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Management of Medically Intractable Epilepsy in Adults

MM. El-Hagrassy*¹

¹Neuromodulation Center, Spaulding Rehabilitation Hospital, Harvard Medical School

*Corresponding author: Mirret M. El-Hagrassy, MD, Neuromodulation Center, Spaulding Rehabilitation Hospital, Harvard Medical School, USA. Address: 79 13th St, Charlestown, MA 02129. Tel: (617) 952-6161 Email: melhagrassy@neuromodulationlab.org, mel-hagrassy@partners.org

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COURSE DESCRIPTION

This course is aimed at students of various levels of training, from medical students to practicing epileptologists and other clinical practitioners; it progresses from a basic to a more advanced level. It will walk students through the diagnosis of medically intractable epilepsy, the mechanisms believed to underlie medical intractability, existing diagnostic modalities, available management techniques and the science behind them. The course is composed of mini-modules with the main mini-modules explaining basic concepts, followed by testing to encode them and to connect them with more advanced concepts in a meaningful way. Bonus modules will help students develop a deeper understanding of advanced concepts; they will also help target important principles for professionals in various specialties, and push students toward a deeper understanding of the subject matter.

While this course can be taken on students' own time at any time during the year, they will have the opportunity to interact with current students and alumni on the forums, to discuss topics with students at different levels of training, and to raise questions that may lead to future collaborations.

COURSE GOALS

Students who complete this course successfully will be able to:

- Diagnose medically intractable epilepsy in adults.
- Take a thorough history and physical exam to clarify seizure frequency, comorbidities, previous management, and to rule out confounders.

- Understand the mechanisms thought to underlie medical intractability.
- Understand neurophysiologic and imaging findings.
- Demonstrate a deep understanding of medically intractable epilepsy, etiological factors, and connect these with available diagnostic and therapeutic options.
- Choose appropriate medications.
- Understand the different non-pharmacological management options available, and when they can and should be considered.
- Recognize when to refer patients for pre-surgical evaluations.
- Choose and interpret appropriate diagnostic modalities for localization of epileptic networks according to their level of training. Students who participate in additional/bonus coursework will be able to:
- Understand the medical literature underlying diagnosis and management, and identify its strengths and weaknesses.
- Ask innovative questions about causes of medically intractable epilepsy and potential management options, depending on their training level.
- Discuss their own clinical cases and challenges.
- Find partners for future collaboration.

LEARNING METHODOLOGY

Encoding strategies

- Lectures will be very short and focused on one main concept, presented in a maximum of 5-10 minutes each.
- Reading materials will be equally short, and both formats will build serially upon one another in minimodules.
- Learning will involve multiple senses (including static images, GIFs, audio and video, with voice modulated for

impact); basic concepts will be presented in contrasting ways, and highlighted with humor, famous quotes and references to pop culture.

- Students will not only watch lectures but answer questions and puzzles using a number of different techniques.
- Students will demonstrate that they remember key information points and understand key concepts before moving on to the next lectures.

How to engage students and drive their attention – topdown and bottom-up strategies

- Each mini-module will be focused on one subtopic or basic concept.
- Lectures, reading materials and questions will be as short as possible, and will engage as many senses as necessary to get the points across.
- Students will be advised to sleep well and avoid hunger and fatigue before complex topics are presented, and they will be periodically reminded that they have to focus fully.
- Attention will be drawn to key points in advance (top-down), repeated, contrasted and used in multiple areas (bottom-up).
- Students will be given different scenarios to work through based on what they learned, and will have trick questions to engage their attention.
- Simple gamification techniques will be utilized, including imaginary role-play, with students being placed in “choose-your-own-adventure” games as if they were physicians of various specialties and levels in different types of institutions, as well as patients and their family members. In this way they will put on different hats, helping them identify ways to present their questions, empathize with characters in the “adventure”, and identify more effective modes of management for different scenarios.
- Some modules and evaluations will present key concepts in high speed, high intensity bursts, repeating the same concept 3 times with some variation (making connections, increasing relevance and meaning), and will ask them to take physical-activity related breaks in between to improve focus.

Consolidation/retrieval strategies

- Basic concepts, key points and topics that require buildup of understanding will be repeated and presented from different angles throughout related modules.
- Active recall will be encouraged in the lectures and questions.
- Concepts will be utilized and connected with new information in different scenarios.
- Some evaluations

will be timed, forcing students to think critically and come up with answers quickly. The minor stress should also enhance consolidation and make retrieval more efficient. Most feedback will be immediate and automated.

- Students will demonstrate that they know how to use the knowledge before lectures build on it.

Extrinsic Motivation Strategies

- Students will be reminded that they need this information to effectively manage their patients, improving patient retention and reducing the risk of avoidable errors and lawsuits.
- Simple gamification strategies will be used, such as students receiving scores for answering various questions in each module, weighing the score more heavily toward basic concepts that they must know. Their scores will be compared (anonymously) to their peers to increase competitiveness. Their progress and speed on answering questions that are based on consolidation/retrieval will be marked to encourage further progress.
- They will have to score at 100% to pass modules assessing key concepts, and based on their responses on assessments, they will receive constructive feedback (automated and from peers).
- Tools that will help them manage patients or answer questions on rounds will be unlocked only when they complete certain modules successfully. However, the environment will be safe for them to make mistakes.

Intrinsic Motivation Strategies

- This course aims to serve an important need for students, which is to give them an understanding and strategies to identify intractable epilepsy in adults, manage it, answer questions on formal evaluations (such as board exams, although this course does not focus on board preparation) and on daily rounds. I will use cues to show the appeal of the subject matter as much as possible.
- Cues will have aspects of novelty, utility, applicability, anticipation, surprise, challenge, feedback, and closure. Learning and using the material will increase their autonomy and they will develop a level of mastery commensurate with their course goals (e.g. medical students will have a different level to reach compared to epileptologists).
- Students will have feedback on their own progress, demonstrating their improvements in an encouraging way.
- This course will give students access to a community of peers at different levels of training who may help them – and whom they may help - with their own challenging clinical cases (which can be starred or flagged for

urgency), and they will have the opportunity to network with potential future collaborators and mentors.

- This course will remind students that there is no such thing as a lone inventor or spontaneous eureka moment; but rather, all of the above require backwork and collaboration, learning from smaller efforts and findings.
- The course will also remind them that experts are sometimes too constrained by their assumptions and might benefit from relative inexperience; this may help stimulate discussions on the forums.

TEACHING METHODOLOGY

This course aims to make medical students and MDs (mainly neurologists) more comfortable with the identification and management of intractable epilepsy. It is largely automated, but some aspects of student-centered learning will be incorporated. Students will give a brief personal biography in their profile, but can answer questions anonymously if they wish. Students will engage in the course based on their needs, and different mini- and bonus modules will be based on their training level and success on previous modules. Each mini-module will have very short lectures or reading materials, given in short bursts with graded case studies, MCQs, short quizzes, short form answers and other assessments ensuring that basic and key concepts are understood deeply and connected to patient care.

Stories and gamification techniques will be utilized as mentioned above, including case-based “choose-your-own-adventure” games. Tools to use in the hospital or clinic, and modules based on understanding previous modules will be locked until they demonstrate mastery of the necessary material. Feedback loops will be designed to help identify real understanding before teaching anything new, then after learning to compare before-after progress. The course will also provide a safe space for failure, to ask questions, and to receive constructive feedback from peers.

Learning will be on students’ own time, although I can potentially later incorporate Office Hours or webinars to discuss challenging concepts and cases with students, and Q&As with highly specialized experts. Feedback will go both ways, with past and current students helping identify concepts they have trouble with and the reasons for this difficulty, as well as making suggestions for improvement.

Using the MSLQ (Motivated Strategies for Learning Questionnaire) on students might help in organizing their coursework, and ultimately enhance their autonomy, competence (the feeling and the fact), relatedness, and mastery as well as help them identify and fulfill their purpose in taking this course.

The course will train students on how to effectively search for and find information they need, how to synthesize and organize the information they’re learning and gain a bigger picture view. Bonus practice questions will be given on a “need to know basis”, with more time given to difficult concepts.

The course will also train students to perform critical thinking by incorporating its concepts into the teaching, by using tricks and techniques to make them constantly reflect, question themselves, avoid biases, consider all sides, analyze, and make judgments but keep open minds and reassess opinions. It will allow them make mistakes in a safe environment, to create new questions; it will encourage the flow of ideas as they make new connections, and encourage them to change their thinking. It will help nudge students toward a “scout mindset”, to want to see the world with utmost clarity and to use Bayesian thinking:

1. To remember background knowledge.
2. To imagine what would be different if their theory was wrong.
3. To update their knowledge incrementally. Students will be encouraged to self-monitor and selfregulate through course-related materials by reminding them of their relevance.

COURSE OUTLINE

Module 1: The Basics

1.1 What is a seizure?

- What happens in the brain?
- Why does it happen?
- Why does it propagate?
- When is it not a seizure?
- What causes seizures?
- Seizure risk factors
- Seizure classification
- Differential Diagnosis (DD) of seizures
- What is epilepsy?
- Definition of epilepsy
- Challenges of defining epilepsy
- What causes epilepsy?
- Epilepsy risk factors
- Epilepsy classification
- Electroclinical syndromes and other epilepsies

1.2 Epidemiology of epilepsy

Bonus Module 1:

1. Going deeper into seizure DD
2. The Seizure Games

Module 2: How do we diagnose epilepsy in adults?

2.1 Clinical diagnosis

2.1.1. Semiology (by history and as seen at bedside/on video-EEG)

2.1.2 History

- Age relationship to semiology
- Risk factors
- Altered mental status 2.1.3 Physical exam 2.1.4 Status epilepticus (SE)
- Convulsive
- Non-convulsive/subclinical SE 2.1.4 Other clinical challenges 2.2 Neurophysiology:
- Routine EEG
- Extended EEG
- Ambulatory EEG
- Video-EEG (VEEG)
- Epilepsy Monitoring Unit (EMU)
- Continuous EEG (CEEG) on other floors
- ICU CEEG monitoring.

2.3 Imaging studies:

- CT
- MRI
- PET
- SPECT

2.4 Other investigations Bonus Module 2:

1. How to take the History and Physical exam of a patient suspected to have epilepsy
2. EEG diagnostic challenges
3. Non-epileptic spells
4. Going deeper into epilepsy imaging studies
5. Choose your own clinical adventure

Module 3: Initial management in epilepsy

3.1 When to treat a first "unprovoked" seizure

3.2 Choosing the right AED

- AED pharmacokinetics - a briefer
- AED pharmacodynamics and drug interactions - a briefer 3.3 Management of seizure triggers in epilepsy
- Sleep deprivation
- Stress
- Drinking/drugs
- Metabolic/hormonal disturbances

3.4 Reflex epilepsies

3.5 Driving Bonus Module 3:

1. How do we treat pregnant patients with epilepsy?
2. How do we treat catamenial epilepsy?
3. How do we manage comorbidities?
- Identification of common comorbidities

- Patient referral to other specialists

4. How should primary care physicians and other specialists deal with epilepsy patients?

5. Game: put yourself in their shoes

Module 4: Epilepsy prognosis

4.1 Prognosis by etiology

4.2 Patient related factors

4.3 Environmental factors

4.4 Systems based practice

Bonus Module 4:

1. What else can you do for your patient?
2. Why is it important to aim for "no seizures and no side effects"?
3. Long-term AED effects
4. Tips on critically evaluating the literature
5. Game: You Are the Patient

Module 5: What is intractable epilepsy?

1.4 Defining intractable epilepsy

1.5 Is it truly intractable or just sub-optimally managed?

1.6 What causes intractable epilepsy?

1.7 Modifiable risk factors

1.8 Systems based practice

Bonus Module 5:

1. Test yourself
2. Questions to ask your patients and yourself
3. What is going on with the patient?
4. Choose your own clinical adventure

Module 6: How to evaluate medically intractable epilepsy?

6.1 History, history, and history – what to ask and when to ask it

6.2 Interpreting semiological factors

6.3 Referring your patient to an epileptologist

- When to do it
- How to prepare
- Key information
- Media

6.4 How to optimize your VEEG admission

6.5 Planning for intracranial monitoring:

- SEEG
- Subdural EEG

Bonus Module 6:

1. Practice Cases
2. More questions to ask your patient
3. More questions to ask other specialists

4. More questions to ask yourself
5. Choose your own clinical adventure

Module 7: Management of medically intractable epilepsy

7.1 Pre-surgical evaluation referrals

- When to refer your patient for a pre-surgical evaluation
- Referral challenges

7.2 Epilepsy network hypothesis:

- H&P
- VEEG
- SPECT
- PET
- MEG
- WADA
- Subdural/SEEG/ECOG

7.3 Is the patient a surgical candidate?

7.4 Management during and after surgery

7.5 When your patient is not a surgical candidate:

7.5.1 - Diet therapy

7.5.2 - Neuromodulation

- Vagus nerve stimulation (VNS)
- Responsive neurostimulation (RNS)
- Deep brain stimulation (DBS)
- Non-invasive brain stimulation (NIBS)

7.5.3 - Other investigational techniques

Bonus Module 7:

1. Going deeper into the network hypothesis
2. Practice Cases
3. More questions to ask
4. Major challenges
5. Choose your own clinical adventure

Module 8: Putting it all together

8.1 Overview of Modules 1-7

8.2 More resources

8.3 When to seek help and how

Bonus Module 8:

1. Challenge yourself
2. Share your cases
3. Collaborate with your peers

USE OF TECHNOLOGY

• I will use Teachable as a platform as it allows us to upload Word, PowerPoint and PDF documents as well as audio and video recordings. It also allows writing MCQs and short form questions, and provides a forum to communicate with other members, with my team and

myself. The materials shared are password-protected and can be seen only by students and alumni. Teachable is relatively affordable, can be upgraded to an even more efficient form with more technical support, and can be integrated with different types of software and apps, including email marketing software. In this way, course materials can be taught and graded in various formats. Teachable is well trusted, is sufficiently sophisticated for single individuals and small groups, and it also processes payments and refunds.

• Convertkit will be my email list provider, as it is relatively affordable and can segment the emails I send to students based on their training level, their course interests, their results, and by any other factors I choose (e.g. if they did not complete the course, I can send them automated reminders). I can also use it to inform students and alumni of updates to the course, additional modules, and to send reminders of important concepts periodically.

• To create course materials:

• Powtoon will be my go-to method for creating visually appealing short videos for some of the lectures, as it is user-friendly and affordable. I will use PowerPoint for simple slide shows if video would not add much.

• Canva will help me create appealing visuals fairly easily using free elements, layouts, and images legally. I can edit the images on Word, PowerPoint and also on photo-editing software such as that on Lunapic.com (a free website).

ASSESSMENTS

• I will use MCQs on key concepts and graded case studies as those can reflect real clinical cases. Cases can also be gamified into “choose-your-ownadventure” games where students select one of multiple options, and follow where that might lead. They can also then test the other options.

• Feedback loops will be designed to help identify real understanding before giving access to modules that depend on previous understanding, then after learning to compare before-after progress, and to also provide a safe space for failure and constructive feedback from peers.

• The format of the graded assessments is not conducive to plagiarism. However, plagiarism is possible in the materials and statements they submit on the forums, so I will use anti-plagiarism software such as turnitin.com and/or Grammarly.

OVERVIEW OF METHODS

Lecture strategies

- I will use mini-lectures, typically under 5-10 minutes, followed by interactive assessments and some short form questions, which will be part of the learning process. Some of the questions will be openended, encouraging students to make connections between different lectures and different threads of evidence, and to provide their own evidence as well as their personal experiences.

Off-learning collaboration/assignments

- Between modules and their related assessments, students will have bonus (optional) modules that will take them deeper into the subject matter; these bonus modules will also involve gamification. There will be a forum area to discuss what they learned with these methods. They will be invited to share their (deidentified) clinical cases. Their responses will go to a forum available only to course participants and alumni. Periodically, I will pose a question and open it up for group discussion on the forums, and potentially for future office hours or webinars. Additionally, there will be a forum to suggest ideas for collaborative research among participants, and for participants to help suggest potential partners in other fields as well.

General schedule

- While it would be possible to take the main course over 8 weeks, at about 3-4 hours/module/week (longer if they take the optional modules and participate in the optional assignments), the schedule would be open to participants' time availability.

RESEARCH BASED EDUCATION

This course depends on enhancing mainly intrinsic motivation, because high intrinsic motivation correlates with learning strategies (SepúlvedaVildósola, Carrada-Legaria, & Reyes-Lagunes, 2015). It encourages students to become deep learners rather than strategic or surface learners (Bain, 2004; Home et al., 2016) by showcasing the appeal of the subject matter, and by providing learning activities that promote intellectual stimulation and a sense of personal control (DeLong & Winter, 2002; Middleton, 1995). The course will also train them to detect and avoid cognitive biases in medicine (Saposnik, Redelmeier, Ruff, & Tobler, 2016).

While automated and descriptive feedback will be obtained from the students, the research on medical education is limited overall; there is also disagreement on the best forms of such research, e.g. RCTs can be limited (Sullivan, 2011). Perhaps this course will help generate ideas for comparative effectiveness research in formal epilepsy training programs (Cook, 2012).

GRADING

The course will be pass/fail in order to receive a certificate. As this course is aimed at students and practitioners with a real-world need to learn the material, giving a final score would be superfluous and may detract from intrinsic motivation. However, in order to pass the course, students will have to take assessments that will guide them toward understanding the subject material. Passing rate will be based on receiving 100% on the MCQs testing basic concepts at the end of the main modules (which will be the same for medical students and MDs), and (for MDs, not medical students) at least 75% on select specialized MCQs at the end of mini-modules. MCQs testing basic concepts will be pulled from a question bank, and if the answer is incorrect, students will be required to answer a short form question on why they thought this was the correct answer (allowing them to reassess their thinking, and giving me feedback on concepts students struggle with). If more than 3 MCQs are answered incorrectly in a row, students will be required to review the module again. Otherwise, they will have the option to redo the questions, but they will receive an email several days to week later reviewing the concepts they got wrong. New modules and some mini-modules will not be unlocked until understanding is demonstrated by answering the MCQs correctly. Students will be surveyed on the difficulty of the material according to their training level, and course materials as well as test questions will be adjusted accordingly. Additionally, students will receive stars for engagement if they participate in the forums, share their cases, upload relevant papers (legally), participate in the group discussions, help other students and network.

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REFERENCES

- Bain, K. (2004). *What the best college teachers do*. Harvard University Press.
- Cook, D. A. (2012). If you teach them, they will learn: Why medical education needs comparative effectiveness research. *Advances in Health Sciences Education, 17*(3), 305–310. <http://doi.org/10.1007/s10459-012-9381-0>

- Delong, M., & Winter, D. (2002). Learning to teach and teaching to learn mathematics : resources for professional development. Mathematical Association of America.
- Home, V., Navigation, P., Consultations, I., Support, B., Faculty, S., Program, F., ... Fellows, T. (2016). Center for Teaching, 4, 1–9.
- Middleton, J. A. (1995). A Study of Intrinsic Motivation in the Mathematics Classroom: A Personal Constructs Approach. *Journal for Research in Mathematics Education*, 26(3), 254. <http://doi.org/10.2307/749130>
- Saposnik, G., Redelmeier, D., Ruff, C. C., & Tobler, P. N. (2016). Cognitive biases associated with medical decisions: a systematic review. *BMC Medical Informatics and Decision Making*, 16(1), 138. <http://doi.org/10.1186/s12911-016-0377-1>
- Sepúlveda-Vildósola, A. C., Carrada-Legaria, S., & ReyesLagunes, I. (2015). Motivation and learning strategies in pediatric residents . *Gaceta Medica de Mexico*, 151(4), 477–484. Retrieved from <https://www.scopus.com/inward/record.uri?eid=2-s2.0-84942770027&partnerID=40&md5=81c38f282fc0e0490879f76eb040ed90>
- Sullivan, G. M. (2011). Getting Off the “Gold Standard”: Randomized Controlled Trials and Education Research. *Journal of Graduate Medical Education*, 3(3), 285–289. <http://doi.org/10.4300/JGME-D-11-00147.1>