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Reflective Essay - Lang Prize 2024

I wrote the narrative review paper 'Efficacy of Non-Invasive Neuromodulation in the Treatment of Drug-Resistant Epilepsy' as part of a project in UWP 104FY (Winter 2024, Professor Brendan Johnston). Due to my background and interest in neuroscience, I decided to write a paper on non-invasive neuromodulation/brain stimulation. Through my experience reading literature in refractory epilepsy, surgical resection and invasive techniques such as deep brain stimulation are often the prioritized treatments by clinicians. However, less known to the public is the existence of non-invasive stimulation devices that have the potential to lessen the burden of this disease. Without the risks or permanent effects associated with surgery, these non-invasive methods amazed and prompted me to take a closer look at recent findings.

The narrative review paper was written using a systematic approach. I learned in UWP 104FY the importance of the methods section in scientific research. Knowing how researchers design and perform their study can be informational for readers when selecting the most credible sources. As a writer, I also decided to include this section for the same purpose. Furthermore, I believe that it is important to include the specific search terms/entries in the supplemental material. Relevant literature was selected across 3 different databases that are accessible through the UC Davis Library: *Pubmed*, *Embase*, *Scopus*. While *Pubmed* and *Embase* are both known as some of the biggest and most reliable bibliographic databases for biomedical sciences and neuroscience, they were also recommended by the UC Davis Library's research guide for UWP 104F Health Sciences. Furthermore, the addition of *Scopus* provides a multidisciplinary approach, enriching the selection pool.

During this process, one of the biggest challenges was finding effective search strategies and narrowing down articles in a systematic way. At first, I simply typed the terms (ie. tACS or tDCS) into PubMed for a list of findings. Since I aimed to look at multiple interventions, I realized that this was not feasible. Hundreds of thousands of studies popped up for each stimulation method. I also needed better search strategies to filter out the outdated and unrelated studies. Later on, suggestions from Erik Fausak, a UC Davis librarian that visited and presented on search strategies in UWP 104FY, guided me toward using advanced search. Following the end of Winter quarter, I followed up with Erik Fausak and gained further insights into what makes a well-written and effective systematic review. I learned that creating an organized table with clear search terms and inclusion/exclusion criteria is crucial. I also learned about the usefulness of using AND/OR, combining previous searches, and Mesh terms/abbreviations/full forms to achieve best findings. In databases where the number of available papers on a topic comes up to hundreds of thousands, knowing selection criteria and keeping track of them is one of the keys to success.

In the review article, I decided that the majority of sources need to come from randomized controlled trials to ensure the most experimentally verified findings. Hence, this became one of my main search criteria. Due to the limited number of trials on Non-invasive Brain Stimulation (NIBS) in patients with drug-resistant epilepsy (DRE), some pilot (smaller sized and usually on more novel protocols) randomized controlled trials are also subjected for review. The goal is to evaluate three primary outcome measures from the results: Seizure Frequency (SF), Adverse Events (AE) and Quality of Life (QoL). Although not all clinical trials performed follow-up questionnaires to analyze effects on QoL after treatment, all researchers evaluated SF and AE. In epilepsy research, SF is often a direct indicator of disease burden on

patients. I also considered SF and AE to be the prioritized primary outcomes, as it is more important in early evaluation of these techniques for the patient population through early clinical trials.

The number of articles were narrowed down using a search strategy of 7 criteria: **1) Non-invasive modulation** (""rTMS" OR "tDCS" OR "tACS" OR "ta-VNS" OR "brain stimulation" OR "non-invasive neuromodulation" OR "non-invasive brain stimulation" and the full terminology); **2) Epilepsy** ("Epilepsy" OR "seizures"); **3) Drug-resistance** ("Drug Resistant Epilepsy" OR "refractory" OR "drug resistant"); **4) Clinical Trial** (Either "controlled clinical trial" or Clinical trial Filter); **5) Human** (Either "Human" or Human Filter); **6) English Language** (Filter); **7) Date** (2015-2024 only). This initial search yields a total of **137** articles in Pubmed, **202** in Embase and **191** in Scopus. After a review of title and abstract, articles are screened out if they focus on other diseases (ie. neuropathy, mood disorders, etc), use Non-NIBS techniques (ie. Deep brain stimulation) or are case studies. To ensure the most credible findings, only randomized and controlled clinical trials are included for primary analysis. Published abstracts were also not selected for this review as they do not have detailed information on methods and statistical analysis. In UWP 104FY, I included 4 clinical trials for analysis. In the weeks following, I broadened my analysis to all 6 relevant clinical trials across 4 NIBS techniques that are identified after screening.

Selected articles were also subjected to critical appraisal using some of the qualitative measures from Joanna Briggs Institute Critical Appraisal tool. One of the limitations that prevent this paper from being a 'true' systematic review lies in the lack of quantitative measure for study bias, and also the lack of multiple authors for combined opinions in the process.

As I begin the writing for this paper, I realize that this topic is especially heavy on scientific terminology. There are 8-10 abbreviations that are consistently used throughout the paper. I made the decision of making the lists of 'Key Words' and 'Abbreviations'. I recognize that putting these terms in the second page may allow the readers to readily refer to, as they progress through the introduction and findings. Another thing I found challenging about this project was during the synthesis of primary findings in the 'Results' section. For me, the priority was to identify and compare findings across different studies, while also pointing out strengths, limitations and potential risk of biases. Ultimately, I have come to appreciate the importance of evaluating and analyzing instead of summarizing existing data for the creation of a comprehensive review.

Throughout this search, I also performed a similar search on the above criteria, but for existing systematic and narrative reviews on this topic. While there have been numerous reviews on NIBS, only a few are in drug-resistant epilepsy. There is also a lack of current updates on recent clinical trials. Throughout the search, I also found reviews that evaluate only one or two of the most commonly used NIBS. In this review, I wanted to include a broad range of NIBS under trials. Since NIBS is a growing field, making the efforts of some of the most novel clinical trials on tACS, and especially ta-VNS (a highly convenient and portable device) known to the public, is highly important in my opinion. Still, the information from these existing reviews allow me to draw comparisons with my current analysis, especially in the 'Discussion' section.

Overall, the amount of extensive resources made available by the UC Davis library directly supported the writing of this review. The articles that I identified were accessed via the library using the button "Get it at UC" or from the publisher's page, either through VPN access

or being on campus. Single sign-on was also used to access the articles. I recognize that all the information and sources are not in one particular database, and UC Davis library's decision of making resources available to students allows for the comprehensiveness of this review.

No AI tools/technologies were used in the writing of this essay.