The Aging Patient in Critical Care

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Aging Population

From US Census Bureau (2020):

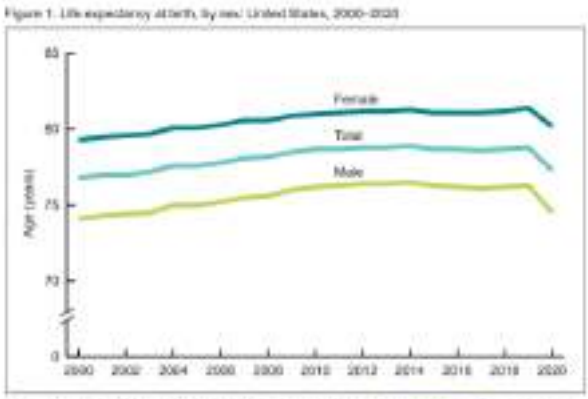
- Percent persons under age 5 yrs: 6%
- Percent persons under 18 years: 22.3%
- Percent persons over age 65 years 16.5; was 14% in 2010

2

More Stats

- Decrease in life expectancy linked to COVID 19
- 1 in 4 persons undergoing surgery > 65 years
- 12% of patients > 65 years use 65% of available medical resources

https://www.cdc.gov/nchs/ndi/index.htm



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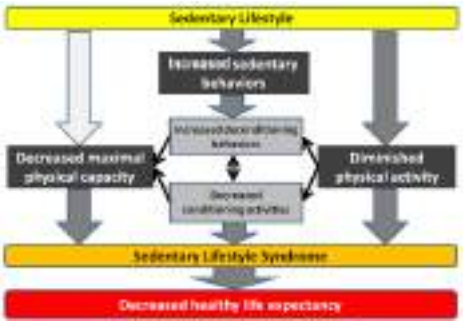
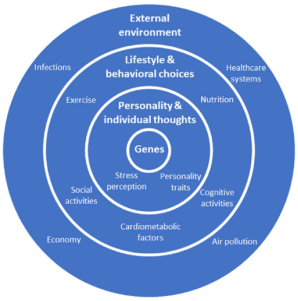
Concepts in Aging

Three key concepts guide our understanding of aging:

- Senescence
  - Cell's progressive loss of ability to replicate over time
  - This makes the human organism more vulnerable to challenges from disease, injury, or environmental factors
- Loss of Physiological Reserve
  - As organisms age, the ability to repair damage and adapt to physiological stressors decrease
  - physiological reserve is correlated with an individual's functional status
- Multicausality
  - the view of aging as an extremely complex, multifactorial process
  - Several processes may interact simultaneously to cause aging





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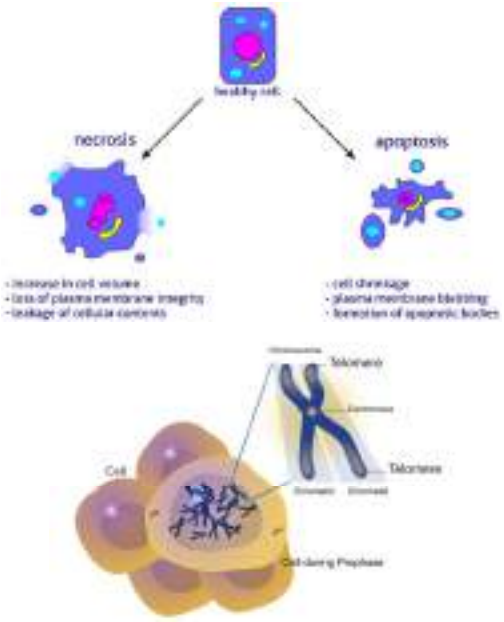
Theories of Aging

- Programmed Cell Aging (apoptosis)
  - The aging clock depends on genetics to turn on & off signals to systems to maintain homeostasis
    - Example: Lifespan of ovaries; 20% of ejaculated sperm are apoptotic
    - Occurs as a defense mechanism in immune system
    - Damaged cells
- Telemere shortening
  - Telemere is a portion of chromosome; with repeat mitosis, the telemere area shortens
    - Thought that limit to number of times a cell can divide by mitosis



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More Theories

- Damage Theory of Aging
  - Cellular damage over time from by-products of metabolism
    - Leads to error in DNA then errors in metabolism and protein synthesis
- Free Radicals
  - Contain a free oxygen electron, bind to other molecules
  - Target cells structures, DNA
    - Injure vascular endothelium – atherosclerotic plaque

How Free Radicals Affect your Body/HowStuffWorks. https://science.howstuffworks.com/life/cellular-microscopic/free-radicals.htm

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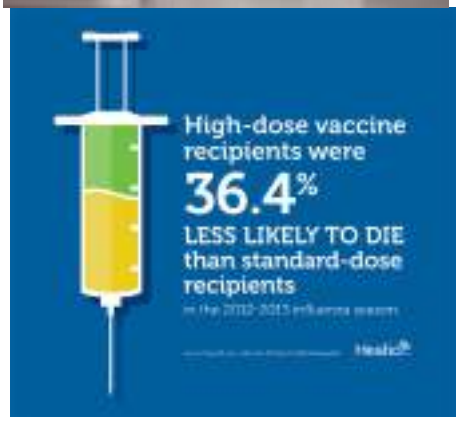
Immunosenescene

Weakening of innate and adaptive immune systems

- More NK cells but less functional
- T cells less able to recognize antigens
  - Decreased production of T cells
- Decrease in cytokine secretions
  - Decreased inflammatory response
    - Decreased white blood cell rise with bacterial infections
    - Decreased ability to have fever
    - Less able to conserve body heat
    - Immunizations less effective



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Cardiovascular System

- Need to differentiate from diseases, such as coronary artery disease
- CV changes with age occur in everyone but at different rates:
  - Decrease in elasticity and increased stiffness of the arterial system – effects of free radicals
    - Result is increased left heart afterload
    - Increased in systolic BP
    - Left heart hypertrophy
    - Prolonged relaxation of left ventricle in diastole
  - Decreased intrinsic heart rate
    - Dropout of atrial pacemaker cells
  - Calcification of the base of the aortic valve and damage to the bundle of HIS
  - Decreased responsiveness to beta adrenergic stimulation
    - Decreased reactivity of baroreceptors and chemoreceptors
      - Orthostatic hypotension
    - Increase in circulating catecholamines

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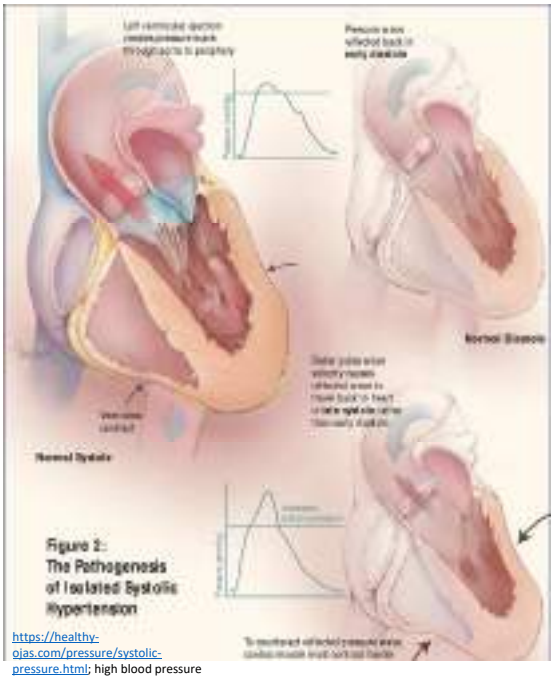
CV Consequences

- All these are a set up for:
  - isolated systolic HTN
  - diastolic dysfunction and heart failure
  - atrioventricular conduction defects
    - Maximum achievable HR:
      220 – age = maximal heart rate
  - aortic valve calcification

https://healthjade.com/aortic-valve-disease/



https://healthy-ojas.com/pressure/systolic-pressure.html; high blood pressure

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Respiratory System Changes

- Recall that the function of the respiratory system is oxygenation and ventilation
  - Decrease in aerobic capacity 10% per decade beginning in mid-20s!!!
  - Changes to lung function from disease, smoking, poor fitness are in addition to this age-related decline
- Overall response to stress on the respiratory system is blunted
  - Slower changes in oxygen uptake, carbon dioxide elimination
    - Reduces the ability to increase RR and decreases body work
  - Diminished sensitivity of chemo receptors
  - Slower response to recovery also
  - Reduced cough and ciliary function

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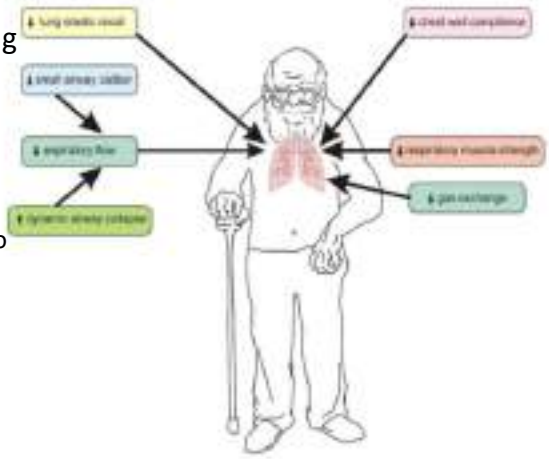
Respiratory Mechanics

Three primary components: thoracic cage, lungs, diaphragm

- Structural changes to the thoracic cage decreasing chest wall compliance
  - Stiffening of costal cartilage with calcification
  - Thinning of bones allows for ribcage shape changes
- Lung tissue
  - Lung compliance determines the rate and force of expiration but thoracic compliance determines the elastic load during inspiration, volume and response to pressure
  - Alveoli lose their shape and elasticity: allowing air to become trapped and not exchange
  - Upper airways dilated
  - Residual volume decreased
- Diaphragm weaker
  - Weaker cough



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https://www.researchgate.net/publication/330205818_Handgrip_Strength_and_Pulmonary_Disease_in_the_Elderly_What_is_the_Link/ Rafaela, T., et al. I2019)

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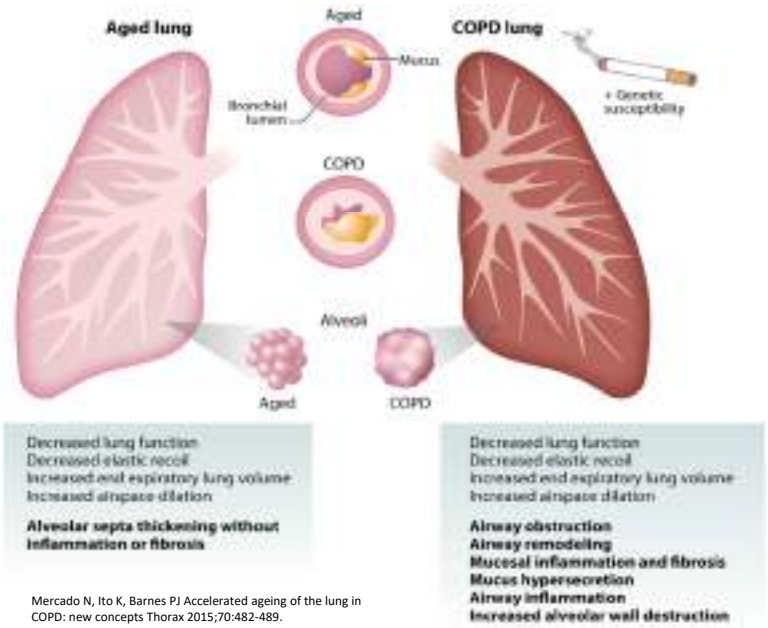
Aging Changes vs Disease

While there are changes to aging lungs, diseases such as COPD add:

- Increased inflammation
- Fibrosis of tissue
- Increased mucus secretion
- Loss of alveolar wall and surface area



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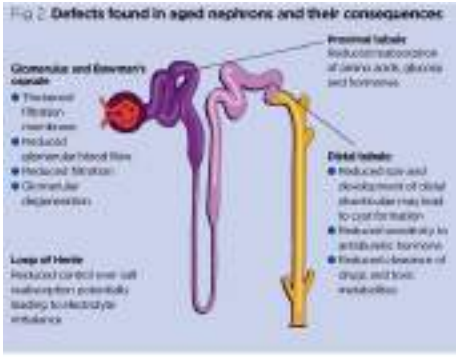
Renal System



Reduction in renal function with age:

- Loss of nephrons
- Changes in tubule functions
- Reduction in renal blood flow
- Decreased ability to handle fluid overload, appropriately concentrate urine – decreased response to ADH
  - Slower secretion of glucose, potassium
  - Higher risk of dehydration
- Slower response by kidneys to acid/base changes and compensation

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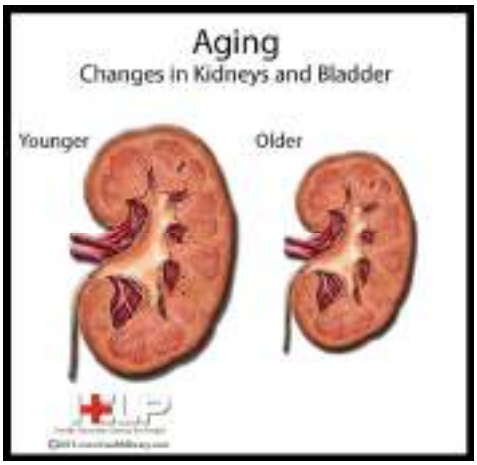
Aging Renal Function

- GFR decreases with decreased renal clearance of drugs
- BUN increases 20% by age 70
- Sodium conservation is diminished
- Bladder capacity decreases
  - Bladder and perineal muscles weakened, more difficult to empty bladder
  - Increased stress incontinence in females
  - Prostatic enlargement related changes in males



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GU Systems

Changes for female linked to loss of estrogen at menopause

- Vulvovaginal atrophy, where the vaginal tissue becomes thinner and vaginal muscle weakens
  - Vulvovaginal dryness, itching, soreness, and dyspareunia
  - Increased risk of uterine prolapse
- Decline in estrogen levels also weakens the pelvic musculature, bladder, and urethra
  - Weakening of the bladder musculature can cause stress incontinence
- Changes in vaginal flora allows more pathogenic organisms to colonize

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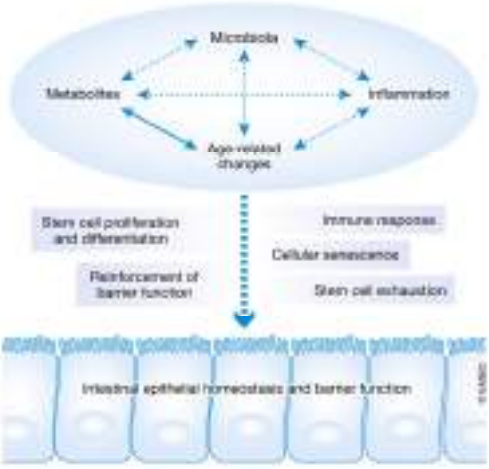
GI System Changes

- Age related changes in the GI system can lead to many quality of life concerns:
  - Slowing of GI peristalsis, motility; constipation
  - Changes in taste may lead to decreased appetite
  - Poor dentition may lead to infections, difficulty chewing, tooth loss
  - Presbyesophagus – age related dysphagia with weaker oral pharyngeal muscles; higher aspiration risk and GERD
  - Decrease in gastric parietal cells leading to increase in pernicious anemia
    - Symptoms include paresthesias of hands and feet; severe cases can mimic dementia
  - Decreased HCl in stomach can reduce iron and calcium metabolism leading to deficiencies
  - Decreased motility, especially in distal large bowel can lead to wall weakness and development of diverticuli – pockets in distal large bowel with trapped secretions and potential for infection and perforation



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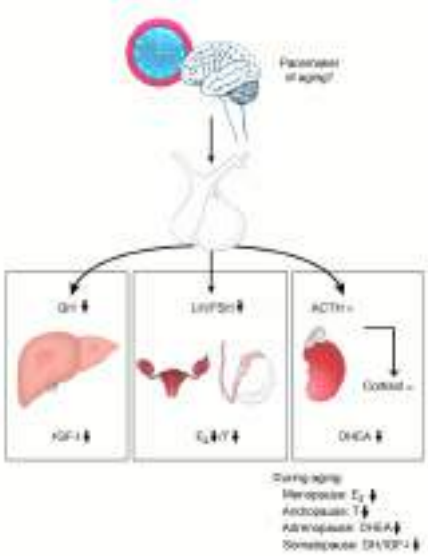
Endocrine System

- Decreased release of insulin by beta cells results in higher glucoses
- Decrease in thyroid function tied to lowered metabolic rate
- Decrease in thermoregulation and immune response



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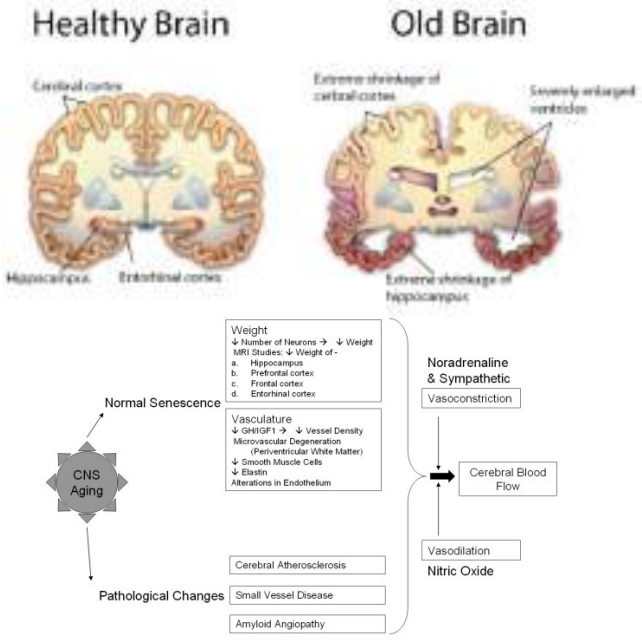
Nervous System Changes

- Enlargement of lateral ventricles can put stress on nearly nerves for locomotion
  - Gait and balance changes
- Decreased NM may lead to sleep/rest disorders
- Stimuli changes to pain; increased visceral pain
  - Higher pain thresholds



(n.d.) Aging: Changes in Nervous System. HELP: Health Education Library for People

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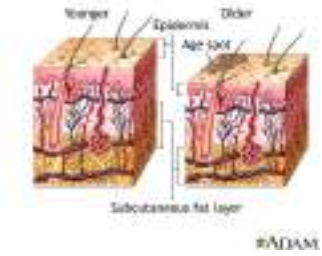
Changes associated with aging

- Aging promotes skin fragility, delayed wound healing, susceptibility to irritants, increased sensitivity to sun exposure, increased risk for pressure-related skin problems, skin tears and blisters
- Aging leads to dry skin, risk of heat stroke/hypothermia, increased risk for trauma and formation of wrinkles



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Geriatric Syndromes

- Common age-based conditions
- Not disease processes
- At least one reported by > 90% of critical care survivors
- Results in higher care level, decreased independence, decreased QOL

Geriatric Syndromes
Incontinence
Pressure ulcers
Falls
Functional decline
Delirium
Frailty

Brunker, et al., (2023)

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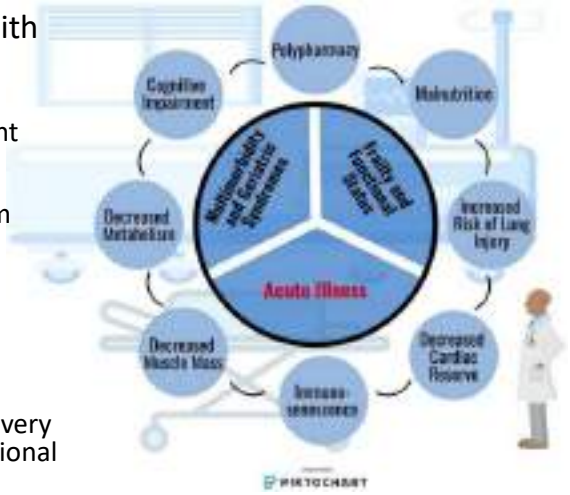
Impact of Geriatric Syndromes

- Guide the unique pre-operative evaluation with goal of improving peri- and postoperative outcomes
  - Discussion of risks plays a role in informed consent
- Post-intensive care syndrome
  - Often difficult to separate condition changes from baseline
  - Physical disabilities
  - Cognitive impairment now persistent
    - Up to 60% ICU elder survivors
- Longer term outcomes
  - Those with less comorbidities, any age, older and very old with better 1 year post ICU survival and functional status



McDonald, S. R. (2017)

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Concept of Multimorbidity

- Co-occurrence of two or more chronic conditions
  - Common comorbidities in aging include HTN, DM, COPD, heart failure, cancer, and cognitive impairment
- Associated with increased short- and long-term mortality among all ICU patients
  - Significant risk for older populations.
  - Frail older adults experience higher hospital and long-term mortality than their non-frail counterparts
- Prevalence of multi-morbidity is close to 90% in patients aged 85 years or older

Guidet B, Vallet H, Boddaert J, et al. (2018). Chen Y, et al. (2022). The Johns Hopkins ACG System. (2017).

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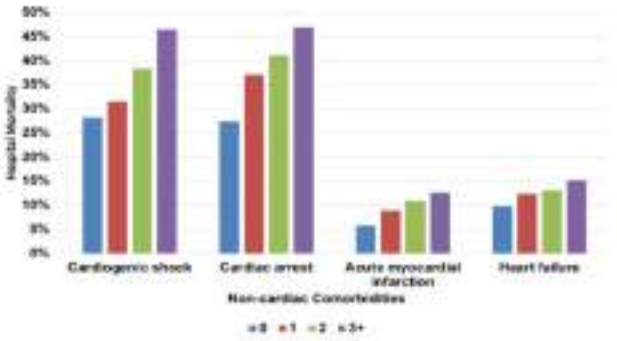
Prevalence of Multimorbidity and ICU Outcomes

- Two center study with combined cohort of > 16,000 patients

Noncardiac Comorbidities	0	1	2	>/= 3
Prevalence	37.7%	31.4%	19.9%	11.0%

Proportion of hospital mortality from cardiac conditions based on number of non-cardiac comorbidities



Miller, E. P., et al. (2021)

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Links to ABCDEF Bundle

ABCDEF Elements	Bundle Intervention	Age Specific Barriers
A: Assess, prevent, & manage pain	• Use of evidence-based pain scales • Use of regional analgesia, non-opioid • Use of fentanyl for sedation	• Cognitive & communication difficulties • Baseline pain from DJD, immobility • Decreased muscle mass & metabolism influence drug metabolism
B: For the MV pt: sedation reduction & SBT	• Daily linked sedation reduction and SBT • Team coordination	• Potential reluctance despite evidence of differences in SBT/weaning with age • Sedation vacations important with metabolic changes
C: Choice of sedation	• Target light sedation • Avoid benzos; Use of dexmedetomidine	• Difficulty achieving light sedation • Inappropriate prescribing
D: Delirium monitoring & management	• Routine delirium screening with evidenced tool • Non-pharmacologic interventions	• Under-recognized, especially hypoactive • Emphasis on avoidance or dose adjustment of high- risk medications • Focus on nonpharmacologic methods
E: Early mobility & exercise	• PT/OT eval and treat; PROM to AROM • Coordination of activity with sedation reduction	• Hesitation with concern of causing harm or injury • Pre-existing immobility or frailty • Availability of staff
Family engagement & empowerment	• Family education and orientation to plan • Emotional, verbal support and empowerment • Multidisciplinary rounds	• Family reluctance or fear • Family member illness • Unclear goals of care or understanding of expected clinical outcomes

Brunker, L. B., et al. (2023)

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Case Review

- 82F presents via EMS following MVC
- Was front seat passenger with her 85M husband driver
- Were on the way to church for prayer meeting
- Head on collision with speeding wrong way, intoxicated driver
- Has mild cognitive impairment, chronic AF on anticoagulation, DJD
  - Other wise independent ADLs and care of home

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Case Review

- Patient hit in forehead by auto visor resulting in degloving injury to scalp
  - Excessive bleeding from scalp and internally with supranormal INR
  - Right chest tube placement
  - Surgical consult
- Was belted; received injury to sternum with fracture
  - Right flail chest and fractured ribs 6-9

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Case Review

- Short term intubation with light sedation and fentanyl analgesia
- Sitting upright HD 3, OOB standing HD 4
- PT/OT evaluations
- Placement of nasal feeding tube to meet needs
- Initial debridement of scalp wound with graft placement prior to DC
  - Further surgery needed
- No acquired hospital complications
- Discharge to STR HD 12 and home three weeks later

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