NR546 – Advanced Pharmacology: Psychopharmacology for Psychiatric-Mental Health Nurse Practitioner

Exam Study Guide – **Midterm Exam**

Exam Format: Non-Cumulative exam
Question Type: Multiple Choice
Number of Questions: 75
Number of Points: 150 points
Time Allotted: 90 Minutes
Testing Timeframe: The final exam will be available starting on **Wednesday of Week 4 at 12:01 am MT until Saturday of Week 4 at 11:59 pm MT.**

Exam Coverage

Week 1:

Content Areas:

1. Introduction to Psychopharmacology
2. Unique Prescribing Considerations
3. Symptom-Based Selection of Medications
4. Medication Adherence
5. Ethical/Legal Considerations
6. Neuroscientific Basis for Behavior
    - Informed consent
    - Compliance
    - Off-label prescribing
7. Genetics and Epigenetics

Key Concepts to Study:

- **Functional Neuroanatomy**: covered in both the course Explore section and readings
    - Brain anatomy and physiology.
    - Link symptoms to affected brain areas (e.g., inability to copy a word or drawing → what part of the brain is affected).

Gray matter:

- Consists of the cerebellum, cerebrum, brain stem, and the butterfly-shaped portion of the central spinal cord
- Contains **neural cell bodies, axon terminals, dendrites**, and all nerve synapses
- Working area of the brain, linked to learning
- Changes are linked to psychiatric diagnoses (alzheimers, schizophrenia, MDD)

White matter:

- **Contains nerve fibers that connect neurons from different regions into functional circuits**
- "Transit system"
- Breaks in these circuits within the brain affect behavior
- Damage to myelin (coating on neuronal axons) impact sensory and motor function and cognition
- Abnormalities associated with autism and vascular dementia

Frontal lobes *(action); Very tips of frontal lobe involved in planning a motor movement*
The frontal lobes are associated with **movement (motor control), intelligence, abstract thinking, the ability to organize, personality, behavior, and emotional control.** Traumatic brain injuries can result in personality changes, difficulty controlling emotions, and other cognitive functions.

Parietal lobe *(concerned w/ the 'where'; right parietal - keeps us alert to what is going on around us)*
The middle part of the brain, responsible for proprioception, is the home of the **somatic senses**. This part of the brain helps a person to identify **spatial awareness/relationships, interpret pain and touch in the body, and identify and give meaning to objects.** Damage to the anterior portion of the parietal lobe may cause **astereognosis** (the loss of the ability to recognize objects via the sense of touch). This may be experienced by patients with post-cerebral vascular accidents.

Temporal lobe *(concerned w/ the 'what'; object identification)*
The temporal lobe is located on the side of the brain and is involved in **short-term memory, speech, processing auditory signals** *(superior temporal gyrus)***, and recognizing smells**. It identifies "what" things are – **object identification**. It contains the limbic system, amygdala, and hippocampus. There are multiple pathways within the temporal lobe that affect object identification and **language comprehension**, including the ability to understand semantics. A dominant temporal lobe lesion can present as Wernicke's aphasia. Temporal lobe disorders include dementia, affective disorders, and attention-deficit hyperactivity disorders (ADHD).

Occipital lobe *(Primary visual area)*
This is the back part of the brain and controls **visual processing.** Damage to this lobe results in the inability to form **visual memories**. Bilateral lobe damage results in the inability to recognize items by sight, even though vision is normal. Occipital lobe seizures can cause hallucinations, such as lines of color.

Central sulcus
This separates the frontal lobe from the parietal lobe.

Lateral sulcus
This separates the parietal lobe from the temporal cortex.

Precentral gyrus *(Human Primary Motor Cortex)*
Contains neurons that send axons to the spinal cord. Dexterity and speech; hands, fingers, lips, tongue.

Postcentral gyrus
Receives information from the skin; primary somatosensory cortex (*touch*)

Corpus callosum
This controls the communication between the two brain hemispheres. The corpus callosum is involved in attention, impulse control, and emotion regulation. It integrates impulses from both sides of the brain. It is said that Albert Einstein had a very large corpus callosum. Persons with an underdeveloped or missing corpus callosum may have intellectual impairment.

Hippocampus
This is located deep in the temporal lobes and is involved in **anxiety and memory**, and shifting short-term to **long-term memory**. Hippocampal function is impaired in schizophrenia and dementia.
There is ongoing research into the role the hippocampus plays in anxiety and decision-making. May play a role in PTSD. Early physical/emotional abuse may cause changes in this area.

- In a position to compare information about current state of world w/ information from past and to determine whether we are currently experiencing is familiar or not
- Dysfunction can lead to inappropriate levels of anxiety when there is no danger around (panic disorder/PTSD)

Amygdala *(key in the formation of fear)*
This is located deep in the temporal lobes and is involved in **emotional regulation and perception of odors**. All smells travel directly to the amygdala. Cooking smells can elicit memories of childhood events and holidays. A traumatic event can result in the formation of the fear response, causing the **fight-or-flight** reflex within the autonomic nervous system and affecting the hypothalamic-pituitary-adrenal (HPA) axis, which leads to the release of stress hormones (e.g., cortisol). The amygdala is also involved in the interpretation of facial expressions and sexual stimuli.

Thalamus
This is an egg-shaped structure involved in **sensory organ and motor command processing** *(from the frontal cortex & basal ganglia)*. All sensory systems except for the olfaction process through the thalamus, which is responsible for processing all external information. The thalamus has been associated with symptoms related to schizophrenia and post-traumatic stress disorder (PTSD).

- **Hypothalamus** (*head ganglion of sympathetic nervous system*): influences 'fight or flight' reaction

Basal ganglia
A group of structures involved in **voluntary motor movements, cognition, and emotion**. Basal ganglia movement disorders include Parkinson's disease, obsessive-compulsive disorder (OCD), and Tourette syndrome. The striatum is a group of structures that includes the caudate, putamen, and nucleus accumbens. The dorsal striatum contains the caudate nucleus and the putamen. The ventral striatum contains the nucleus accumbens. Both are involved in facilitating voluntary movement.

Dorsal striatum *(complex motor acts; converses w/ frontal lobes)*
This is involved in **complex motor actions and the linkage of cognition to motor actions**. It is the main input area for the basal ganglia and is activated when anticipating or engaging in pleasure.

Ventral striatum *(converses w/ limbic part of cortex [related to emotion])*

Concerned w/ behaviors related to survival, particularly aggression, sexuality, and eating. Circuitry critical to experience of reward.

Nucleus accumbens *(involved in reward process)*
This is involved in the **reward circuit and reinforces addictive behaviors.** Located in the ventral striatum.

Limbic system *(Includes circuits that are associated w/ pleasure & reward)*
This is associated with **pleasure, reward, and reinforcing behavior**. Drug abuse affects the limbic system, disrupting emotions and feelings associated with normal behavior. **Emotions** & learning.

Broca's Area (Remember: ***B**oys don't **Talk***) - Speech

Wernicke's area (Remember: ***W**omen don't **Understand**)* - **Speech comprehension**

Cerebellum: Coordination

Motor Cortex: Movement

Sensory Cortex: Makes sense of the 5 senses. Contains nerve cells and dendrites

Prefrontal cortex: Encompasses the largest part of the frontal lobe.

- **Two major subdivisions of the prefrontal cortex region:**
  - **Dorsolateral prefrontal cortex (DLPFC): Higher cognitive functioning**
  - **Ventrolateral prefrontal cortex (VLPFC): Involved in motor inhibition**

Unique Prescribing Considerations

- Pediatrics
  - These clients have heightened drug sensitivity
  - Show greater individual drug variation
  - At increased risk for adverse drug reactions
  - Dosage selection can be challenging because their brains and bodies are still developing
- Pregnancy/breastfeeding
  - The use of certain drugs during pregnancy can result in birth defects
  - Use of certain drugs can result in the presence of the drug in breastmilk, affect the breastfed child, or affect milk production
  - Potential risks to the fetus or breastfed child and benefits to the mother must be considered when prescribing psychotropic therapy
- Older adults

- There are physiologic changes associated with aging that impact drug processes, so lower than normal dosages may be needed
- Most recent BEERS criteria should be reviewed to avoid prescribing potentially inappropriate medications for older adults
- Older adults may also have multiple illnesses or chronic diseases for which they have medications prescribed; they have an increased risk of drug interactions

Ethical Issues:

- Understand principles like autonomy and **informed consent.**
- **Informed consent**: Clients have the right to receive sufficient information to make informed decisions about their treatment, including potential risks associated with medications. They have the right to refuse treatment and cannot be forcibly medicated in non-emergencies. However, clients can be forcibly medicated if they are violent toward themselves or others and when less restrictive methods have failed.
- Compliance: A court order may be issued for a client to receive treatment against their wishes if they are a danger to themselves or others. For example, clients with schizophrenia or sex offenders. Guardians (POA) can also provide consent for clients who have limited cognitive capabilities or are incompetent to make decisions.
- The **client's cognitive status can result in an ethical concern** if the client is unable to self-determine care or is a danger to self or others.

- **Epigenetics**:
  - Gene modifications that can be passed down
  - Turns genes on and off
    - Your DNA (genetic code) is like the **hardware** of a computer.
    - Epigenetics is like the **software**: it tells the hardware what to do, when, and how much.
  - External and internal factors activate portions of the genome, resulting in the manifestation of mental health symptoms. Activation is often a result of a stressful event, which, when combined with genetic risk, results in disease.

- **Genetics and CYP450**:
  - Learn the effects of inducers and inhibitors on pharmacodynamics and pharmacokinetics. Also, Review Stahl Ch. 2.
  - Drugs that increase the rate of drug metabolism are ***inducers***. Drugs that decrease the rate of drug metabolism are called ***inhibitors.***
  - **Pharmacokinetics** is the study of what happens to the drug **from the time of administration until the parent drug and all metabolites leave the body.** This process includes absorption, distribution, metabolism, and excretion.
  - **Pharmacodynamics** involves 3 MOA: receptor, enzyme, and nonselective interactions.
    - **Receptor interactions:** Drugs bind to specific receptor sites, usually proteins in the cell membrane. For example, calcium channel blockers prevent calcium from entering cells, which lowers muscle contraction and

blood pressure. The drug with the strongest receptor affinity will have the greatest effect, leaving weaker drugs in circulation.

- **Enzyme interactions**: Drugs can either enhance or block enzyme activity. Since enzymes control many chemical reactions, this affects both drug action and elimination. For instance, grapefruit juice inhibits liver enzymes that break down statins, raising drug levels and potentially leading to dangerous muscle breakdown (rhabdomyolysis).
- **Nonselective interactions:** Some drugs act by altering cell processes or structures directly. Chemotherapy is a key example; it targets rapidly dividing cells. While this helps destroy cancer cells, it also harms healthy fast-growing cells, causing side effects.

- **Inhibitors** (what do they do?)
  - Slows down the metabolism of medications.
  - Inhibitors are medications that inhibit the activity of one or more of the CYP450 enzymes. Medicines that inhibit an enzyme can slow that enzyme's activity required for the metabolism of other medications, thereby increasing the levels of medications dependent on that particular enzyme for biotransformation.
  - Inhibitors act on the liver through a process known as inhibition. By slowing the rate of metabolism, inhibition can cause an increase in active