Thus, satisfactory completion of the rotation will entail having each component of the neurological physical examination observed at least once by a senior resident/staff member. It is often difficult to arrange small-group tutorials for traditionally didactic topics given the time constraints in clinical practice. For this reason, online modules have been proposed as an alternative option in the past.<sup>8</sup> Below, we have proposed a comprehensive FC curriculum to address the current gaps in knowledge and preparedness.

## **Chapter 5: Implications**



***Figure 1. Adapted Kern's model for development of a neurology curriculum for IM residents***<sup>20</sup>

Based on our results, we have developed a comprehensive blended curriculum for IM residents based on Kern's framework<sup>20</sup> (Figure 1). The curriculum would be delivered over the combination of protected half-day teaching and during learners' neurology inpatient rotation. Overall, we have suggested a transition to a blended curriculum utilizing various mediums to deliver information. Table 6 has organized the goals and objectives based off the identified themes.

**Table 6. Development of curriculum according to themes**

Themes	Goals and Objectives	Delivery (discuss where FC is being implemented)
Discomfort with neurology and perception of under-preparedness amongst IM trainees	-Provide ample neurology exposure to IM residents during their training through academic half day lectures and clinical rotation	-Deliver scheduled and case-based neurology lectures at IM academic half day (have the lectures recorded and uploaded for post-call residents) -Simultaneously provide online resources for physical exam skills and pathological signs to look for during examination  <b>Rotation</b> -Topics and delivery to complement the clinical teaching on the neurology rotation
Overlap between needs identified by learners, teachers, and external assessments	-Focus on high-yield topics -Need to have solid foundation for localization and physical examination skills -Should feel prepared for neurologic emergencies -Important to be able to generate a differential diagnosis with an appropriate management plan	<b>AHD</b> -Provide virtual resources with information on localization and physical exam to review prior to half-day lectures -Following topics to be covered during AHD session  a. Approach to weakness/ numbness and pain: stroke, multiple sclerosis, amyotrophic lateral sclerosis, neuropathy, radiculopathy, myasthenia gravis, Guillain-Barre syndrome. b. Approach to altered LOC: coma, delirium, language, seizure/syncope c. Approach to abnormal movements: Hypo/hyperkinetic, (Parkinson's/parkinsonian), Tremor, Gait d. Approach to headache, dizziness, and cranial nerves: Diplopia, Dysphagia/dysarthria, dizziness, and headaches  <b>Rotation</b> -Provide dedicated lunch-time localization/physical exam sessions during rotation
Environmental barriers to learning and teaching while on service  (Time/Volume, Demands of ward service, faculty perceptions, multi-level learners)	-Strike a balance between patient care and learning opportunities -Set clear expectations with learners at the onset of the rotation regarding their EPAs/goals -Delegate teaching and observation of clinical skills amongst senior neurology trainees	<b>Rotation</b> -Set expectations for each component of the physical examination to be observed by staff/residents at least once and documented. -Teaching offered at morning sessions or dedicated lunch-time sessions -Provide online resources during course of rotation that can be accessed for help with clinical skills, and preparedness for night-call shifts
Perception of competency for call, clinical duties, and board assessments	-Ensure residents are prepared for their first night of call on their neurology service -Communicate expectations and goals of clinical rotation prior to block starting -Provide regular feedback to rotators throughout the block	-Orientation session includes session on physical exam and review of common neurological emergencies (identification and approach) -Resources will be accessible prior to rotation to review common conditions encountered on call -Staff and senior residents should provide regular feedback throughout rotation to make sure learner is progressing appropriately

	-Evaluate residents post-rotation to ensure learning objectives have been met	-Consider formative assessment at the end of rotation to ensure residents confident
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**Year 1** Introductory neuro bootcamp → revision of online materials → academic half-day lectures -->OSCE

**Year 2** Revision of online materials → Selective neurology rotation → OSCE

**Year 3** Neurology preparatory sessions for RC examination

### **Internal Medicine Academic Half-Day**

- 1) Propose four academic half-days dedicated to neurology
- 2) Curricula will be presented via FC with resources posted online for learners to review before case-based discussions. There will be videos posted around neurological examination and tailoring exam techniques for specific patients (e.g., tremor exam, differentiating peripheral vs central vertigo, or differentiating neuropathy from radiculopathy). Topics include:
  - a) Approach to weakness/numbness and pain: stroke, multiple sclerosis, amyotrophic lateral sclerosis, neuropathy, radiculopathy, myasthenia gravis, Guillain-Barre syndrome.
  - b) Approach to altered LOC: coma, delirium, language, seizure/syncope
  - c) Approach to abnormal movements: Hypo/hyperkinetic (Parkinson's/parkinsonian), Tremor, Gait
  - d) Approach to headache, dizziness, and cranial nerves: Diplopia, Dysphagia/dysarthria, dizziness, and headaches



3) Assessments of understanding incorporated in academic half-day sessions. Facilitators will be trained in how to utilize polling software to quiz residents during the discussion of the case. Thus, there may be questions around the localization, differential, investigations, or management of the patient.

### **Neurology Rotation**

1. Will propose that the residents standardize morning lectures every rotation to minimize confusion and/or repetition.
2. Greater emphasis to be placed on teaching around localization and physical examination skills. Will recommend a dedicated lunchtime localization session at the beginning of the block and encourage preceptors/senior residents to perform each component of the neurological examination. There will be documentation that needs to be completed to ensure this occurs.
3. Communication of perceived barriers to stroke department and discussion around staff perceptions of off-service rotators
4. Prior to the start of the rotation, residents should receive preparatory materials and resources. Morning orientation should include a basic introduction to neurologic examination (given that some students will never have had any exposure to clinical neurology) and neurologic emergencies.

### **Strengths and limitations**

Strengths of the study: this is the first time there has been a needs assessment to gauge the level of preparedness when residents start their neurology rotation, understand which topics IM residents find challenging, and gain insight into what factors would increase buy-in for a

FC neurology curriculum for IM residents with the combined perspectives of IM residents, neurology faculty, and neurology residents. This was essential as it is important to gain perspectives from each of the stakeholders to increase the probability of buy-in. Given our recruitment and sample size, there would be transferability of these results to IM programs at other mid-sized academic institutions.

Limitations: we were not able to interview trainees at the same point during the neurology rotations. There were residents who were able to meet on the first day versus some who were not available until mid-rotation or near the end of their rotation. We did ask them to fill out the surveys based on how they felt when initially starting the rotation. However, the “testing” may still have been affected by residents who had gained exposure to neurology. Another issue was our lack of respondents for the post-call survey (<10). However, given that the year cohort has around 30 residents, this was a 30% response rate. We opted to not contact third year residents as it had already been a year since their neurology rotation and the first-year residents had not yet rotated through neurology. There was also attrition when it came to entry surveys vs. post-call surveys. Less respondents were available post-call to fill out the questionnaires. All these factors could have affected the internal validity of the study. In terms of generalizability, we feel that the results could be generalized to internal medicine programs with a similar number of residents at a mid-size university. Given the sample size and demographics, it would be difficult to generalize these findings to other off-service specialties rotating through neurology.

While our team has developed a comprehensive blended curriculum (Appendix G) for IM residents to be delivered at the half-day and on the neurology rotation, these findings have

yet to be approved by the IM curriculum committee and the neurology CASCO (curriculum and assessments sub-committee). However, initial discussions have generated great interest in reforming the current approach.

### **Conclusions**

In summary, IM residents, neurology faculty, and neurology residents agree that there are gaps in the current curriculum and discomfort with neurology yet feel it is important. We found that IM residents are eager to move away from the current didactic curriculum to a more blended format so that a shift can be made from surface learning to deep learning. However, there is a need for more research to evaluate student satisfaction, buy-in, and knowledge retention when implementing FC curricula within neurology.

It is important to note that currently there is no standardized neurology curriculum across Canada or the US for off-service rotators. Rather, each university creates its own curriculum for learners. Future directions could involve implementing massive open online courses (MOOCs) across North America so that each university does not have to prepare its own virtual resources. This could be supplemented at with weekend neurology bootcamps at local institutions for those residents not currently rotating through neurology (emergency, family medicine, etc).

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## **Chapter 7: Appendices**

### **APPENDIX A**

#### **Interview Guide (Residents-GIM)**

1. Please introduce yourself, your specialty, and your year of training
2. Prior to residency, how much exposure to neurology did you have?
  - a. During residency, how well did you feel your half-days prepared you for your neurology rotation
  - b. How useful did you find your neurology rotation?
3. Are there any subspecialties within medicine you find particularly challenging? Why?
  - a. How did you perceive neurology?
  - b. Is there anything about it as a specialty which you feel makes it different from other subspecialties?
4. What could be done to improve the neurology curriculum within the GIM residency?
  - a. How would you feel if instead of didactic lectures, you were asked to watch a 10-minute video the night before and come prepared to discuss a patient case?
  - b. How likely do you think it would be for residents to prepare prior to half-day?
  - c. Would anything increase the likelihood of preparation prior to half day?
5. If e-modules were developed for the GIM half-day, how would you like them to be designed?
  - a. What topics?
  - b. Any features that you think would enhance the e-modules?
6. What were some of the greatest challenges you faced on the neurology rotation?
  - a. How prepared did you feel for your first night on call? How do you think this could be improved?
7. Any concluding thoughts?

**APPENDIX B**  
**Focus Group Guide (Residents-Neuro)**

1. Please introduce yourself, your specialty, and your year of training
2. Let's start with discussing your learning styles and effective educators you have come across during your training
3. What are your thoughts around the current neurology rotation?
  - a. How does it meet the needs of off-service residents?
  - b. How do you feel it could be improved?
4. When working with off-service/GIM residents, how do you think they perceive neurology?
  - a. Why do you think that is?
  - b. How do neurology staff interact with off-service learners?
3. How prepared do you feel GIM residents are when they start their neurology rotation?
  - a. How do you think this can be improved?
4. How do you feel you learn most effectively (classroom, ward, etc)?
  - a. What are your views around a flipped classroom (define)?
  - b. What do you think would increase resident buy-in when it comes to utilizing e-modules?
5. What topics do you think we should focus on when teaching GIM residents?
  - a. How do you think we can help prepare off-service residents for their first night on call?
6. Any concluding thoughts?

**APPENDIX C**  
**Focus Group Guide (Staff)**

1. Please introduce yourself and describe your role within the department of neurology.
2. What kind of previous experience do you have teaching residents? (This question will be amended)
  - a. Did you receive prior training for this?
  - b. How many years' experience do you have with teaching?
3. How do you feel neurology could be taught better to off-service residents?
  - a. in particular, internal medicine residents
4. In your experience, how do you think residents learn best (i.e., Classroom setting, ward setting, etc)?
- 5.. What do you think should be included in the neurology curriculum to internal medicine residents?
  - a. what approach should be used?
  - b. what topics should be emphasized?
6. If e-modules were to be developed for off-service residents, what do you think would increase buy-in from residents?
  - a. What are your thoughts around a 'flipped classroom' approach?
  - b. What do you think about faculty development courses for staff to implement this approach? What do you think would be barriers to participating?
7. How do you think we can evaluate whether this approach has been effective?
  - a. What measures do you use to evaluate your own teaching methods?
  - b. How do you incorporate the feedback you receive?
8. Any concluding thoughts?



**APPENDIX D**  
Entry Survey

Age

Gender

Have you already completed your neuro rotation? Y/N

Year of training?

Sub-specialty of interest?

Previous neurology experience? Y/N If yes, please specify?

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
<u>Comfort with Neurology</u>					
1. I feel comfortable with the neurology physical exam					
2. I feel comfortable managing neurologic emergencies					
3. I feel comfortable with localizing lesions					
4. I feel comfortable generating a ddx for common neurologic symptoms such as weakness, sensory change, altered LOC, headaches, etc					
5. Neurology is a useful rotation for GIM residents					
<u>Method of Instruction</u>					
6. I find the current structure of neurology lectures useful					
<u>Prior to half-day, I would be willing to:</u>					
7. Watch a short neuro video					
8. Read a brief neuro journal article					
9. Read a neuro chapter					
10. Review a PowerPoint presentation					

I feel prepared for my:					
<b>11.</b> U of A IM OSCE- Neuro subsection					
<b>12.</b> Royal College- Neuro subsection					
<b>13.</b> Neuro rotation (leave blank if not applicable)					
What topics do you find most challenging within Neurology?					
What do you think are the strengths/weaknesses of the current curriculum?					
How do you think you can improve your preparedness for your neurology rotation and/or exams? (If rotation completed, what do you think would have increased your preparedness?)					
What topics would you like to see incorporated into potential neurology e-modules?					
Do you think you would watch a 10–15-minute video prior to coming into half-day? Why or why not?					

**APPENDIX E**  
Post-Call Survey

Gender

Age

Year of training?

Sub-specialty of interest?

Previous neurology experience? Y/N

If yes, please specify?

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
<u>Comfort with Neurology</u>					
1. I feel comfortable with the neurology physical exam					
2. I feel comfortable managing neurologic emergencies					
3. I feel comfortable with localizing lesions					
4. I feel comfortable generating a ddx for common neurologic symptoms such as weakness, sensory change, altered LOC, headaches, etc					
5. Neurology is a useful rotation for IM residents					

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
<u>Preparedness for call shift</u>					
6. I felt adequately prepared for my first call shift					
7. The morning teaching/orientation prepared me for my call shift					
8. The neurology teaching at my IM half-day prepared me for my call shift					
9. My senior supported me during my call shift					

List the cases seen overnight

What do you think would have helped prepared you for your first call shift?

Did you do any preparation at home (reading, watching videos around neuro topics, etc) prior to your call shift? If so, please describe.

What topics would you like to have covered prior to you call shift?

**APPENDIX F**

## Royal College Objectives for IM residents

2.1.8.1. Altered mental status and disorders of consciousness	2.1.8.9. Movement disorders including Parkinson's syndrome	2.1.8.17. Cerebral vascular disease: stroke and transient ischemic attack (TIA)
2.1.8.2. Dementia and delirium	2.1.8.10. Seizure disorders and status epilepticus	2.1.8.18. Guillain-Barré syndrome
2.1.8.3. Syncope	2.1.8.11. Meningitis and encephalitis	2.1.8.19. Amyotrophic lateral sclerosis
2.1.8.4. Dizziness and vertigo	2.1.8.12. Multiple sclerosis	2.1.8.20. Acute spinal cord compression
2.1.8.5. Tremors	2.1.8.13. Brain tumours	2.1.8.21. Peripheral neuropathy
2.1.8.6. Acute and chronic headache	2.1.8.14. Increased intracranial pressure	2.1.8.22. Myasthenia gravis
2.1.8.7. Localized and generalized weakness	2.1.8.15. Determination of brain death	
2.1.8.8. Alcohol abuse and withdrawal	2.1.8.16. Abnormal cranial nerve function	

## APPENDIX G

## Neurology curriculum at half-day structure:

Learning objectives	Topic	Delivery
<p>-Able to localize neurologic deficit/injury correctly</p> <p>-Be able to demonstrate thorough and detailed neurologic history</p> <ol style="list-style-type: none"> <li>I. Headache</li> <li>II. Altered consciousness (delirium vs. dementia)</li> <li>III. Seizures and LOC</li> <li>IV. TIA/Stroke</li> <li>V. CNS infections</li> <li>VI. MS and Vasculitis</li> <li>VII. Movement disorders</li> <li>VIII. Neuromuscular disorders</li> </ol> <p>-Able to independently perform complete neurologic examination and recognize/characterize neurologic deficits</p> <ol style="list-style-type: none"> <li>I. Perform complete neuro examination</li> <li>II. Perform focused neuro examination (language exam, cerebellar exam, NIHSS)</li> <li>III. Common signs seen with MS, MG, GBS</li> <li>IV. Be able to differentiate between nerve and root lesion on examination</li> </ol> <p>-Will understand how to generate an appropriate neurologic differential diagnosis and suggest plan for management</p> <p>-Understands the pathophysiology and presentations of common neurologic conditions</p> <p>-Has a basic understand of the common neurologic emergencies</p>	<p>a. Approach to weakness/numbness and pain: stroke, multiple sclerosis, amyotrophic lateral sclerosis, neuropathy, radiculopathy, myasthenia gravis, Guillain-Barre syndrome.</p>	<p>Delivery of these topics will be via residents reviewing online materials the week prior. On the day of the AHD session, there will be case-based discussion around presentation, examination findings, localization, ddx, work-up, and treatment.</p>
	<p>b. Approach to altered LOC: coma, delirium, language, seizure/syncope</p>	
	<p>c. Approach to abnormal movements: Hypo/hyperkinetic, (Parkinson's/ parkinsonian), Tremor, Gait</p>	<p>During the in-class portion, the individuals will be paired to practice physical examination skills under supervision of the preceptor.</p>
	<p>d. Approach to headache, dizziness, and cranial nerves: Diplopia, Dysphagia/dysarthria, dizziness, and headaches</p>	
<p>-Each session will cover history taking, physical examination, localization, differential diagnosis, workup, and management.</p> <p>This will either be done in person or through a mixture of in-class and virtual materials.</p>	<p>The online materials will involve videos of how to examine for certain pathologic signs and brief overview of the topic.</p>	

## Neurology curriculum at orientation:

Learning objectives	Topics
-Can recognize critical neurologic presentations and manage emergencies (altered mental status, seizures, TIA/stroke, GBS)	-Neurologic emergencies lecture
-Are familiar with documentation and logistics of the ward services (consults, general, stroke)	-Lecture presented at orientation - Will consist of logistics of neurology service and examples of consult notes posted Online resources: -Sample consults -Samples of filled out stroke order sets for hemorrhagic/nonhemorrhagic stroke
-Understand basic neuro localization and examination	-Online resources: Physical examination videos Localization notes/ppt
-Enable an active learning experience for learners by allowing them to individualize their learning objectives	-Pre-rotation formative assessment -Resident-led communication of learning objectives to seniors/staff

## Neurology curriculum during rotation:

Learning objectives	Topics	Method of Instruction/Assessment
-Demonstrates ability to take detailed and thorough neurologic history	-Assignment of patients with diverse neurologic pathology to each resident - Opportunity to observe GOC discussions with palliative patients	-EPAS -Supervision by residents/staff

<p>-Can independently perform a focussed and comprehensive neurologic physical examination</p>	<p>-Opportunity to perform daily examinations on patients and be observed by residents/staff -Regular bedside teaching with staff/seniors</p>	<p>-EPAS -Supervision by residents/staff</p>
<p>-Understands how to appropriately document neurologic history and examination</p>	<p>-Teaching provided at orientation and also from seniors during ward rounds</p>	<p>-Supervision by residents/staff</p>
<p>-Able to formulate appropriate localization and differential diagnosis based on history and examination</p>	<p>-Morning teaching sessions -Lunchtime localization and physical examination sessions</p>	<p>-EPAS -Supervision by residents/staff</p>
<p>-Can initiate relevant workup and suggest management plan with oversight from staff/seniors In particular, for following conditions:</p> <ol style="list-style-type: none"> <li>I. Headache</li> <li>II. Vascular disease</li> <li>III. Epilepsy</li> <li>IV. Parkinson's</li> <li>V. MS (acute setting)</li> <li>VI. CNS infections (meningitis, encephalitis)</li> <li>VII. GBS/MG (acute setting)</li> </ol>	<p>-Morning teaching sessions -Discussion during ward rounds -On-call exposure to myriad of pathology and discussion with senior resident</p>	<p>-EPAS -Supervision by residents/staff</p>
<p>-Demonstrates appropriate administration of medications depending on neurologic condition. Understand adverse effects and contraindications of commonly used medications (AEDs, TPA, anticoagulation, IVIG)</p>	<p>-Morning teaching sessions -Discussion during ward rounds -On-call exposure to myriad of pathology and discussion with senior resident</p>	<p>-Supervision by residents/staff</p>
<p>-Basic understand of how to interpret various modalities of neuroimaging (CT/MR) -Be able to point out major structures (lobes, ventricles, brainstem, cerebellum, ACA/MCA vascular territories)</p>	<p>-Dedicated neuroimaging teaching (including discussion of ADC/DWI images) -Case discussions with team</p>	<p>-Supervision by residents/staff</p>



<ul style="list-style-type: none"><li>-Know appropriate indications for ordering neuroimaging and neurophysiology</li></ul>	<ul style="list-style-type: none"><li>-Discussion during ward rounds</li><li>-On-call exposure to myriad of pathology and discussion with senior resident</li></ul>	<ul style="list-style-type: none"><li>-Supervision by residents/staff</li></ul>
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