The Adverse Effects of Levetiracetam and the Importance of Educating and Healthcare Providers

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by

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Background and Significance

Problem

Epilepsy is one of the most common neurological disorders, affecting around 50 million people worldwide. Epilepsy is a chronic disease affecting the brain (World Health Organization [WHO], 2025). This disease causes seizures, which is abnormal brain electricity firing, manifesting itself in various ways (Cleveland Clinic, 2024; WHO, 2025). People of all ages, genders, races, and ethnic backgrounds can develop epilepsy (Mayo Clinic, 2023). Due to perinatal and neonatal complications as well as increased risk of infection, epilepsy incidence is higher in children than adults (Biset et al., 2024). Without proper treatment, epilepsy can have high morbidity and mortality rates, doubling the risk of dying (Fisher, 2024).

Due to modern medical advances, there are many medical treatments for epilepsy. These treatments include anti-epileptic drugs (AED), surgery, implanted devices, diet, and lifestyle changes. These treatments can significantly reduce seizures and potentially stop seizures completely (National Health Service, 2025; WHO, 2025). With proper medical interventions, up to 70% of patients could become seizure free (WHO, 2025). Drug development started in the 1850s and has continued to make major advancements over the last two centuries. In the 1990s new drugs were developed with better tolerability and increased efficacy. In this new round of drugs, Levetiracetam (Keppra) was invented. It was approved for use in 1999 (Ochoa, 2024). The popularity of this drug quickly increased due to the unique chemical profile. The distinct chemical make-up of the drug has led to multiple benefits including increased efficacy, limited drug-drug interactions, and improved safety profile (Kumar, 2023). As of 2022, it was the 123rd most prescribed drug with approximately 5 million people using it (Kane, 2025). 41-60% of

patients had positive response rates, meaning that they had over a 50% reduction in their seizures (Grant et al., 2000).

Despite the many benefits of this drug, there are also significant mental side effects that can severely affect the quality of life of the patient, caregivers, and family (Tekin, 2025). These mental effects can range from aggression to suicidality. These changes are specific to Levetiracetam and can be up to three times higher than any other antiepileptic drug (Kawai et al., 2021). 10-20% of patients on Levetiracetam will experience irritability and aggression (Kawai et al., 2021; Kawai et al., 2022). Irritability and aggression can have a more significant effect on quality of life than seizure frequency (Kawai et al., 2022). 3% of patients will experience depression and anxiety (Kawai et al., 2022). Levetiracetam can also induce severe and life-threatening psychiatric conditions. Levetiracatam has the highest occurrence of suicide-related behavior out of any anti-epileptic drug (Patra, 2023). Severe effects such as psychosis and hallucinations occur in 1-3% of cases (Kawai et al., 2021; Ogunsakin et al., 2020).

There are some risk factors that can help us in assessing which patients are most at risk for these behaviors. The reason and usage of the medication can determine the potential for side effects. Levetiracetam has a higher chance of adverse effects when used for seizures (Hansen, 2015). It also has a higher risk when titrated rapidly (Ogunsakin et al., 2020) or after the dose is increased (Esang et al., 2020; Mula et al., 2015; Yumnam, et al., 2021;). Age also affects chances of adverse effects. Older adults may be more susceptible to adverse effects (Ogunsakin et al., 2020). Children are more likely to experience mental side effects. About 13% of adults experience symptoms such as irritability or aggression. However, this number is increased to 30% when Levetiracetam is used for children (Zhang et al., 2022). Gender also plays a role in who will experience side effects, with women having a higher rate (Ogunsakin et al., 2020).

Finally, the history of psychiatric comorbidities or intellectual disability are one of the most significant predictors for experiencing adverse psychiatric effects of Levetiracetam (Pinckaers et al,. 2019).

The adverse effects of Levetiracetam are important and impactful. Adverse effects can lead to suboptimal dosing, poor adherence to medication regimen, and discontinuation of the medication. 6.9% of patients will discontinue Keppra due to the adverse effects (Chen, 2017; Mula et al., 2015). Adverse effects are also the number one reason why patients do not adhere to their medication regimen which can lead to uncontrolled epilepsy and increased morbidity and mortality. However, these neurological effects are not permanent and lowering the dosage or discontinuing the medication can decrease or stop adverse effects. Without timely identification and intervention, these side effects can severely affect quality of life (Kawai et al,, 2022; Tekin et al., 2025). Quality patient education is essential to increase early identification and treatment. The population of people who experience epilepsy and adverse effects of medication may not be able to advocate for themselves due to factors such as age and disabilities. Thus, it is imperative that medical providers, caretakers, and patients are aware and observant of any adverse effects.

Purpose and Rationale

This paper will explore the psychiatric side effects of Levetiracetam specifically on the pediatric population and the importance of quality education about the drug. While possessing many benefits, Levetiracetam has been proven to have severe psychiatric effects. Children and adolescents on Levetiracetam are at an increased risk to experience these adverse psychiatric effects (Zhang et al., 2022). This can be especially concerning as this is a very vulnerable population that may be unable to advocate for themselves, understand the psychiatric effects, or alert the medical team or caregivers of their feelings. Additionally, children and adolescents have

a baseline of decreased emotional regulation, meaning their symptoms may be ignored or written off as normal behavior (Ricci, 2021). Increased education for healthcare providers, caregivers, and patients is of utmost importance and can help ensure identifying adverse effects swiftly to maintain quality of life.

Review of Literature

Search Strategies

To conduct the literature review, multiple government and medical websites and academic databases were used. EbscoHost and Google Scholar were searched and accessed for information that contributed to the literature review. Websites include Centers for Disease Control and Prevention (CDC), National Library of Medicine, World Health Organization (WHO), Mayo Clinic, CliniCAL, and EpilepsyHealth. Several keywords were used to find relevant articles. These keywords included: “Levetiracetam OR Keppra”, “antiepileptic drugs OR anticonvulsants OR antiepileptic medications”, “adverse effects OR side effects OR negative effects OR complication OR risk”, “mental health OR mental illness OR mental disorder OR psychiatric illness”, “pediatric OR child OR children OR infant OR adolescent”, “suicide OR suicidal ideation OR suicidality OR suicide attempts” , and “aggression OR aggressive behavior OR aggressiveness”. Searches were limited to articles published since 2014 and full text articles. With these search strategies, over 30 articles were found that contributed to a literature review.

Seizure Disorders

Every year 5 million people are diagnosed with epilepsy around the globe (WHO, 2025). Epilepsy is a chronic brain disease that consists of recurrent seizures. Seizures are when the neurons in the brain fire signals irregularly and rapidly, instead of in the usual coordinated manner. At a healthy baseline, brains are constantly sending action potentials down neurons to

communicate with other cells to perform involuntary and voluntary functions in the body. In seizures, the action potential is rapid and random, serving no purpose and not effectively communicating throughout the body systems. This atypical firing leads to abnormal brain activity which manifests in changes of muscles and movements, behaviors, sensations, or states of awareness. This misfiring can have a wide range of severity and lead to a variety of negative effects across a patient's life (Johns Hopkins Medicine, 2021).

Seizures may affect different parts of the body. Focal seizures start in one specific part of the brain and then gradually spread and symptoms become worse. When the seizures start on one side of the brain they are more mild, often called an aura. Aura refers to a slight change in mood and promotion. These seizures may progress into more severe symptoms such as confusion, dizziness, shaking, and muscle stiffening. There are two types of focal seizures: focal aware seizures, when a person is aware of changes, or focal unaware seizures, when the person is unaware of seizures. Focal seizures may eventually progress into tonic clonic seizures, or generalized seizures, which affect both types of the brain. Generalized seizures start on both sides of the brain at the same time. There are severe types: absence (which results in lack of reactions, movements, behaviors), tonic and atonic (where muscles will stiffen causing the patient to fall), mayo-clonic (muscle spasms), and tonic-clonic (stiffening and shaking of muscles) (John Hopkins Medicine, 2021).

Epilepsy may be due to a variety of causes. Any illness or injury to the brain can lead to seizures. These include infections such as meningitis, trauma, strokes, tumors, and congenital and genetic disorders. They can affect anyone, but are more common in children due to perinatal and neonatal complications as well as increased risk of infection. Seizures are also more

common in low and mid-income areas due to endemic conditions, injuries, and decreased medical access (WHO, n. d.).

Due to the severe symptoms, epilepsy can have a high morbidity and mortality rate and quality of life can be severely affected. The type of seizure is not as significant as the frequency and severity when assessing the effect of the seizures on the patient's overall well-being. If the seizures are more frequent and severe, they require more energy and safety measures, are more disruptive to everyday activities, and can cause more emotional distress to patients and caregivers. Epilepsy affects all aspects of life including but not limited to social, physical, mental, and financial (Bujan, 2021). It is responsible for more than 0.5% of the burden of disease globally (CDC, 2025). These patients are at a higher risk for premature death as the mortality rate is two to three times higher in those with epilepsy than in the general population. This mortality rate is increased if the seizures are medication resistant, demonstrating the importance of a proper medication regimen (Fisher, 2024).

Up to 70% of those struggling with epilepsy could become seizure free with the appropriate treatment and medication (CDC, 2025). There are a variety of treatments. Antiepileptic drugs (AEDs) are the first line of defense. Other treatments include surgery, implantable electronic devices, and diet. The treatment regimen should be tailored to the individual needs of the patient and their response to trialed treatment.

Development of Levetiracetam

The development of AEDs has been happening since the 1850s, when Bromides were first used for seizures (Epsy, 2022). In 1910, Phenobarbital, a sleep inducing drug, was found to prevent seizures and became the primary used drug and inspired similar drugs. 30 years later, in 1940, Phenytoin was discovered and remains a first line treatment today. From then until the

1980s many drugs came out with different methods of action and targeting different types of epilepsy. The drugs developed at this time are referred to as first generation anticonvulsants and remained the mainstay of treatment until the 1990s. In the 1990s a new wave of antiepileptic drugs were developed with decreased side effects, better efficacy, and increased tolerability (Ochoa et al., 2024). These are known as the second generation drugs and are correlated to better quality of life. Levetiracetam (LEV), or Keppra, is part of these second generational drugs (Bujan et al., 2021)

Drug Profile of Levetiracetam

Developed in 1999, Levateracam has quickly gained popularity due to its increased efficacy, limited drug-drug interactions, and safety profile (Kumar, 2023). As of 2022, it was the 123rd most prescribed drug with approximately 5 million people using it (Kane, 2025). Its effectiveness is clear as 41-60% of patients had positive response rates, meaning that they had over a 50% reduction in their seizures (Grant et al., 2000). Dosing for Levetiracetam is dependent on weight but typically between 250 mg to 3,000 mg. The dosage will start low and then often increases depending on response (National Health Service [NHS], 2022a). The most commonly cited side effects are headaches, tiredness, and blocked nose or itchy throat (NHS, 2022b)

Levetiracetam's Method Of Action

The mechanism of the drug is mostly unknown and not clearly identifiable. The most clearly identifiable mechanism of action is that Levetiracetam binds to a unique synaptic vesicle protein 2A (SV2A). The SV2A decreases the vesicle release, decreasing the amount of excitability and potential for abnormal electrical firing. Once the drug is in the system, it has a 96% bioavailability, ensuring that it is rapidly absorbed. The drug is less than 10% protein

bound, lessening the amount of drug to drug interaction. It is not extensively metabolized through the system. 66% of the drug is excreted unchanged by the kidneys and only 2.5% is excreted through the hepatic system. This means that the drug will cause very little damage to major organs such as the kidneys and liver. While these major organs are not damaged, there are side effects seen neurologically (Kumar et al., 2023).

Adverse Effects of Levetiracetam

While often known for decreased side effects compared to other antiepileptic drugs, Levatiractam can lead to a myriad of adverse neurological effects. While these can severely affect quality of life in patients they are often viewed as less concerning because they are not doing permanent damage to organs. A study reported that 38.3% of the patients on Levetiracetam in their research group had a negative psychiatric change (Von Wrede et al., 2021). These negative changes can occur three times more with Levetiracetam than any other antiepileptic drug (Ogunsakin et al., 2020). Aggression is the most common behavioral adverse reaction and is highest in Levetiracetam when compared to any other antiepileptic drug. It occurs in about 10-20% of patients. This aggression can include both verbal and physical types of aggression and severe hostility. The aggression can lead to other mental health issues such as depression, distress, anger, and polypharmacy as providers try to treat the aggression with more medications (Mula et al., 2015).

Irritability, similar to aggression, is very common, up to 9.9% and can have damaging effects on the life of the patient (Steinhoff et al., 2021; Tekin et al., 2022). It can lead to increased suicidality, lower education level, impaired functionality, decreased income and more social problems (Tekin et al., 2022). These adverse effects can severely affect the life of the patient across many domains such as social, mental, and physical. It also affects family members and

caregivers as side effects may be directed towards them. It is important to address the aggression quickly and with serious consideration as it can progress into more serious side effects (Mula et al., 2015).

Severe Effects of Levetiracetam

While aggression is a common and detrimental side effect, there are other neurological effects with increased morbidity and mortality rates. Depression and anxiety rates are significantly increased (Kawai et al., 2021). Both of these occur at about 3% rate of patients on this drug (Kawai et al., 2021), with depression being slightly more common than anxiety (Mula et al., 2025). One study showed a significant increase in depression symptoms in women three months after starting Levetiracetam treatment (Mehvari-Habibabadi, 2023). About 1% of Keppra patients experience psychosis (Kawai et al., 2021). In another study, researchers found that 7.6% of patients had experienced adverse reactions of Levetiracetam and hallucinations were a common reaction reported as one of the top adverse reactions (Tao, 2024). Some estimate that 3.7% of patients experience hallucinations. There have also been reports of Levetiracetam inducing obsessive-compulsive disorder (Yumnam, et al., 2021).

Suicidality and homicidality are the side effects with the biggest risk of mortality. According to Mula et al., 2015 about 0.7% of patients experience suicidal ideations. Levetaracatm has the highest incidence of completed suicide of any AEDs. 6.8% of Levtiracetam patients die by suicide, however, this does not account for other factors at play (Esang et al., 2020). Levetiracetam has also had reports of homicidality. Published case reports included a 16 year old female and an 80 year old woman both needing treatment for severe homicidal ideations (Anonymous, 2020; Esang et al., 2020).

Despite the drastic side effects, there are no warnings for Levetiracetam. For example, Propranolol, a Beta-Blocker used for hypertension has a similar rate of increased aggression and received a black box warning for an increase of aggression. Additionally, many antidepressants have similar rates of suicidality and have black box warnings. Yet, no such warning exists for Levatarcatam despite it having many adverse effects (Esang et al., 2020).

Risk Factors for Adverse Reactions of Levetiracetam

There are many uncontrollable risk factors that may predispose a patient to experiencing adverse effects of Levetiracetam. These are important to know and recognize as they can guide monitoring and intervention. History plays a major role in the amount of risk. Disease, dysregulation, or injuries in the brain, such as psychiatric comorbidities, traumatic brain injuries (TBI), and substance use can all predispose a person to potential side effects. Depression increases the risk for aggression by seven fold (Mula et al., 2015). Because Levetiracetam is used for epilepsy, a brain disease, these risk factors have a higher prevalence in the surveyed population. The rate of epilepsy in those with intellectual disability is 22.2%, contrasting with the general population rate of 0.8% (Allard, 2024). Additionally, the severity of epilepsy also plays a role, with the more severe or treatment resistant epilepsy increasing the risk for adverse effects.

The intended use of the drug can also increase adverse reactions. While Levetiracetam can be used for other things, when used for its main purpose of epilepsy, there is an increased risk of adverse reactions. While literature is mixed it appears that the side effects are not dose dependent (Ogunsakin et al., 2020). However, there is increased risk for adverse reactions during the start of the treatment and during any dosage increase.

Other risk factors include inherited traits such as gender, genetics, and age. Females have increased behavioral side effects from Levetiracetam (Dhungel et al., 2023). Additionally, there is a strong genetic component to Levetiracetam reactions (Hansen et al., 2018). Age has a significant effect. Older adults are more prone to adverse effects, most likely due to slowed metabolization of the drug (Pisan et al., 2018). Children are also more affected by Leveataracatm and may present in different ways; this will be further discussed.

Pediatric Population Reaction to Levetiracetam

Levetiracetam is commonly used and well-tolerated in the pediatric population with good efficacy rates. However, these children may experience increased adverse reactions. Where adults' aggression and irritability is seen in about 13% of cases; children will experience adverse reactions at a 30.1-37% rate (Mula et al., 2015; Ekinci et al., 2019). These adverse reactions may present in different ways such as tantrums, attempts to run away, and violent behaviors. Additionally, these adverse reactions have an increased chance of going unnoticed due to the patient's inability to understand and verbalize their emotions.

Interventions for Levetiracetam Adverse Reactions

If adverse effects do occur, there are ways to correct them. Once Levetiracetam is stopped, the adverse effect will subside. The medication may need to be switched or stopped while still controlling epilepsy. Switching to Brivaracetam (BRV) decreases adverse events in 93.1% of patients leading to a 66.6% decrease of adverse events overall. 77% of patients with depression and/or aggressive behavior while on LEV did not experience these symptoms while on BRV. In other patients, 11.3% reduced the dose and 6.5% adjusted the dosage of the medication (Thelengana et al., 2019). It is important that patients are properly educated, as these side effects can be detrimental without intervention. Adverse reactions are the main reason that

patients stop medications against medical advice. Without proper support against adverse reactions, patients can stray from prescribed care and place their health at risk (Boyd, M. A., & Luebbert, R., 2023). Evidence shows that there are ways to decrease adverse side effects while working with providers. These side effects have a greater effect on quality of life than even seizure frequency (Kawai, 2022), so it is important that we treat them in a timely manner and advocate for our patients.

Methods

The aim of this study is to educate current and future health care providers about the adverse effects of Levetiracetam. It is imperative that patients receive proper education so that intervention can be swift. Education starts with our healthcare providers as they are who educate and advocate for patients.

Intervention Design

The design for this research was Quasi-Experimental, which is considered Level 3 of evidence two groups were compared, pre- and post-knowledge before education (Marquis & Huston, 2021). Before beginning education, a baseline knowledge was established using a quantitative questionnaire. This questionnaire (Appendix A) was developed by this author based on important knowledge and topics covered in the presentation. The questionnaire was then content validated by two experts in the field. The questionnaire employed a total of 10 questions. These questions had a variety of styles including true or false, multiple choice, and select all that apply to fully assess knowledge. The participants' questionnaires were scored on a scale of zero to ten. Zero meant no knowledge and ten reflected complete mastery of the material. After initial survey completion, education was given to participants using a ten-slide Google Slides presentation during a ten minute lecture. Topics covered in the presentation were: purpose and

significance of this research, background information of epilepsy and Levetiracetam, side effects of Levetiracetam, risk factors of adverse effects, and actions that healthcare workers can take to improve usage of this drug. The initial survey was then regiven to assess new knowledge gained. Overall, the presentation and surveys took 15 minutes to complete. These were given at the start of class or the start of morning meetings.

Sampling

The population educated was staff and students of a private liberal arts university in Southern California, who were actively working in or studying healthcare. Participants were recruited via convenience sampling at different classes and departments at the university. To educate future healthcare workers, surveys and presentations were given to nursing students of both the sophomore and junior levels. To inform current healthcare workers of information, nursing instructors as well as staff from the Wellness Center, an on-campus medical center which included nurses and nurse practitioners, were educated via presentation and survey.

Data Collection

Approval for this project was obtained by the university's Institutional Review Board (IRB) prior to surveys and education. Informed consent was listed at the top of the pre- and post-survey. Participants were told that participation in the survey was encouraged, but not mandatory. There was no incentive or repercussion for participation or lack of participation. The survey was completed through Google Forms, where email addresses were hidden to protect confidentiality. No names, emails or other identifying information was requested.

Data Analysis

Once all presentations were completed, data was collected and analyzed. A Descriptive Statistics test was run on the data. Additionally, the Mann Whitney Test, a nonparametric test that compares two data sets, was used to compare the pre- and post-education data.

Results

The number of participants in the survey were 103 (*n=103*) healthcare faculty and staff at a private liberal arts university. In the pre-test, there were 103 participants. For the questionnaire given before and after the education, there were a total of 10 questions, each question being worth one point. The lowest possible score was 0 (no questions answered correctly) and the max score was 10 (every question answered correctly). The average score was 5.29, the median score was 5, and the range of scores was 2-10. In the post-test, there were 93 participants (Appendix B). The average score was 7.73, the median score was 8, and the range of scores was 4-10 (Appendix C). When analyzed, the results between the pre- and post-test were significant at a p-value of <0.001. This reflects that there was significant knowledge gained in the participants after the educational intervention.

Strengths and Limitations

There are both strengths and limitations associated with this survey. First, the pre- and post- tests were a quality way of instantly assessing initial and gained knowledge. The pre-test gave a clear starting point. Additionally, these surveys had different question formats and levels of difficulty, which assessed knowledge in different ways. Another strength is that staff and students were both able to participate, providing a diverse level of knowledge and experience to the sample of subjects. Finally, participation for the survey was very high. Almost everyone that was educated participated in the survey, totalling over 100 responses.

Limitations also apply to this survey. First, there are a variety of factors that may have affected pre- and post-survey results. These factors include but are not limited to: previous knowledge of Levetiracetam, test-taking ability, and engagement in educational materials. Additionally, the presentation was given by the presenter multiple times over the course of three months. While the script was followed as closely as possible, variations may have happened and affected outcomes of participants' knowledge. Another limitation is the small convenience sample. Due to financial and time limitations, education was only given to a specific university demographic. These participants work or study more generalized healthcare, instead of neurology specifically. This means that education may not be as effective as they are not seeing patients on Levetiracetam. Additionally, because it was a convenience sample, original baseline knowledge cannot be applied to the population as a whole. Finally, numbers for pre- and post-education surveys varied slightly with pre-education surveys having 103 responses and post-education surveys totalling 93 responses. This may have affected the statistical analysis.

Discussion

Every year, thousands of patients with epilepsy struggle in silence with the adverse effects of Levetiracetam. While this drug has helped many, it has also caused psychological harm to patients. The adverse psychological reactions can range anywhere from aggression to suicidality and have severe effects on quality of life. These reactions affect not just the patient, but also the caregivers and family members. With early identification, these reactions can be reversed, by lowering the dosage or switching the medication (Kawai et al., 2022; Kawai et al., 2021; Ogunsakin, 2020; Patra, 2023). However, the effects are often unknown, because despite the high incidence of the reactions, there is no Black Box Warning or alert, even for high risk patients. Being unaware and unprepared for these side effects can lead to delayed identification

and intervention; leaving patients and caregivers feeling confused, upset, and alone. Patients have the right to full discretion when it comes to their treatment, something the treatment team cannot give if they are not informed themselves.

This project aimed at rectifying the knowledge gap of adverse reactions of Levetiracetam in current and future healthcare workers. With just ten minutes of education, participants had significant knowledge gained. This knowledge will better equip healthcare workers to know risk factors and signs and symptoms of adverse psychological reactions. By identifying adverse reactions, healthcare workers will be able to educate patients and caregivers so that they can identify these reactions themselves and seek prompt medical attention.

Conclusion

Levetiracetam is an excellent drug that has helped thousands of people. However, there is also a significant prevalence of adverse reactions. While psychiatric effects severely affecting quality of life are prevalent in patients, these effects are generally unknown by healthcare professionals and patients. This has the potential to lead to an under diagnosis of adverse events, feelings of helplessness in the patients and caregivers, and delay in intervention.This evidence based practice project sought to rectify the knowledge gap in healthcare workers by educating over 100 current and future healthcare workers. With proper education, significant knowledge was gained in only ten minutes. To protect and advocate for the vulnerable it is important to educate about risk, signs, and interventions for adverse reactions. Interventions such as continuous research, healthcare worker education, and Black Box Warnings can significantly increase patient outcomes. As this project demonstrated, carving out ten minutes of time can lead to significantly increased quality of life and outcomes for our patients.

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Appendix A

Pre and Post Exam Questions

1. Keppra is used primarily to treat:
    - ☑ ~~Epilepsy~~
    - ☐ Schizoaffective disorder
    - ☐ Cerebral Palsy
    - ☐ Autism
2. Select all that apply: Which of the following risk factors can increase risk for adverse neurologic reaction when taking Keppra:
    - ☐ Liver damage
    - ☐ Polypharmacy
    - ☑ ~~Under 18~~
    - ☑ ~~Women~~
3. Which of the following is the most common adverse neurological reaction for Keppra:
    - ☐ Blurred vision
    - ☐ Headache
    - ☐ Nausea
    - ☑ ~~Aggression~~
4. True or False: Once pt. exhibits adverse psychiatric effects, they are permanent:
    - ☐ True
    - ☑ ~~False~~
5. Select all that apply: Keppra can cause:
    - ☑ ~~Irritability or aggression~~
    - ☑ ~~Homicidality or suicidality~~
    - ☑ ~~Psychosis or hallucinations~~
    - ☑ ~~Depression and anxiety~~
6. Select all that apply: When is pt. most at risk for adverse reaction to Keppra?
    - ☐ In times of stress
    - ☑ ~~At start of treatment~~
    - ☑ ~~When dose is increased~~
    - ☐ Once drug resistance has begun to build
7. If pt. experiences adverse effect:
    - ☐ Discontinue drug immediately, tell provider at next appointment
    - ☐ Allow side effects to minimize over time
    - ☐ Mention side effects at next appointment
    - ☑ ~~Contact provider as soon as possible to discuss side effects/options~~
8. True or False: Only patients with history of behavioral or psychiatric disturbances are prone to Keppra's adverse effects:
    - ☐ True

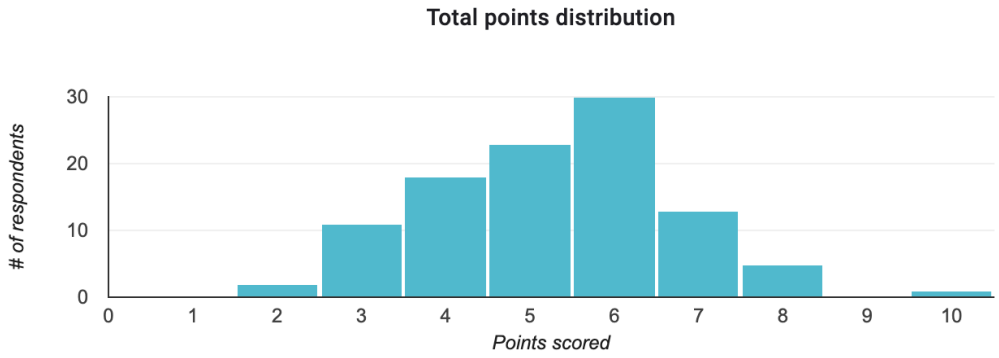
- ☑ ~~False~~

9. Select all that apply: Signs of adverse Keppra reaction may include:
   - ☑ ~~Withdrawal from social activities~~
   - ☐ Euphoric mood
   - ☑ ~~Hallucinations and delusions~~
   - ☑ ~~Tantrums or lashing out~~
10. What is Keppra's efficacy rate?
    - ☐ 25-30%
    - ☐ 90-100%
    - ☐ 5-10%
    - ☑ ~~40-60%~~

Appendix B

Pre-Education Test Results

Average	Median	Range
5.29 / 10 points	5 / 10 points	2 - 10 points



Appendix C

Post-Education Test Results

Average	Median	Range
7.73 / 10 points	8 / 10 points	4 - 10 points