Week 2 – The Nervous System and Mental Health

Spring 2022

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Outline for Today's Homeroom

- Structure and function of the nervous system

- Presentation and diagnosis of mental disorders

- Healthcare careers involved in neurological and mental disorders

- Medical ethics case study and discussion

- Tips on promoting mental health

- Don't forget that the anatomy elective is tomorrow at 5:00; sign up by midnight tonight if you haven't already!
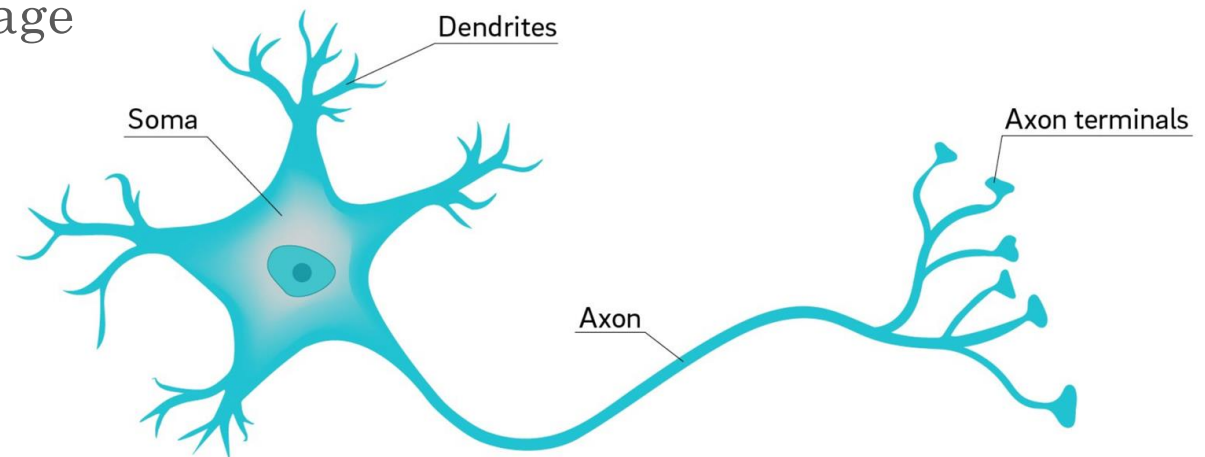
Function of the Nervous System

- The nervous system is a collection of cells that transmit messages throughout the body via electrical signals

- These electrical signals control things like
  - Muscle movement
  - Sensation (sight, smell, touch, taste, hearing)
  - Thinking, memory, and emotion

# Neurons are the Functional Cells in the Nervous System

- **Neurons** are specialized cells that transmit electric signals throughout the nervous system

- The electric signals are called **action potentials**

- Action potentials travel down the **axon** to the axon terminals

- At the axon terminals, the neuron connects and transmits the message to other cells

- Cell to cell communication in the nervous system is through the release of molecules called **neurotransmitters** from axon terminals
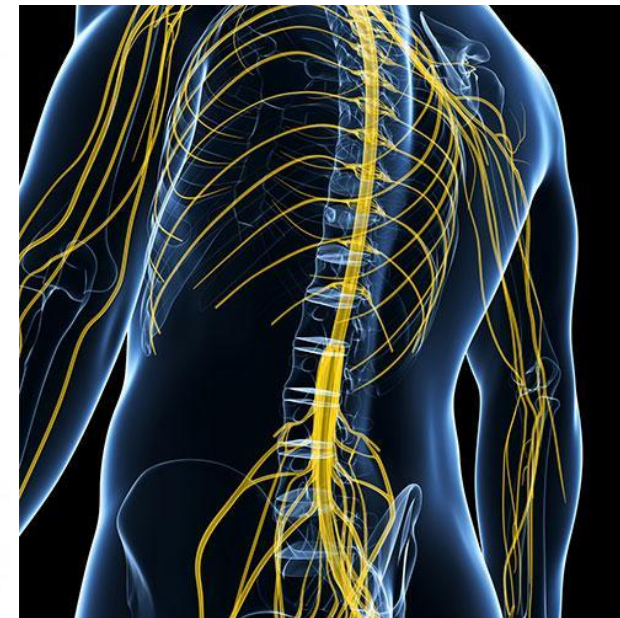

Dendrites

Soma

Axon terminals

Axon

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# Parts of the Nervous System
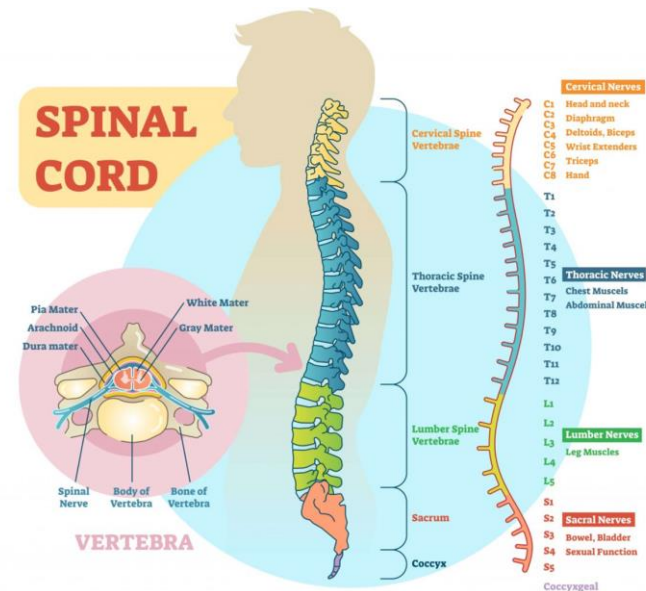
Brain

Spinal Cord

Nerves

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Parts of the Nervous System

- The **brain** is the center of the nervous system.
  - Processes signals coming into it
  - Controls the rest of the body by sending signals out of it (down the spinal cord)

- The **spinal cord** allows electrical signals to be transmitted up and down the body (to and from the brain)

- **Spinal nerves** (bundles of axons) jut out from the spinal cord to the periphery of the body and transmit signals to and from the spinal cord

Brain

Spinal cord

Peripheral nerves

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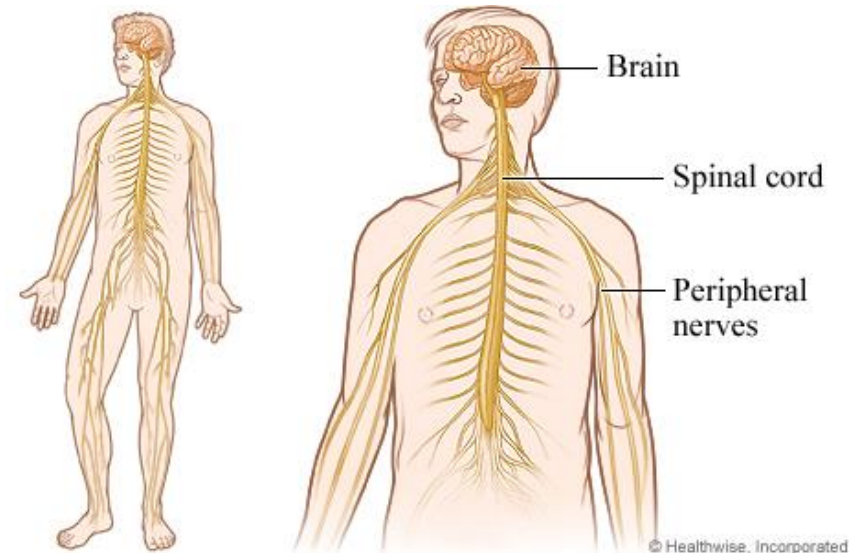
Mental Disorders

- *Can you name any mental disorders?*

Mental Disorders

- An official definition, from the Mayo Clinic:
  "Mental illness, also called mental health disorders, refers to a wide range of mental health conditions — disorders that affect your mood, thinking and behavior. Many people have mental health concerns from time to time. But a mental health concern becomes a mental illness when ongoing signs and symptoms cause frequent stress and affect your ability to function."

- Some common examples include:
  - Depression
  - Anxiety disorders
  - Schizophrenia
  - Eating disorders
  - Addictive behaviors

Major Depressive Disorder (Depression)

- A common and serious medical illness that negatively affects how you feel, the way you think, and how you act

- Causes feelings of sadness and/or a loss of interest in activities you once enjoyed

- Can lead to a variety of emotional and physical problems and can decrease your ability to function at work and at home

Clinical Presentation and Diagnosis of Depression

- Depressed mood and the "**SIG-E-CAPS**" symptoms
    - **S**leep disturbance
    - **I**nterest (reduced interest in activities you once enjoyed)
    - **G**uilt (feelings of worthlessness and regret)
    - **E**nergy loss and fatigue
    - **C**oncentration problems
    - **A**ppetite changes
    - **P**sychomotor agitation or retardation (too much or too little movement)
    - **S**uicidality

- To be diagnosed with depression, the criteria are 5 or more of the "depressed mood + SIG-E-CAPS" symptoms over a 2 week period
    - The 5 symptoms must include EITHER depressed mood OR loss of interest

Anxiety Disorders

Characterized by **excessive fear and/or anxiety** on most days lasting for **at least 6 months** and adversely affecting the patient's life

These include generalized anxiety disorder (GAD), agoraphobia, social anxiety disorder, post-traumatic stress disorder (PTSD), and obsessive compulsive disorder (OCD)

Affects 18.1% (42 million) of Americans

An estimated 31.9% of adolescents had an anxiety disorder *(NIH)*

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GAD – Myths and Misconceptions

- Myth #1: Generalized Anxiety Disorder is not a "real" illness.
  - Almost everyone experiences anxiety at some point
  - But generalized anxiety disorder causes **excessive** or **unrealistic** anxiety and worry — well beyond what's appropriate for a situation

- Myth #2: Someone with an anxiety disorder should avoid situations that cause stress
  - Avoidance of the situations that cause anxiety just reinforces the anxiety disorder
  - Effective anxiety treatment involves **gradually** and **safely** exposing you to the source of your anxiety so that you can learn to cope with it, not avoid it

Bipolar Disorder

- Condition that causes extreme mood swings that alternate between emotional highs (manic episodes) and lows (depressive episodes)

- Moods can shift from hopelessness and no interest to extreme joy and full of energy

- Can affect person's judgement and sleep

- Amount of bipolar episodes a person has depends on the individual (can happen multiple times in a year or barely at all)

Bipolar Disorder - Diagnosis

- A diagnosis of bipolar disorder is generally made by a psychiatrist, though this may be after another physician has performed tests to rule out other conditions

- There are different types of bipolar disorder, but they usually involve at least one period of mania, i.e. an elevated, expansive, or irritable mood that lasts at least a week

- During this period, three or more of the following symptoms must be present and represent a significant change from usual behavior:

  - Inflated self-esteem or grandiosity
  - Decreased need for sleep
  - Increased talkativeness
  - Racing thoughts
  - Distracted easily
  - Increase in goal-directed activity or psychomotor agitation
  - Engaging in activities that hold the potential for painful consequences, e.g., unrestrained buying sprees

Physiological Basis for Mental Illness

- "Researchers studying mental illness believe that **abnormalities in how particular brain circuits function contribute to the development of many mental illnesses**. Connections between nerve cells along certain pathways or circuits in the brain can lead to problems with how the brain processes information and may result in abnormal mood, thinking, perception, or behavior."

- Mental illnesses, just like other illnesses, have a physiological cause

- Because mental illnesses have physiological causes, you cannot just "snap out of" a mental illness

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Mental Illness in America

- **1 in 5 Adults in the U.S. experience mental illness each year**

- Mental illness affects everyone regardless of race, ethnicity, gender, or sexual orientation

- **1 in every 5 children ages 13-18 in America experiences or will experience mental illness**

- **Depression** is the **leading cause of disability worldwide** and a major contributor to the global burden of disease
  - There are often long delays between appearance of first symptoms and when people get help (sometimes decades)
  - This is partly due to the stigma associated with mental illness

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Treatment of Mental Illness in America

Treatment in America

60%
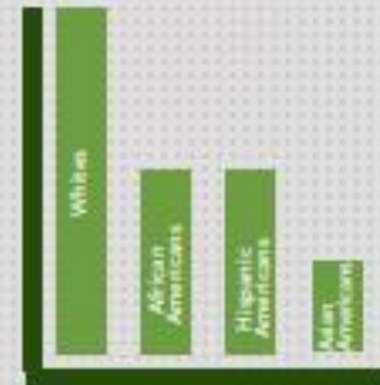Nearly 60% of adults with a mental illness didn't receive mental health services in the previous year.[4]

50%
Nearly 50% of youth aged 8-15 didn't receive mental health services in the previous year.[1]

African American & Hispanic Americans used mental health services at about 1/2 the rate of whites in the past year and Asian Americans at about 1/3 the rate.[2]

Consequences of Lack of Treatment

Difficulty adjusting to society:

26% of homeless adults live with serious mental illness

20% of state prisoners have a recent mental health condition

70% of youth in juvenile justice systems affected

Individuals living with serious mental illness face **increased risk of chronic medical conditions**

Higher drop out rates for affected students, with the highest dropout rate of *any* disability group

Suicide = 10th leading cause of death in US, **2nd leading cause of death for people aged 10-34**

90% of those who die by suicide have underlying mental illness

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Supporting Friends with Mental Illness

- Learn about their condition

- Listen with an open mind

- Help them get help

- Stay connected

- Reach out to a trusted adult/professional
  - A trusted adult may be more capable of connecting your friend with services they may need
  - **Always reach out to an adult or call 9-1-1 if someone is talking about suicide as this is an emergency and requires immediate help**

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Healthcare Professions Involved in Neurological and Mental Disorders

- **Neurosurgeons** perform surgeries to correct disorders of the nervous system; this can include removing tumors, fixing bleeding in the brain, and installing surgical hardware (e.g. inserting screws to stabilize the spine)

- **Neurologists** diagnose and treat disorders of the nervous system without performing surgery; they might prescribe medications for chronic migraines, determine whether a patient's muscle weakness is due to nerve damage or an autoimmune condition, and counsel patients with degenerative conditions like dementia
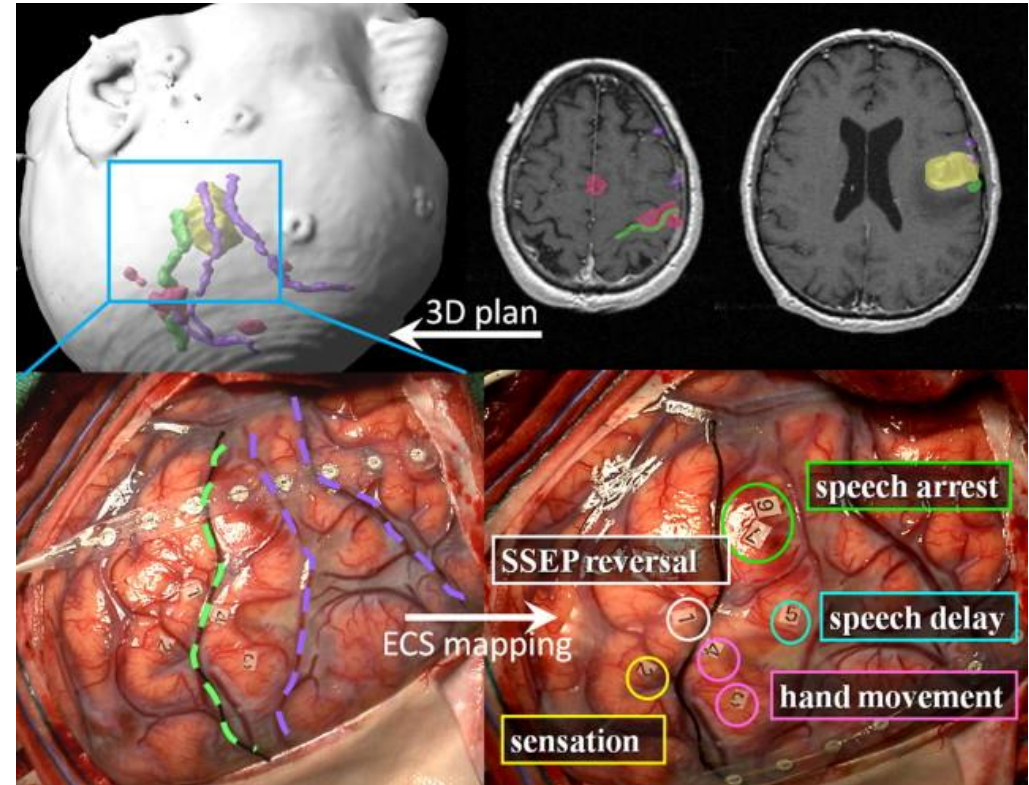
Mapping important areas of the brain with MRI and electrodes before tumor removal

Healthcare Professions Involved in Neurological and Mental Disorders

- **Psychiatrists** specialize in the prevention, diagnosis, and treatment of mental, behavioral, and emotional disorders; they often use some form of discussion (e.g. individual therapy or psychoanalysis) to evaluate and treat problems, in addition to using pharmacological treatments

- Neurosurgery, neurology, and psychiatry all require a medical degree (i.e. four years of medical school) and 4+ years of residency

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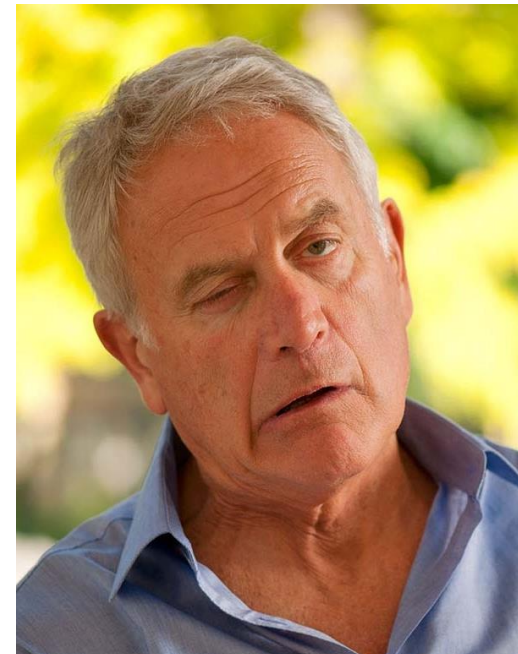# Healthcare Professions Involved in Neurological and Mental Disorders

- There are also a number of professions involved in treating mental health issues aside from medical doctors:
  - **Psychologists** can diagnose and treat emotional and behavioral disorders, though they usually can't prescribe medication; this usually requires a master's or doctoral degree in psychology
  - **Therapists** provide mental health therapy to clients, often for conditions like depression (though many therapists focus on general mental health rather than specific disorders), but they generally can't make diagnoses or prescribe medications; this usually requires at least a master's degree in psychology
  - **Psychiatric nurse practitioners and registered nurses** are nurses that have undergone additional training to specialize in caring for patients with psychiatric and mental disorders

Medical Ethics Case Study – Sudden-Onset Hemiparesis

- A 51-year-old male, Mr. K, presented to the Jan Swasthya Sahyog hospital, a small hospital in a rural region of India, with a sudden onset of dense right hemiparesis (paralysis on one side of the body), facial droop, and inability to speak. He remained interactive, motioning with his left arm to his nonfunctioning right arm. His vital signs were normal.

- *What do you think might be different about practicing medicine in a rural area vs a densely-populated urban area?*

- *What are some challenges a physician in a rural area might face?*

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Chowdhury, S. et al. Democratizing Evidence Production — A 51-Year-Old Man with Sudden Onset of Dense Hemiparesis. N Engl J Med 381, 1501–1505 (2019).

Medical Ethics Case Study – Sudden-Onset Hemiparesis

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- *Any guesses as to what might wrong with Mr. K given these symptoms?*

Right facial droop

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Chowdhury, S. et al. Democratizing Evidence Production — A 51-Year-Old Man with Sudden Onset of Dense Hemiparesis. N Engl J Med 381, 1501–1505 (2019).

Medical Ethics Case Study – Sudden-Onset Hemiparesis

- The doctors determined that Mr. K had likely had an **ischemic stroke**, in which a blood clot blocks blood flow to part of the brain

- The standard of care for ischemic strokes required a CT scan to rule out other causes; a type of drug called a thrombolytic could then be given to break up the clot, but **only if it were administered within a few hours** of the stroke

- However, the hospital Mr. K was at **did not have a CT scanner**; the nearest one was in a city that was an hour away

- Therefore, if the standard of care was followed, by the time Mr. K travelled to the imaging center, received a CT scan, and traveled back to the hospital, **it would be too late for the thrombolytic drug to be useful**

- *If you were Mr. K's doctor, what things would you take into consideration when trying to decide how to treat him?*

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Medical Ethics Case Study – Sudden-Onset Hemiparesis

- The senior doctor sought more information in the medical literature, but the evidence regarding stroke management presumed ready access to a CT scanner

- In addition, the hospital only had access to an older thrombolytic drug, streptokinase, that had mostly been replaced by a newer drug, t-PA

- The evidence base for using streptokinase was patchy: three large studies had been ended prematurely because of safety concerns, but research on streptokinase was stopped when t-PA became available

- The doctors realized that there was **no pragmatic standard of care for acute ischemic strokes** in their setting

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Chowdhury, S. et al. Democratizing Evidence Production — A 51-Year-Old Man with Sudden Onset of Dense Hemiparesis. N Engl J Med 381, 1501–1505 (2019).

Medical Ethics Case Study – Sudden-Onset Hemiparesis

- *Thinking of the four pillars of medical ethics (beneficence, non-maleficence, autonomy, and justice), which do you think were **not** upheld by the medical research that went into creating the standard of care for acute ischemic strokes in this case?*

- *What **changes** or **improvements** do you think could be made to the process of medical research to make sure that situations like this are avoided?*

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Medical Ethics Case Study – Sudden-Onset Hemiparesis

- Case follow-up:
  - As the doctors explained the complexity of the care involved, Mr. K.'s son asked how his father would be treated in a city hospital. Informed that the next step would be a CT scan, the family decided to transport Mr. K. to the nearby city and Mr. K. was subsequently lost to follow-up

- Recommendations from the authors of this case study:
  - Expert committees can **expand diagnostic and therapeutic algorithms** to include situations for which the standard procedure isn't viable
  - Research sponsors can **prioritize global impacts** in research spending, as research into high-cost and resource-intensive treatments are not likely to be useful to large numbers of people around the world
  - The global health community can **support researchers in lower-resource settings**, as these individuals are generally in the best position to conduct research that is beneficial to the communities they serve

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Chowdhury, S. et al. Democratizing Evidence Production — A 51-Year-Old Man with Sudden Onset of Dense Hemiparesis. N Engl J Med 381, 1501–1505 (2019).

Promoting Good Mental Health

- We'll wrap up today's session with some information about mental health

- According to the WHO, "Mental health is defined as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community."

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Promoting Good Mental Health

1. Value yourself

2. Take care of your body (eat nutritious meals, drink water, exercise, and get enough sleep)

3. Surround yourself with good people

4. Give yourself in service of others (e.g. volunteer, help someone in need)

5. Learn how to deal with stress (e.g. Tai chi, yoga, writing, playing with a pet)

6. Quiet your mind (e.g. meditation, mindfulness)

7. Set realistic goals

8. Avoid abusing alcohol and other drugs (avoid self medicating)

9. Get help when you need it

Important Phone Numbers to Write Down

- National Suicide Prevention Lifeline: 1-800-273-TALK (8255)

- Crisis Text Line: Text "home" to 741741

- Substance Abuse and Mental Health Services Administration (SAMHSA) National Helpline: 1-800-662-HELP (4357)

- National Alliance on Mental Illness (NAMI) Helpline: 1-800-950-NAMI (6264)

- If you feel that you may be dealing with a mental illness, please reach out to a trusted adult or a doctor

That's all for today!

- Enjoy your faculty lecture with Dr. Pletcher and we'll see you next week!

References

- https://www.apa.org/depression-guideline/case-examples

- https://www.psychiatry.org/patients-families/depression/what-is-depression

- https://www.mayoclinic.org/diseases-conditions/depression/in-depth/depression/art-20045943

- https://www.sapnamed.com/blog/10-surprising-facts-about-the-spinal-cord/

- https://www.mayoclinic.org/diseases-conditions/mental-illness/symptoms-causes/syc-20374968

- https://www.mayoclinic.org/diseases-conditions/bipolar-disorder/symptoms-causes/syc-20355955

- Chowdhury, S. et al. Democratizing Evidence Production — A 51-Year-Old Man with Sudden Onset of Dense Hemiparesis. N Engl J Med 381, 1501–1505 (2019).