

Rewiring the brain:

The Power of Neuroplasticity in Aging

Aging@DU

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Overview



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1. Introduction to neuroplasticity.
2. How neuroplasticity changes with age.
3. Ways to stimulate and maintain plasticity as we age.

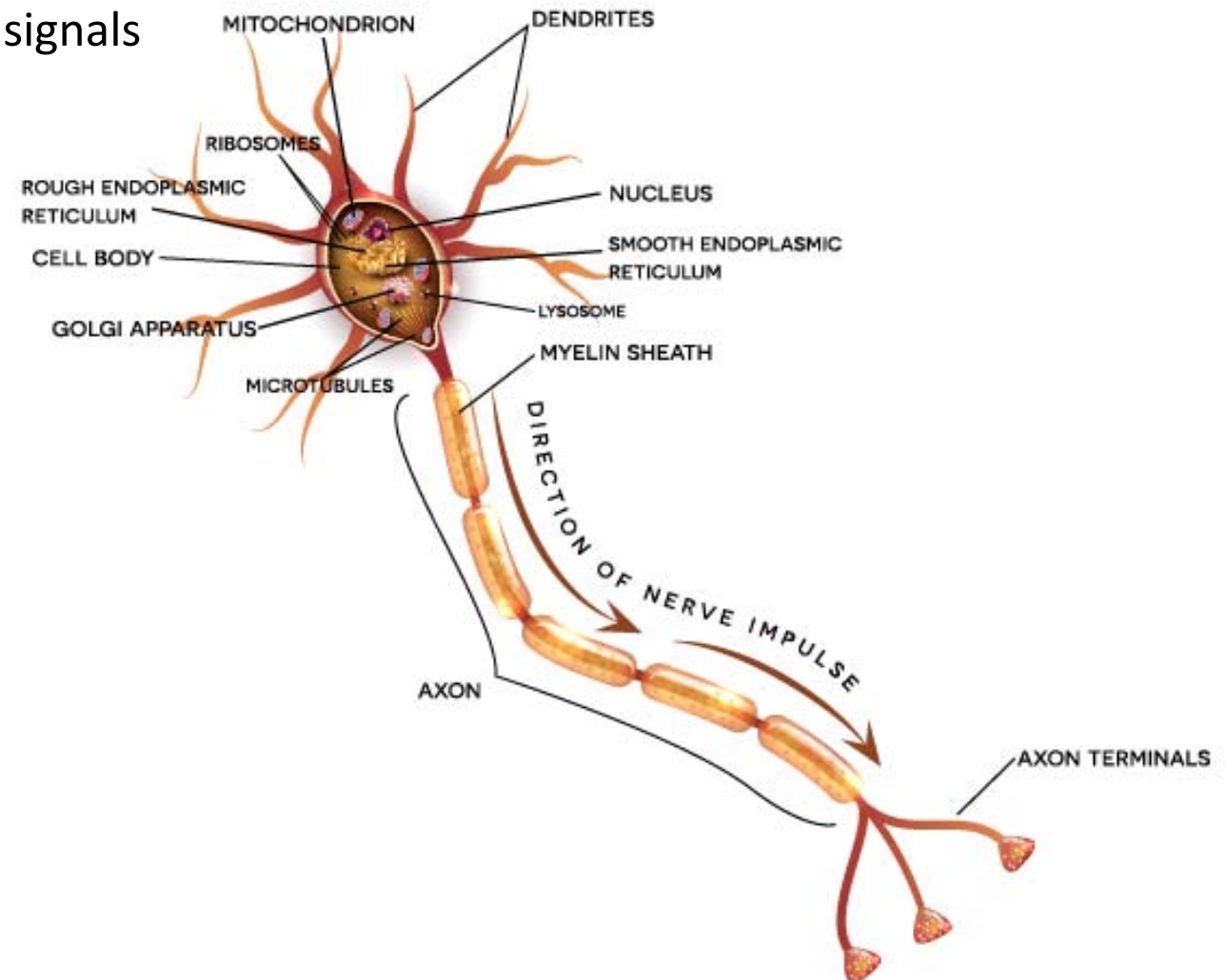


How do brain cells (neurons) work?



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- Neurons communicate through electrochemical signals
- Neuron structure
 - Dendrites
 - Soma
 - Nucleus
 - Axon
 - Axon terminal
 - Synapse
- Transmission
 - Action potential
 - Neurotransmitter release



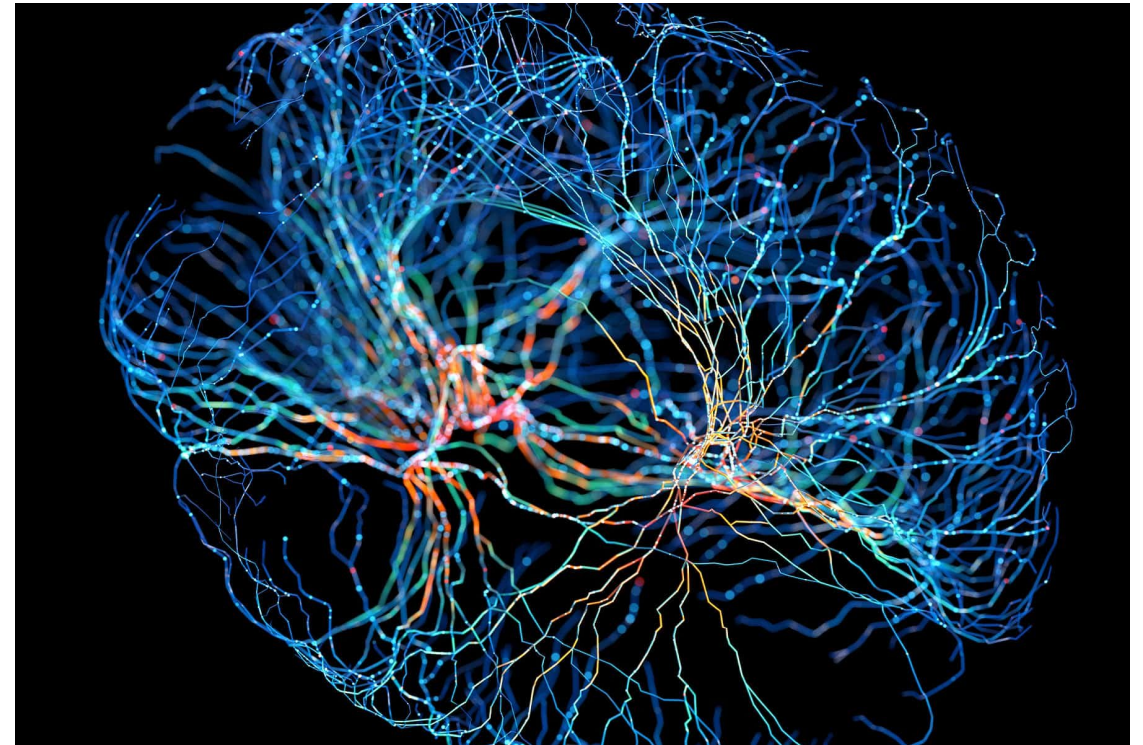
Neuroplasticity: Adapt and Change



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Also known as *neural plasticity* or *brain plasticity*, is a process that involves adaptive structural and functional changes to the brain.

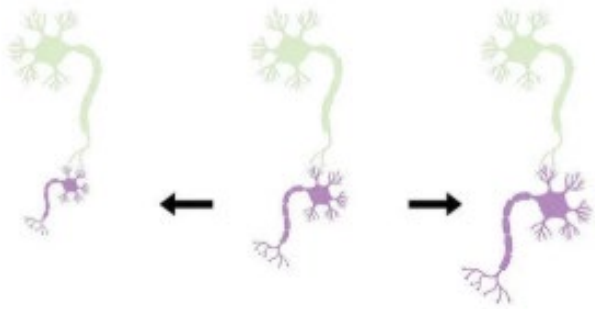
It is defined as the ability of the nervous system to change its activity in response to intrinsic or extrinsic stimuli by reorganizing its structure, functions, or connections after injuries, such as a stroke or traumatic brain injury (TBI).



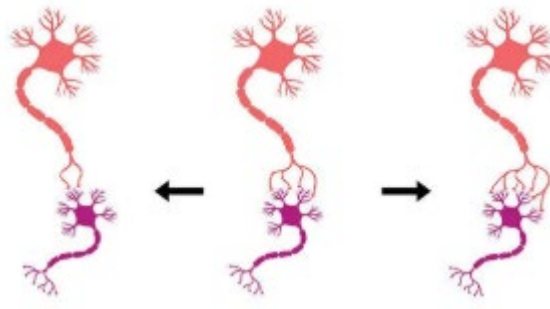
Mechanisms of neuroplasticity



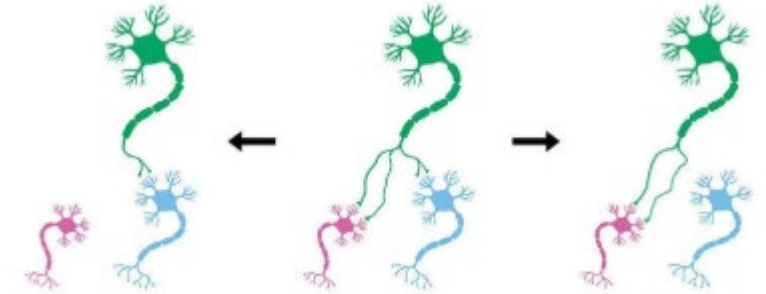
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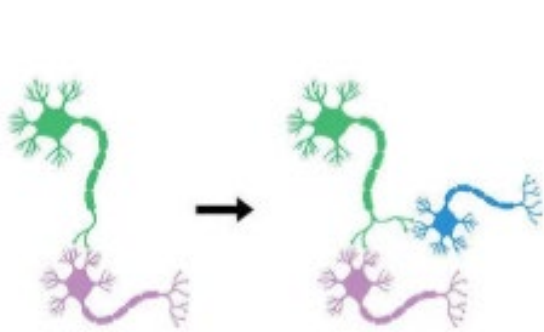
Growing or shrinking of individual neurons



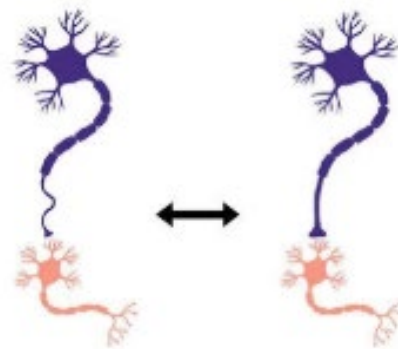
Changes in the *number* of connections neurons make to other neurons



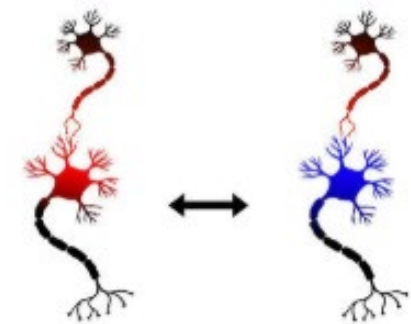
Changes in where neurons are making their connections



The appearance of *brand new neurons* (neurogenesis)



Changes in the *strength* of the connections neurons make to each other (also known as synaptic plasticity)



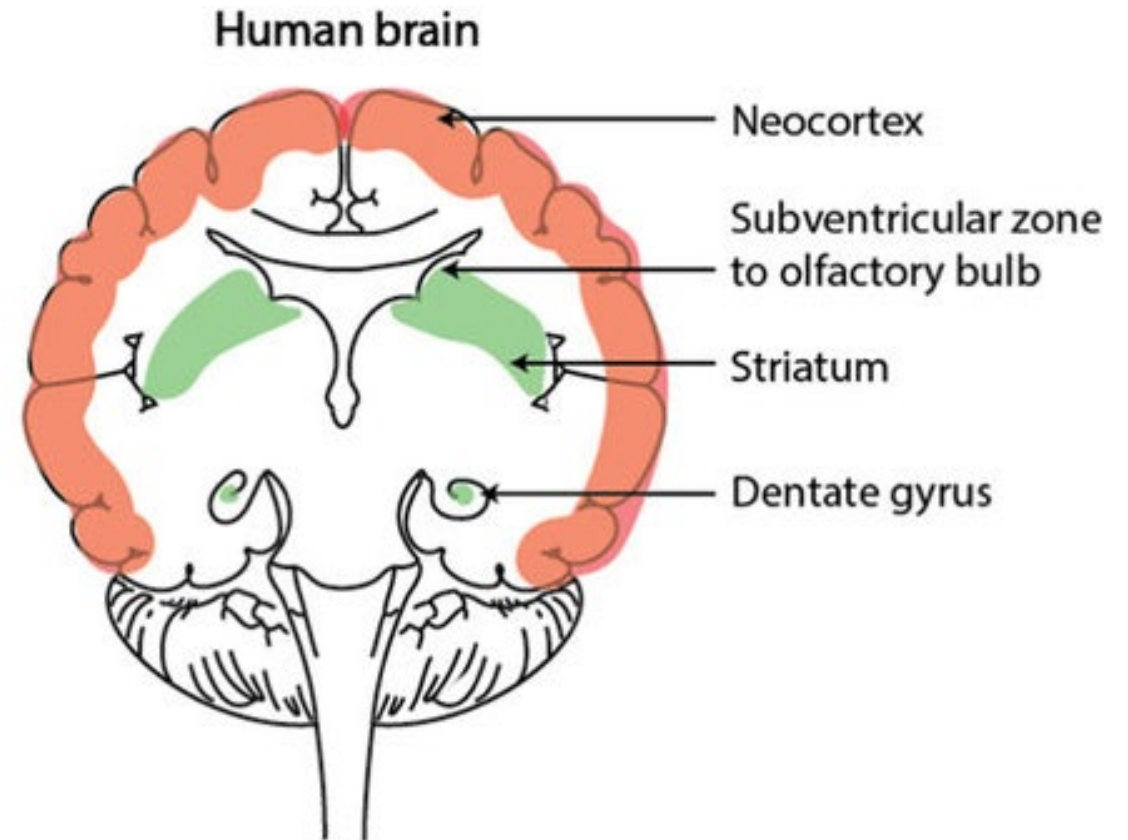
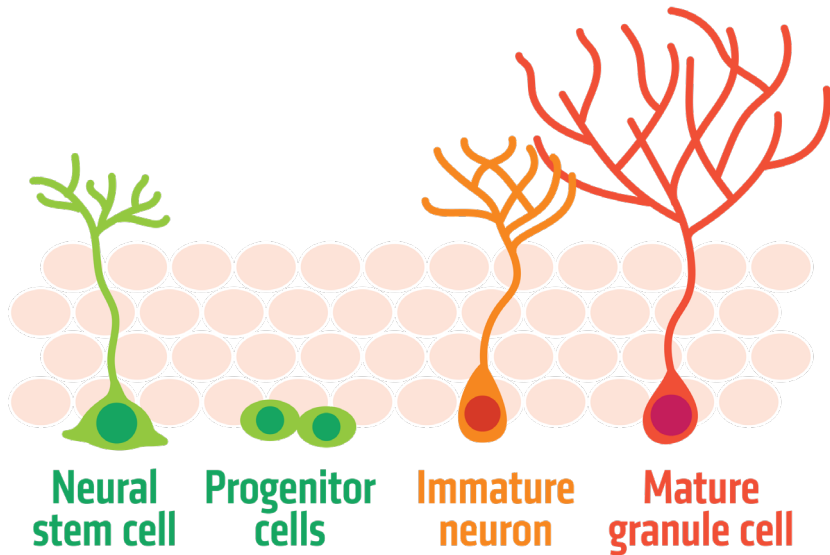
Changes in the way neurons *respond* to signals

Adult Neurogenesis



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The birth of new neurons is created throughout the lifespan in 2 specific brain regions.



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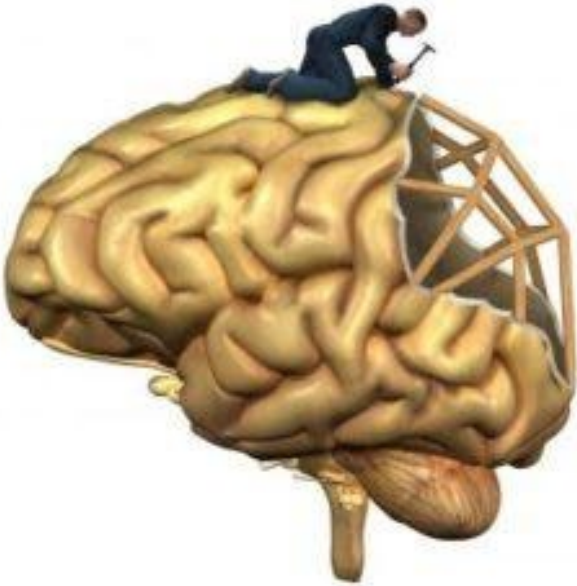
1. Introduction to neuroplasticity.
2. **How neuroplasticity changes with age.**
3. Ways to stimulate and maintain plasticity as we age.



Neuroplastic changes in aging



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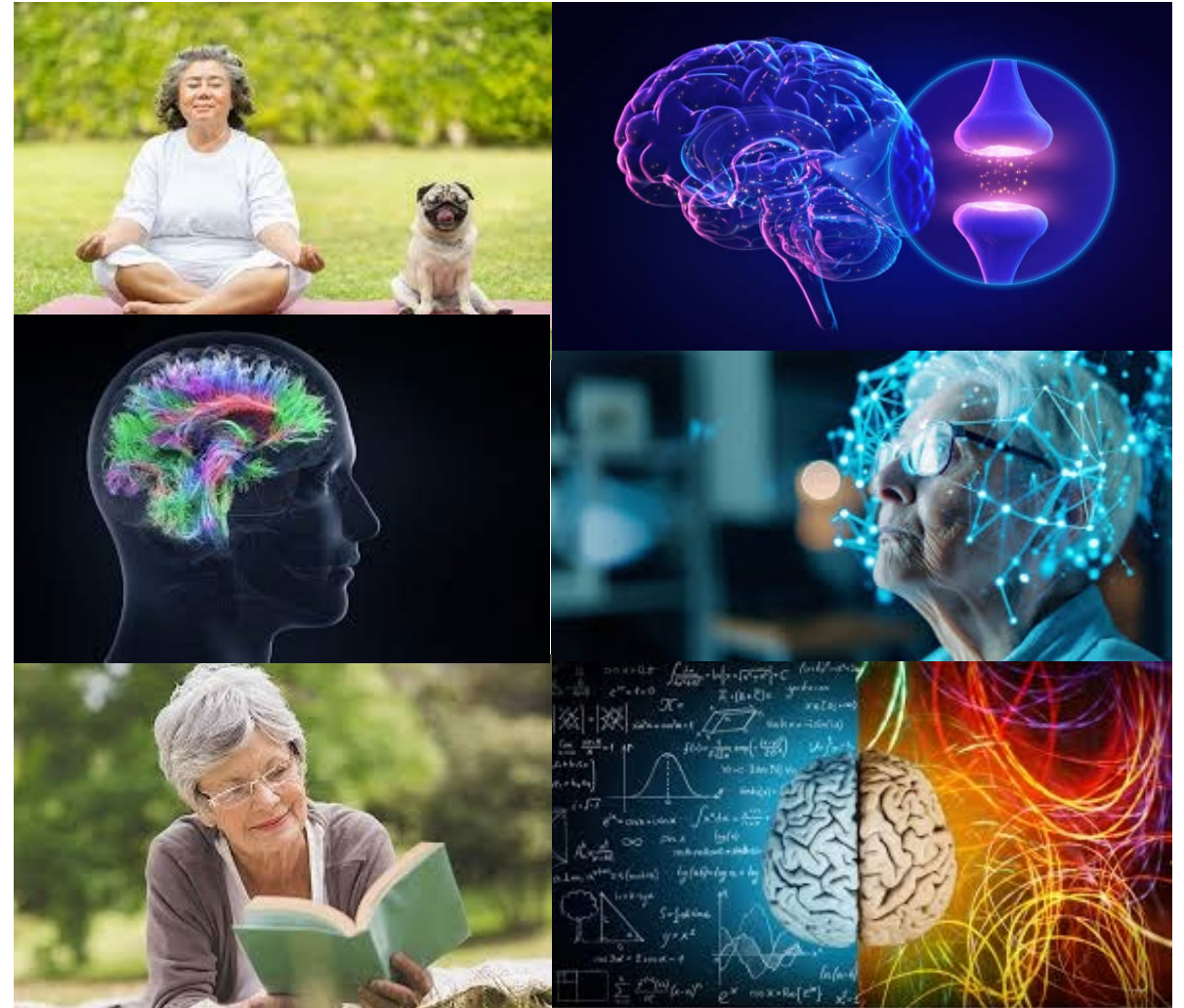
- Neuroplasticity declines with age due to reduced connectivity, impaired signaling, and increased cellular stress, limiting the brain's adaptability:
 - **Synaptic plasticity declines**, reducing the brain's ability to strengthen or weaken connections based on experience.
 - **Dendritic spine density decreases**, limiting the structural basis for learning and memory.
 - **Calcium regulation becomes impaired**, disrupting signaling pathways essential for plasticity.
 - **Neuroinflammation increases**, creating a hostile environment for neural adaptation.
 - **Mitochondrial efficiency drops**, leading to energy deficits and oxidative stress that impair plastic changes.
 - **Neurogenesis slows**, especially in the hippocampus, reducing the formation of new neurons.
 - **Gene expression shifts**, often repressing excitatory and plasticity-related genes.
 - **Protein clearance mechanisms weaken**, allowing toxic aggregates to interfere with synaptic function.
 - **Hormonal and metabolic signaling pathways alter**, affecting neuronal growth and resilience.
 - **White matter integrity declines**, reducing communication efficiency between brain regions.

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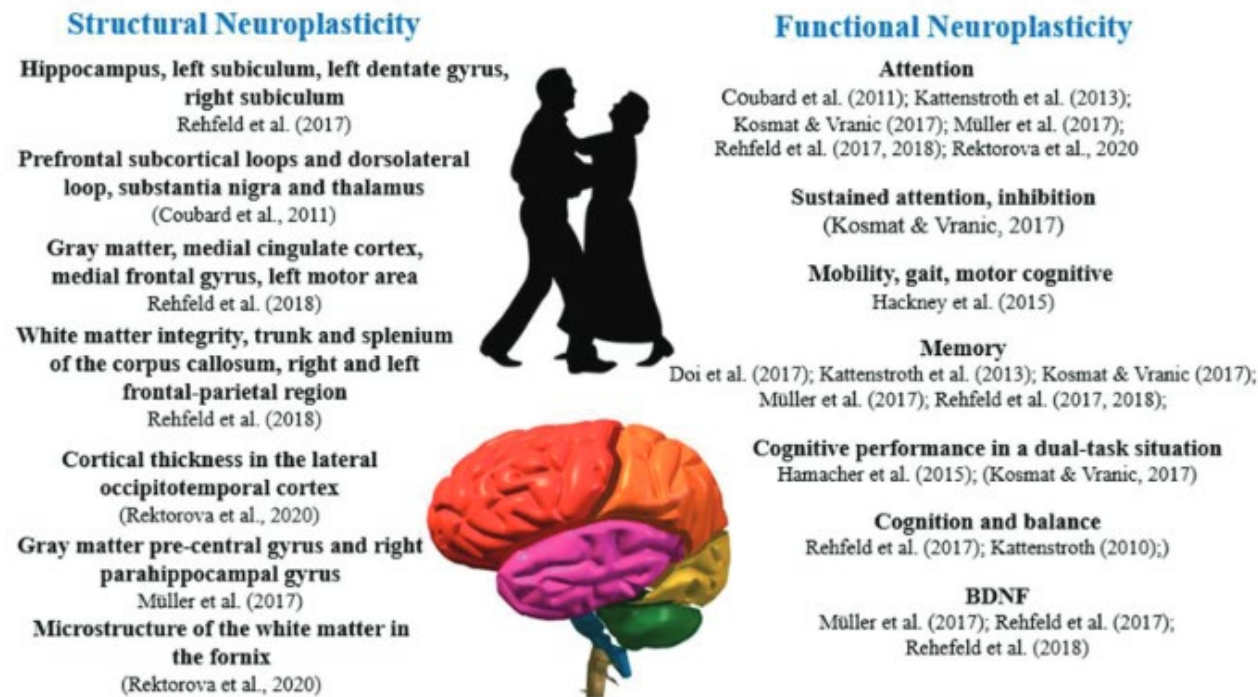


Strategies to boost neuroplasticity



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- Exercise
 - Increases BDNF, hippocampal plasticity & memory function (Erickson et al, 2012)
 - Dancing!!



(From: Nascimento et al, 2021)

Ways to boost neuroplasticity

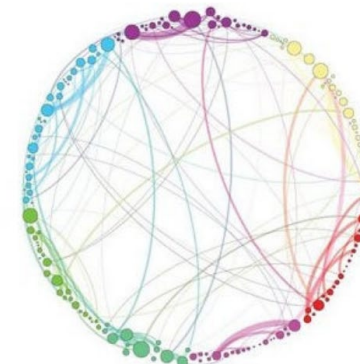


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- Meditation
 - Associate to more neurons and increased emotional regulation (Vestergaard-Poulsen et al, 2009)
- Diet
 - High-sugar, high-fat diets in rodents have been shown to negatively affect neurogenesis (Reichelt et al, 2019).
 - Walnut- and blueberry-rich diets could both improve neuroplasticity in the hippocampus, and potentially improve memory (An et al, 2017; Carey et al, 2019)
 - MIND diet
- Psychedelics
 - LSD and DMT help neurons grow more branching connections (Ly et al 2018)
 - Psilocybin increased neurogenesis (Catlow et al, 2013)
 - Psilocybin increases entropy (Tagliazucchi et al, 2014).
 - Psilocybin can “reset” the typical control structures, Default Mode Network (DMN)



Placebo



Psilocybin

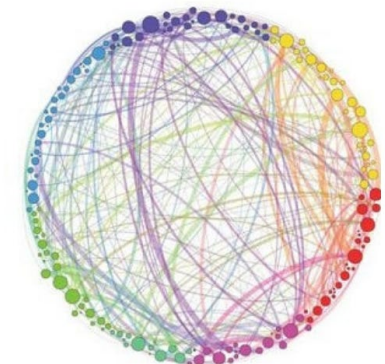


Image from Petri et al, 2014, showing the additional connections made between distinct areas of the brain on psilocybin.

14 dementia risk factors



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3 Excessive alcohol consumption



4 Air pollution



1 Physical inactivity



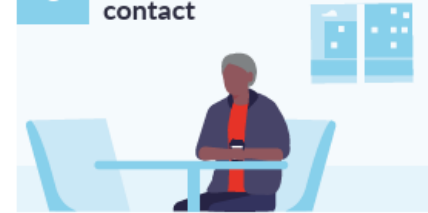
2 Smoking



5 Head injury



6 Infrequent social contact



7 Less education



8 Obesity



9 Hypertension



10 Diabetes



11 Depression



12 Hearing impairment



13 High LDL cholesterol



14 Vision loss



Modifying the 14 identified risk factors will potentially prevent or delay nearly **half of all dementia cases** (Livingston et al., 2024).

Source: Dementia prevention, intervention, and care: 2024 report of the Lancet standing Commission, Livingston, Gill et al. The Lancet, Volume 404, Issue 10452, 572–628

www.alzint.org



Building Cognitive Reserve



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1. Ensure good quality education is available for all and **encourage cognitively stimulating activities** in midlife to protect cognition
2. Make **hearing aids** accessible for people with hearing loss and decrease harmful noise exposure to reduce hearing loss
3. **Treat depression** effectively
4. Encourage use of **helmets and head protection** in contact sports and on bicycles
5. Encourage **exercise** because people who participate in sport and exercise are less likely to develop dementia
6. Reduce cigarette **smoking** through education, price control, and preventing smoking in public places and make smoking cessation advice accessible
7. Prevent or **reduce hypertension** and maintain systolic blood pressure of 130 mm Hg or less from age 40 years
8. Detect and treat high **LDL cholesterol** from midlife
9. Maintain a **healthy weight and treat obesity** as early as possible, which also helps to prevent diabetes
10. Reduce high **alcohol consumption** through price control and increased awareness of levels and risks of overconsumption
11. Prioritize age-friendly and **supportive community** environments and housing and reduce social isolation by facilitating participation in activities and living with others
12. Make screening and treatment for **vision loss** accessible for all
13. Reduce exposure to **air pollution**
14. Prioritize good **sleep** habits

Engagement opportunities



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- Caregiving – now streaming on PBS

The screenshot shows the PBS website interface. At the top, there's a navigation bar with 'PBS', 'Live TV', 'Shows', 'My Station', 'My List', a 'Donate' button, 'ROCKY MOUNTAIN PBS', and a 'Sign In' button. Below this, a banner for the 'caregiving' documentary is displayed. The banner features a colorful illustration of hands of various colors (blue, yellow, orange, red, purple) reaching out and holding each other. The text on the banner reads: 'caregiving', 'NOW STREAMING', and a description of the documentary. A 'Watch Now' button with a plus icon is visible. At the bottom, there's a list of supporters: Otsuka, Comfort Keepers, CareScout, Cherish, and care.com.

PBS • Live TV Shows My Station My List

Donate ROCKY MOUNTAIN PBS Sign In

RMPBS is your local station. Change

caregiving

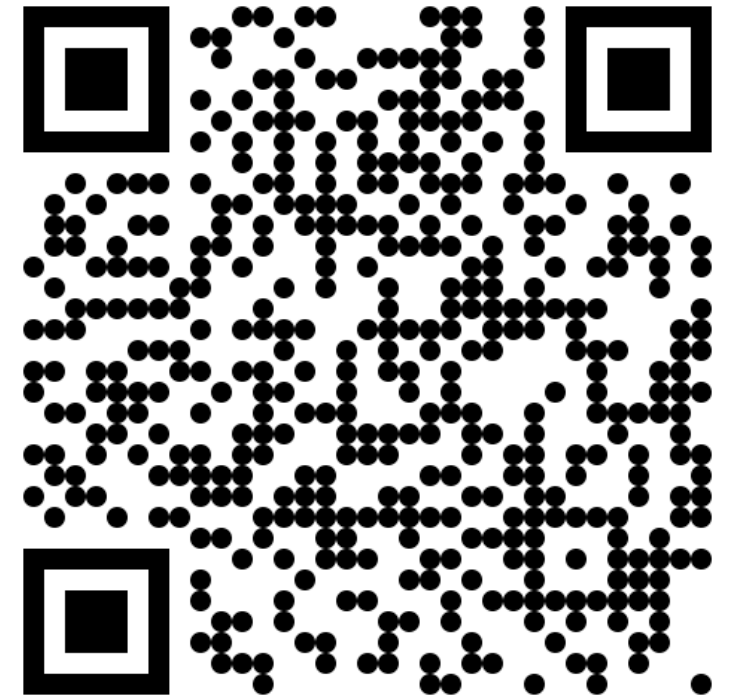
NOW STREAMING

From Executive Producer Bradley Cooper, this is the story of paid and unpaid caregivers navigating the challenges and joys of this deeply meaningful work. Intertwining intimate personal stories with the untold history of caregiving, the documentary reveals the state and the stakes of care in America today. Narrated by Uzo Aduba (The Residence, Orange is the New Black), directed by Chris Durrance.

▶ Watch Now +

Support for Caregiving is made possible by Otsuka America Pharmaceutical Inc.; OneAmerica Financial Foundation; Comfort Keepers; CareScout Holdings, Inc.; Cherish Health Inc.; Care.com; Evelyn Y. Davis Foundation; Richard King Mellon... MORE

Support provided by: Otsuka Comfort Keepers CareScout Cherish care.com



Engagement opportunities



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- July 1 – Multisector Plan on Aging will be released



Engagement opportunities



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- AAIC – free virtual registration on final day



ALZHEIMER'S  ASSOCIATION
AAIC > 25



MANAGING

THE SCARIEST HEALTH JOURNEYS

LIVING WITH DEMENTIA

A watercolor illustration of a large teal flower with five petals, a dark brown center, and several red buds on a stem. The style is soft and painterly.

PAULA ENRIETTO PHD

CEO - AFFIRMICARE

For Us It's Personal!



IT ALL STARTED WITH A BOX OF CHOCOLATES

WHAT DO YOU DO NOW?

A photograph of a doctor in a white lab coat with a stethoscope around their neck, holding a clipboard. Another doctor is visible in the background, also in a lab coat. The image is used as a background for the text.

**CHALLENGE #1: A TRIP TO
THE DOCTOR
LOOKING FOR ANSWERS!**



CHALLENGE #2: WRONG DIAGNOSIS

WHAT ARE THE CONSEQUENCES?



CHALLENGE #3: NO ONE TO LOOK AFTER MOM!

WHAT HAPPENS IF THE CAREGIVER GETS SICK?

A close-up photograph of a person's hands holding a white smartphone. The person is wearing a white long-sleeved shirt. The background is blurred, showing a laptop keyboard and some papers. A semi-transparent white box with rounded corners is overlaid on the bottom half of the image, containing the title and subtitle text.

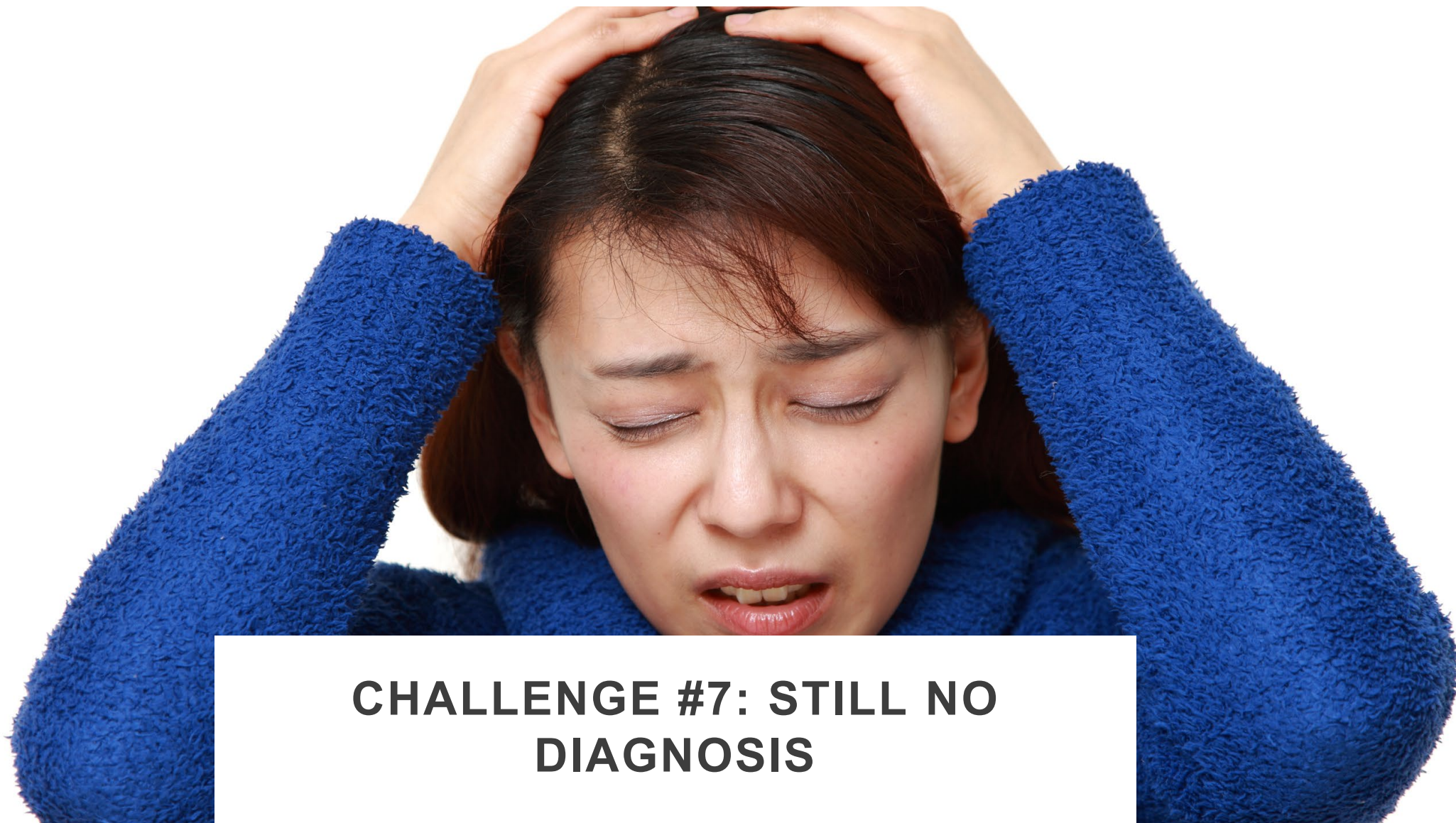
CHALLENGE #4: LONG DISTANCE CAREGIVING

GETTING TO THE TRUTH

Challenge #5:
Caregiver
Overwhelmed!



CHALLENGE #6:
SAFETY FIRST
IS THE STOVE ON?



**CHALLENGE #7: STILL NO
DIAGNOSIS**



CHALLENGE #8: A DIAGNOSIS!

NOW WHAT DO I DO?

Challenge #9: Learning a New Way of Being

Living with Someone Who Has
Dementia

Be with Them Where They Are



Challenge #10: Changes in Communication

- Finding the right words
- Understanding what words mean
- Paying attention in conversation
- Speaking in the first language learned
- Repetitive questioning

Mom lost her words and ability to make a complete sentence..except when she had a moment of clarity



Challenge #11: Changes in Behavior

- Agitation and aggression
- Wandering
- Anxiety
- Hiding items
- Hallucinations
- Sleep problems/Sundowning
- Paranoia

I walked into the room and Mom said, "Do you see that angel in the corner. She won't hurt us."



Challenge #12: Everyday Care

- Oral care
- Meal time
- Contenance
- Bathing

Mom hated the feeling of water on her skin

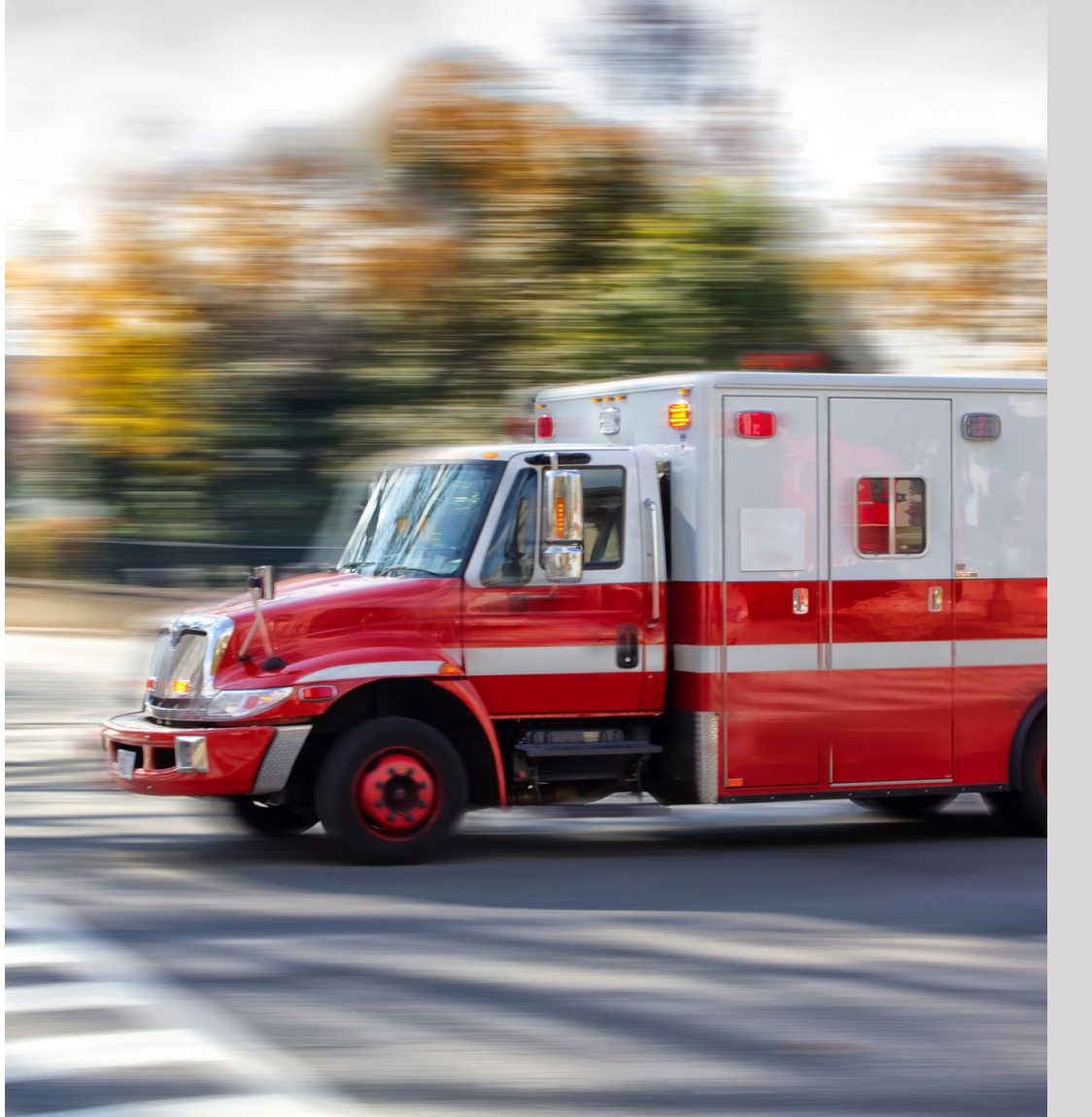


Challenge #13: Common Medical Problems

- Dehydration
- Constipation
- Incontinence
- Urinary tract infections
- Hearing and vision loss
- Falls

No one ever drinks enough water!





Challenge #14: Taking Care of Yourself

- You can't take care of someone else if you don't take care of yourself
- It's not unusual for the caregiver to get ill
- Stress, burnout, anger, resentment are real

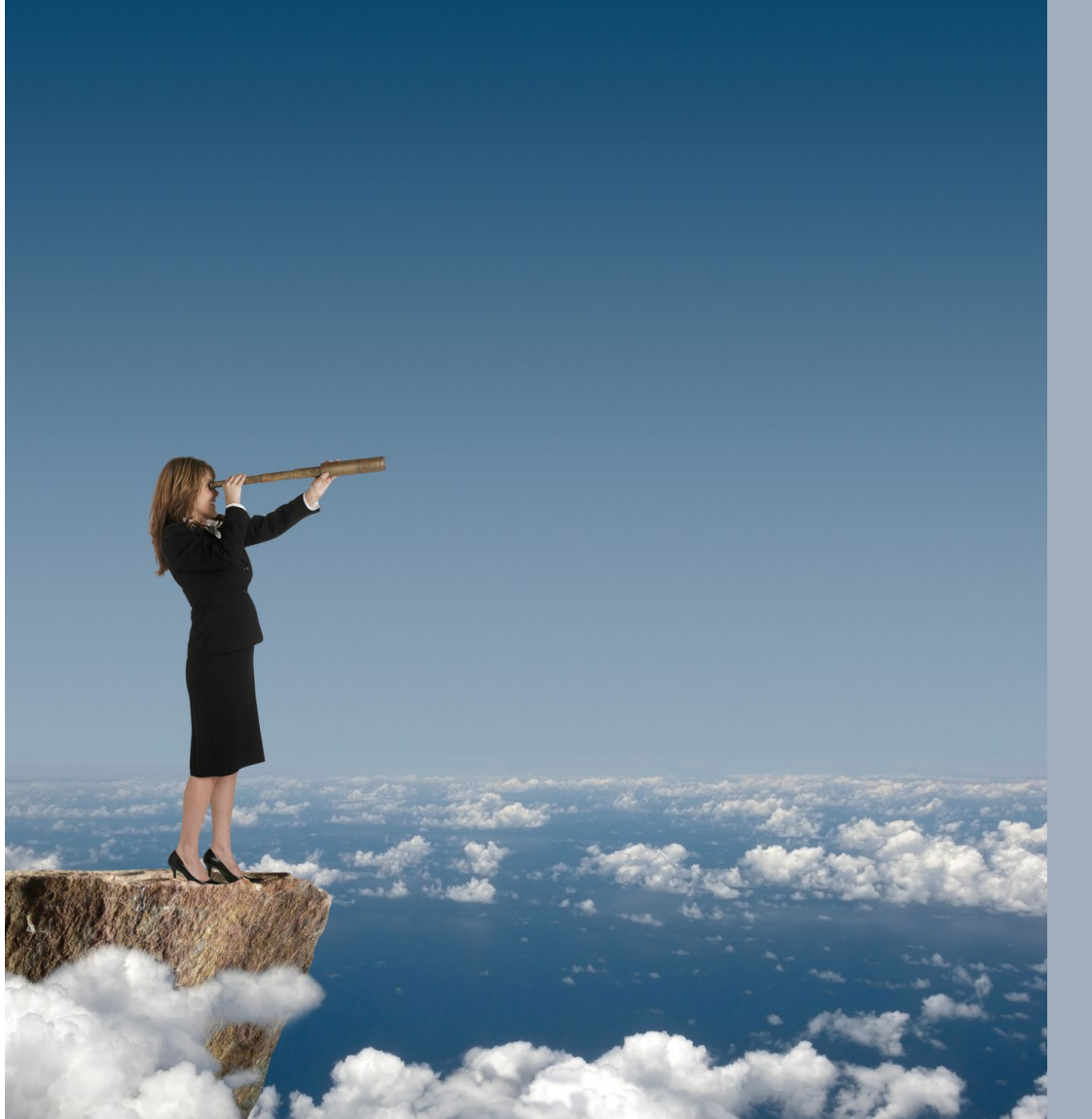
I turned the corner near Mom's home to find the emergency services outside the house. I thought it was Mom but, no, it was Dad.



Challenge #15: Accepting Help

- We don't want anyone in house
- What would they do
- How much would it cost
- I would feel guilty letting someone else take care

Letting go is key. Dad couldn't take care of Mom...he was an engineer not a caregiver.



Challenge #16: Finding Help

- Friends and family network
- Home care
- Adult day care
- Respite
- Long term care facility

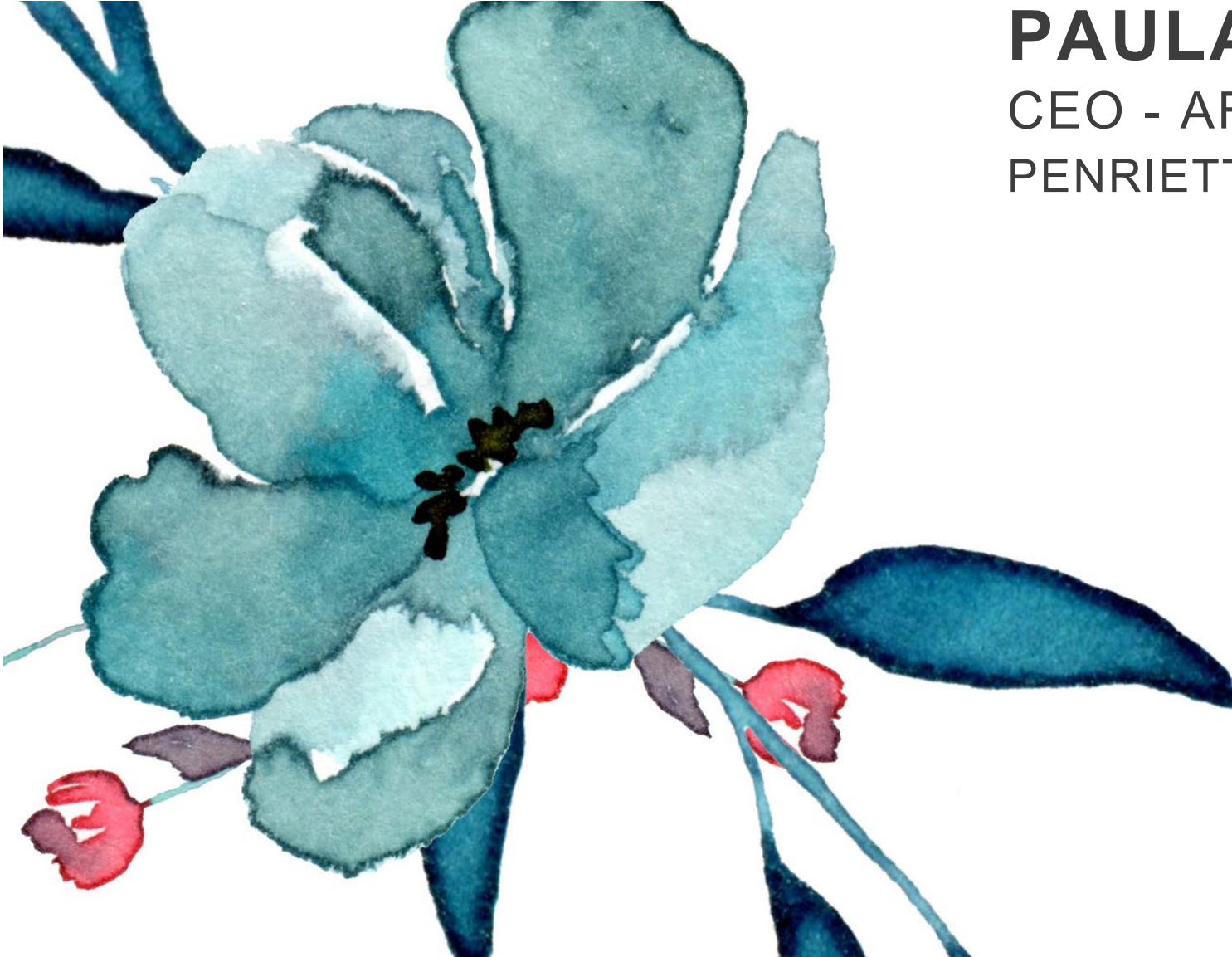
Difficult decisions...Mom moved to a memory care facility for the last year of her life.



Challenge #17: Finding the Joy

- Learning new ways to be with the person
- Surprises along the way
- Getting joy by bringing joy

Mom loved caramel corn and olives, seeing my son, and being her true self!



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RESOURCES

- **The National Institute on Aging**
- **The National Institutes of Health**
- **The Alzheimer's Association**
- **Dementia Together**
- **Local Area Agencies on Aging**
- **Dementia Friendly America**