

## Brief Communication

# “Building Your Neurology Acumen”: A Flipped Classroom Approach for Internal Medicine Residents

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**ABSTRACT:** Globally, internal medicine (IM) residents often feel they lack the knowledge and skills to approach patients presenting with neurologic issues. We conducted a multiple method needs assessment to determine the feasibility of a novel neurology flipped classroom (FC) curriculum for internal medicine residents. Our primary findings include participants: (1) finding neurology a useful rotation; (2) feeling uncomfortable with the neurological examination; and (3) endorsing flipped classroom as a potential alternative but with significant barriers. Our findings elucidate upon the various extrinsic/intrinsic motivators for resident education and illustrate the need to re-examine the way in which neurology is being taught to off-service residents.

**RÉSUMÉ :** « Développer son acuité en matière de soins neurologiques » : la méthode en classe inversée pour les résidents en médecine interne. Partout dans le monde, les résidents en médecine interne (RMI) estiment souvent qu'ils manquent de connaissances et de compétences pour aborder les patients atteints de troubles neurologiques. À cet égard, nous avons mené une évaluation de leurs besoins à l'aide de multiples méthodes et tenté de déterminer la faisabilité d'un nouveau programme d'enseignement en classe inversée (CI) axé sur la neurologie et destiné aux RMI. Nos principales conclusions ont été les suivantes : 1) les participants ont estimé que la neurologie constitue un champ de pratique utile dans leur formation ; 2) ils ont affirmé être mal à l'aise avec le fait d'effectuer un examen neurologique ; 3) ils ont approuvé la méthode en classe inversée comme solution de rechange mais ont aussi évoqué des obstacles importants. Nos résultats apportent ainsi un éclairage sur les divers éléments motivateurs extrinsèques et intrinsèques de la formation offerte aux résidents et illustrent la nécessité de réexaminer la manière dont la neurologie est enseignée aux résidents qui sont hors-service.

**Keywords:** Neurology; Medical education; Internal medicine; Curriculum

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Numerous studies have demonstrated that medical students and resident physicians find neurology to be one of the most difficult subjects within medicine.<sup>1–5</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>6</sup> The authors reported that low interest and knowledge levels also contributed to neurophobia.<sup>7</sup>

Across Canada, neurology is a selective rotation within medical schools and for internal medicine (IM) and family medicine residents. Thus, they will receive limited or no dedicated neurologic clinical training during their careers. Lazarou et al. proposed a nationally standardized neurology curriculum for internal medicine residents, but this has yet to be adopted widely.<sup>8</sup> There is still no consensus on a standardized national neurology curriculum for internal medical residents.

Because neurology is a selective rotation for IM residents, we need a curriculum that can augment the rotation for those who opt-in but that can also provide the necessary tools for those who do not. Thus, the pedagogical approach needs to be

maximized. Flipped classroom (FC) is a more active learning approach where the learner reviews content at home in a self-directed manner and then discusses it with fellow students in the presence of a facilitator.<sup>9</sup> While this method has been utilized at the level of undergraduate medical education,<sup>10</sup> it has a mixed reception at the postgraduate level. 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>11</sup> While FC curricula are successful in increasing knowledge acquisition and retention, 24% of residents in one study perceived that there was not enough protected time on inpatient rotations to implement this approach.<sup>12</sup> While residents “enjoy the curricular material,” they have “significant concerns about the time and motivation” required to do the pre-work.<sup>13</sup>

Due to these perceived hurdles with FC, the aim of our study was to conduct a needs assessment to gauge the level of preparedness when residents start their neurology rotations and gain further insight into barriers, methods of teaching, and factors that would increase buy-in for a flipped class neurology curriculum for

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**Table 1:** “Kern step and representative quotes”

Kern step	Identified themes
Step 1 Problem identification (as discussed in introduction)	“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.”
Step 2 Targeted needs assessment	“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?”
Step 3 Goals and objectives	“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.” “I think tailoring the teaching and making them do a flipped classroom, and then having questions around those topics that are similar to the way that they get Royal College questions, I think [this] is the only way to make them do [the reading] cause they do have a gain.”
Step 4 Methods and setting	“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.” “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.” “I find that seeing someone do an exam or seeing a pathology in real life, is different from reading about ‘this is the deficiency you would see; this is dysarthria.’ It’s a bit hard for me to kind of visualize what it actually is, unless someone’s saying, ‘this I what you would see’ with that particular disease.”
Step 5 Implementation of the curriculum	“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.” “For neuro, specifically, if there was a complementary video for whatever finding, then that would be helpful, but I like readings.”
Step 6 Evaluation and feedback	“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.”

IM residents. We conducted surveys (with 5-point Likert scales) and interviews at the University of Alberta with second-year IM residents in addition to focus groups with neurology residents/staff members. We were able to conduct rotation entry and post-call surveys which are novel for a curricular needs assessment. Surveys explored aspects such as previous neurology exposure, comfort with neurological physical examination/subject matter, preferred method of instruction, and preparedness for their clinical rotation/first night on call. Data were collected via:

1. One-on-one IM resident interviews ( $N = 12$ )
2. Focus groups with neurology residents ( $N = 7$ )
3. Focus group of neurology staff ( $N = 7$ )
4. IM resident entry ( $N = 14$ ) and post-call surveys ( $N = 9$ )

We followed the six-step process for thematic analysis as outlined by Kiger and Varpio to analyze interview transcripts, focus group transcripts, and survey comments.<sup>14</sup> Qualitative data analysis involved generating themes organized within Kern’s six-step framework for curriculum development (Table 1).<sup>15</sup> Quantitative analysis of the survey data was completed with SPSS software. We used one-sample  $t$ -tests to compare Likert means to the neutral score of 3.0 and paired  $t$ -tests to analyze differences in means between the questions. Two-sided  $p$ -values of less than .05 were considered significant.

### Step 1: Problem Identification

#### Theme: Discomfort and Perception of Under-Preparedness amongst IM Trainees

Participants’ endorsed minimal clinical neurology exposure and clinical skills teaching prior to the onset of their rotation. Given

that the neurology block is covered during junior years in medical school, there was a significant time gap between the classroom teaching and their clinical rotations. Residents cited that their lack of exposure contributed to the feeling of being out of their depth with the subject matter.

### Step 2: Targeted and General Needs Assessment

Step 2 of Kern’s framework involves 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. Our study aimed to assess 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.

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

#### 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

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

Barrier	Description	Quotes
1) Time and volume of service	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) Logistics of ward rounds	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) Faculty perception	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 focusing on the stroke patients – someone with interesting stroke localization findings." (3-3, IM Res)
4) Multi-level learners	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)

to rare neuromuscular or other subspecialty presentations should not be the focus of the academic half day or neurology rotation.

### External

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

### Step 3: Goal and Objectives

#### Theme: Preparedness

While developing this curriculum, the aim was for it to result in residents feeling prepared for clinical service and board examinations. The data demonstrated that the ideal curriculum would result in preparedness for:

- a. clinical duties
- b. call/emergencies and localization
- c. Royal College examination

### Step 4: Delivery

#### Theme: Classroom Setting vs. On-Demand vs. Bedside

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

### Step 5: Implementation

#### Theme: Setting Where Curriculum Should Be Implemented

A significant component of the study focused on the tension between the likely benefits of the rotation given that not all learners do it and the lack of heterogeneity between rotation experiences from one individual to the next. It was important to understand whether curriculum was best delivered at academic half-day (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. However, numerous barriers were identified (Table 2).

#### Independent of the Rotation

Given that neurology is a selective rotation, and that not all IM residents will rotate through neurology, the curriculum will have to be delivered at AHD in addition to the neurology rotation in a blended format.

### Step 6: Evaluation of Curriculum

Currently, there is no system in place to evaluate any perceived or actual improvement in neurological competence amongst IM residents (through AHD or on rotation), but our study provides some baseline data.

For the statistical comparison to the neutral Likert score of 3 for the entry survey, residents did not endorse comfort with the neurological physical examination (3.14,  $p = 0.435$ , Table 3) prior to

**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

their first call shift but did feel the neurology was a useful rotation for GIM residents (4.14,  $p < .05$ , Table 3). Results from the entry and post-call surveys demonstrate that there is discomfort with managing neurologic emergencies, localization, and generating a differential for neurologic diagnoses. In terms of learning style, prior to IM half-day, Table 3 illustrates that most residents would prefer watching a video (3.86,  $p < .05$ ) or reviewing a PowerPoint (3.71,  $p < .05$ ) in preparation for their rotation as compared to a journal article or textbook.

Our results reiterate that internal medicine residents view neurology as a challenging subspecialty and that IM trainees are uncomfortable with neurological subject matter. Despite this, there is unanimous agreement amongst IM residents that neurology is a

useful rotation. The entry survey also illustrates that trainees are not prepared for their neurology rotation. Interestingly, the post-call survey shows that the residents still felt uncomfortable on their first night of call (Table 4).

In terms of strengths, the utilization of multiple methods and entry/post-call surveys to understand the deficits of the current neurology curriculum is a novel approach. We were able to acknowledge various intrinsic and extrinsic motivations of residents with regard to their education.

Previous research has demonstrated that neuroanatomy, limited teaching, complex diagnoses, and not enough teaching contribute to neurophobia.<sup>2</sup> Our participants echoed these sentiments, acknowledging gaps in these areas.

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>12</sup> Blair et al. also found that there were significant concerns in balancing pre-work with clinical duties.<sup>13</sup> Our participants agreed that time constraint is the limiting factor for blended curricula.

In terms of limitations, it is important to note that we have a limited sample size centered at a single institution. One of the issues is the lack of respondents for the post-call survey (<10). However, given that the year cohort has around 30 residents, this is a 30% response rate. We opted not to 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, and fewer respondents were available post-call to fill out the questionnaires. Future studies could use multiple institutions to increase sample size and generalizability.

In conclusion, residents note flipped classroom could be a potential alternative to traditional didactic teaching at the post-graduate level, but highlight numerous barriers in the clinical setting. Buy-in from residents is dependent on short and concise modules with emphasis placed on bedside teaching. Staff will need to receive training in creating curricula which can be delivered in a blended format and also receive protected time to develop such modules. However, our study emphasized the major benefits associated with this pedagogical approach are utilization of “in-person” time on honing clinical acumen and refining of physical examinations skills staples of the practice of neurology.

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