Project Narrative: Neurology is a difficult field to master, and it moves very quickly, with game-changing studies, diagnostics and treatments coming out every week. There is a lot to learn for neurology residents. Surveys of Stanford neurology residents (data not shown) indicate that we prefer case-based learning (CBL) in teams over lectures, consistent with substantial prior data indicating that CBL is preferred and produces better retention and test scores than lectures in medical resident education[1,2]. Out of 12 hours monthly of Stanford neurology resident didactics, the preferred frequency for team CBL was rated at 1-3 hours per month, yet it has not happened even once over the past two years (data not shown). This gap exists because creating CBL exercises is challenging, time-consuming, and difficult to update in a fast-moving field, leading to an absence of CBL activities in our residency despite the evidence and our preferences. To address this gap, we propose using ChatGPT, an online tool based in artificial intelligence and large language models, to convert real patient cases (which are naturally abundant) into CBL exercises (which are sparse, arduous and taxing to produce by hand). The project aims to expand the library of CBL activities in neurology, benefiting resident learning and ultimately patient care (**Figure 1**). The ultimate vision is that, instead of faculty creating Powerpoint lectures for us, they use the pipeline we develop and test here to generate CBL activities with the help of ChatGPT. Faculty will then proctor their ChatGPT-generated CBL exercise with residents in teams, as opposed to giving a Powerpoint lecture.

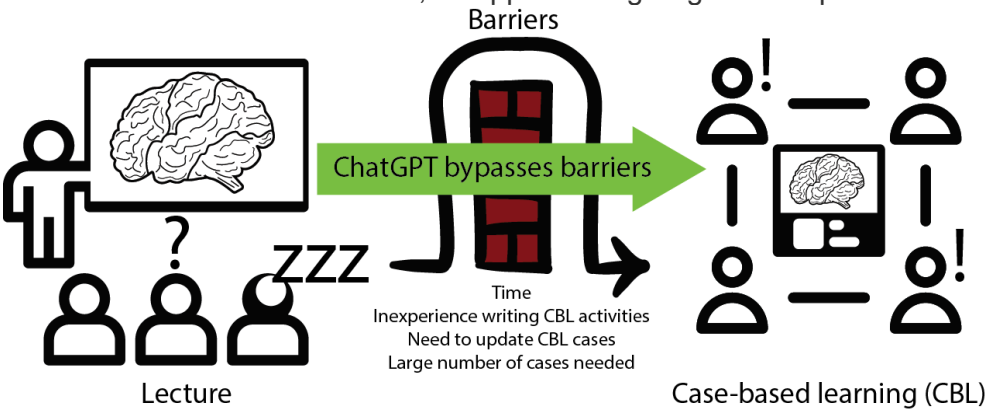

Figure 1: This project proposes to engineer prompts with ChatGPT as a means to bypass barriers to case-based learning (time, inexperience of faculty writing CBL activities). This will facilitate more CBL learning activities.

I. Specific educational aims:

- **Aim 1.** To expand available case-based learning activities in neurology, we will develop a pipeline that utilizes ChatGPT to convert text of anonymized patient cases into case-based learning activities.
    - **Sub-aim 1a.** To evaluate ChatGPT's ability to generate useful CBL activities, we will test which style of prompts produce better CBL exercises, as determined by survey responses from neurology faculty and residents.
    - **Sub-aim 1b.** To assess feasibility and acceptability of this approach, we will ask neurology residents and faculty to assess the activities for accuracy, and for their desire to participate in the ChatGPT-generated CBL activities.

II. Project rationale: Unlike many clinicians, ChatGPT is already familiar with writing in the format of CBL, and can rapidly convert text of cases (including published case reports) into a CBL exercise (data not shown). The current rate-limiting step in CBL is the creation of CBL-oriented questions and activities, and ChatGPT can accelerate this process by converting patient cases to CBL activities with a few keystrokes.

III. Approach: Author DAH is a neurology resident with MD/PhD training in computer programming, statistics, publishing and presentations. I am in my second year as the education co-chief in the neurology residency, providing me with extensive experience in developing and

delivering surveys in education. I will work with other neurology residents and faculty on this topic, under guidance of Dr Rebecca Miller-Kuhlmann M.D., a leader in neurology education.

We will extract 30 teaching cases from faculty Powerpoints given as lectures to neurology residents in 2022, and input them into the ChatGPT chatbot using a variety of different formats – this is a form of “prompt engineering”. It is known that providing slightly different inputs into ChatGPT can produce widely different outputs, hence the term “prompt engineering” whereby people experiment with different prompts in order to obtain the desired ChatGPT output. We will experiment with four main types of prompts, all of which ask ChatGPT to create a CBL exercise: (1) unmodified bulk text of the case, (2) tabulated text with headers such as “History”, “Physical Exam”, “Imaging”, etc, and each of these with educator guidelines (3,4) such as “Desired teaching points” to allow emphasis on important points identified by educators that ChatGPT may not identify on its own. For quality assurance of each output, I will read the output and modify it as needed so that it is readable and for the right audience. I will keep track of how long the quality assurance process takes with each prompt style.

To test which provides the best educational tool, in January 2024 we will survey neurology faculty and residents at Stanford. For each case, survey respondents will select their preference for one of the four different ChatGPT outputs, each generated from a different ChatGPT prompt. For each case, we will also ask if the respondent observes any inaccuracies in the case options, and to rate their preferred case from 1-5 on a Likert scale of whether they think this is a good CBL activity that they would like to use. This totals a 90-question survey. Results will indicate which prompts produce the preferred educational materials, whether the CBL activities appear accurate, and whether the residents and faculty would like to use them for didactics. We will submit an IRB application prior to delivering the survey, and expect exempt status. Surveys will be delivered on RedCap, an interface that the authors have experience with.

IV. Timeline and plan for implementation:

Aug-Oct ‘23	Nov-Dec ‘23	Jan-Feb ‘24	Mar-Apr ‘24	May-June ‘24
Extract 30 cases from existing lectures.	Enter cases into ChatGPT to generate CBL options. Submit IRB.	Survey neurology residents and faculty.	Analyze survey results. Present AAN, submit manuscript.	Develop and disseminate instructions on how to generate CBL cases.

V. Anticipated work product: The results will include publishable survey data, and we will produce How-To written and video instructions about how to convert a patient case into a CBL exercise using ChatGPT. This will give faculty text they can modify, and deliver as part of CBL activities with neurology residents during our scheduled didactic time. Once optimized and validated, this pipeline will continue to be useful long after completion of this project, and may be improved upon in future studies, in particular as new AI tools emerge. It will be an enduring tool for residency education.

VI. Evaluation plan: Analysis of variance (ANOVA) statistics with a Tukey post-test will identify if prompt type 1,2,3 or 4 produces superior usability. Survey responses regarding accuracy and quality will be compared among prompt types, and descriptive overall statistics will be provided (an average of the accuracy and educational quality of each case, for example).

VII. Dissemination of results: Ultimately, results will be disseminated within the Stanford neurology department in the form of CBL activities for residents during didactics. Results will be

submitted for publication for dissemination to the broader education community. Neurology: Education is our preferred journal.

References:

1. Said JT, Thompson LL, Foord L, Chen ST. Impact of a case-based collaborative learning curriculum on knowledge and learning preferences of dermatology residents. *Int J Womens Dermatol*. 2020;6(5):404-408. doi:10.1016/J.IJWD.2020.06.002
2. Zhao W, He L, Deng W, Zhu J, Su A, Zhang Y. The effectiveness of the combined problem-based learning (PBL) and case-based learning (CBL) teaching method in the clinical practical teaching of thyroid disease. *BMC Med Educ*. 2020;20(1). doi:10.1186/S12909-020-02306-Y