Healthy Ageing

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Questions 1 & 2

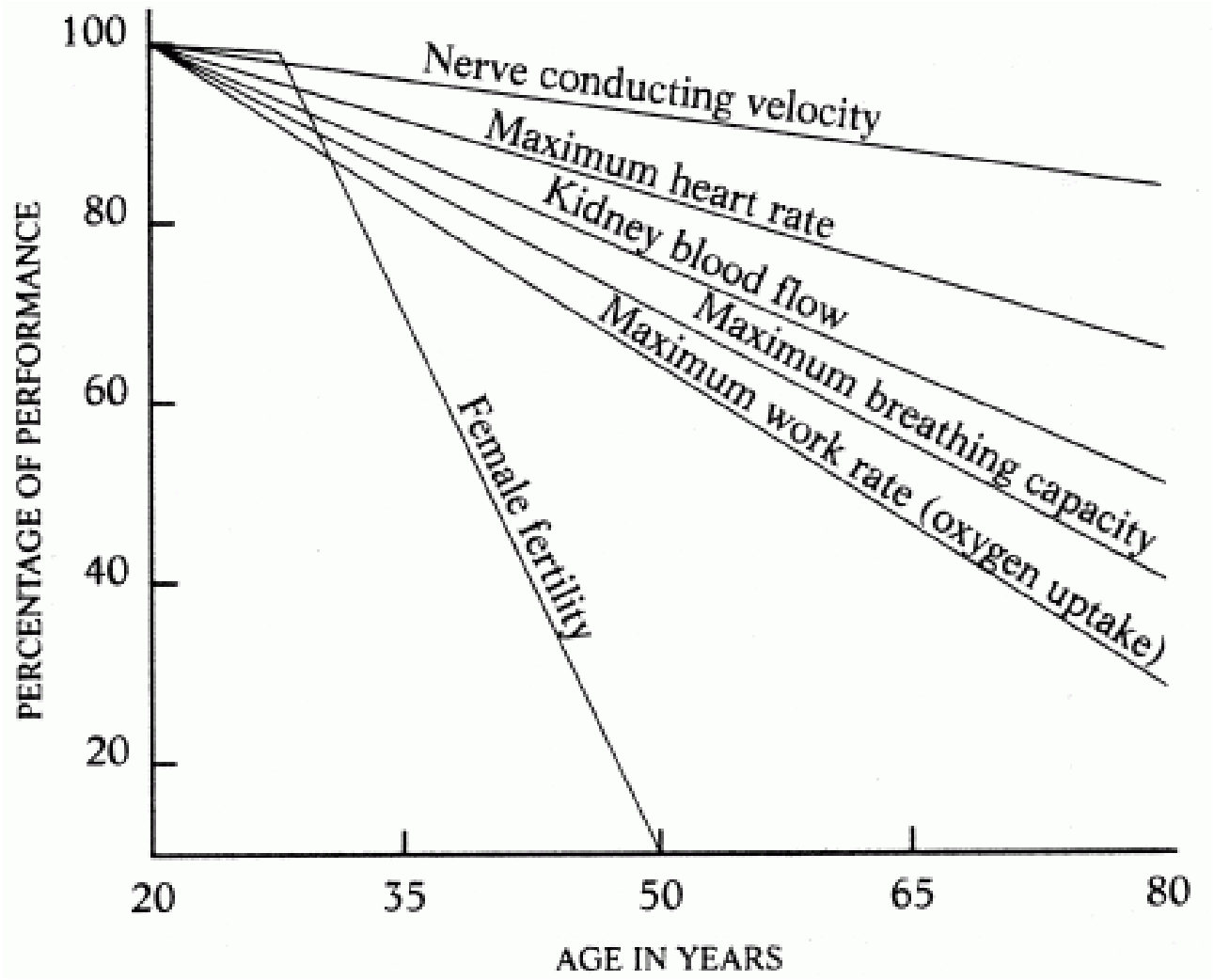
WHAT IS AGEING ?

WHO ARE AGED?

What is ageing?

- Collection of changes that render human beings progressively more likely to die *(Medawar, 1952)*
- **** Loss of viability and increase in vulnerability *(Comfort 1964)*
- Multi-dimension
  - Biological (eg. Immuno-senescence → *infection)*
  - Physical (eg. age-related muscle changes → *disability*)
  - Psychological (eg. learning, value, reflection in life)
  - Social (eg. loss of role)

Ageing -- Biological Model



Physical

Bitlanders.com

Psycho-social theories of Ageing

- **Erikson's psychosocial developmental model**

~ Age	Virtues	Relation	Example
20-39	Love	Friends, Partners	Romantic Relation
40-64	Care	Household, Workmates	Work, Parenthood
65 - death	Wisdom	Mankind, my kind	Reflection life

Aged --- a Social Construct

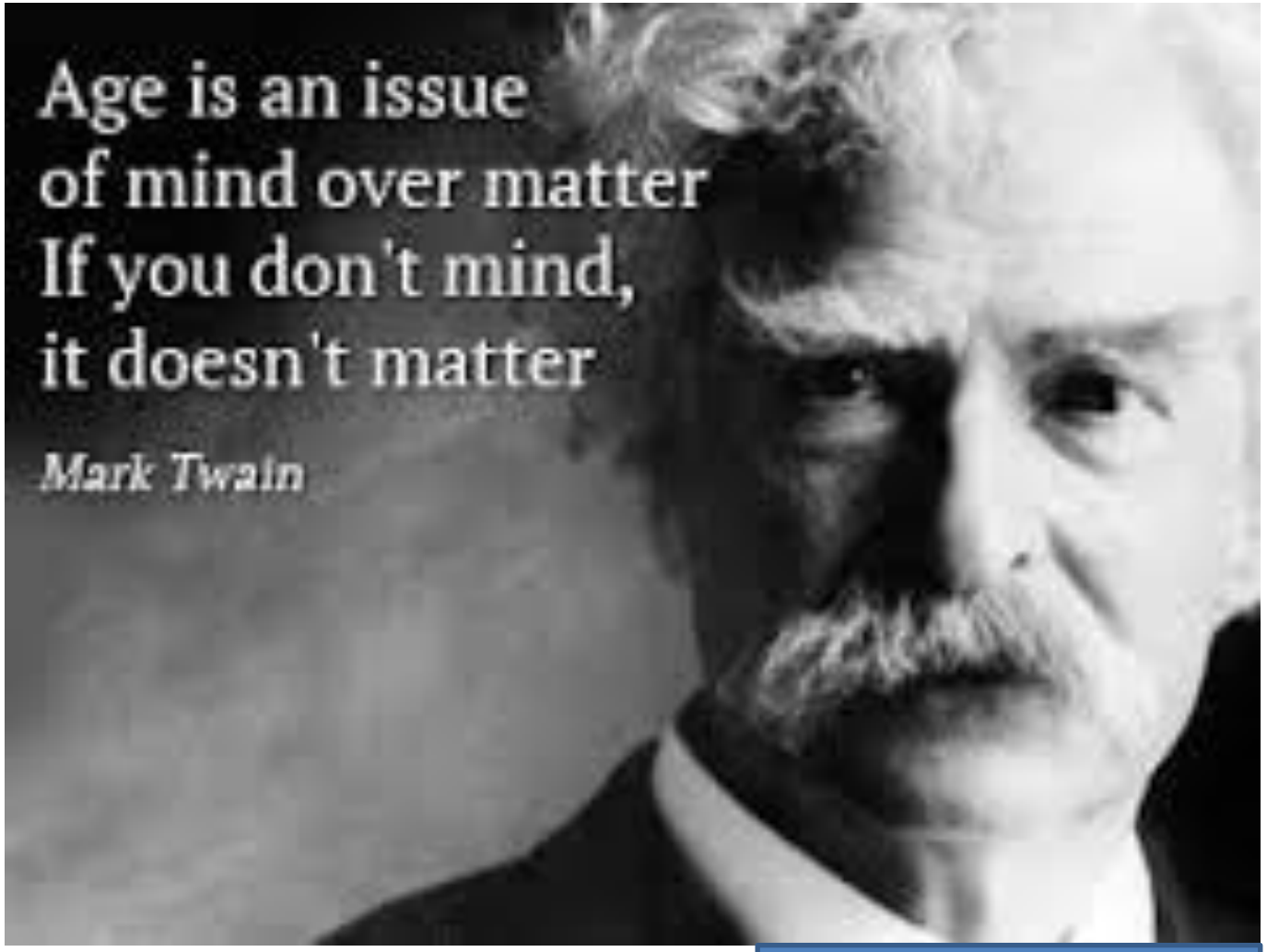
- **Chronological age?**
  - No unified cut off, usually 60-65
  - Many a time, related to pension-able age (socio-economic factor)

- **Dis-engagement Theory**
  - Withdraw between older person and society / social network
  - Society does not provide useful roles to older person
  - Example: Retirement age

Aged -- a Social Construct

- **Activity Theory**
  - Activity → role → satisfaction
  - Loss of role (eg. retirement, widowhood → less satisfied) → loss of value → aged

- **Implications**
  - Multi-dimensional aspects of ageing
  - Multi-dimensional components for successful ageing *(to be discussed later)*



www.hippoquotes.com

Questions 3 & 4

WHY DO WE AGE / CAN WE NOT AGE?
WHY DO WE WANT TO KNOW?

Ageing Theories / Can we not age?

- Cellular senescence
  - Telomere Theory
  - Accumulation of Waste
  - Free Radical Theory

- Ecological Theories

Cellular senescence

- **Dynamic Equilibrium**

  Cell death = Cell production
  - Cell death by ***senescence*** (cell stop dividing), ***apoptosis*** (purposeful cell death), or ***necrosis*** (cell death due to insults)

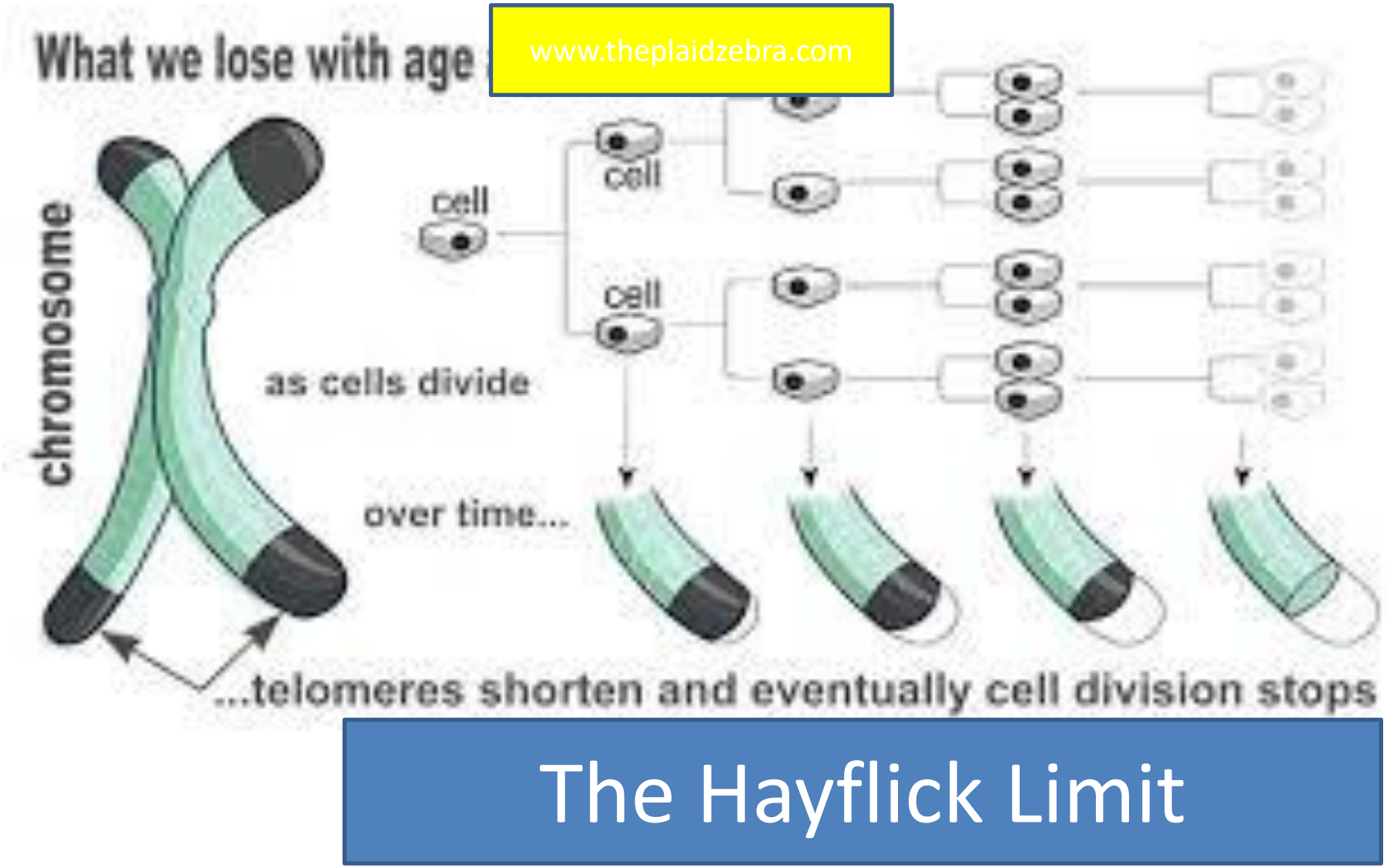
- Cell production (***Controlled)*** > cell death ➔ growth
- Cell production (***Uncontrolled)*** > cell death ➔ Cancer
- Cell death **>** cell production ➔ Disease / Tissue dysfunction

What controls cell senescence?

- Telomere
- Telomerase
  - (repair of telomere)
- Hayflick Limit

Blackburn, Greider and Szostak share Nobel Prize in Physiology or Medicine for discovering telomeres and telomerase (2009)

Cell Senescence



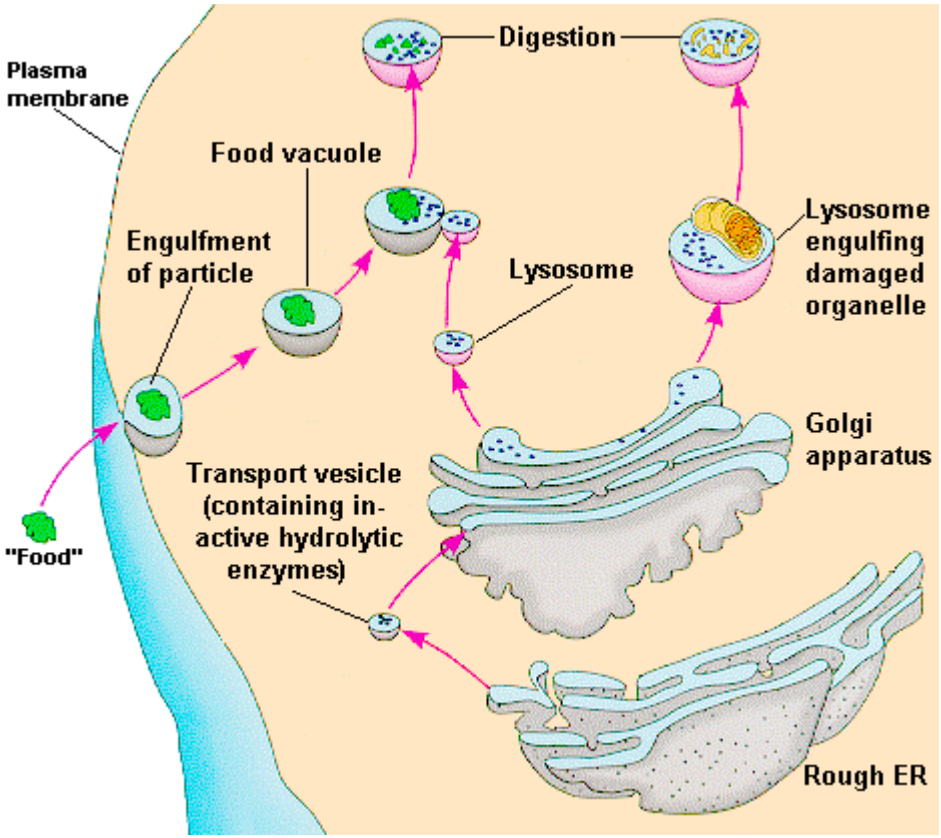
The Hayflick Limit

Factors related to Telomeres

- Shorter telomeres associated with
  - *(genetics)* gender, menopausal status
  - *(life style, demographic, psycho-social)* lower socioeconomic position, smoking, stress
  - *(age related)* obesity, insulin resistance, vitamin D and inflammation

➔ **Stress induced senescence / Implications on healthy ageing**

Cellular Waste Accumulation Theory



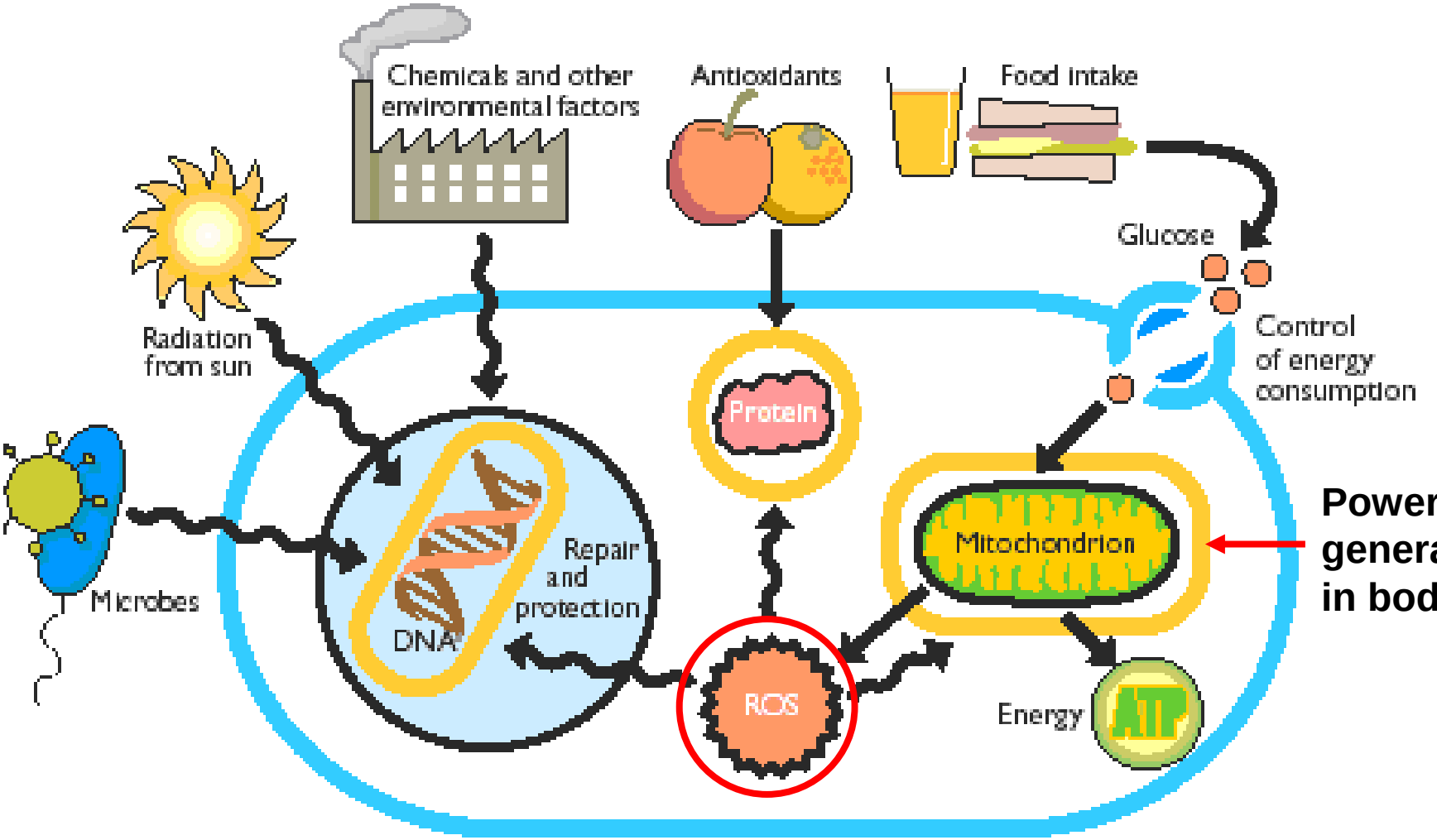
Lysosomes (溶酶體**)** digests damaged organelles, harmful invaders and wastes (including AGEs, lipid oxidation debris, heavy metals) in the cell.

www.people.virginia.edu

Waste accumulates as the cell ages

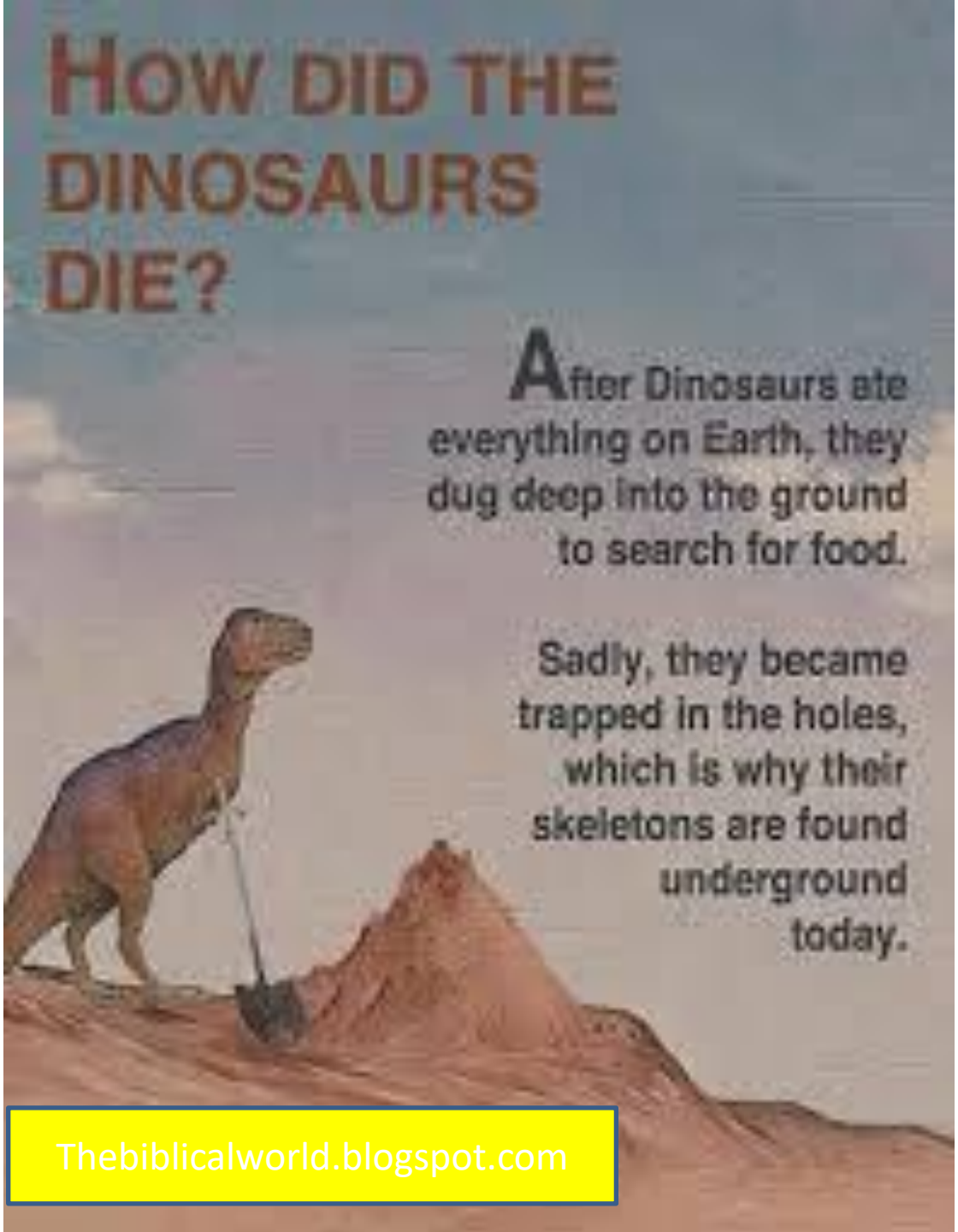
- Some wastes are difficult to breakdown by lysosomes (heavy metals, some AGEs, etc.)
- Detoxicification enzymes functions also decline with age (e.g. cytochrome p450 in liver)
- Problematic particularly in non-dividing cells (heart muscle cells, neurons, muscle cells)

Free Radical Theory



ROS (reactive oxidative species) generates free radicals that damages proteins and DNA

www.heattreat.ca/aging.php


HOW DID THE DINOSAURS DIE?
After Dinosaurs ate everything on Earth, they dug deep into the ground to search for food.
Sadly, they became trapped in the holes, which is why their skeletons are found underground today.
Thebiblicalworld.blogspot.com

Ecological Theories (example)

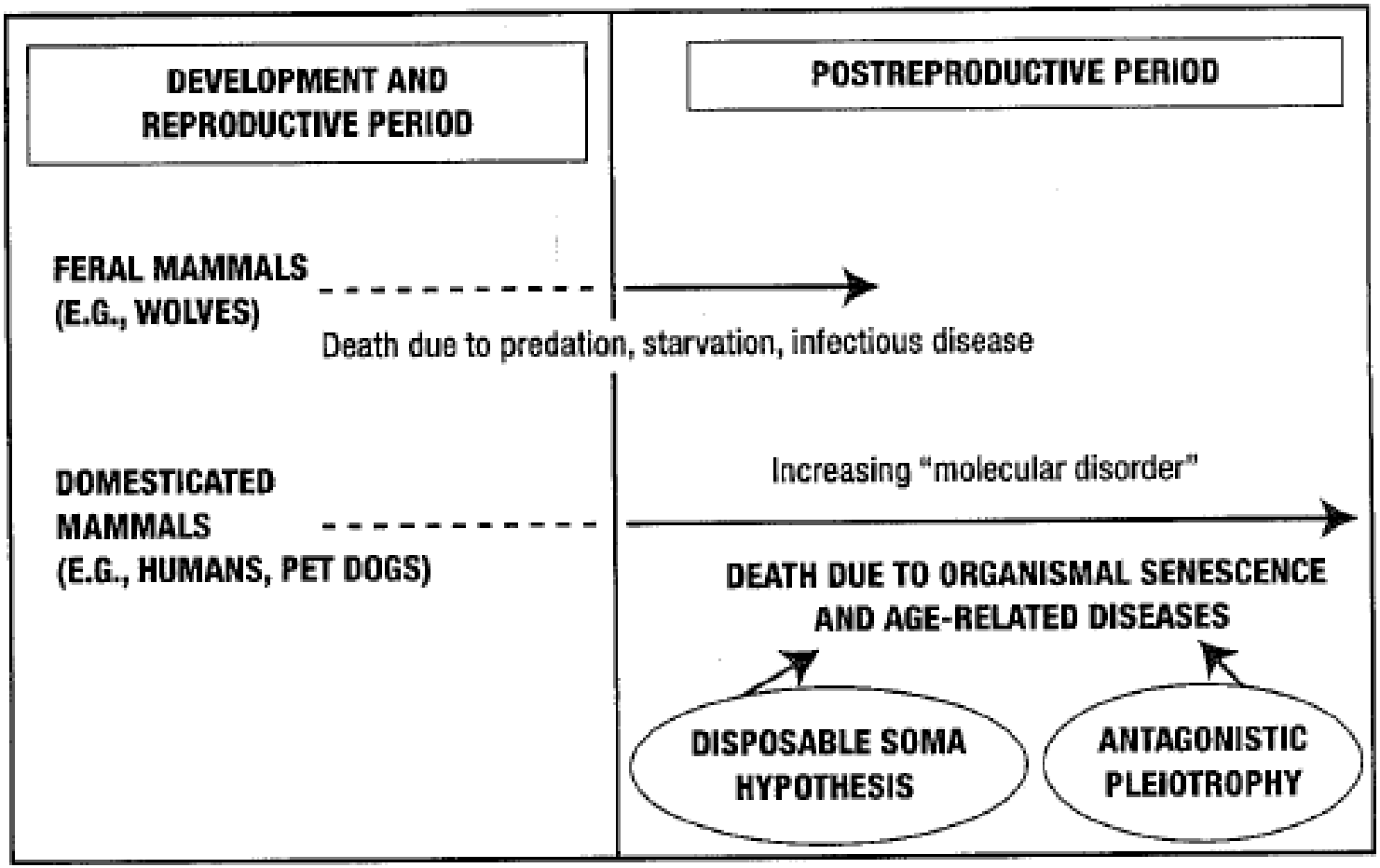


FIGURE 4.1 Domestication's curse: Organismal senescence and the incidence of age-related diseases.

Wilmoth JM, Ferraro KF, 2007

Disposable soma theory

(Kirkwood 1977)

Ageing through optimizing the investment in maintenance

Optimization:

- Given the continual hazard of accidental death, there is no point to “invest” too much for repairing
- Too low an “investment” is also not desirable (death before reproduction)

Thus

- investing on growth and reproduction + minimal investment as need for repair
- When soma dies → resources invested in its maintenance are lost → loss of organ reserves → ultimate death

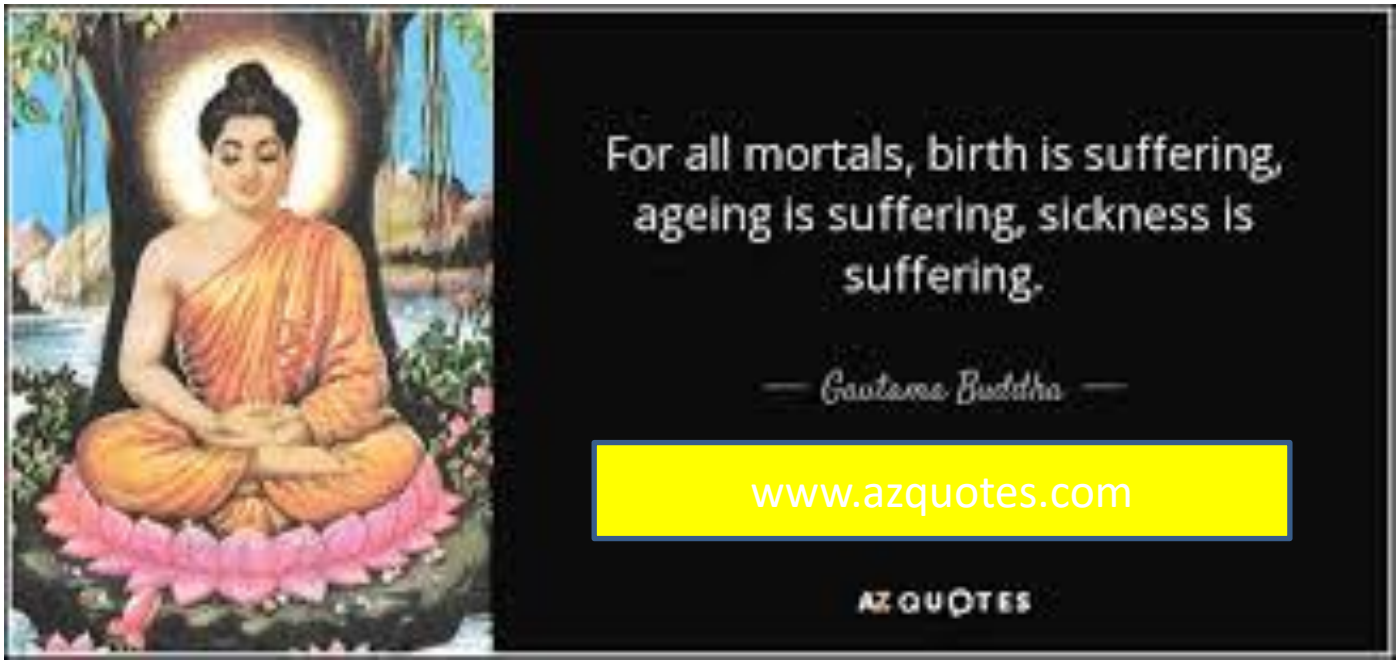
Antagonistic Pleiotropic Gene Theory

(Williams 1957)

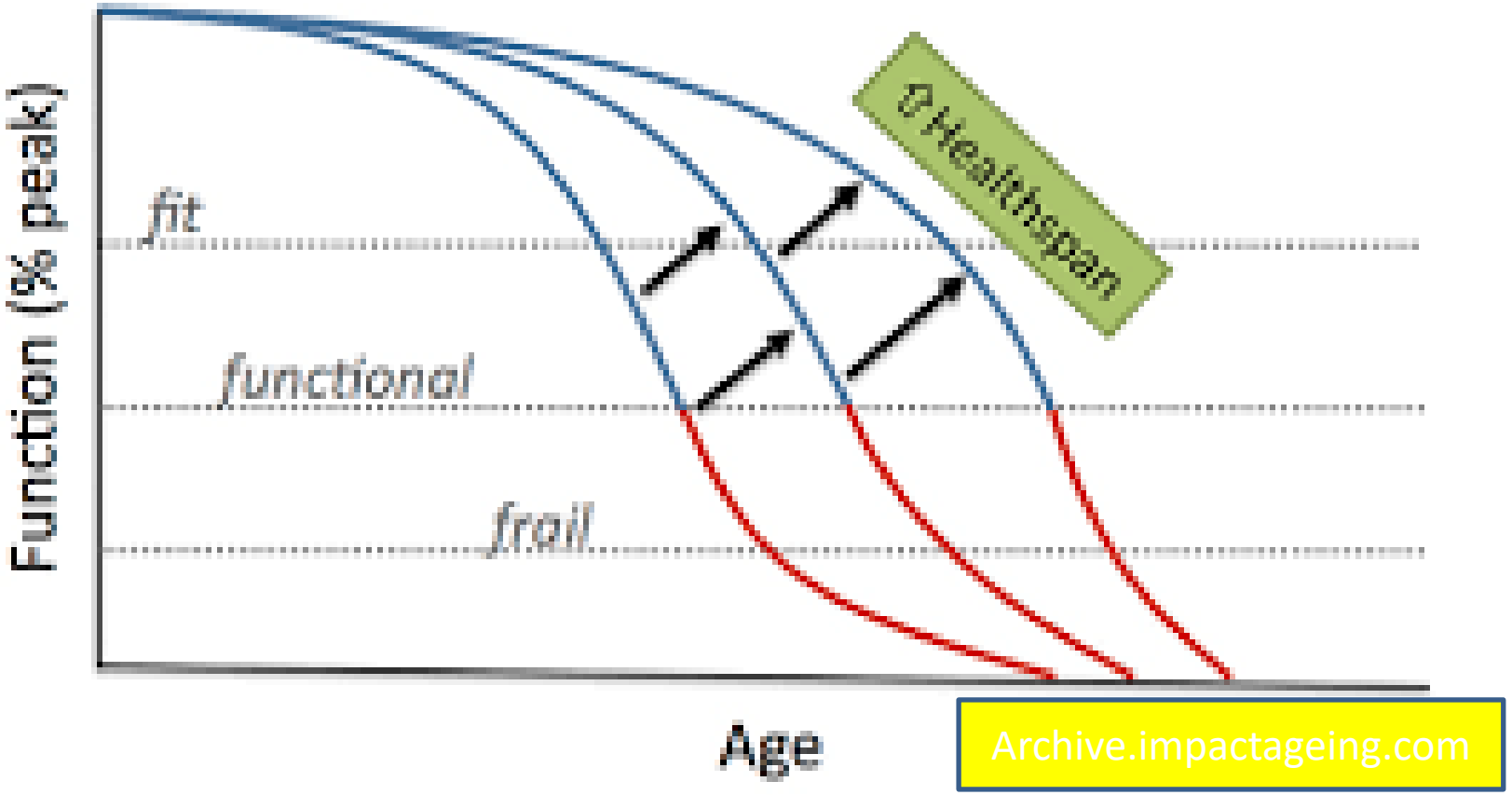
- Ageing as by-product of selection for other beneficial traits

- The same gene is responsible for both good effects early in life and bad effects late in life.
  - Examples:
    - gene for bone development (calcium deposition) pre-disposes to late life arterial calcification
    - Gene for rapid cell division (embryogenesis) → rapid growth of neoplasm

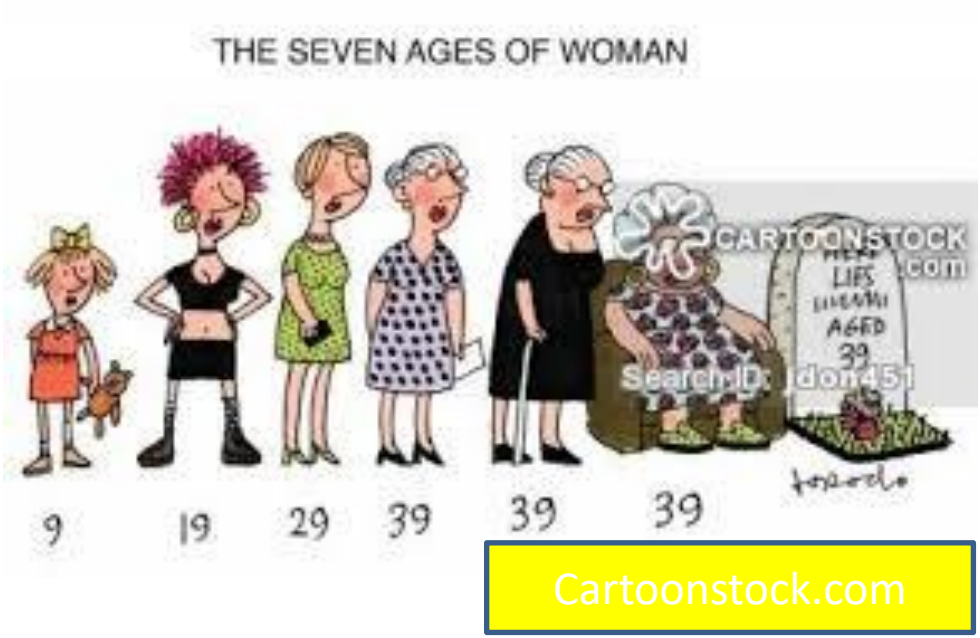
Ageing / Death is inevitable –
why do we want to know?



Compression of morbidity



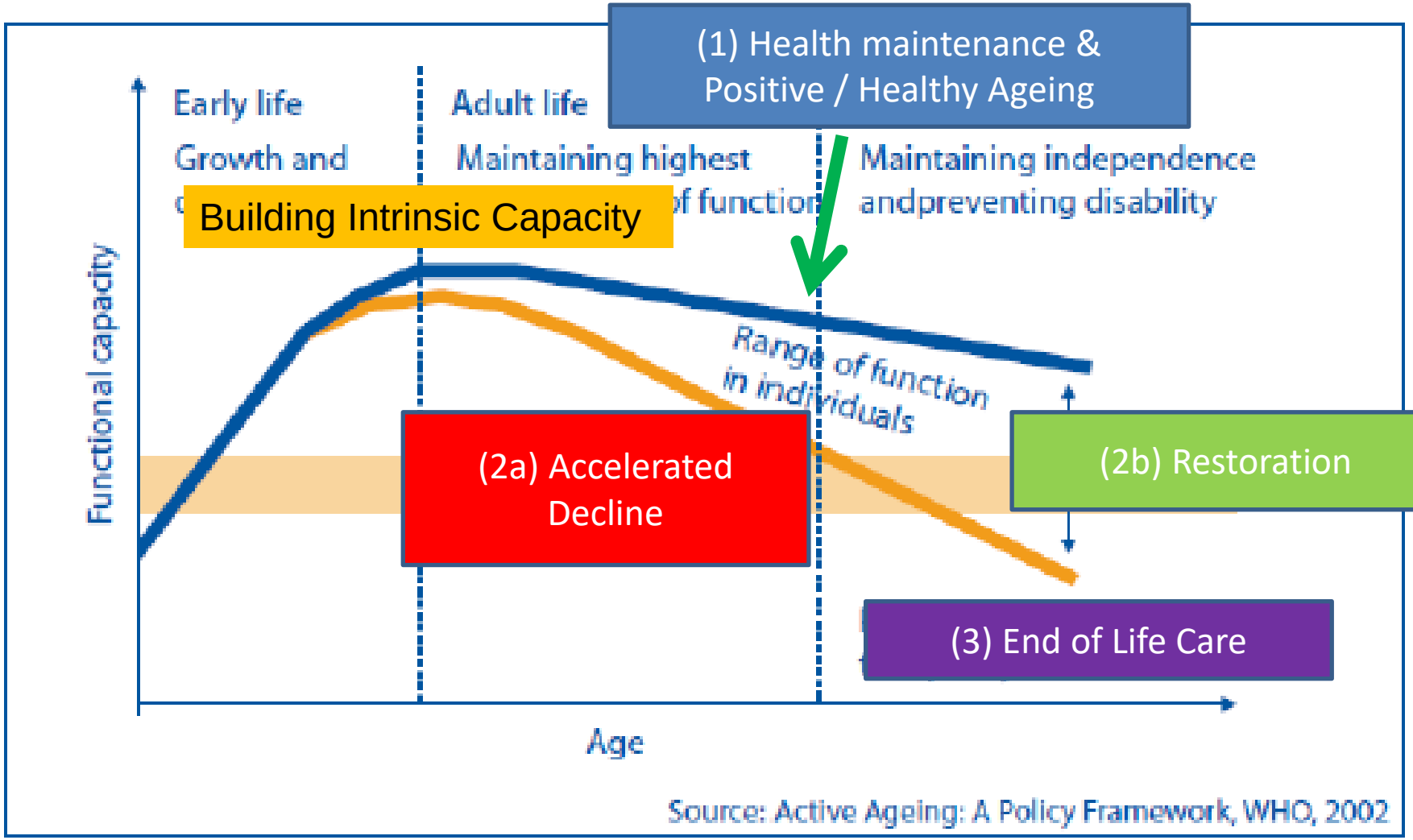
Question 5a



HOW ARE WE TO WORK ON IT?

The Working Model

Figure 2- Functional capacity over the life course



Death is inevitable –
why do we practice medicine?

- To achieve good *(healthcare related)* quality of living at life
  - *(WHO definition of health)* Bio-physical-psycho-social well being

- To achieve good quality of dying .. when the day is to come

Concept of Positive / Healthy Ageing

(Ng SH et al. International J Ageing and Human Development

2011; 73: 313)

- **Multi-dimensions**
  - **Biological:** Illness Avoidance
  - **Physical:** Body Functioning
  - **Psycho-social:** Engagement with Life (CE)
    - Concern and Support to others (lives)
  - **Psycho-social:** Engagement with Life (PE)
    - Financial and Productive Contributions to others (family / career / community)

What is Healthy Ageing?

- Process of developing and maintaining functional ability that enables well being of older age (WHO, 2016)

https://www.hkhs.com/en/our-business/elderly-housing

What is Healthy Ageing?

- The HIGHLIGHT ---- Focus on Functioning

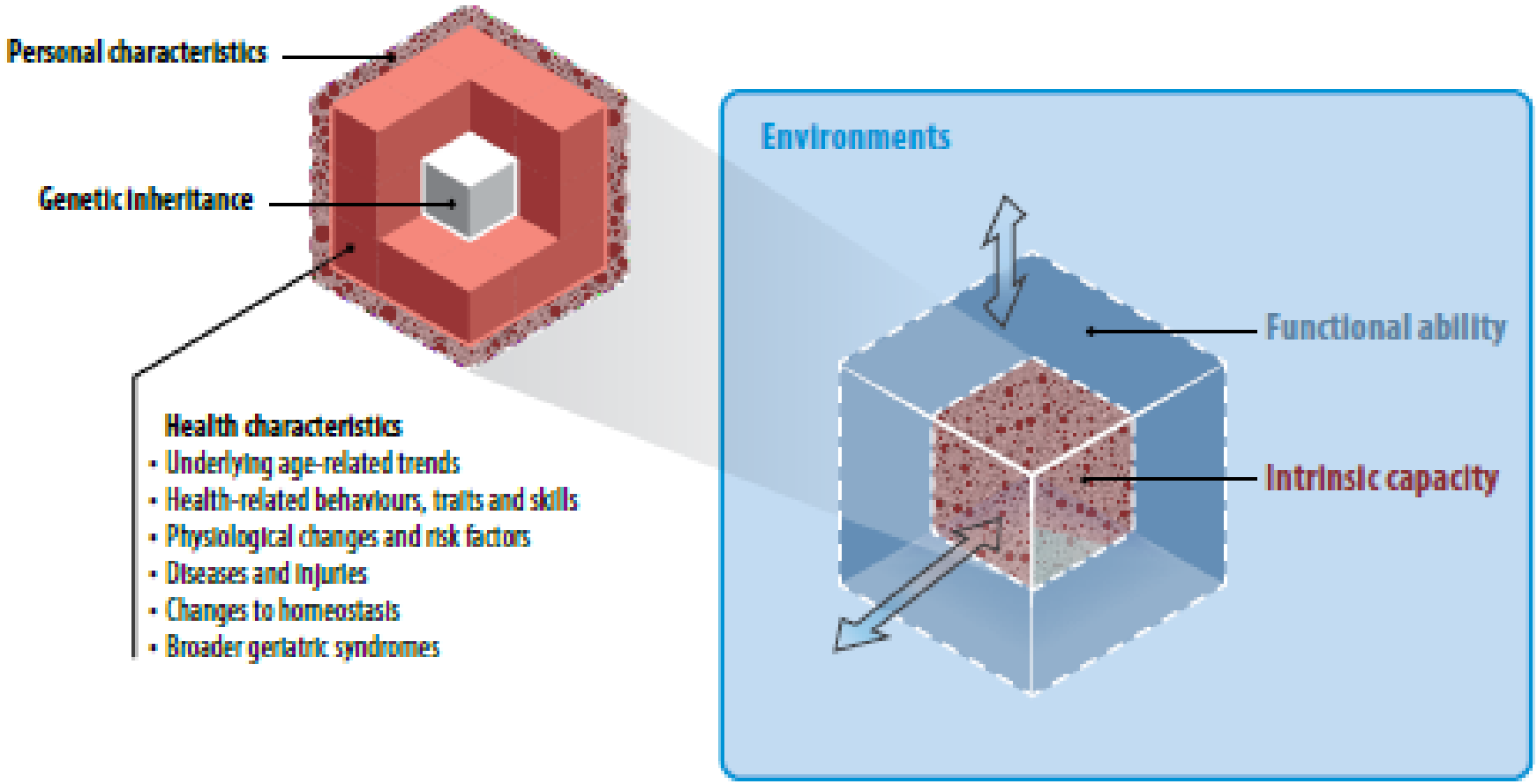
ie. Interactions between individual (intrinsic capacity) and the environment (including physical environment and supporting systems)

https://www.futuregen.solutions/2016/08/16/the-shameful-case-of-elder-abuse-in-society/ &
https://thediplomat.com/2019/11/how-does-japans-aging-society-affect-its-economy/

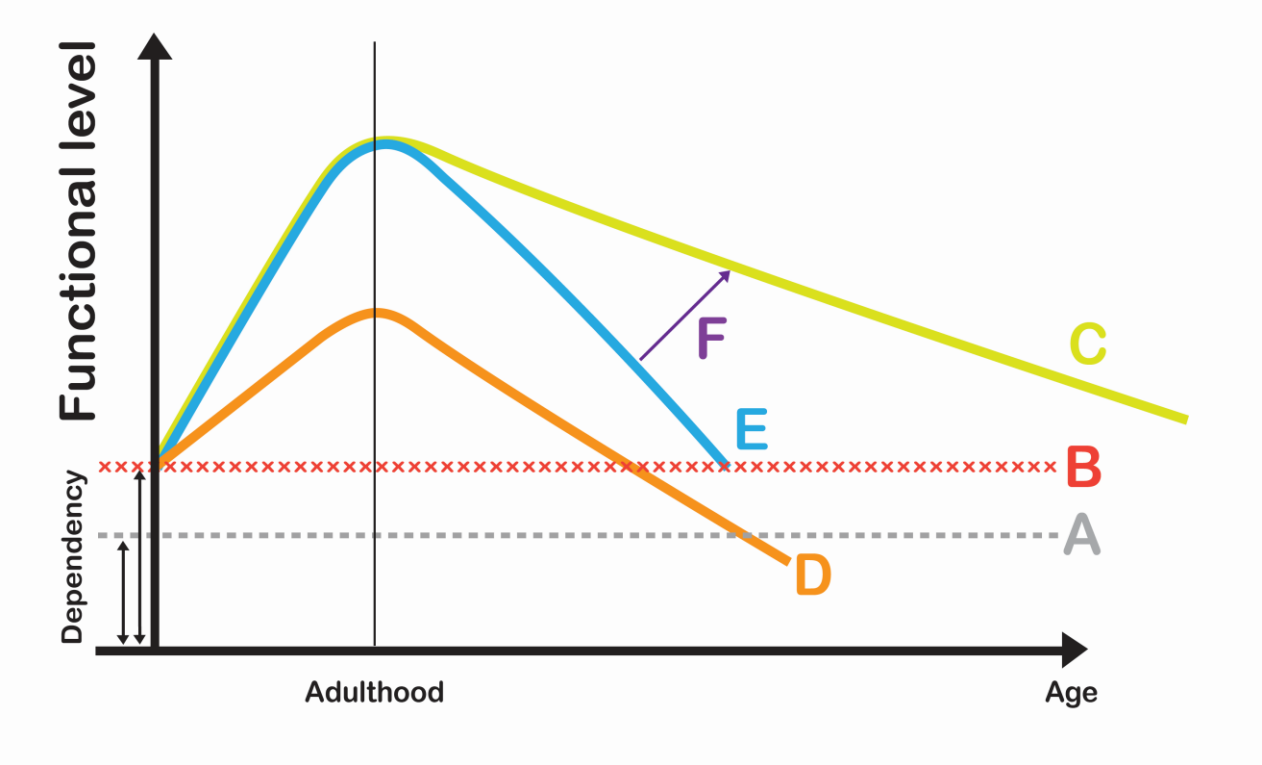
World Report in Ageing and Health

(WHO 2015)

Fig. 2.1. ***Healthy Ageing***



Intrinsic Capacity and function



- A-B: denotes impact of environmental factors

C-D: higher baseline level allows more reserve to lose before requiring assistance

E: Accelerated decline due to unfavourable lifestyle or disease state

F: restoration / reversal attempts

Healthy Ageing: Building up intrinsic capacity / slow down decline

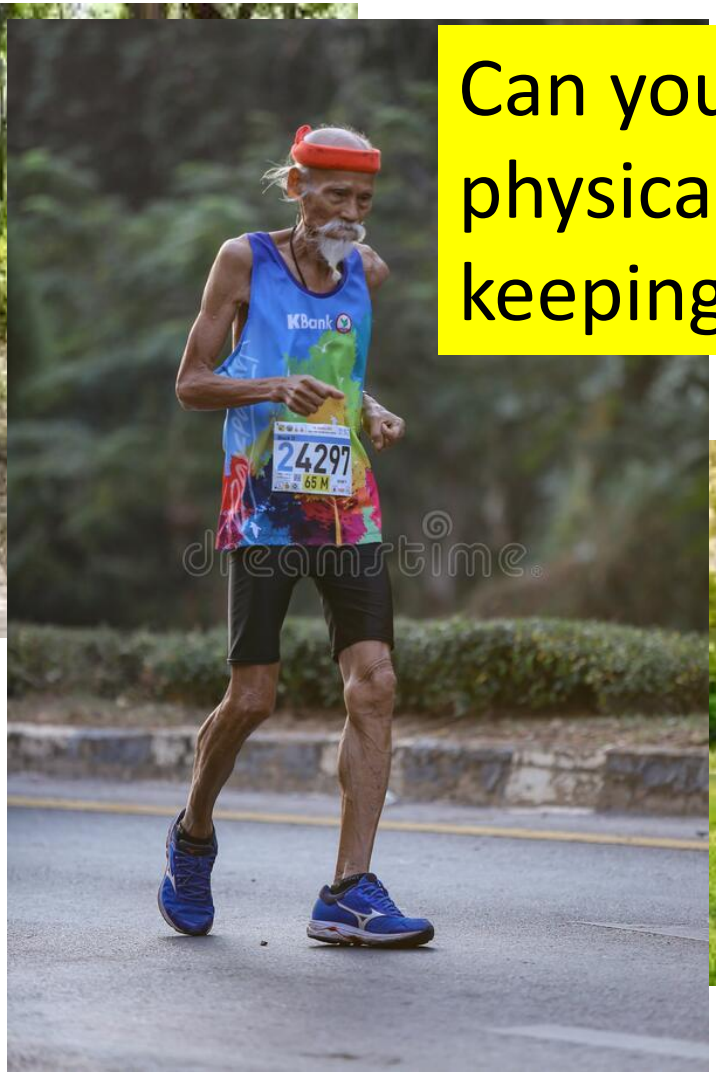
Modifiable factors

- Regular exercise / physical activities
- Healthy dieting and good nutrition
- Disease prevention / good disease control
- Maintain mental health
- Active life engagement with others and society

Non-modifiable factors

- Genetic composition
- Sex
- Chronological age

Physical Health



Can you maintain physical level just by keeping biological health?

Health, nutrition and sarcopenia

Muscle mass

- Decrease by 1% per year after age 30
- Accelerated decrease after age 60

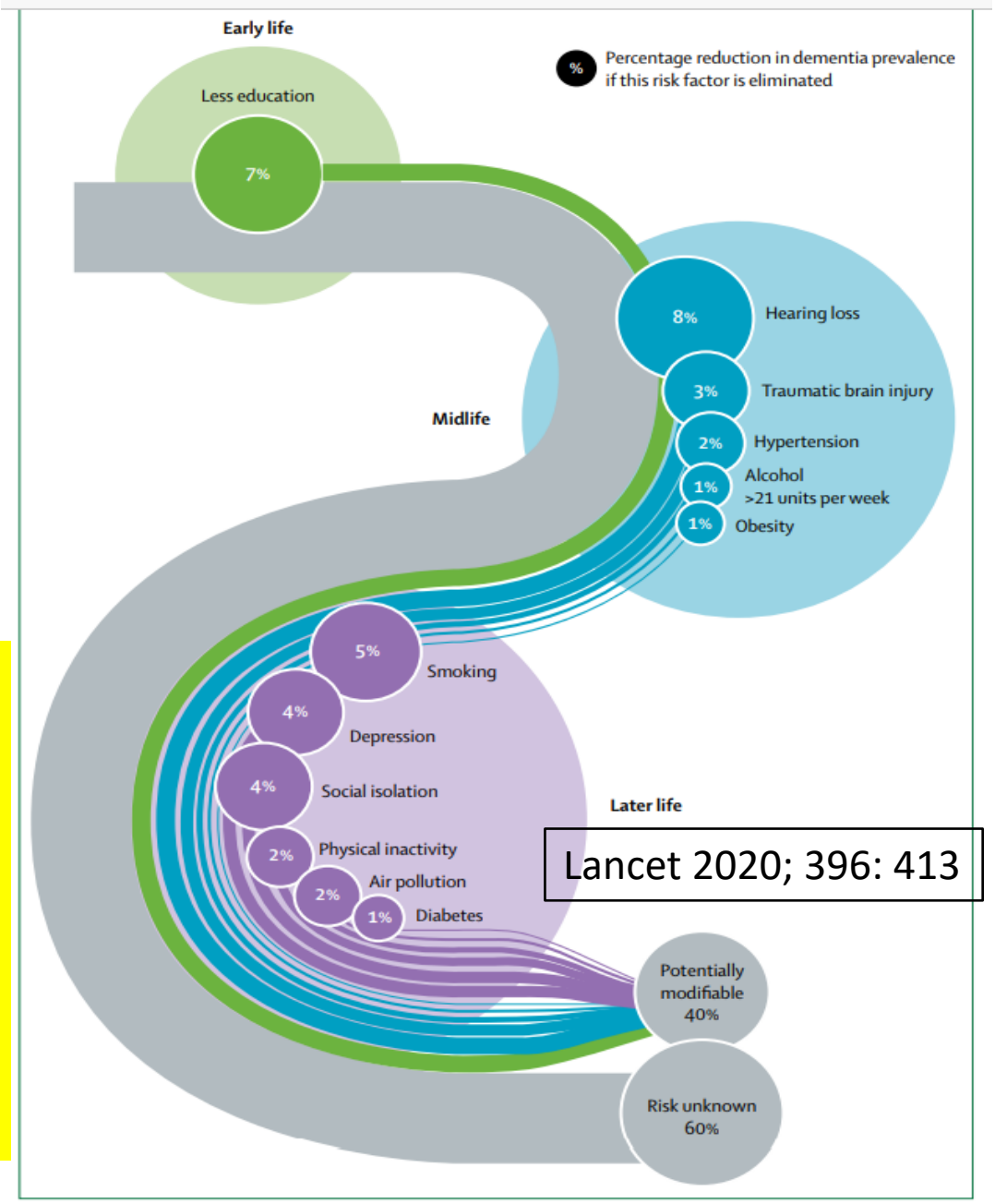
Muscle strength

- Decline by 1-2% per year between 50-60
- Decline by 3% per year after age 60

Can we reverse / maintain it?

Mental health and life engagement: dementia as example

Depression (4%),
Social isolation (4%)
Physical inactivity (2%)
contribute more than
DM (1%) / BP (2%) as
modifiable risk factor
against dementia



Lancet 2020; 396: 413

Figure 7: **Population attributable fraction of potentially modifiable risk factors for dementia**

Promoting psychosocial wellbeing

- Preparation for late adulthood
  - Transition form employment to semi- or full retirement, socially, financially and psychologically

Promoting psychosocial wellbeing

- Maintain harmonious interpersonal relationship
  - Accept changing society and to keep abreast with the changes
  - Open and share experience

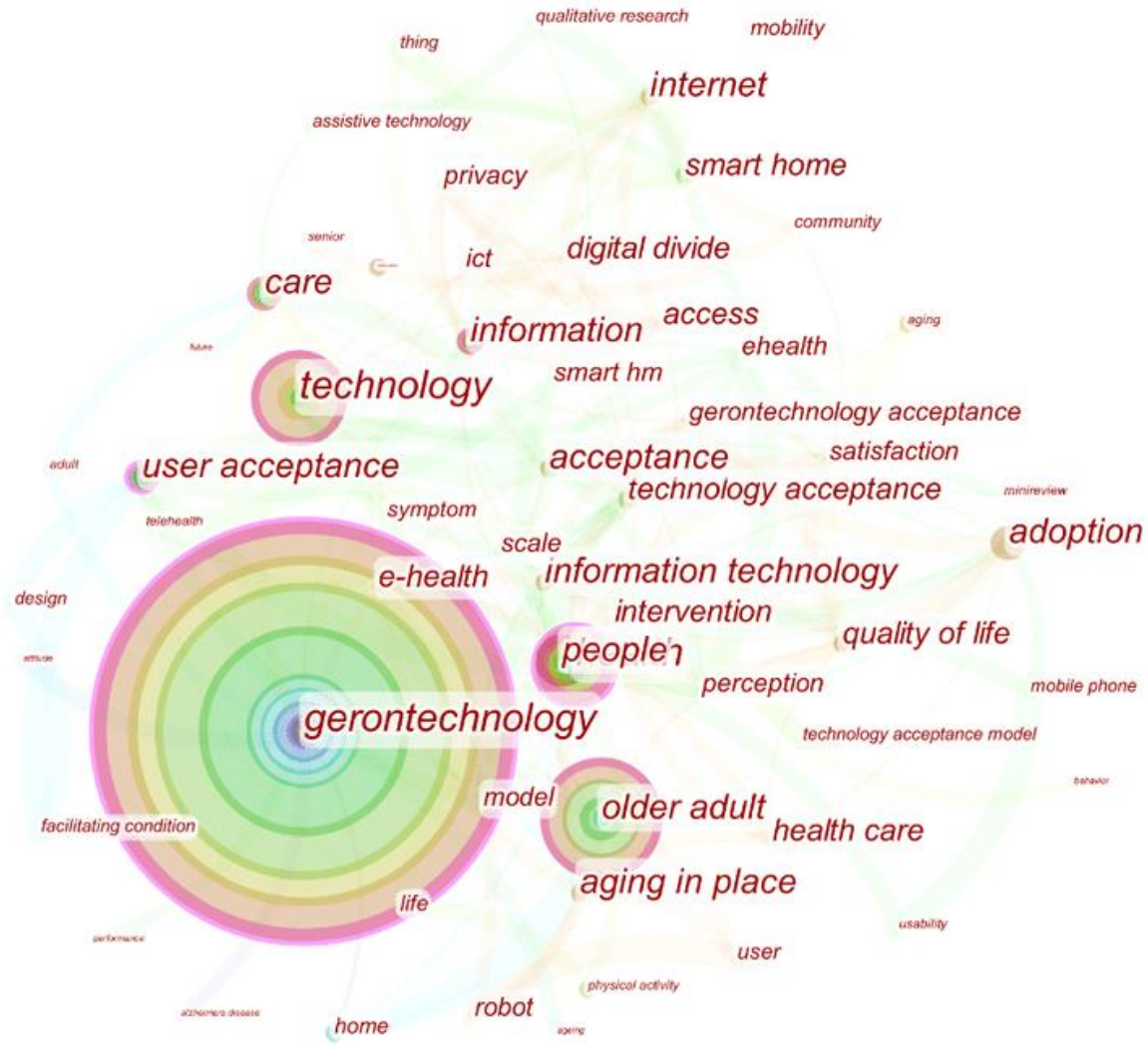
Promoting psychosocial wellbeing

- Positive use of time
  - E.g. care giving, voluntary work, further education, develop new interests
  - Allow social participation, keep in touch with socio-economic changes, keep away from loneliness and social isolation

Promoting psychosocial wellbeing

- Community participation / contribution to life
  - Sense of achievement and worthiness / value in life
- Develop realistic and philosophical outlook on life
  - Positive understanding of life
  - Adequate psychological preparation for all eventualities

Person – environment interface: Role / challenge in Gerontechnology

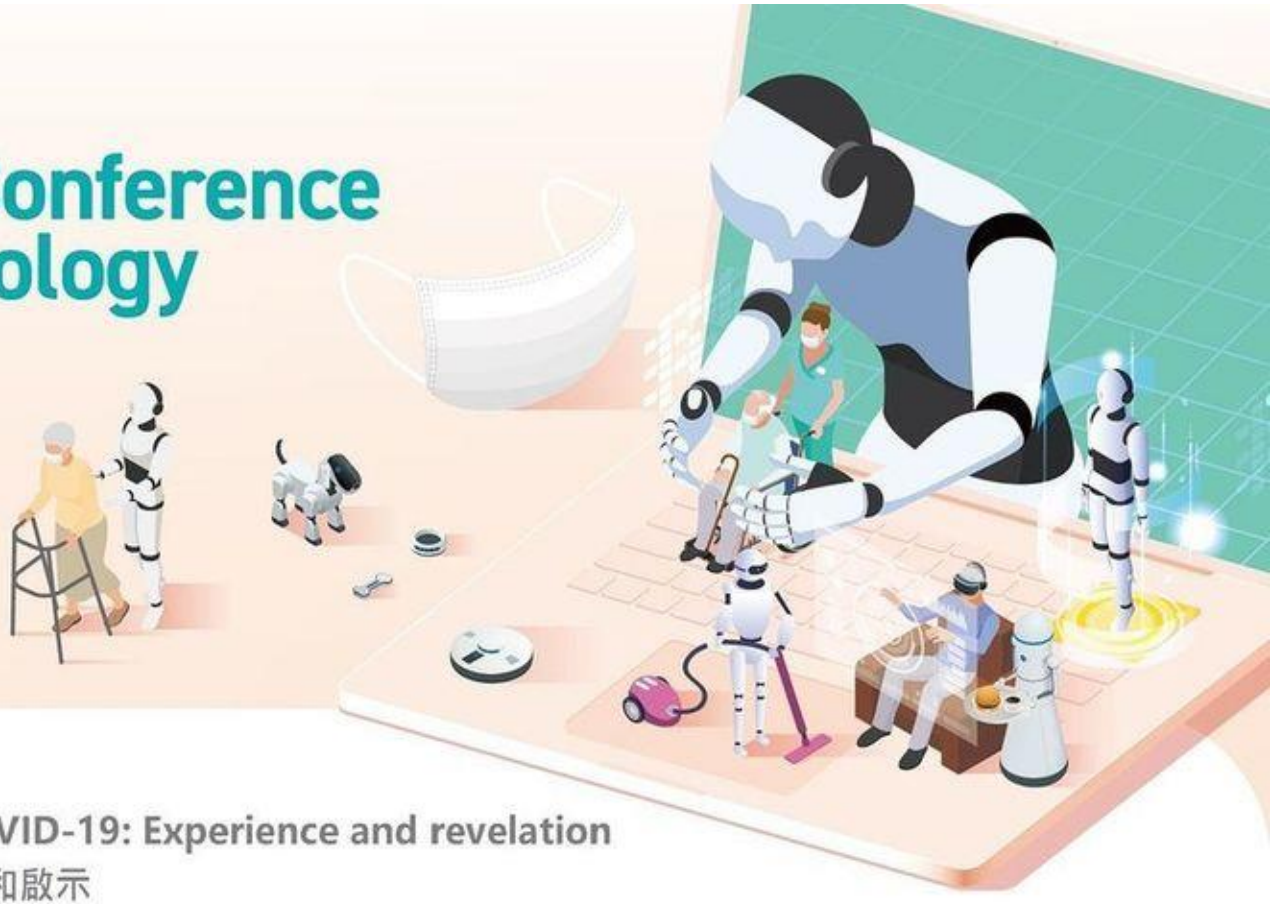


23–25 Nov 2021

International Conference on Gerontechnology 2021

樂齡科技國際會議

Hybrid Conference



Theme Gerontechnology in COVID-19: Experience and revelation

主題 疫情下應用樂齡科技: 經驗和啟示

IT for monitor

Real time (urgency) versus

Continuous record for quality improvement

Save manpower

versus

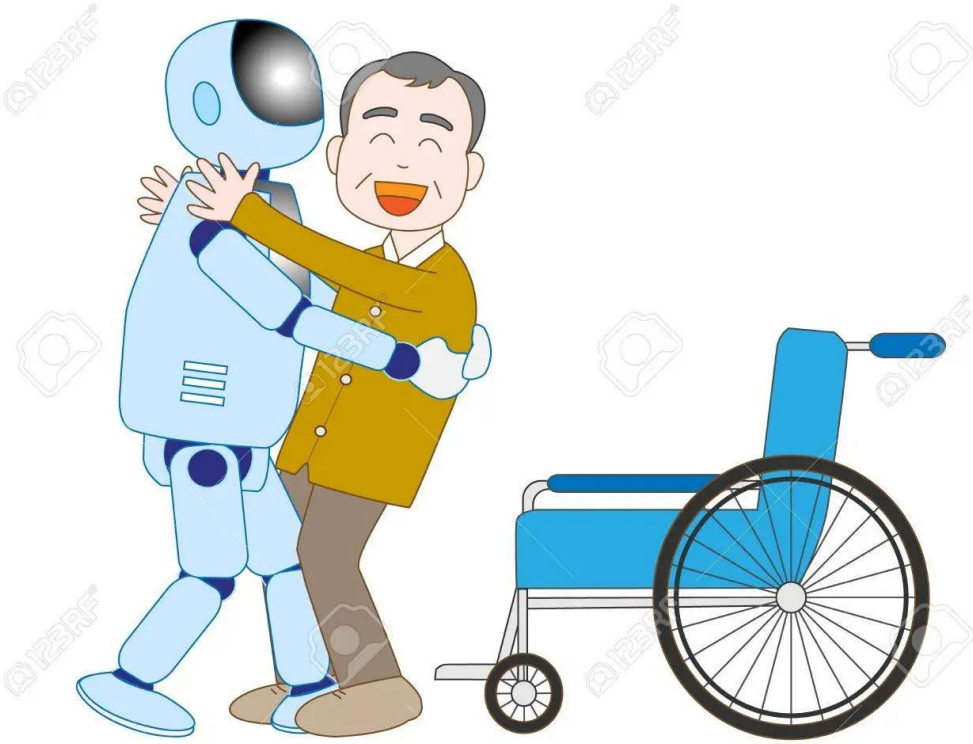
more manpower required

Sensitivity

versus

Specificity

IT for personal care: issue on heterogenicity



IT for companion

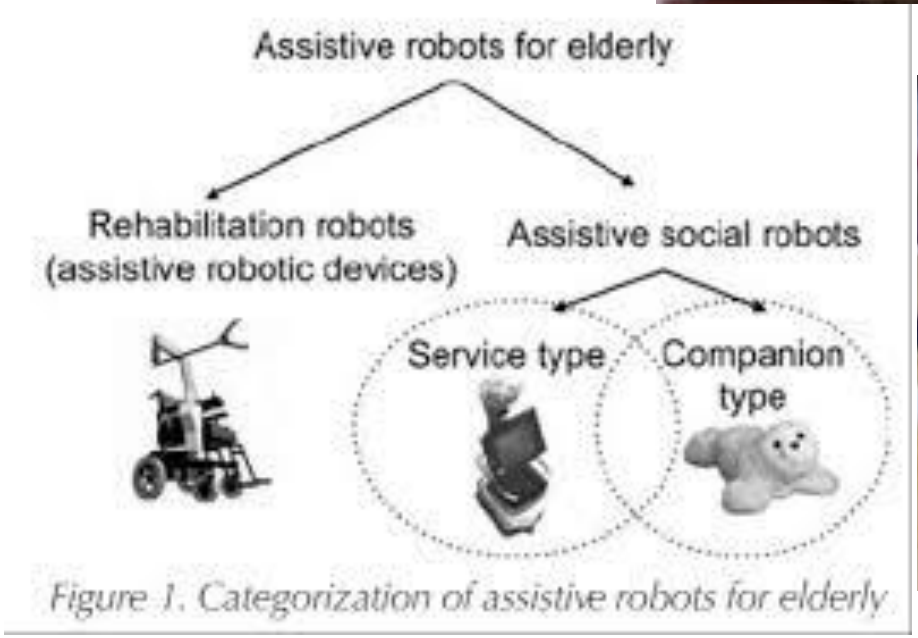
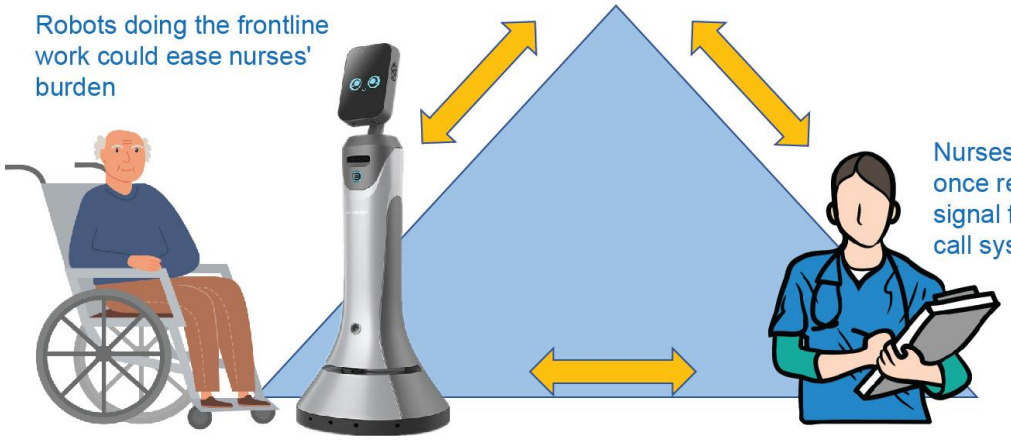


Figure 1. Categorization of assistive robots for elderly

CICS Smart Elderly Care Robot

Alarm Location Indicated on Digital Map (Central Nurse Call Station)

Robots doing the frontline work could ease nurses' burden



Nurses will be alerted once received the alert signal from central nurse call system

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The Journal of The Hong Kong Institution of Engineers

Development of **Gerontechnology** in Hong Kong


THANK
YOU!