Global Trends in Health and Longevity Across Generations

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Recent Trends in Longevity

Why the Future Will Not Be Like the Past

The Faustian Bargain

A New Paradigm in Public Health Has Emerged

Breakthroughs in Aging Biology are Forthcoming
Length of life and timing of death in humans and other sexually reproducing species is a species-specific trait that is highly predictable because it is calibrated to elements of a fixed life history.
Death is a zero sum game. When one disease declines, another must rise—known as competing risks or whack-a-mole. It’s all about tradeoffs.
England and Wales

Five-year average annual mortality improvements

Five-year average annual mortality improvements (solid) compared to trends from 2000-2011 (dashed)


Is longevity still improving? Brian Ridsdale April 2017
The average mortality improvements affect all age bands

Five-year average mortality improvements for different age bands (male shown)

- 20-59
- 60-79
- 80-100


Is longevity still improving? Brian Ridsdale April 2017
So, have longevity improvements reduced?

In the past five years:
UK England and Wales yes
Rest of Europe: France, Germany, Hungary, Netherlands, ........, likely
Australia maybe
Canada likely
USA yes

Is longevity still improving? Brian Ridsdale April 2017
New Forecasting Methodology Indicates More Disease And Earlier Mortality Ahead For Today’s Younger Americans

ABSTRACT Traditional methods of projecting population health statistics, such as estimating future death rates, can give inaccurate results and lead to inferior or even poor policy decisions. A new “three-dimensional” method of forecasting vital health statistics is more accurate because it takes into account the delayed effects of the health risks being accumulated by today’s younger generations. Applying this forecasting technique to the US obesity epidemic suggests that future death rates and health care expenditures could be far worse than currently anticipated. We suggest that public policy makers adopt this more robust forecasting tool and redouble efforts to develop and implement effective obesity-related prevention programs and interventions.
Predictions!

1. Hispanic life expectancy will soon drop rapidly. Why?


3. Advances in biomedical technology will accelerate. The first subgroups to benefit will be the educated/wealthy (higher level insured populations).

4. Life expectancy in Japan will level or soon decline. Why?
Faust's Bargain

- Faust is disillusioned with his own limits to knowledge -- turns to suicide.
- Mephistopheles makes Faust an offer. Faust's soul in exchange for unlimited knowledge and continuous youthful vigor.
- The story of Faust is a metaphor for a bargain that at first seems appealing, but with time is revealed to be a ruse.
The First Longevity Bargain

The Offer

• Declines in infant and child mortality
• 30 years added to life expectancy at birth
  • Most get to survive past age 65

The Price

• Heart disease, cancer, stroke, Alzheimer’s, etc.
• Dramatic increase in all fatal and disabling conditions of aging
  • An insatiable thirst for more longevity
The Latest Longevity Bargain

The Offer

- Reductions in cancer, stroke, and heart disease
- Incrementally smaller gains in longevity (weeks and months)
  - Decelerating increases in life expectancy
  - Additional survival into extreme old age

The Price

- Our fears about Alzheimer’s disease and other neurological conditions rising dramatically come true
- Increased prevalence and duration of frailty and disability
  - The Failures of Success becomes reality
What Have We Done to Ourselves?


The red zone represents a period in life when the risk of frailty and disability begins to increase rapidly. The goal of aging science is to delay and compress the red zone, which may extend healthy life. Sources: 1900 data from Bell and Miller; 2016 data from Human Mortality Database.
Risk Factors for Heart Disease

Risk Factors for Heart Disease

Risk Factors for Cancer

Risk Factors for Cancer

Risk Factors for Alzheimer’s Disease

Risk Factors for Alzheimer’s Disease

In pursuit of the longevity dividend

What should we be doing to prepare for the unprecedented aging of humanity?

S. Jay Olshansky, Daniel Perry, Richard A. Miller, Robert N. Butler

Imagine an intervention, such as a pill, that could significantly reduce your risk of cancer. Imagine an intervention that could reduce your risk of stroke, of dementia, or of arthritis. Now, imagine an intervention that does all these things, and at the same time reduces your risk of everything the undesirable about growing older, including heart disease, diabetes, Alzheimer’s and Parkinson’s disease, hip fractures, osteoporosis, sensory impairments, and sexual dysfunction. Such a pill may sound like fantasy, but aging interventions already do this in animal models. And many scientists believe that such an intervention is a realistically achievable goal for people. People already place a high value on both quality and length of life, which is why children are vaccinated against infectious diseases. In the same spirit, we suggest that a concerted effort to slow aging begin immediately—because it will save and extend lives, improve health, and create wealth.
Affiliated Research Institutions and Universities
New model of health promotion and disease prevention for the 21st century

Our susceptibility to disease increases as we grow older. **Robert Butler and colleagues** argue that interventions to slow down ageing could therefore have much greater benefit than those targeted at individual disease.
Genetics of long-lived people

Caloric restriction

Fewer Calories—Less Disease

<table>
<thead>
<tr>
<th>Type of Disease</th>
<th>Incidence in fully fed animals</th>
<th>Incidence in DR animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer of breast</td>
<td>40%</td>
<td>7%</td>
</tr>
<tr>
<td>Cancer of lung</td>
<td>60%</td>
<td>3%</td>
</tr>
<tr>
<td>Cancer of liver</td>
<td>64%</td>
<td>3%</td>
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<tr>
<td>Cancer of lymph nodes</td>
<td>10%</td>
<td>1%</td>
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<tr>
<td>Kidney disease</td>
<td>100%</td>
<td>3%</td>
</tr>
<tr>
<td>Vascular disease</td>
<td>63%</td>
<td>17%</td>
</tr>
</tbody>
</table>

Compounds with properties that appear to slow aging
Senolytics

Fight Aging by Killing Zombies

BECOMING UNDEAD

Damage or disease can lead a cell down the path to senescence. Scientists are still finding out how cells behave once they get there — and how to get rid of them.

THE TRIGGER
Damage or disease, along with signals from other cells during development, can induce senescence.

SPITTING OUT SIGNALS
Once senescent, cells stop dividing and belch out proteins such as cytokines, which attract immune molecules.

CLEAR OR CLOG
The immune system can kill senescent cells and allow tissue to regenerate. But in diseased or ageing tissue, senescent cells build up.

ZOMBIE KILLERS
Drugs in development turn off a cell’s survival tricks to clear senescent cells from joints, blood vessels or the eye.

strategy in mice. Now it’s about to be tested in humans.

by Megan Scvngllae
Delayed aging would have the largest impact on the number of healthy, older adults...

Source: Goldman et al., 2013
...and it would do so without increasing the number of disabled.

![Graph showing the disabled population 65 and older, with scenarios for 2010 and 2060.](image)

### Source: Goldman et al., 2013