

# WHY DO WE HAVE TO AGE AND HOW DOES IT HAPPEN?

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## OBJECTIVES

- 1. To learn why and how we grow old and whether we will all die.**
- 2. To understand why we do not sleep the way we used to.**
- 3. To appreciate how our brain and nervous function changes as we age**

## DISCLOSURES

- I am growing older
- I have not been paid for ageing by any pharmaceutical company (still a great regret)
- Even my grandsons are aging!



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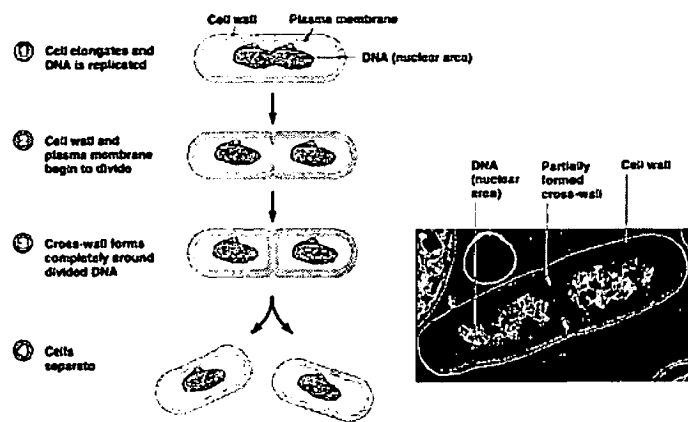
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# ARE ALL CREATURES PROGRAMMED TO DIE?

# NO!



## ASEXUAL REPRODUCTION IN BACTERIA (BINARY FISSION)



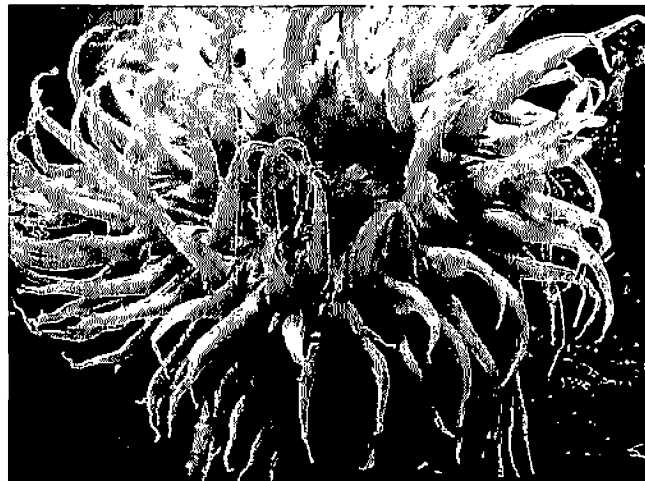
(a) A diagram of the sequence of cell division.

(b) A thin section of a cell of *Bacillus licheniformis* starting to divide.

IS MORTALITY THE PRICE WE  
PAY FOR SEXUAL  
REPRODUCTION?

NO

SEA ANEMONE



UNFORTUNATELY WE HUMANS ARE DESTINED  
TO DIE



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## THEORIES OF AGING

- Wear and tear theories (teeth, knees)
  - Not sufficient by themselves
- Adaptive evolutionary theories
  - Dying is good! (maybe for you but not for me)
  - Ignores fact that in the wild, death by ageing is rare, and this happens after reproductive age
- Non-adaptive evolutionary theories
  - Genes that assure greater reproductive success in early life might have deleterious effects later on



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## WHO LIVES THE LONGEST?

1. Single women
2. Married women
3. Married men
4. Single men

***It seems like when women get married, they 'donate' extra years to their husbands!***



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## EVEN PETER PAN GROWS OLD



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# VISION

CHANGE	CONSEQUENCE
<p>Decreased lacrimation</p> <p>Pupil decreases in size</p>	<p>Dry eyes</p> <p>Poor vision in low light circumstances (less light gets to the retina)</p>
<p>Impaired accommodation (lens and ciliary muscles)</p> <p>Common age related diseases</p> <ul style="list-style-type: none"> <li>• Cataracts</li> <li>• Age related macular degeneration</li> <li>• Glaucoma</li> <li>• Diabetic retinopathy</li> </ul>	<p>Presbyopia, need for bifocals. Bifocals increase risk of falls.</p> <p>Impaired vision with impaired ADLs, risk for falls, medication difficulties, social isolation, etc.</p>
<p>Lens yellows and darkens</p>	<p>Subtle colour discrimination decreases, affects design for seniors (e.g. LTC facilities). Red and orange most visible.</p>

## WHICH TINKERBELL WOULD PETER PAN PREFER



# HEARING

CHANGE	CONSEQUENCE
<p><b>Presbycusis (age-related hearing loss)</b></p> <ul style="list-style-type: none"> <li>•Reduction in threshold sensitivity</li> <li>•Reduction in the ability to understand speech</li> </ul> <p><b>Tinnitus</b></p>	<ul style="list-style-type: none"> <li>• 'I don't understand'</li> <li>• Why are they 'mumbling' especially in poor auditory circumstances and environments (intercoms, uncommon accents, rapid speech, noisy restaurants, large reverberant rooms)</li> <li>• mash vs. math vs. map vs. mat</li> <li>• Sunday vs. someday</li> <li>• Social isolation</li> <li>• Paranoid behaviour</li> <li>• Associated with dementia, especially if vision also impaired</li> </ul> <p>Usually associated with presbycusis, but most people adjust. If they do not, serious decline in quality of life</p>

## HIGH PITCHED SOUNDS HARDEST TO HEAR





## SKIN

CHANGE	CONSEQUENCE
<b>Epidermis and Dermis</b>	
<ul style="list-style-type: none"> <li>• ↓ barrier function</li> <li>• ↓ ability to form Vitamin D</li> <li>• Changes in elastic tissue</li> <li>• ↓ in immune cells</li> <li>• ↓ melanocyte function</li> <li>• ↓ vascular supply (↑ tortuosity)</li> </ul>	<ul style="list-style-type: none"> <li>• Skin is more easily damaged and healing delayed</li> <li>• UV protection decreased</li> <li>• Skin wrinkles and sags</li> <li>• Altered thermal regulation</li> <li>• Vascular abnormalities in skin</li> </ul>
<b>Subcutaneous Tissues</b>	
<ul style="list-style-type: none"> <li>• More fat in abdomen and thighs, less in face and dorsum of hands</li> <li>• ↓ eccrine and apocrine sweat glands</li> <li>• Variable hair changes</li> <li>• ↓ melanocytes in hair follicle bulbs</li> </ul>	<ul style="list-style-type: none"> <li>• Increasing waist size, bruising over hands</li> <li>• Less sweating, less odour, poorer temperature control</li> <li>• Hair growing where we do not want it!</li> <li>• Grey hair</li> </ul>



## CARDIOVASCULAR SYSTEM

CHANGE	CONSEQUENCES
Stiffening of large arteries	Increase in systolic blood pressure Can lead to inappropriate treatment and increase likelihood of falls
Impaired left ventricular filling	Predisposition to diastolic dysfunction
Greater reliance on atrial systole for left ventricular filling	Greater consequences if atrial function impaired (atrial fibrillation)
Loss of sinus node pacemaker cells and increased ventricular ectopic activity	More arrhythmias, especially atrial fibrillation with its risk of embolic stroke
Atherosclerosis	Angina, myocardial infarction
Congestive heart failure	Morbidity, impaired quality of life, death



## RESPIRATORY SYSTEM

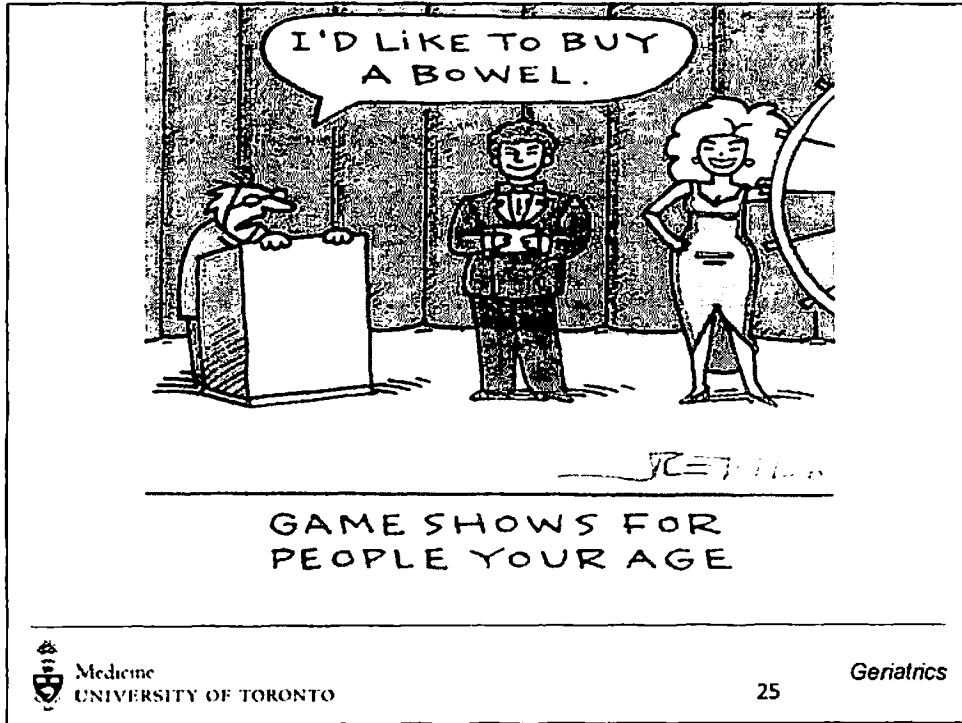
CHANGE	CONSEQUENCES
<b>Decline in Lung &amp; Chest Wall Mechanics</b> <ul style="list-style-type: none"> <li>• ↓ lung elastic recoil</li> <li>• ↑ chest wall stiffness</li> <li>• ↓ respiratory muscle strength</li> </ul>	Decrease in maximal ventilation and thus a decrease in maximal exercise capacity
<b>Decline in Gas Exchange</b> <ul style="list-style-type: none"> <li>• ↓ lung elastic recoil</li> <li>• ↓ pulmonary capillary blood volume</li> <li>• ↓ lung surface area</li> </ul>	Decrease in maximal exercise capacity
<b>Decline in Ventilatory Control</b> <ul style="list-style-type: none"> <li>• ↓ responsiveness to O<sub>2</sub> and CO<sub>2</sub></li> <li>• ↓ sensitivity to loads</li> <li>• ↓ Protective Airway Reflexes</li> </ul>	More prone to hypercapnea and hypoxia
More likely to have smoked longer	All cigarette related maladies (COPD, etc.)



## GASTROINTESTINAL SYSTEM

CHANGE	CONSEQUENCES
Changes in esophageal motility	Increased prevalence of heart burn
Decreased gastric protective factors	More sensitive to effects of NSAIDs More likely to develop gastritis
More vascular abnormalities (angiodysplasia)	More occult (or even large) GI bleeding
Increasing number of colonic diverticulae	Bleeding or infection
Decreased liver drug metabolism	Drug toxicity
Changes in colonic function	Constipation, sensitivity to many drugs





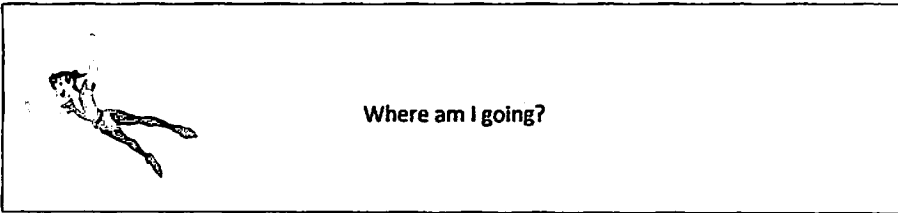
## MUSCULOSKELETAL SYSTEM

CHANGE	CONSEQUENCE
↓ Muscle mass	↓ strength (greater than amount of mass lost), predisposition to falls
↑ bone loss with advancing age	Loss of height, predisposition to fractures (vertebral, hips, pelvis, wrist)
<b>Osteoarthritis risk factors</b> <ul style="list-style-type: none"> <li>• ↑ age</li> <li>• Female sex</li> <li>• Obesity</li> <li>• Major joint trauma</li> <li>• Occupation</li> <li>• Hypermobility</li> <li>• Various diseases</li> </ul>	<ul style="list-style-type: none"> <li>• Impaired mobility</li> <li>• Predisposition to falls</li> <li>• Pain</li> <li>• ↓ quality of life</li> <li>• For Peter Pan: not clear if flying is significantly affected</li> </ul>

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# NEUROLOGICAL SYSTEM

CHANGE	CONSEQUENCE
↓ taste and smell	Weight loss, ↓ enjoyment of food
Changes in cognition (vary widely, more in episodic memory, less in semantic and procedural memory)	Poorer multi-tasking, slower in performance.
Slower nerve conduction (and slowing of processing)	Slower reflexes, predisposition to falling, poorer athletic performance
↑ prevalence of delirium and dementia	Disability and death



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## **DIFFERENT MEMORY FUNCTIONS**

- Human memory is very complex and is best thought of in relation to different functions
- Different memory functions are affected differently by aging and disease



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## **MEMORY FUNCTIONS**

- Primary (working) memory
- Secondary memory
- Implicit memory
- Explicit memory
- Episodic memory
- Semantic memory
- Declarative vs. Procedural memory

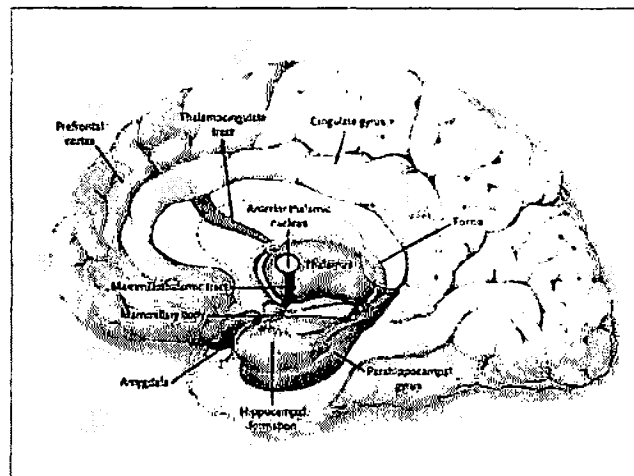


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**Table 1. Selected Memory Systems**

Memory System	Major Anatomical Structures Involved	Length of Storage of Memory	Type of Awareness	Examples
Episodic memory	Medial temporal lobes, anterior thalamic nuclei, mammillary bodies, fornix, prefrontal cortex	Minutes to years	Explicit, declarative	Remembering a short story, what you had for dinner last night, and what you did on your last birthday
Semantic memory	Medial temporal lobes	Minutes to years	Explicit, declarative	Knowing who was the first president of the United States, the color of a lion, and how a fish differs from a comb
Procedural memory	Basal ganglia, cerebellum, supplementary motor area	Minutes to years	Explicit or implicit, nondeclarative	Driving a car with a standard transmission (explicit) and learning the sequence of numbers on a touch telephone without trying (implicit)
Working memory	Prefrontal, prefrontal cortex, Broca's area, Wernicke's area, Spatioprefrontal cortex, visual association areas	Seconds to minutes, information actively rehearsed or manipulated	Explicit, declarative	Phonologic: keeping a phone number "in your head" before dialing Spatial: mentally following a route or locating an object in a room



Prefrontal cortex

Supplementary motor area

Basal ganglia (putamen)

Inferolateral temporal lobe

Cerebellum

Legend:

- Semantic memory
- Procedural memory
- Working memory

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Table 2. The Memory System and Executive Control System: The Memory System

Memory system	
Executive control system	
Working memory	
Procedural memory	
Semantic memory	

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## PRIMARY MEMORY

- Also known as immediate memory or working memory
- Limited capacity memory system, used to store small amounts of information for short periods (often while doing something with it, e.g. remembering a telephone number until after you dial it)
- Forgetting is adaptive as it allows new information to enter



## PRIMARY (WORKING) MEMORY

- Simple tasks such as digit span are not much changed with age alone
- However, when primary memory tasks are combined with a motor task (dialing a phone number) the difference between young and old increases





## SECONDARY MEMORY

- Holds memory for long periods of time
- Older people are slower in encoding and retrieving information
- Recall of 'arbitrary' facts declines, but not recalling meaningful data
- Physical health an important factor



## DECLARATIVE VS PROCEDURAL MEMORY

### Declarative Memory

- Memory for facts
- Older people often know more
- Storage of new facts may slow

### Procedural Memory

- Ability to perform skills. Relatively resistant to aging
- Procedural learning is slower



## SEMANTIC VS. EPISODIC MEMORY

### Semantic Memory

- Stored info re language and meaning of words
- Should remain normal with ageing altho slower to acquire new information
- Tested by tests of verbal fluency e.g. words starting with 'C'

### Episodic Memory

- Remembering events (including verbal or visuospatial)
- Activites and current events, therefore content and context
- Storage of new info slower, but content increases with age



## OTHER COGNITIVE FUNCTIONS

- Language
- Visuospatial function
- Psychomotor function
- Executive functioning

These cognitive functions have some decline with age. Executive functioning is very complex and the variability is great.



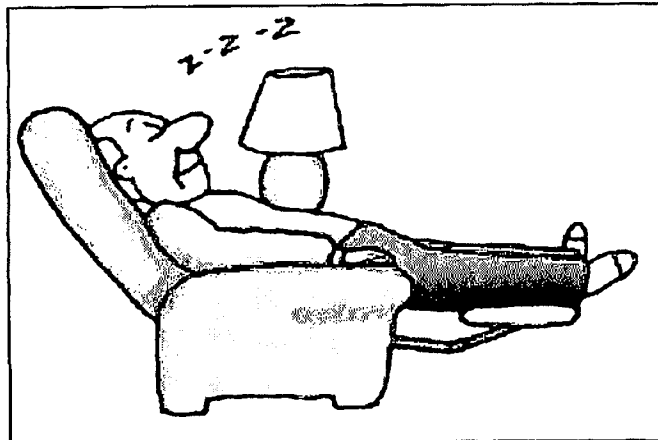
## AGING AND SLEEP



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## CONSEQUENCES OF POOR SLEEP: SLEEPING AT THE WRONG TIME



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## EMBARRASSMENT



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## POOR SLEEP

### Consequences (correlation)

- ↓ quality of life
- ↓ mobility and balance with ↑ falls risk
- ↑ mortality



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## NORMAL AGING AND SLEEP

### Sleep in younger adults

- Entered via non rapid eye movement (REM) sleep
- Progresses from Stage 1 to Stage 4, progressively deeper sleep (stage 3 and 4 are called slow wave sleep or SWS)
- The longer a young person is sleep deprived, the more stage 3 and 4 sleep they get, suggesting it is more restorative. The earlier sleep cycles have more SWS.
- REM or 'dream sleep' and the largest amount occurs later in the night. In infants REM sleep is predominant, suggesting a role in human development



### Sleep in older adults

- Changes start at about age 40 and mostly plateau about age 60 (only sleep efficiency continues to decline)
- SWS declines, perhaps more in women
- REM sleep declines
- More nocturnal awakenings and more daytime napping (? retirement effect)
- Earlier bed time and earlier awakening. The circadian changes in body temperature change in a similar manner with aging
- This suggests that the quality of sleep naturally declines with age, and that we are unlikely to sleep like teenagers as we age



## **COMMON NON SLEEP DISORDERS**

- Depression (and bereavement)
- Cognitive impairment
- Arthritis (shoulders and hips especially)
- Enlarged prostate
- Nocturia
- Medications (including alcohol)
- Functional impairment



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## **Depression (and bereavement)**

- Targeted treatment
- If medication selected as one of the treatment modalities, a sedating medication can be selected
- For bereavement, consider support groups



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## Cognitive impairment

- Very difficult to manage
- Increased activity during the day
- Regular schedule
- Bright lights during the day, avoidance during the evening
- Avoid alcohol
- Melatonin?
- Side effects of sleeping medications increased



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## Arthritis (shoulders and hips especially)

- Night time analgesia
- If shoulder to be injected, should be done under radiologic control
- If hip pain on sleeping, need to exclude trochanteric bursitis (amenable to steroid injection) from arthritis of hip
- The latter usually requires surgery if there is nocturnal pain



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## Enlarged prostate

- Alpha blockers
- Anti androgens
- Surgery-significant side effects (incontinence and impotence)



## Medications (including alcohol)

- Alcohol disrupts sleep
- Many prescription drugs disrupt sleep via numerous mechanisms
  - Diuretics—nocturia, restless legs
  - Calcium channel blockers—heartburn
  - Major Tranquilizers—restless leg type symptoms
- Careful review required





## Functional impairment

- Thorough assessment for reversible causes of impaired function
- General sleep hygiene
- Gradually increasing activity



## MANAGING PRIMARY SLEEP DISORDERS

- Sleep disordered breathing
  - Obstructive sleep apnea
  - Central sleep apnea
- Movement disorders
  - Restless Leg Syndrome (RLS)
  - Periodic Limb Movements in Sleep (PLMS)
- Advanced Sleep Phase Syndrome
- REM disordered sleep
- **Primary Insomnia**



## Sleep disordered breathing

- Suspected by history, especially from bed partner
- Snoring very non specific, partial awakening with a gasp or choking, or observation of apneic episodes more helpful
- Nocturia often part of the syndrome
- Daytime sleepiness not always present
- Weight loss, alcohol cessation, medication review
- Positive pressure (CPAP) or mandibular advancement usual treatment



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## Movement disorders

- Up to 10% of elderly population affected
- Review of medications, check for iron deficiency
- Education, moderate exercise, smoking cessation, avoiding alcohol and caffeine
- Dopaminergic agents (ropinirole, pramipexole) useful, ?gabapentin



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## Primary Insomnia

- 10-20% in general population
- ~40% in those over 65
- Likely co-morbid conditions discussed before are a factor in this increase with age
- Consequences (correlation):
  - ↓ quality of life
  - ↓ mobility and balance, ↑ falls risk
  - ↑ mortality



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## Sleep Diary

- Daytime Activities and Pre-sleep Ritual (Completed before bedtime)
- Naps (how many/how long)
- Exercise (what type/how long)
- Alcohol and caffeine (amount/how many)
- Food and drink (heavy or light; meal timing)
- Feelings (1, very tired; 2, somewhat tired; 3, fairly alert; 4, wide awake)
- Stress/irritability level before bedtime (1, none; 2, some; 3, moderate; 4, high)
- Medications or sleep aids (types/dose/timing)
- Activities the last hour before bedtime
- Bedtime routine (meditation/relaxation/how long)
- Bed time, time of "lights out"
- Sleeping and getting back to sleep (completed on awakening)
- Wake-up time, time of "lights on"
- Time to fall asleep (minutes)
- Sleep breaks (number of awakening and total time awake)
- Quality of sleep (0-10; 0 worst to 10 best ever)
- Total sleep time (in hours)

Data must be documented daily for a minimum sample time of 2 weeks.



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## Sleep Hygiene

### Behavioural Patterns

- Keep a regular sleep/wake schedule (including weekends and holidays).
- Do not go to bed unless sleepy.
- Decrease or eliminate daytime naps ( $\leq 30$  min daily, no later than the early afternoon).
- Exercise regularly (but not within 3-5 h of bedtime).
- Increase exposure to natural light and bright light during day and early evening; avoid exposure to bright light close to bedtime or when awakening during night.
- Avoid heavy meals and liquids within 3 h of bedtime.
- Limit or eliminate alcohol, caffeine, and nicotine, especially before bedtime.
- Keep relaxing routine (wind down before bedtime, maintain a routine period of preparation for bed, use warm bath/ socks).
- Wear comfortable bed clothing.
- Avoid distressing "pillow talk" with bed partner.
- Do not use bed for reading or watching television.
- Get out of bed once



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If unable to fall asleep within 30 min, get out of bed and relax (by listening to soft music or light reading)

### Sleep Environment

- Identify snoring or disruptive bed partners.
- Keep bedroom cool and dark.
- Eliminate as much noise from sleeping quarters as possible.
- Place clocks out of sight.
- Address pets that interfere with sleep.



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### Drugs 'Safer' in the Elderly

Agent	Adverse Effects	Indications
Zolpidem	Abdominal pain, dizziness, headache, rebound insomnia, somnolence, memory loss	Sleep onset
Zaleplon	Δ in colour vision Nausea, myalgia	Sleep onset and maintenance
Eszopiclone	Headache, bitter taste, dry mouth, somnolence, amnesia	Sleep onset and maintenance
Ramelteon (melatonin receptor agonist)	Headache, fatigue, somnolence, dizziness	Sleep-onset latency and total sleep time in chronic insomnia



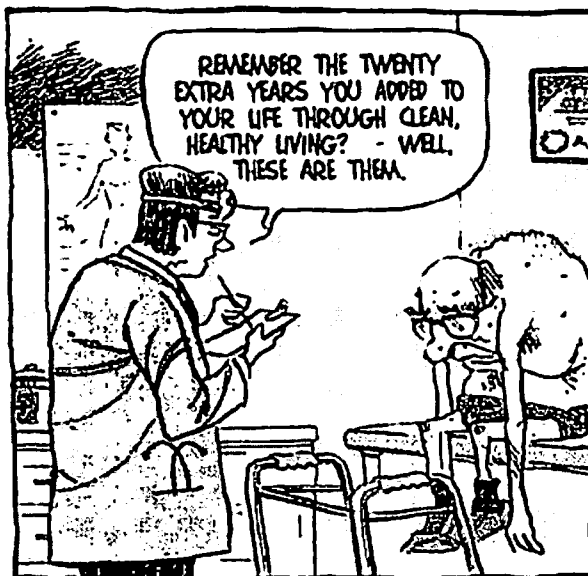
### SUMMARY

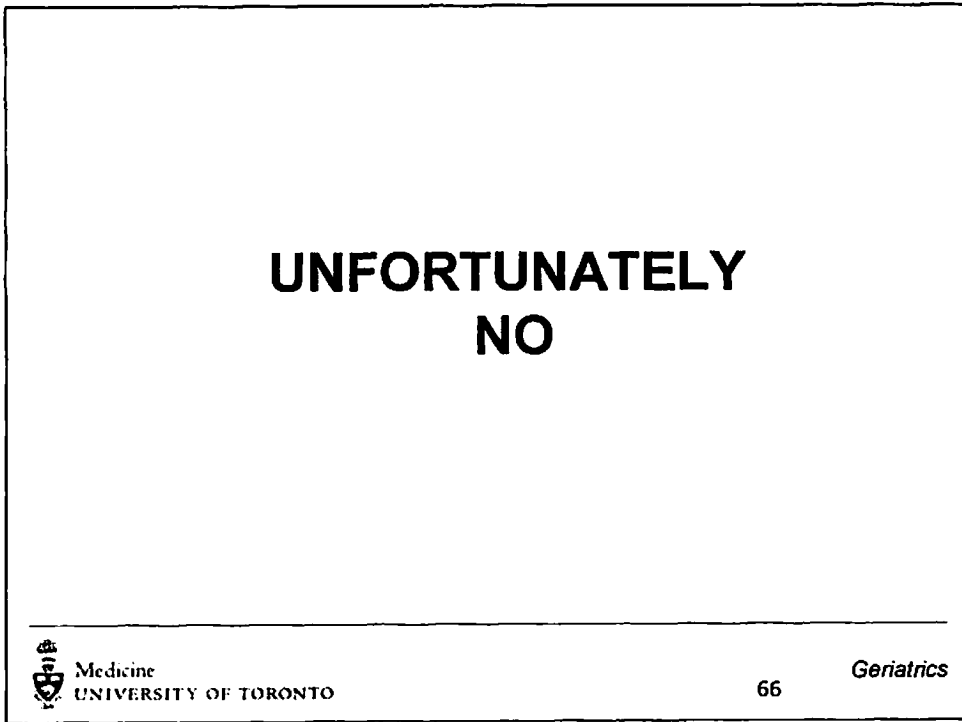
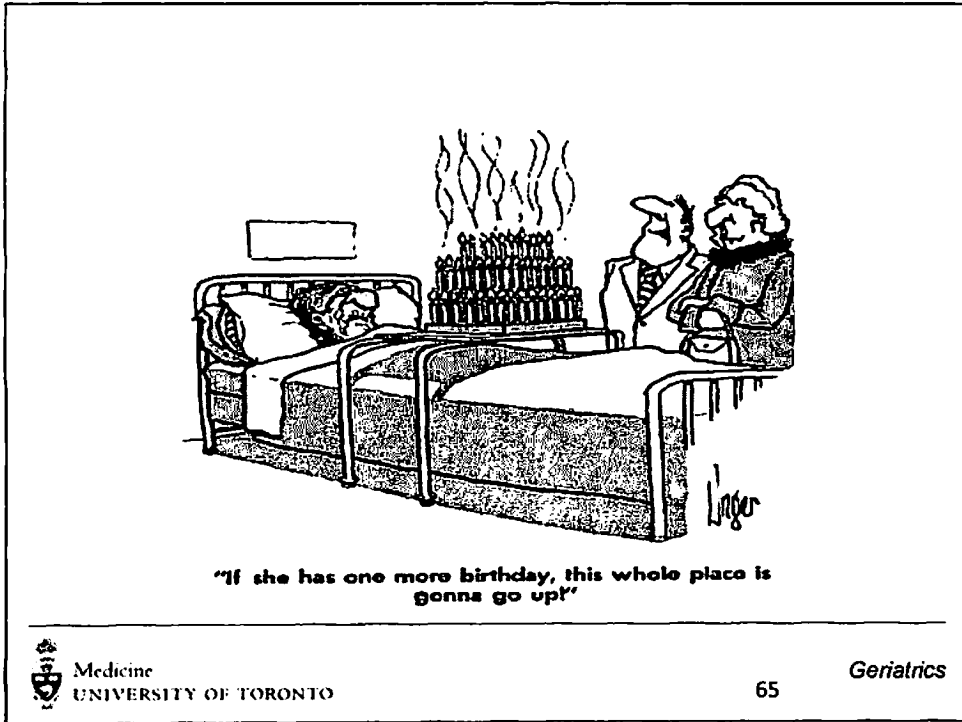
- Insomnia is common and associated with decrease in quality of life
- Many medications (including alcohol) disrupt sleep
- A careful medical evaluation for co-morbid conditions and primary sleep disorders is helpful
- Sleep hygiene is the first step for primary insomnia
- Medications carry significant risks that increase with cognitive impairment and advancing age



# ANTI-AGEING MEDICINE

DOES IT WORK?







**GUIDE TO THE PERPLEXED**  
**No illness which can be treated by the diet should be treated by any other means**

**Maimonides**

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**As long as a person exercises and exerts himself...sickness does not befall him and his strength increases.... But one who is idle and does not exercise...even if he eats healthy foods and maintains healthy habits, all his days will be of ailment and his strength will diminish."**

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## HOW LONG WILL I LIVE?

"When a man knows he is to be hanged...it  
concentrates his mind wonderfully."

-Samuel Johnson as quoted by James Boswell

