Anti-Aging: State of the Art

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22. Juli 2021

Seminar Bioinformatics

Why is aging a problem?

Is aging necessary?

What is aging?

How can we slow down aging?

What can I do?

How can bioinformatics help?

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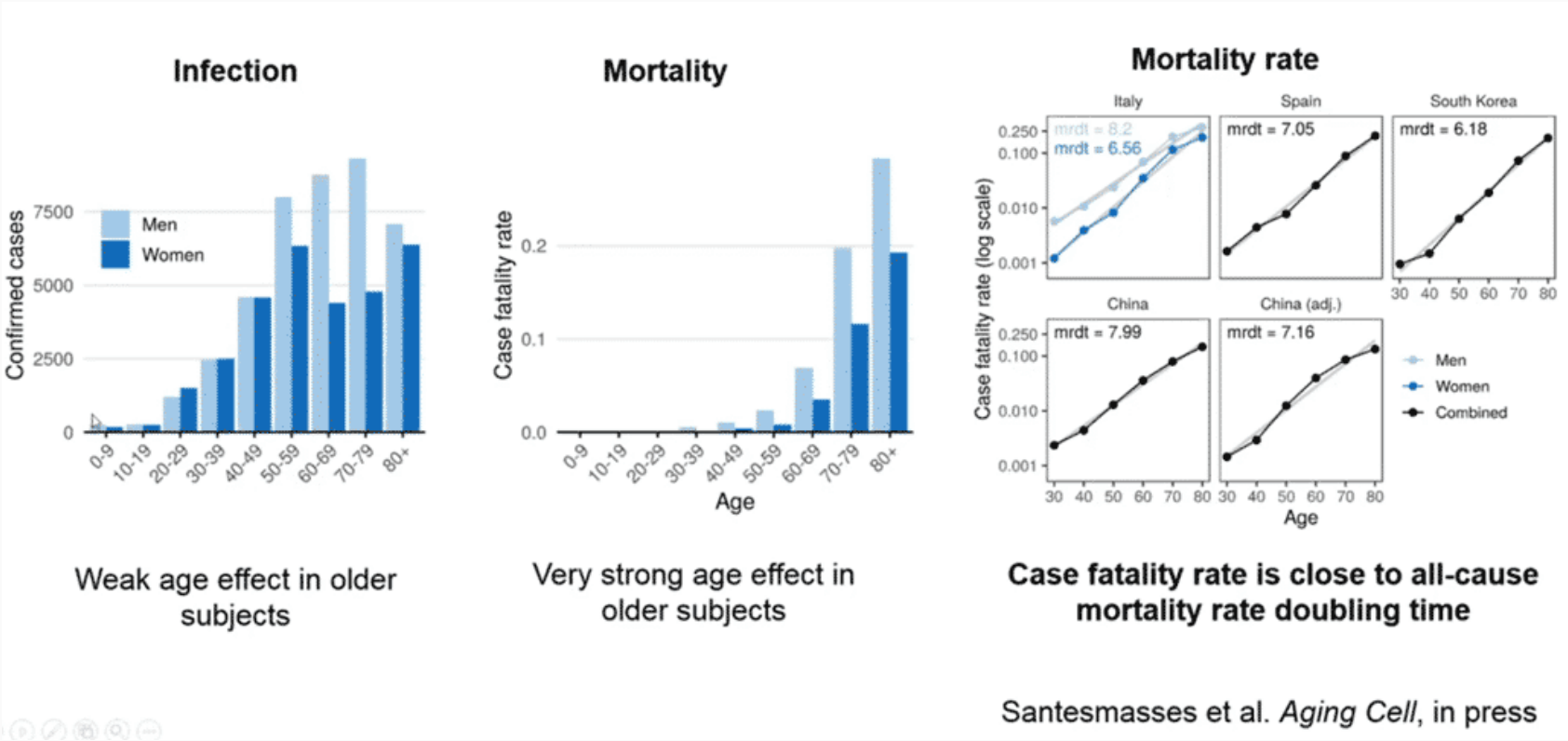
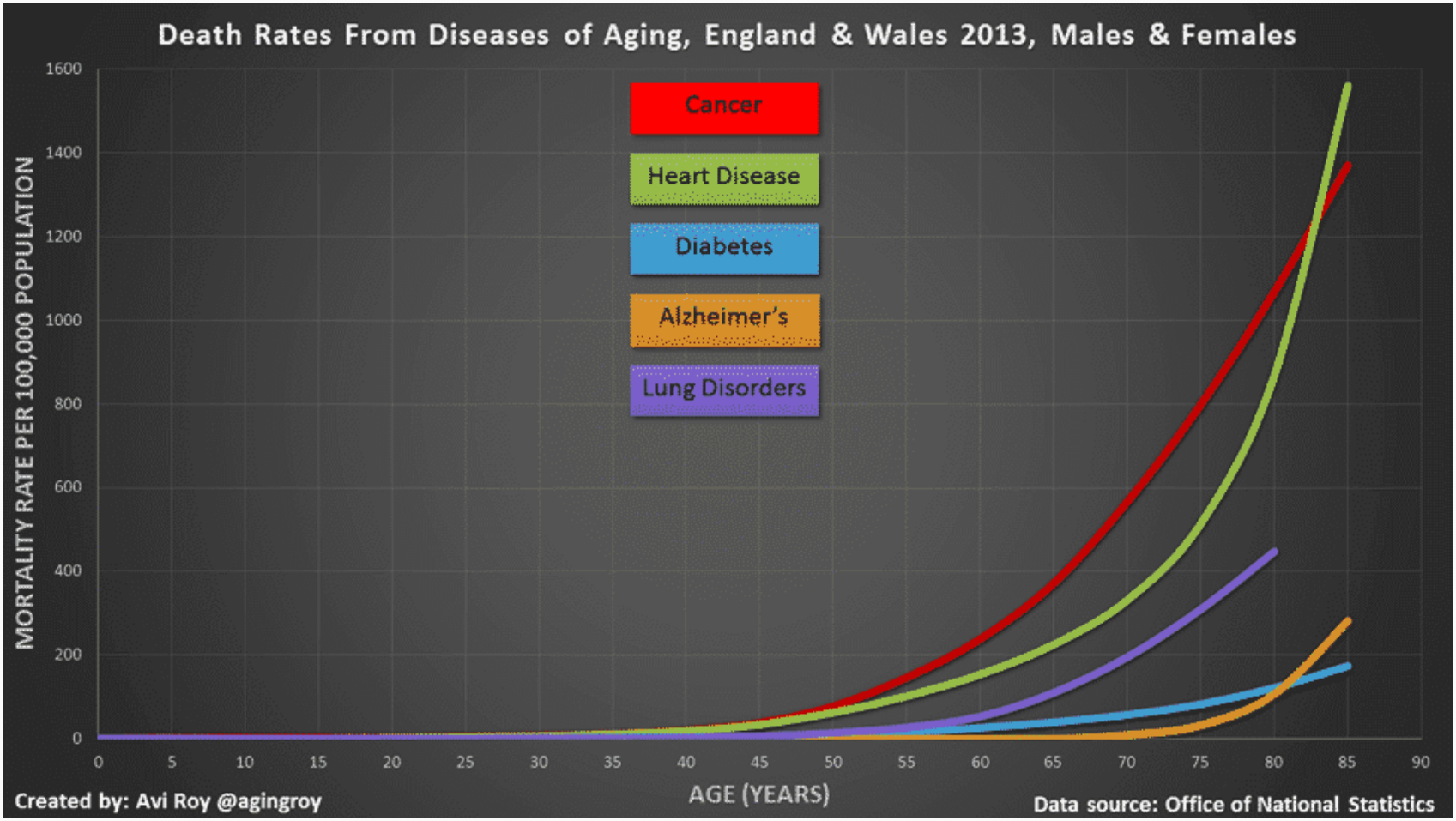
Corona Deaths correlate with Age



[Santesmasses et al., 2020]

Conclusion: They don't die due to Corona, they die due to old age!

All causes for Death correlate with Age



Same with all other primary causes!

Slowing aging has incredible potential

[Kaeberlein, 2019]

And yet it receives less than 1/100th of Funding!

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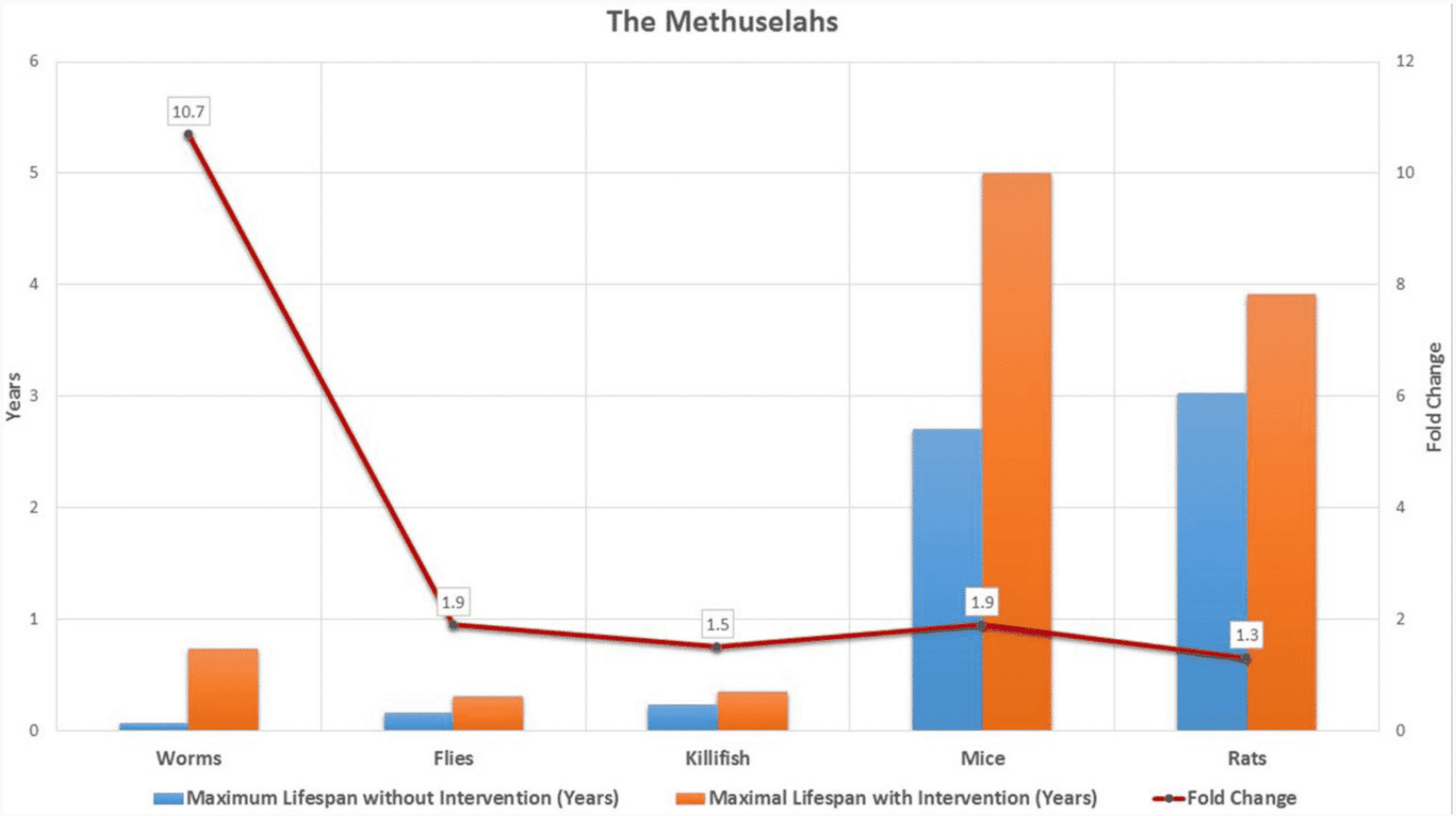
Animals that don't senescence (age)

- hydra (biologically immortal) [Martıñez, 1998]
- naked mole rats [Ruby and Smith, 2018]
- tortoises [Miller, 2001]
- some sharks: 400y [Pennisi, 2016]
- some clams: 500y [Munro and Blier, 2012]

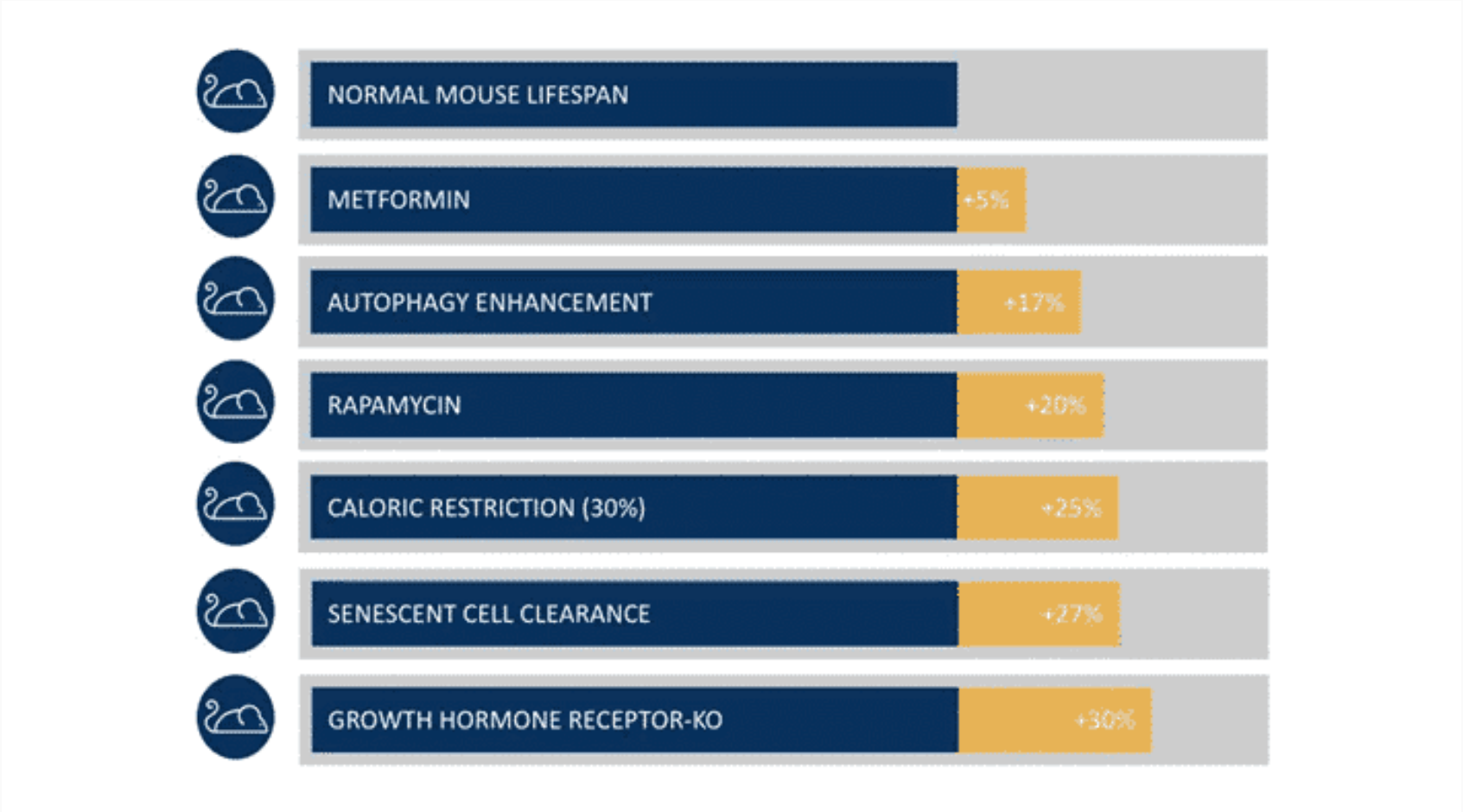
Conclusion: Biological creatures don't *have* to age

Extending Life in different animals



[Bulterijs et al., 2015]

Most effective Mice Treatments



[Brunemeier, 2020]

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What is aging?

Definition and Hallmarks

Common Root Cause Existence

Assumed Root Causes

Aging

Definition

Ageing is characterized by a progressive decline in organismal fitness occurs with increasing age, ultimately ending in death.

But how can we measure it?

Hallmarks of Aging

According to [López-Otín et al., 2013]:

- Genomic instability
- Telomere attrition
- Epigenetic alterations
- Loss of proteostasis
- Deregulated nutrient-sensing
- Mitochondrial dysfunction
- Cellular senescence
- Stem cell exhaustion
- Altered intercellular communication

Hallmarks are mostly just side-effects we can measure!

What is aging?

Definition and Hallmarks

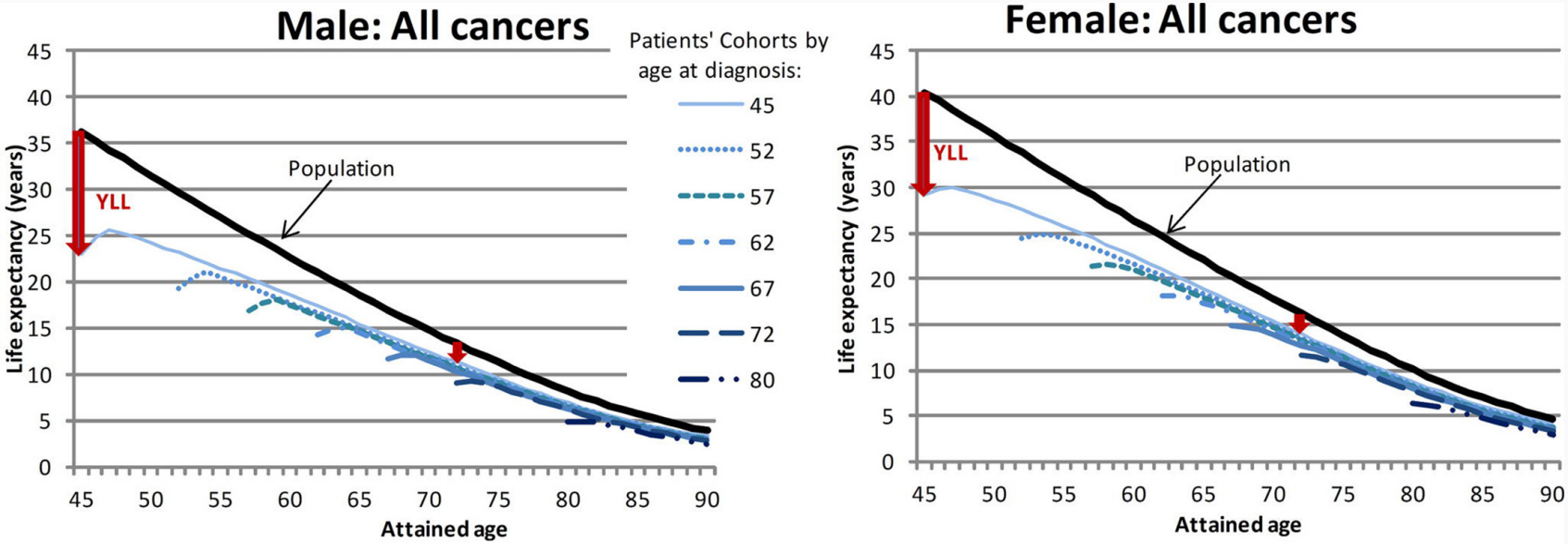
Common Root Cause Existence

Assumed Root Causes

Diabetes: Life Expectancy

Life Expectancy is at least 10 years lower with Diabetes Type 1 [Livingstone et al., 2015] and about 5 lower less with Type 2.

Cancer: Life Expectancy



YLL= Years of life lost, difference between patients' LE and that of the age and sex matched general population

[Botta et al., 2019]

Existence proof of common pathways

someone who has one severe illness early is likely to have others

Similarity of diseases of aging

[Wentworth, 2021] At the cellular level:

- decrease in cell count
- increase in damaged proteins/DNA/fats
- inflammation

Roughly this pattern for:

- alzheimers
- atherosclerosis
- muscle loss
- many others

What is aging?

Definition and Hallmarks

Common Root Cause Existence

Assumed Root Causes

Mitochondrial dysfunction

Turns out, mitochondrial dysfunction accounts for telomere-dependent senescence
[Passos et al., 2007].

Assumed root causes: free radicals and transposon damage

Maybe not in too much detail? Could fill 30min itself [Wentworth, 2021]

p21 and reactive oxygen feedback for senescence [Passos et al., 2010]

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Goal

Goal of anti-aging research: stop aging / neglegible senescence
intermediate goals: slow down aging, increase QUALYs (QUality-Adjusted-Life-Years)

Potential strategies

Picture with blood exchange, senolytics, cellular reprogramming and others

full slide for each of them

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Pharmacological

Some medicaments: Not medical advice!

Lifestyle

Exercise, low-calorie-diet, others

Research!

A lot to be done, just see what you can do

Donate!

A lot of money is needed

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How can bioinformatics help?

Analysis

Simulation

Analysis

Large datasets, ever-more data

Analysis

Will need new tools and software

How can bioinformatics help?

Analysis

Simulation

Simulation

current Pharmaceutical battle: better simulator

Simulation II

AlphaFold2 and others

Questions?

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