Major change factors in the world of medicine and their implications

Prof. Eldad Katorza MD, MSc, MBA

Director of Gertner Institute for Epidemiology & Health policy Research

Director of Arrow Project for Young Investigators

Sheba Medical Center, Tel-Hashomer, Israel

Sackler School of Medicine, Tel Aviv University

The Future of Health care systems?

1. **Introduction.**
2. **Technological revolution.**
3. **Economic burden.**
4. **Demographic changes.**
5. **Future illnesses.**
6. **Hospitals and community.**
7. **Sociological and cultural aspects.**
8. **Spirit and summary.**

1. Introduction

The Chaim Sheba Medical Center at Tel HaShomer
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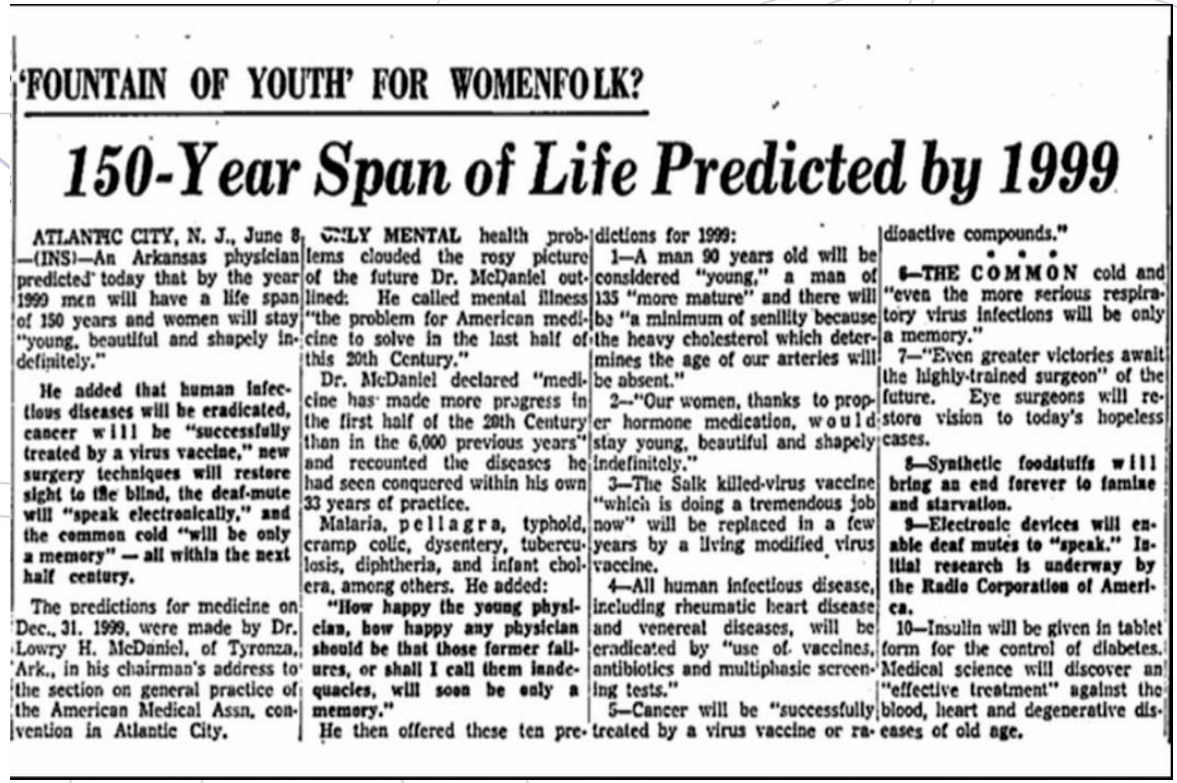
Can we predict the Future?



'FOUNTAIN OF YOUTH' FOR WOMENFOLK?

150-Year Span of Life Predicted by 1999

ATLANTIC CITY, N. J., June 8 —(INS)—An Arkansas physician predicted today that by the year 1999 men will have a life span of 150 years and women will stay "young, beautiful and shapely indefinitely."

He added that human infectious diseases will be eradicated, cancer will be "successfully treated by a virus vaccine," new surgery techniques will restore sight to the blind, the deaf-mute will "speak electronically," and the common cold "will be only a memory" — all within the next half century.

The predictions for medicine on Dec., 31, 1999, were made by Dr. Lowry H. McDaniel, of Tyronza, Ark., in his chairman's address to the section on general practice of the American Medical Assn. convention in Atlantic City.

ONLY MENTAL health problems clouded the rosy picture of the future Dr. McDaniel outlined: He called mental illness "the problem for American medicine to solve in the last half of this 20th Century."

Dr. McDaniel declared "medicine has made more progress in the first half of the 20th Century than in the 6,000 previous years" and recounted the diseases he had seen conquered within his own 33 years of practice.

Malaria, pellagra, typhoid, cramp colic, dysentery, tuberculosis, diphtheria, and infant cholera, among others. He added:

"How happy the young physician, how happy any physician should be that those former failures, or shall I call them inadequacies, will soon be only a memory."

He then offered these ten predictions for 1999:

1—A man 90 years old will be considered "young," a man of 135 "more mature" and there will be "a minimum of senility because the heavy cholesterol which determines the age of our arteries will be absent."

2—"Our women, thanks to proper hormone medication, would stay young, beautiful and shapely indefinitely."

3—The Salk killed-virus vaccine "which is doing a tremendous job now" will be replaced in a few years by a living modified virus vaccine.

4—All human infectious disease, including rheumatic heart disease and venereal diseases, will be eradicated by "use of vaccines, antibiotics and multiphasic screening tests."

5—Cancer will be "successfully treated by a virus vaccine or radioactive compounds."

• • •

6—THE COMMON cold and "even the more serious respiratory virus infections will be only a memory."

7—"Even greater victories await the highly-trained surgeon" of the future. Eye surgeons will restore vision to today's hopeless cases.

8—Synthetic foodstuffs will bring an end forever to famine and starvation.

9—Electronic devices will enable deaf mutes to "speak." Initial research is underway by the Radio Corporation of America.

10—Insulin will be given in tablet form for the control of diabetes. Medical science will discover an "effective treatment" against the blood, heart and degenerative diseases of old age.

DR. LOWRY H. MCDANIEL, CHAIRMAN
AT THE AMA CONVENTION IN ATLANTIC CITY IN 1955

Can we predict the Future?

"Heavier-than-air flying machines are impossible."

Lord Kelvin, British mathematician and physicist, president of the British Royal Society, 1895.

1. Introduction

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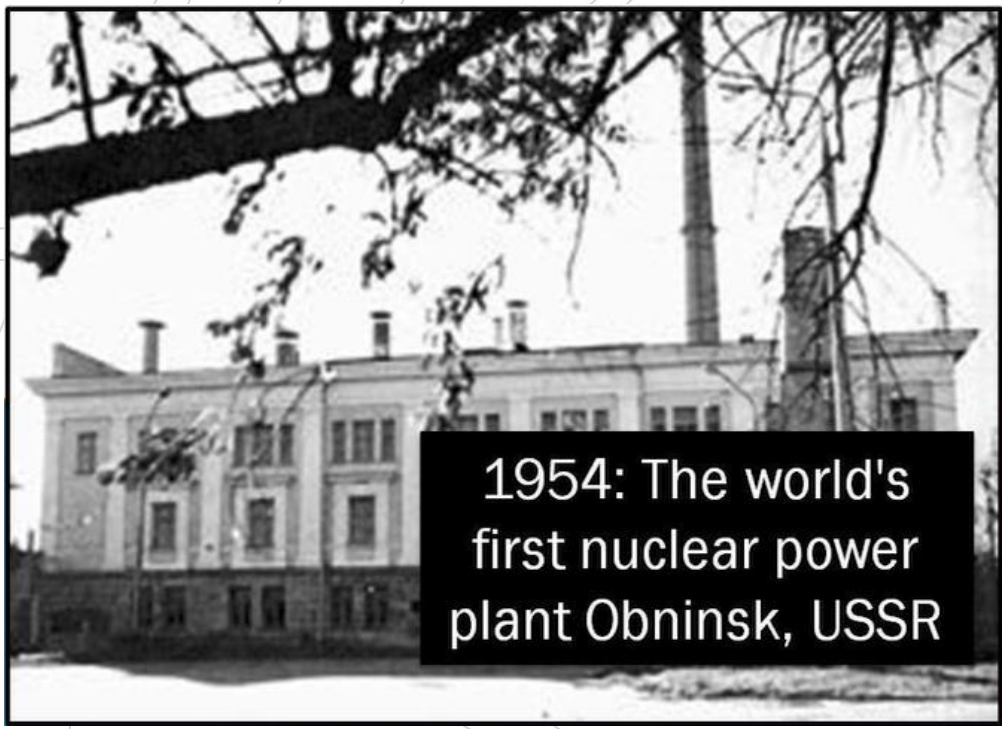
Can we predict the Future?

"There is not the slightest indication that nuclear energy will ever be obtainable. It would mean that the atom would have to be shattered at will."

Albert Einstein, 1932



1. Introduction

Can we predict the Future?

Russian Flu	1889-1890	Believed to be H2N2 (avian origin)	1M
Spanish Flu	1918-1919	H1N1 virus / Pigs	40-50M
Asian Flu	1957-1958	H2N2 virus	1.1M
Hong Kong Flu	1968-1970	H3N2 virus	1M
HIV/AIDS	1981-present	Virus / Chimpanzees	25-35M
Swine Flu	2009-2010	H1N1 virus / Pigs	200,000
SARS	2002-2003	Coronavirus / Bats, Civets	770
Ebola	2014-2016	Ebolavirus / Wild animals	11,000
MERS	2015-Present	Coronavirus / Bats, camels	850
COVID-19	2019-Present	Coronavirus – Unknown (possibly pangolins)	1.4 M

1. Introduction

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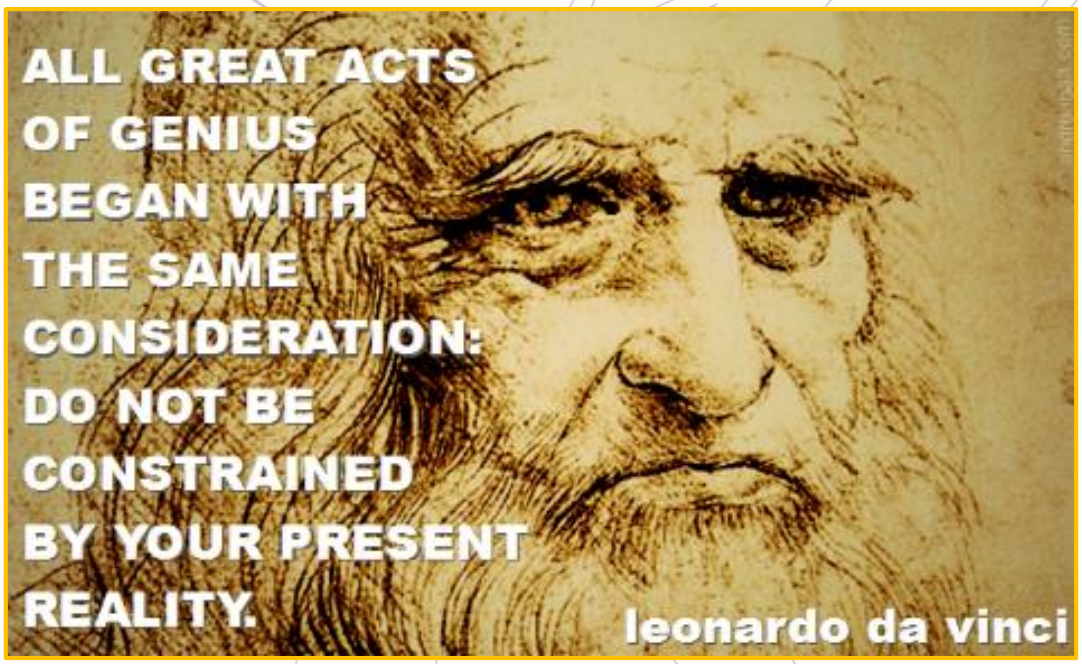
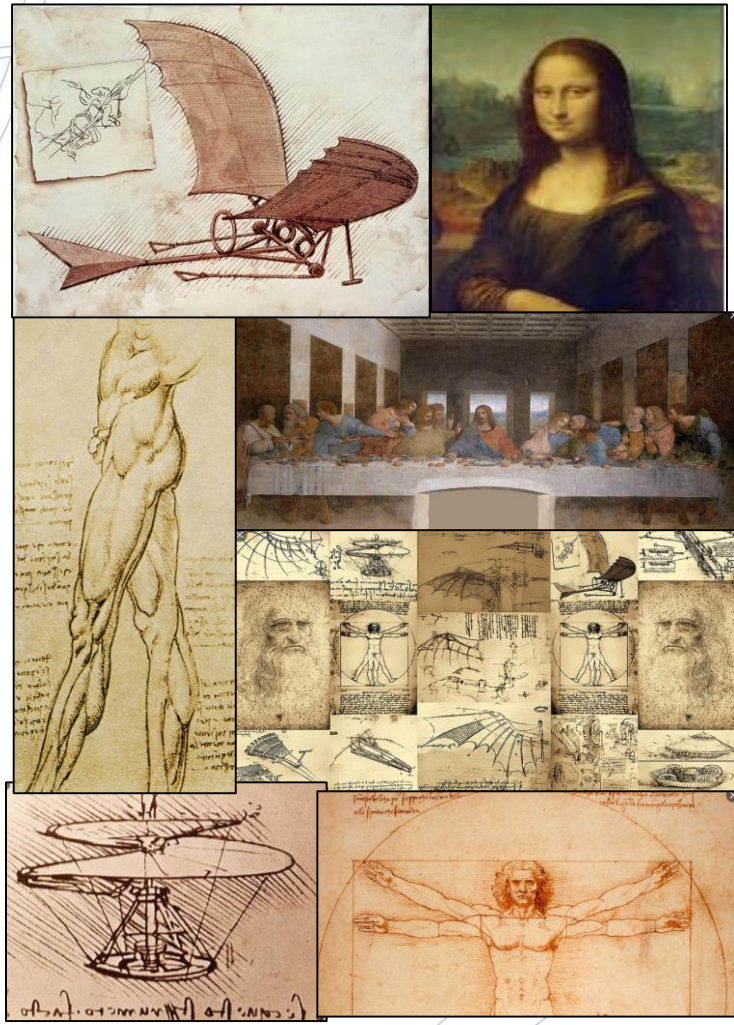
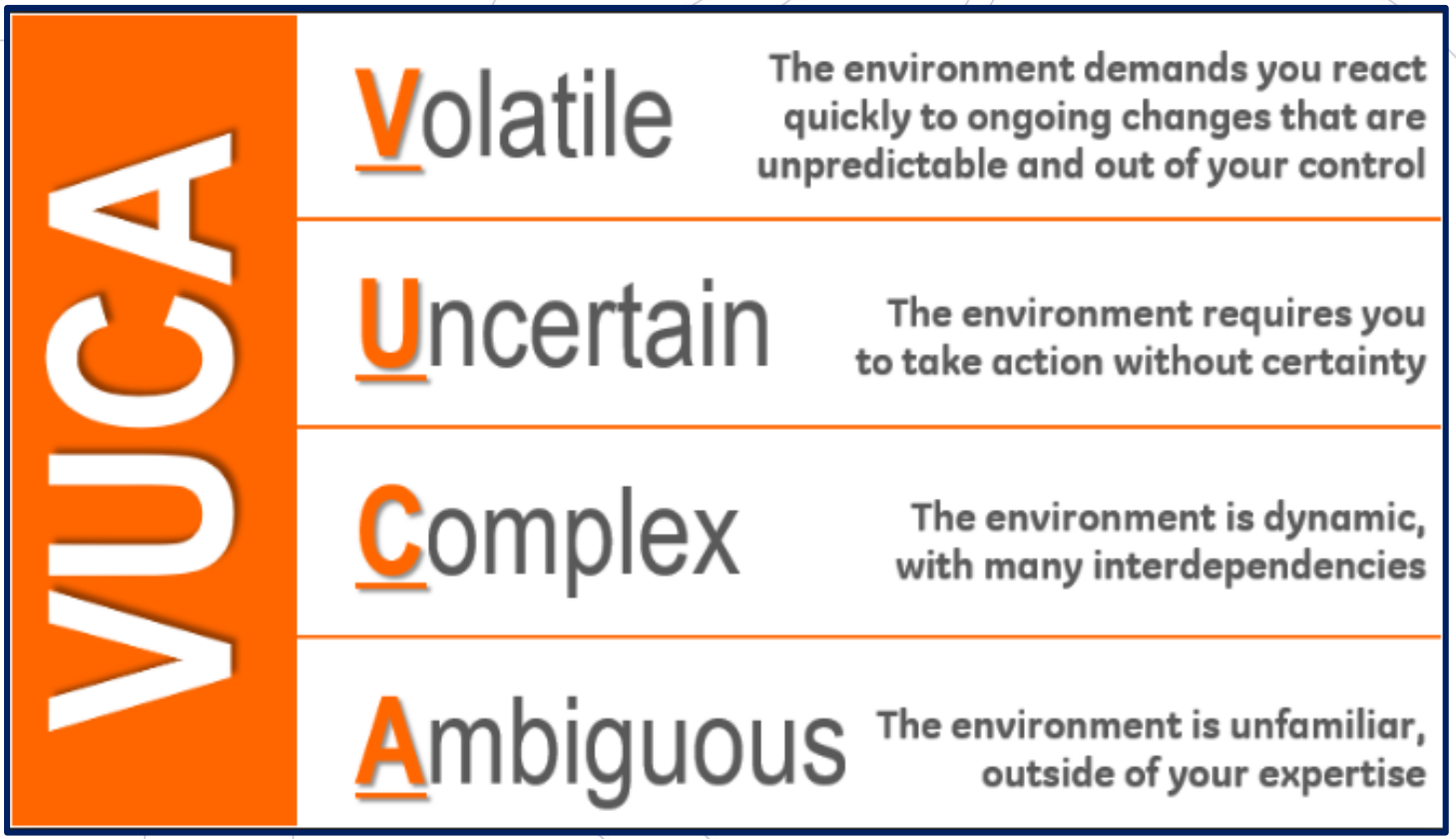
Leonardo Da Vinci (1452 –1519)





A New World Necessitates A new Strategy



1. Introduction

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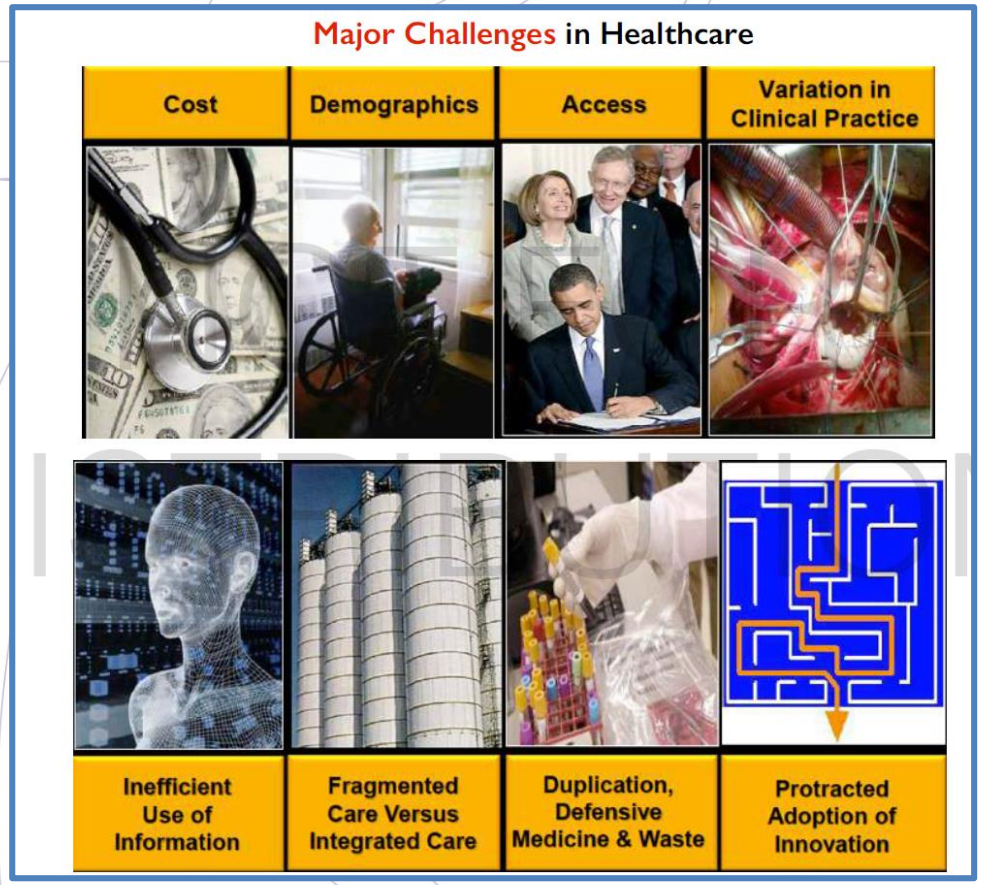
Health systems are facing ongoing major challenges:



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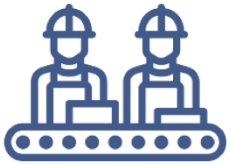
The 4th Industrial Revolution

"The Fourth Industrial Revolution will affect the very essence of our human experience."— Klaus Schwab

1st

Mechanisation, Steam and Water Power

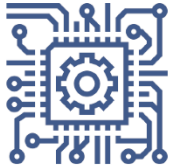


2nd

Mass production, Assembly lines, electricity

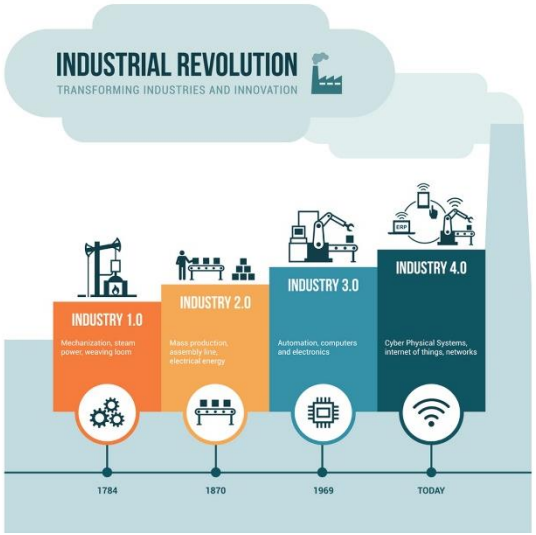
3rd

Computer & Automation



4th

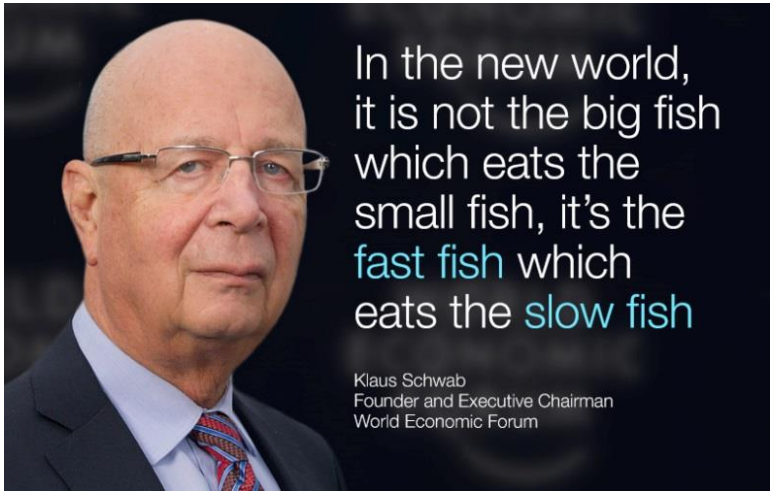
Cyber Physical Systems, networks, AI



2. Technological revolution

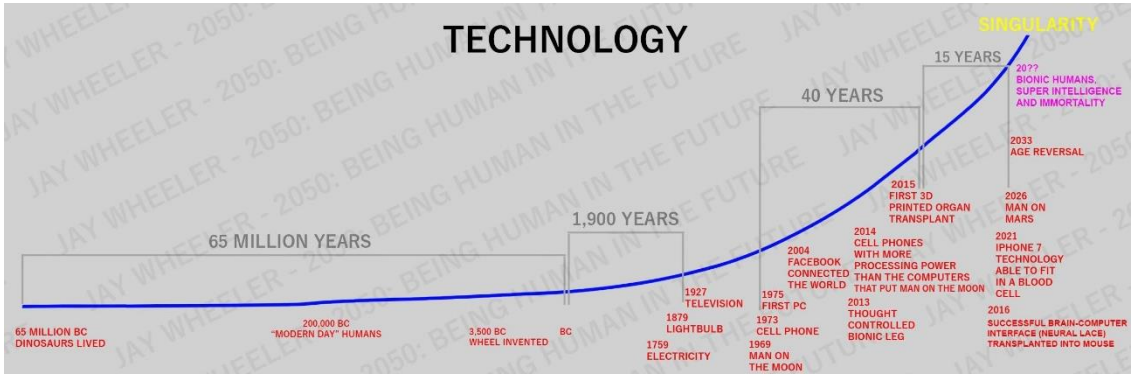
- **AI - Artificial Intelligence**
  The theory and development of computer systems able to perform tasks, normally requiring human intelligence, such as decision-making.

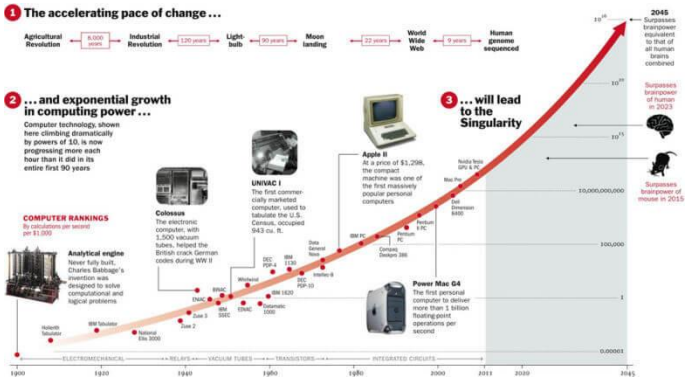
- **Digital health**
  Use of information & communication technologies to address health problems.
  Technologies include telemedicine, web-based analysis, email, mobile phones and applications, text messages, wearable devices, and clinic based or remote monitoring sensors.



2. Technological revolution

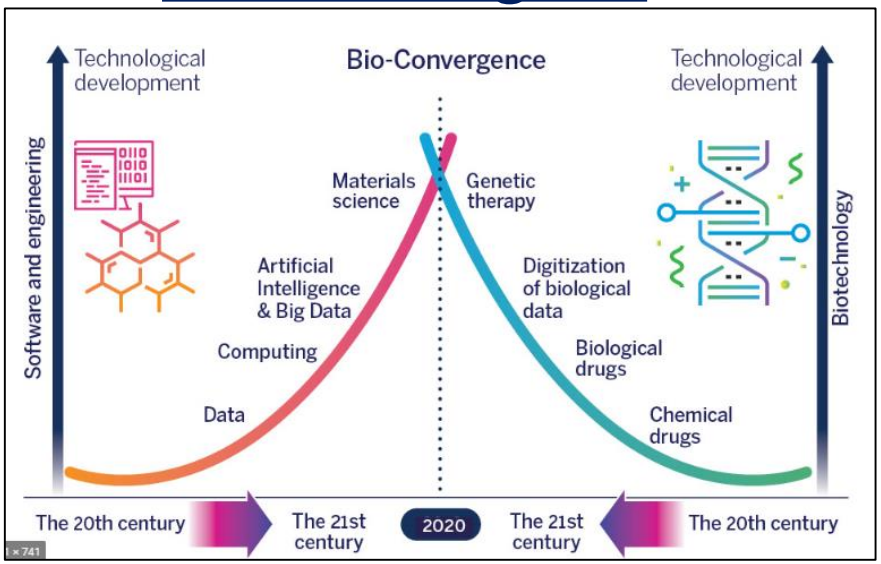
- **Linear to exponential growth in technology.**
- **The Technological Singularity**
  The hypothesis that the invention of AI will trigger escaped technological growth, resulting in profound changes to human civilization.

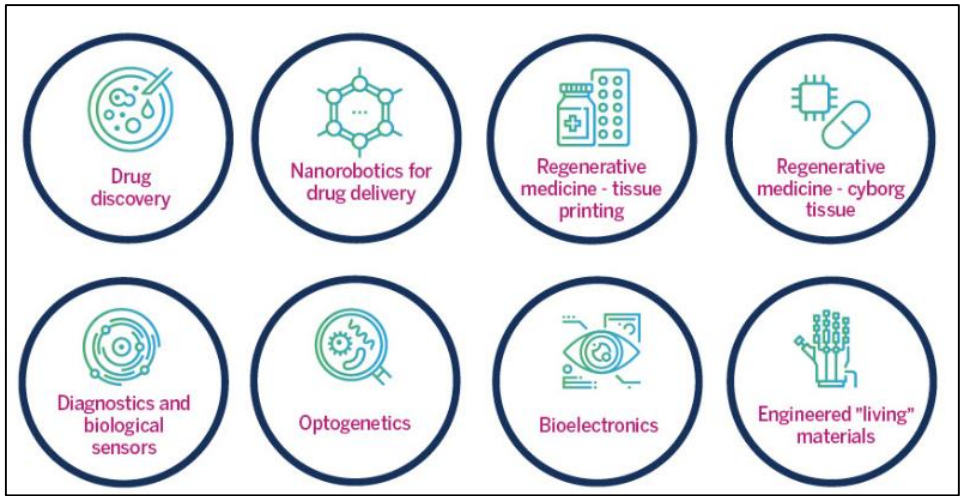




2. Technological revolution

Bio- Convergence





2. Technological revolution

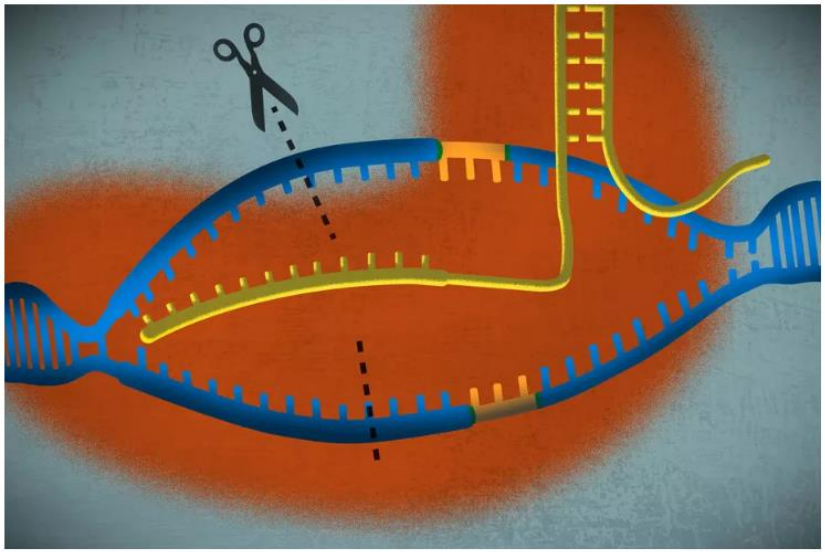
A simple guide to CRISPR, one of the biggest science stories of the decade

It could revolutionize everything from medicine to agriculture. Better read up now.

By Brad Plumer, Eliza Barclay, Julia Belluz, and Umair Irfan | Updated Dec 27, 2018, 2:45pm EST

Graphics: Javier Zarracina

SHARE



https://youtu.be/2pp17E4E-O8

2. Technological revolution

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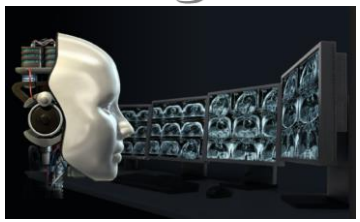
Innovation Enabling Transformation

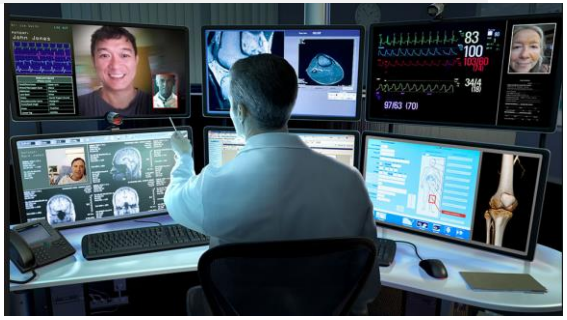
Tele-health

Artificial Intelligence

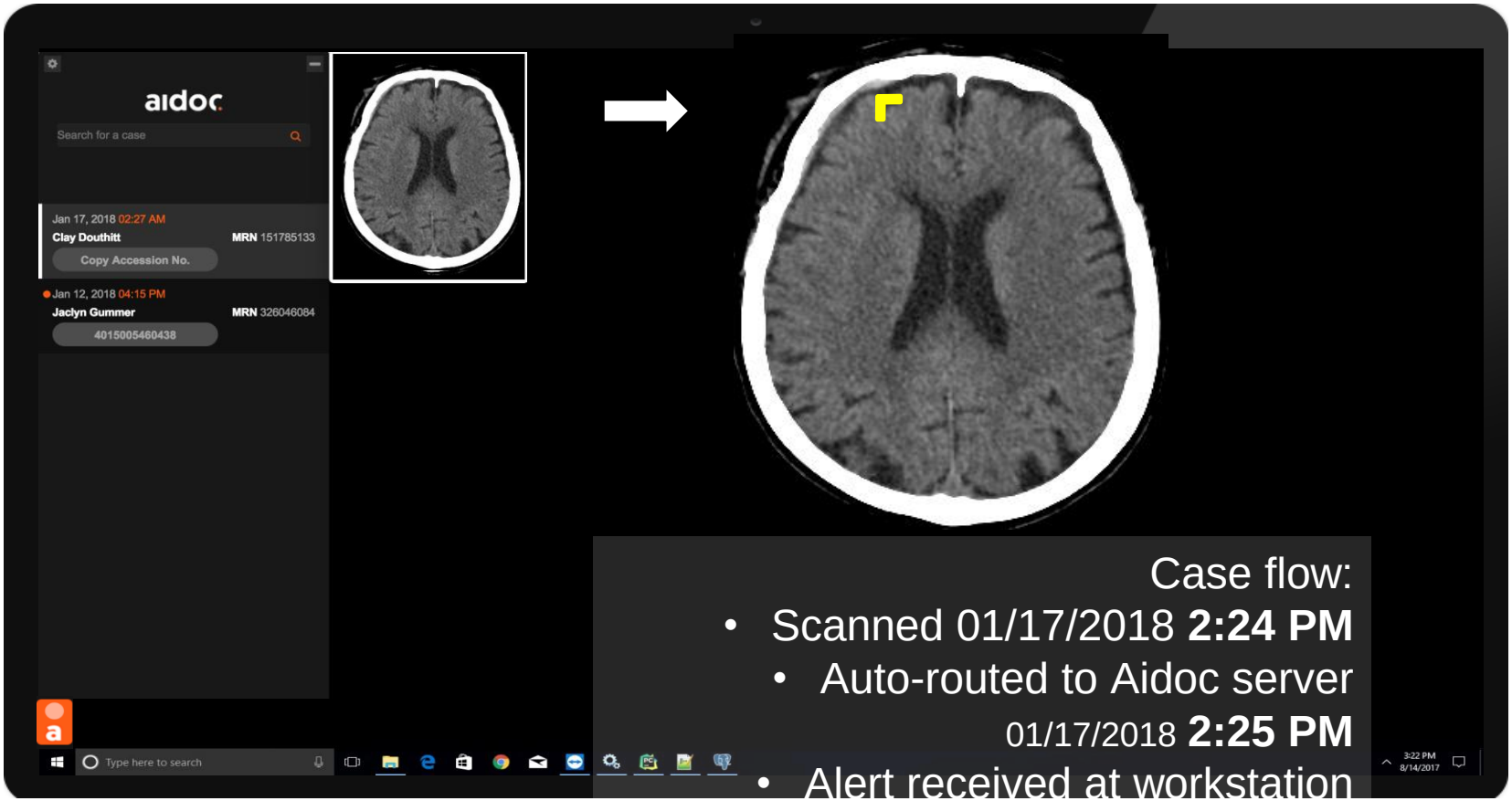


VR and AR

Robotics



2. Technological revolution



2. Technological revolution

ORIGINAL ARTICLE

The End of Radiology? Three Threats to the Future Practice of Radiology

Katie Chockley, BA, Ezekiel Emanuel, MD, PhD

Abstract

Radiology faces at least three major, potentially fatal, threats.

First, as care moves out of the hospital, there will be a decrease in demand for imaging. More care in patients' homes and in other nonhospital settings means fewer medical tests, including imaging.

Second, payment reform and, in particular, bundled payments and capitation mean that imaging will become a cost rather than a profit center. These shifts in provider payment will decrease the demand for imaging and disrupt the practice of radiology.

Potentially, the ultimate threat to radiology is machine learning.

Machine learning will become a powerful force in radiology in the next 5 to 10 years and could end radiology as a thriving specialty.

J Am Coll Radiol 2016;13:1415-1420.

2. Technological revolution

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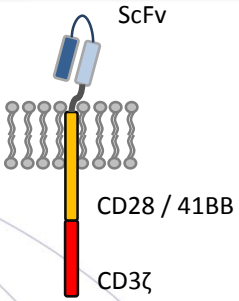
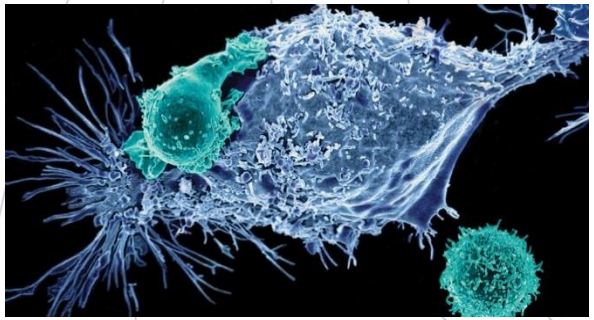
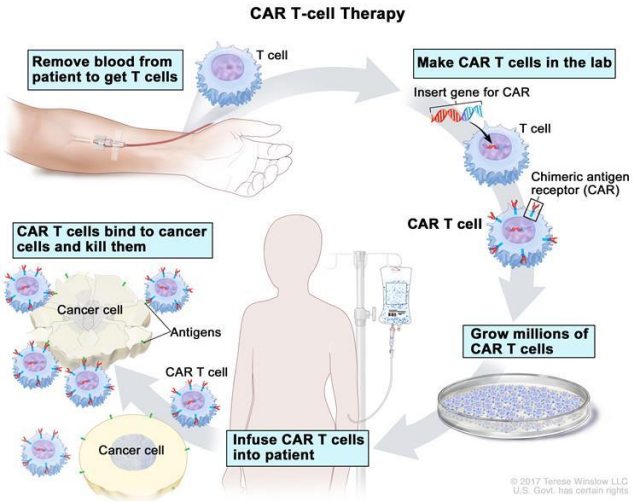
Chimeric Antigen Receptors CAR-T Cell Therapy



1. **CARs, are receptor proteins engineered to give T cells new ability to target a specific protein.**
2. **The receptors are chimeric because they combine both antigen-binding and T-cell activating functions into a single receptor.**
3. **CAR-T immunotherapy modify T cells to better recognize and kill cancer cells.**





2. Technological revolution

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CAR-T Cell Therapy

1989: Concept

2003: CD19 as a target

2010: First patient: NHL

2011: First patient: CLL

2012: First patients: ALL

2016: First patients at Sheba

2017: FDA approval: ALL & NHL

2018: EMA approval: ALL & NHL

2018: 1000 pts world; 60 Sheba; 30 England

2019: Israeli Healthcare Basket?

Proc. Natl. Acad. Sci. USA
Vol. 86, pp. 10024–10028, December 1989
Immunology

Expression of immunoglobulin-T-cell receptor chimeric molecules as functional receptors with antibody-type specificity

(chimeric genes/antibody variable region)

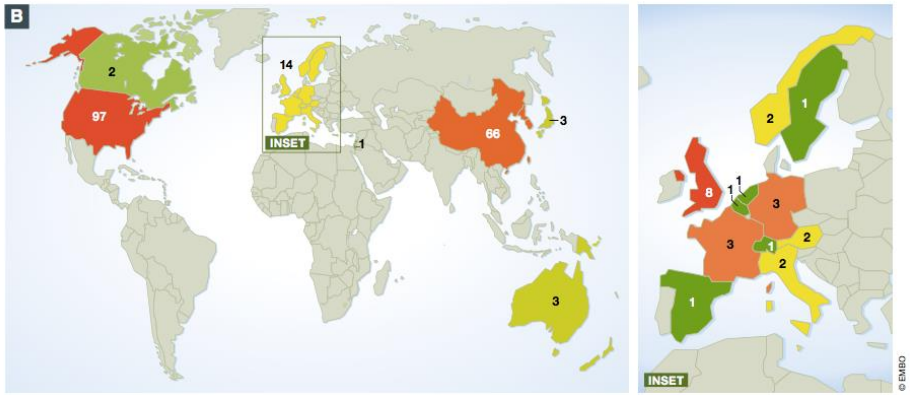
GIDEON GROSS, TOVA WAKS, AND ZELIG ESHHAR*
Department of Chemical Immunology, The Weizmann Institute of Science, Rehovot 76100, Israel

blood
2010 116: 4099-4102
Prepublished online July 28, 2010;
doi:10.1182/blood-2010-04-281931

Eradication of B-lineage cells and regression of lymphoma in a patient treated with autologous T cells genetically engineered to recognize CD19

James N. Kochenderfer, Wyndham H. Wilson, John E. Janik, Mark E. Dudley, Maryalice Stetler-Stevenson, Steven A. Feldman, Irina Maric, Mark Raffeld, Debbie-Ann N. Nathan, Brock J. Lanier, Richard A. Morgan and Steven A. Rosenberg

CAR-T cells trials (summer 2017)



The Future of Health care systems?

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3. Economic burden

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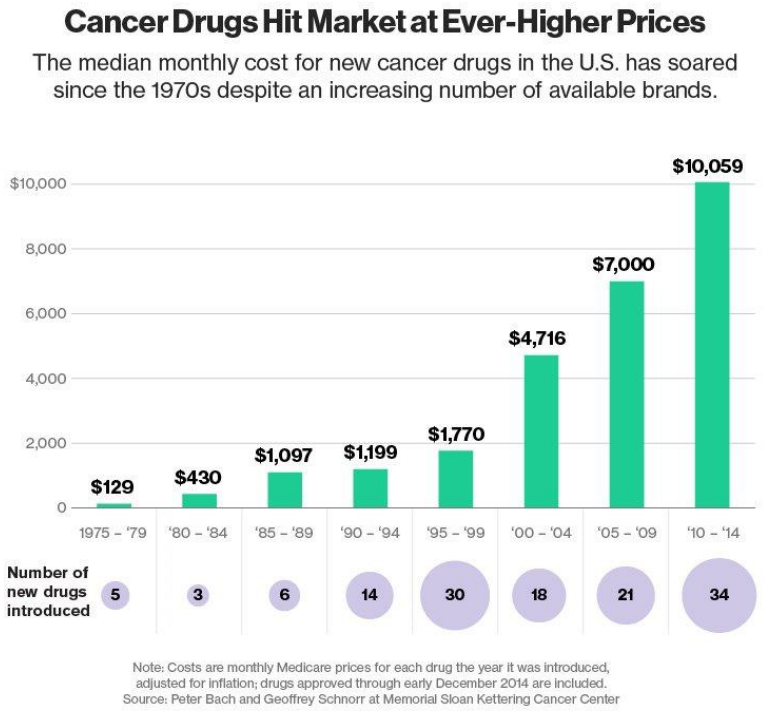
Health for all?

Can countries provide optimum healthcare to the entire population?

Ex: Increase use and cost of drugs in developed countries



Health for all?

- Only the developed, industrialized countries have established health care systems (40 of the world's 200).
- Most of the nations are too poor and disorganized to provide any kind of medical care to their entire population.
- Only the rich and powerful get medical care; the poor stay sick or die.

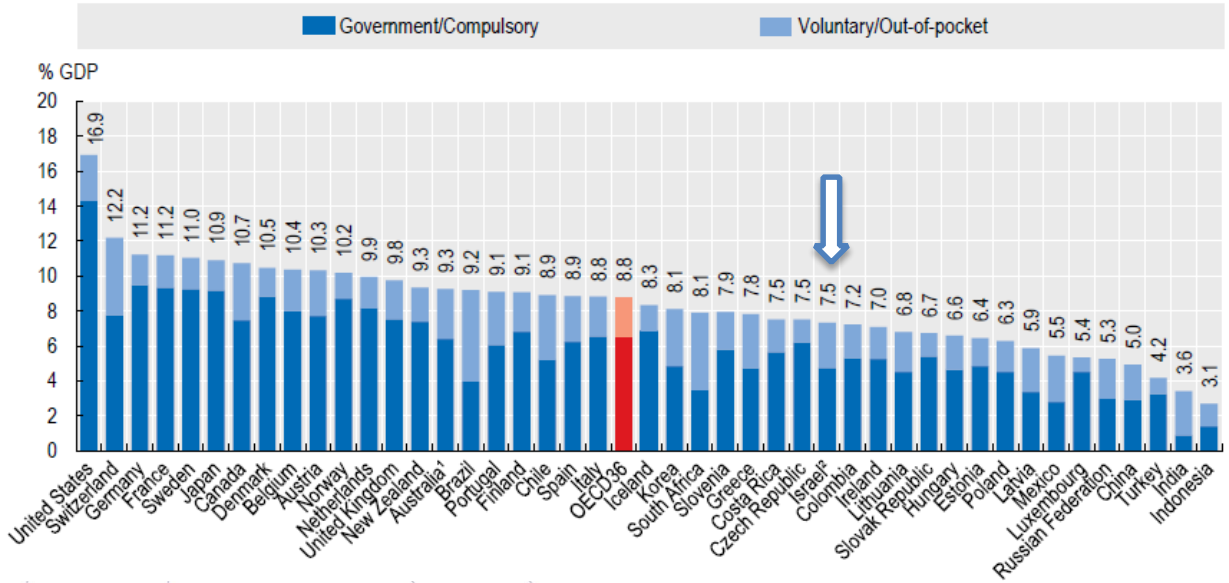
3. Economic burden

Health Expenditure as a share of GDP, 2018:

Israel spends 7.5% of its GDP on health

USA 16.9%; Germany 11.2%; OECD average 8.8%.

Figure 7.3. **Health expenditure as a share of GDP, 2018 (or nearest year)**



Source: OECD Health at a glance 2019

3. Economic burden

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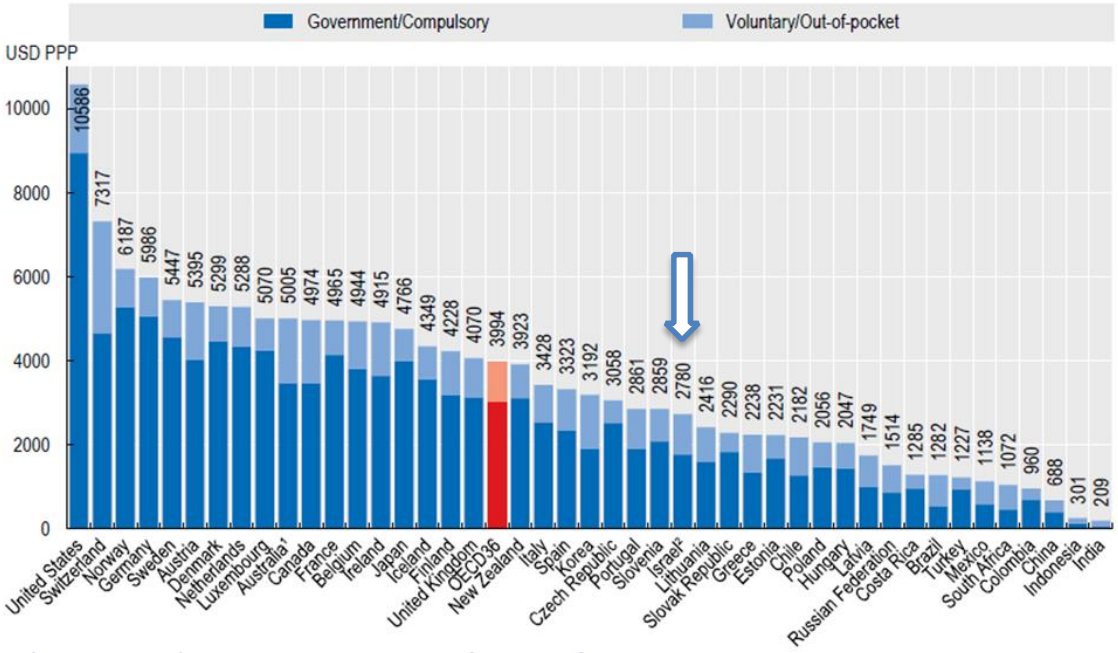
Health Expenditure per Capita per Year, 2018:

Israel spends 2780 USD.

USA-10586 USD; Germany-5986 USD; OECD-3994 USD.

Figure 7.1. **Health expenditure per capita, 2018 (or nearest year)**



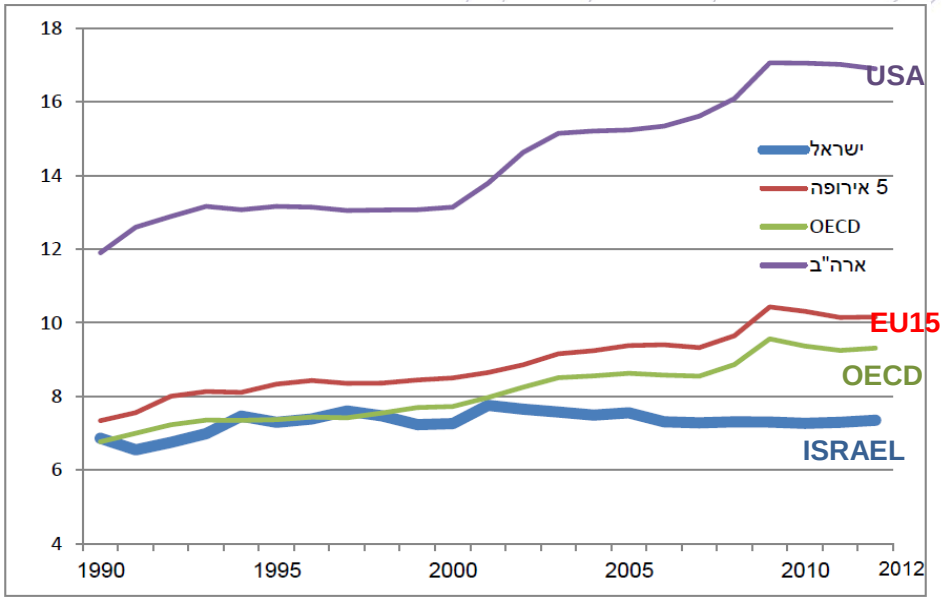
Source: OECD Health at a glance 2019

3. Economic burden

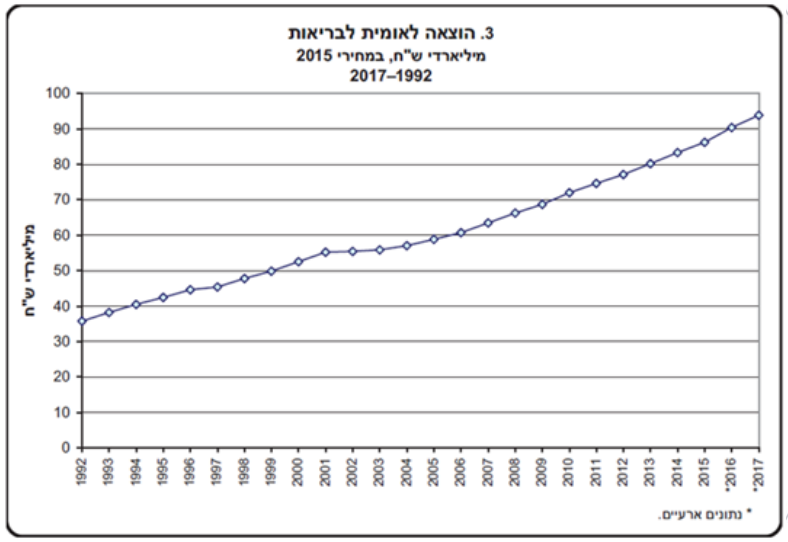
Israel Health Expenditure as a share of GDP (1990-2012):

Israel's spending on health has remained constant for the last 20 years

Percent of GDP on healthcare expenditure 1990-2012



Source: Strategic Planning and Economics, Israeli Ministry of Health

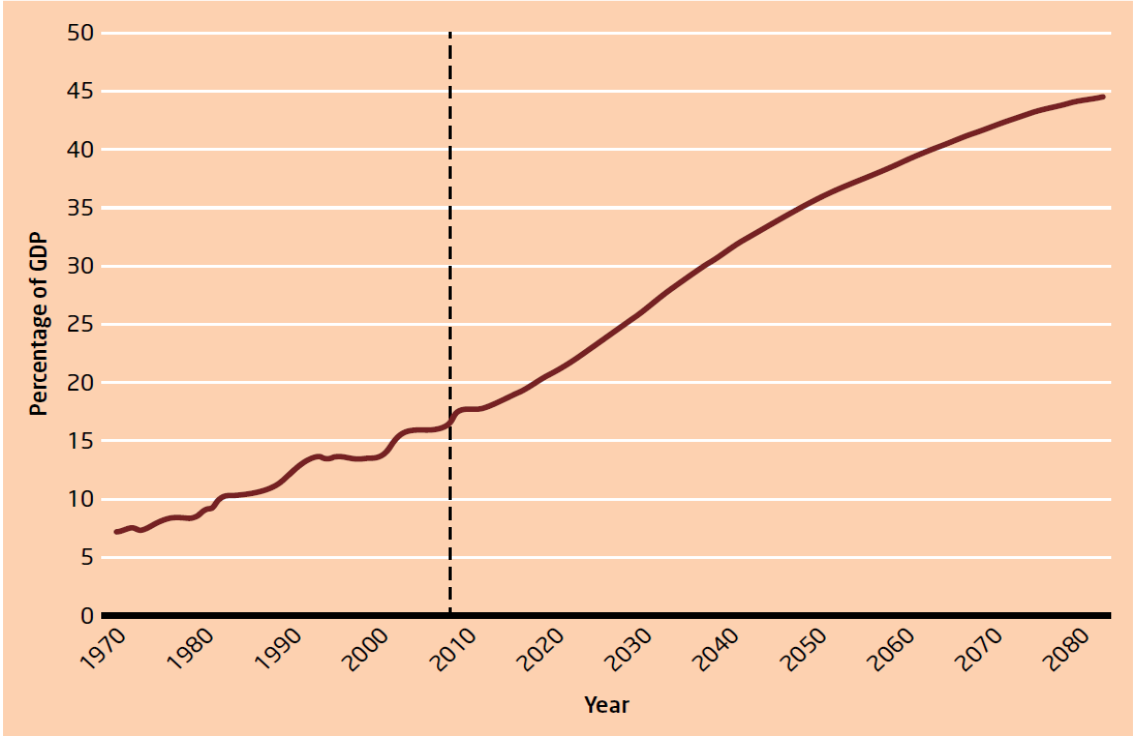


Israel Health Expenditure- Billions of IS (1992-2017):

3. Economic burden

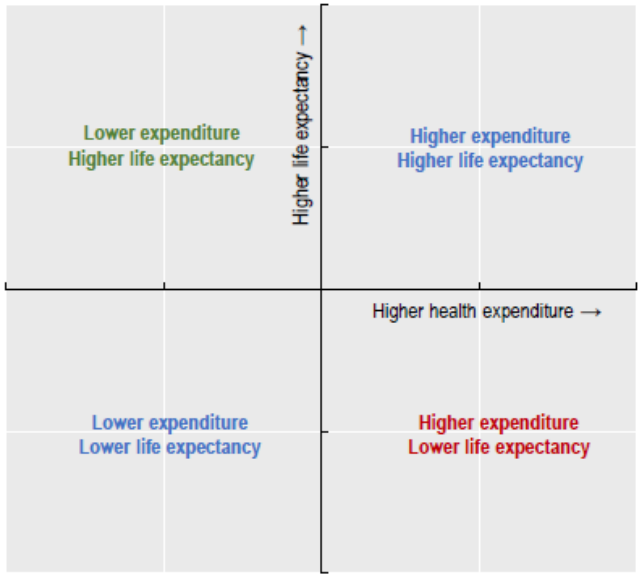
US Health Expenditure

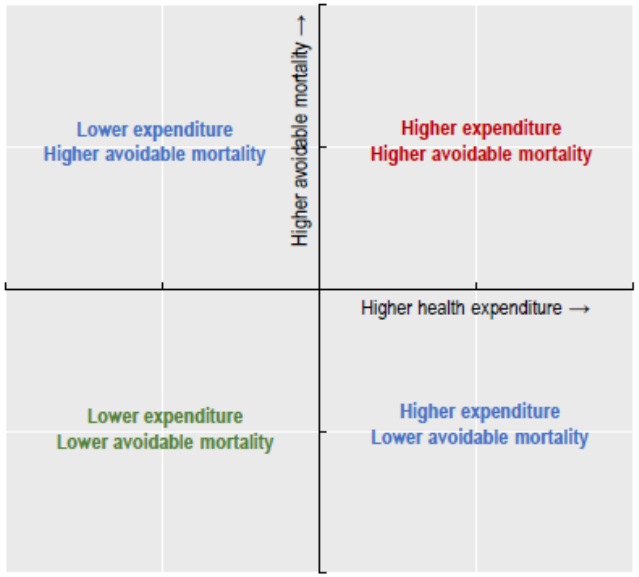
US total health expenditure as a percentage of GDP 1970–2083



Economic Efficiency

Figure 1.1. **Interpretation of quadrant charts: Health expenditure and health outcome variables**





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Economic Efficiency

Figure 1.7. **Life expectancy and health expenditure**

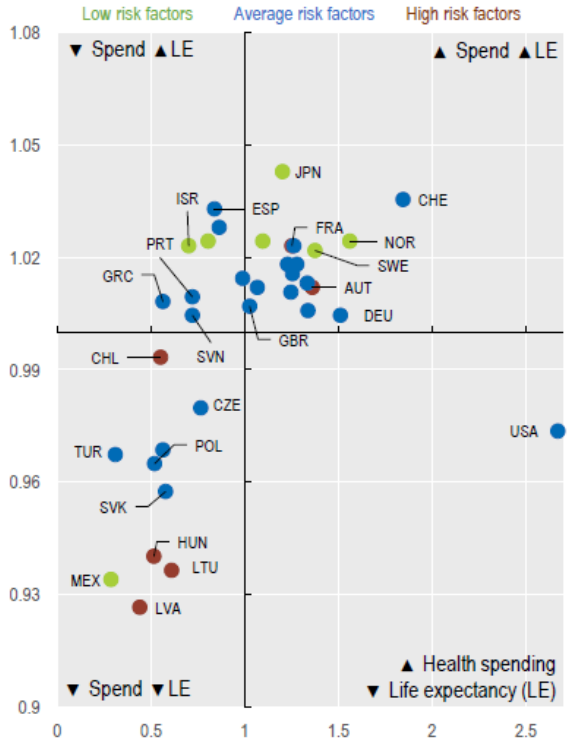
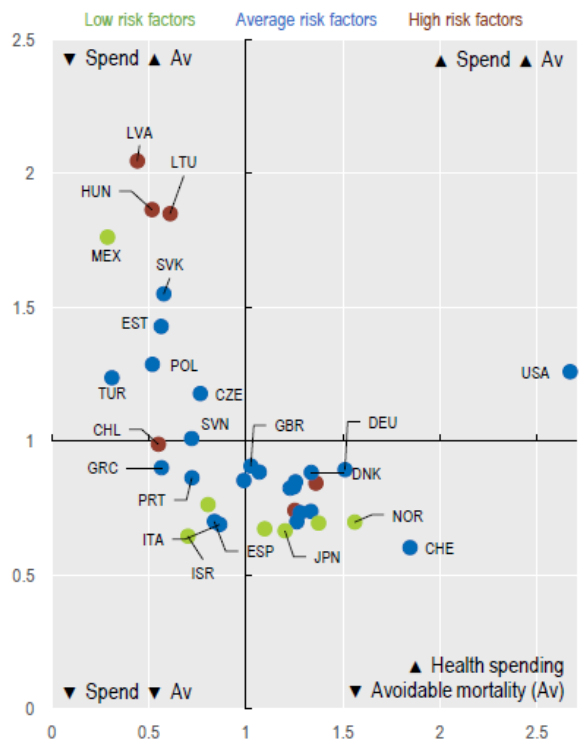
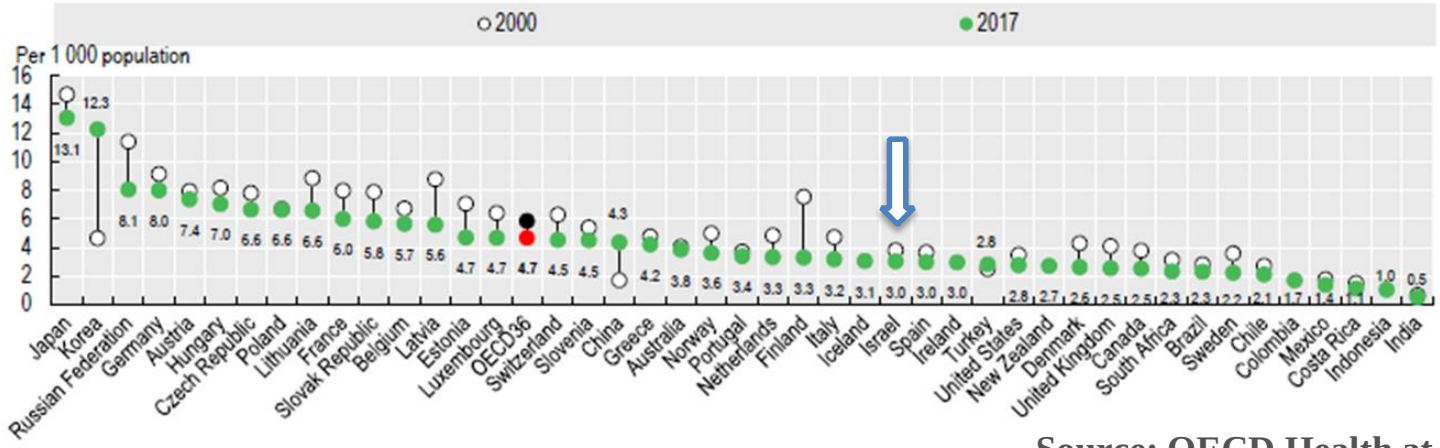


Figure 1.8. **Avoidable mortality (preventable and treatable) and health expenditure**

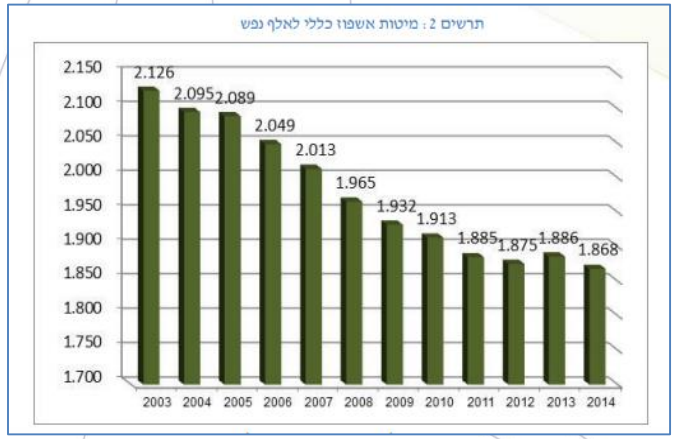


General Hospitalization Beds- Israel and OECD:

Figure 9.6. **Hospital beds, 2000 and 2017 (or nearest year)**

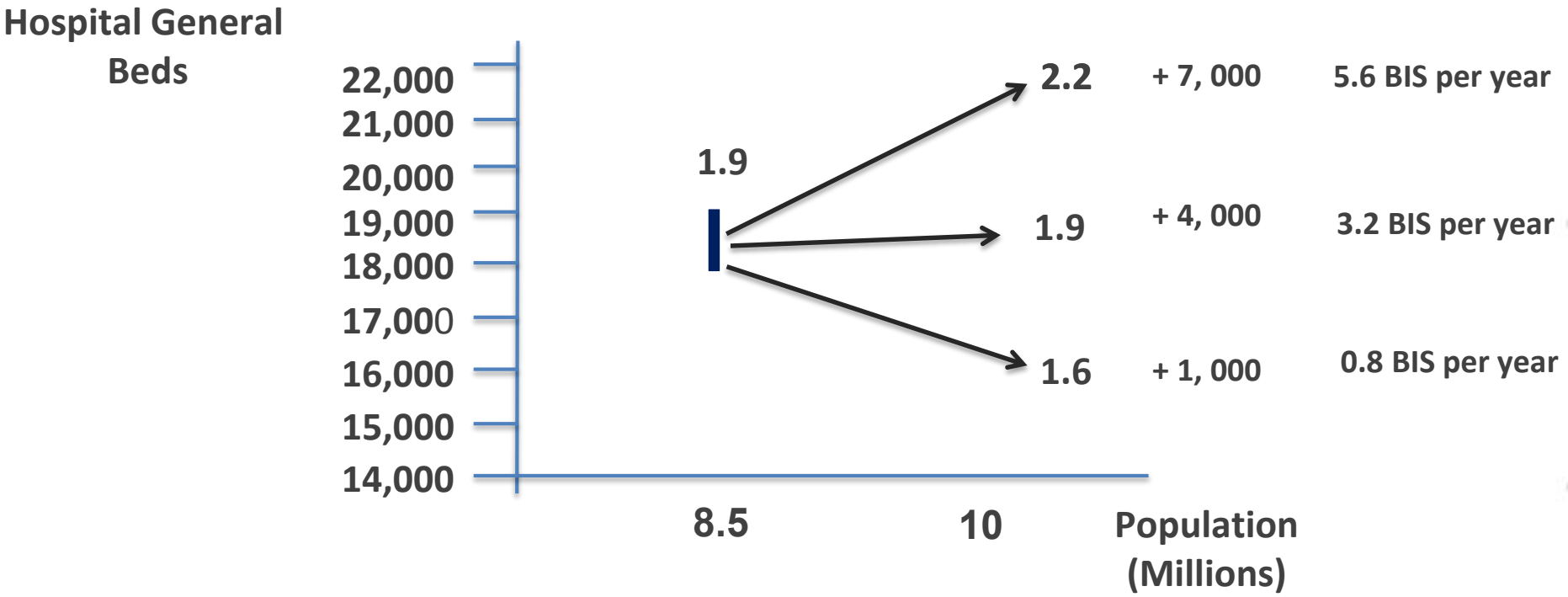


Source: OECD Health at a glance 2019



Number of beds in relation to population size (Israel)

Beds per 1,000 Persons



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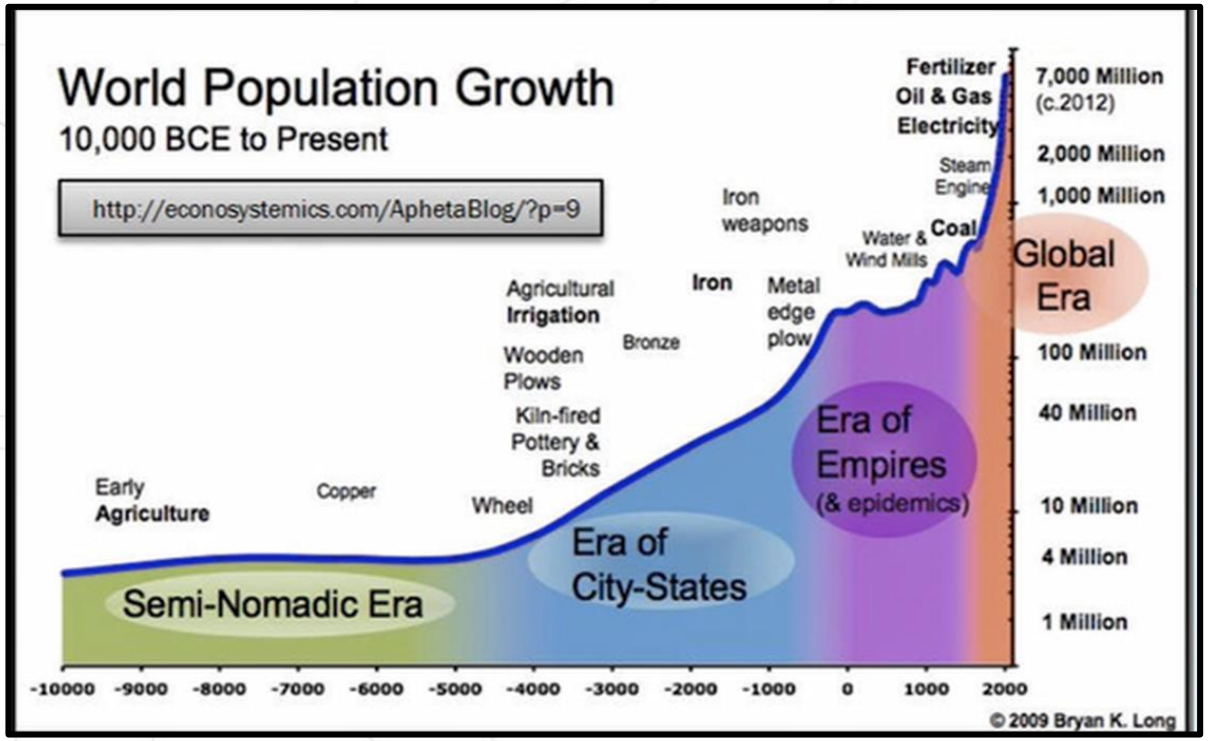
Growth in World Population:



4. Demographic changes

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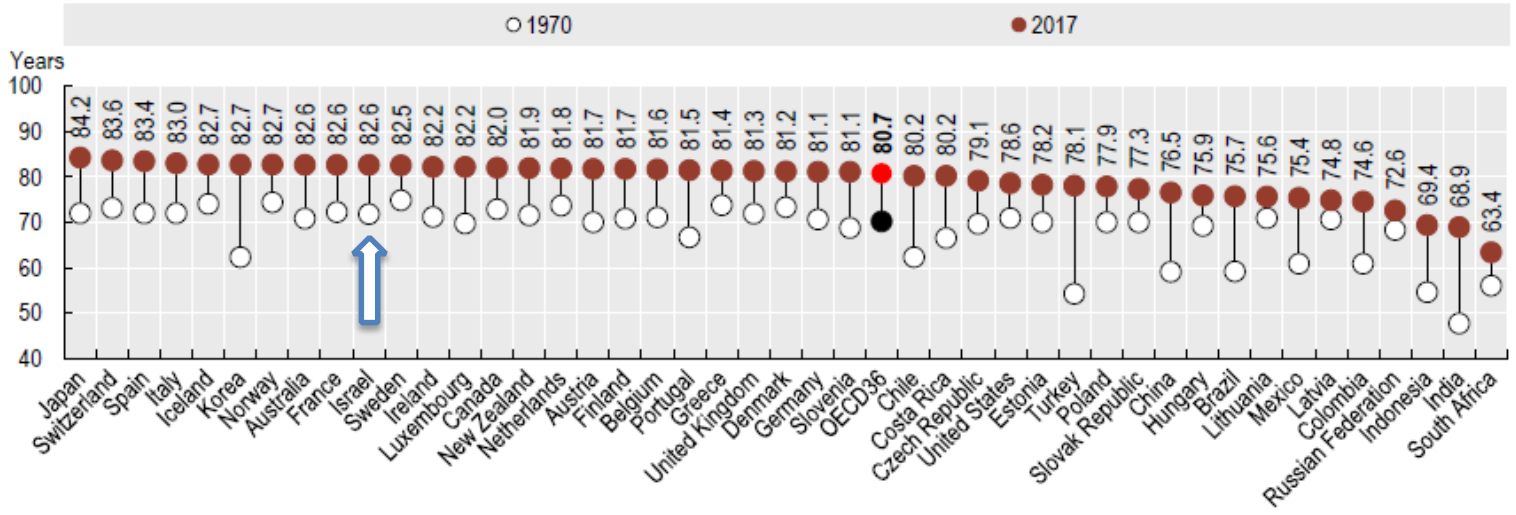
Healthcare Indices – Life expectancy at birth:

Israel is ranked 10th in the OECD (82.6y) Vs (80.7-OECD).

Men 3rd (80.1y); Women 9th (84.1y)

Figure 3.1. **Life expectancy at birth, 1970 and 2017 (or nearest year)**



Source: OECD Health Statistics 2019.

StatLink https://doi.org/10.1787/888934014821

4. Demographic changes

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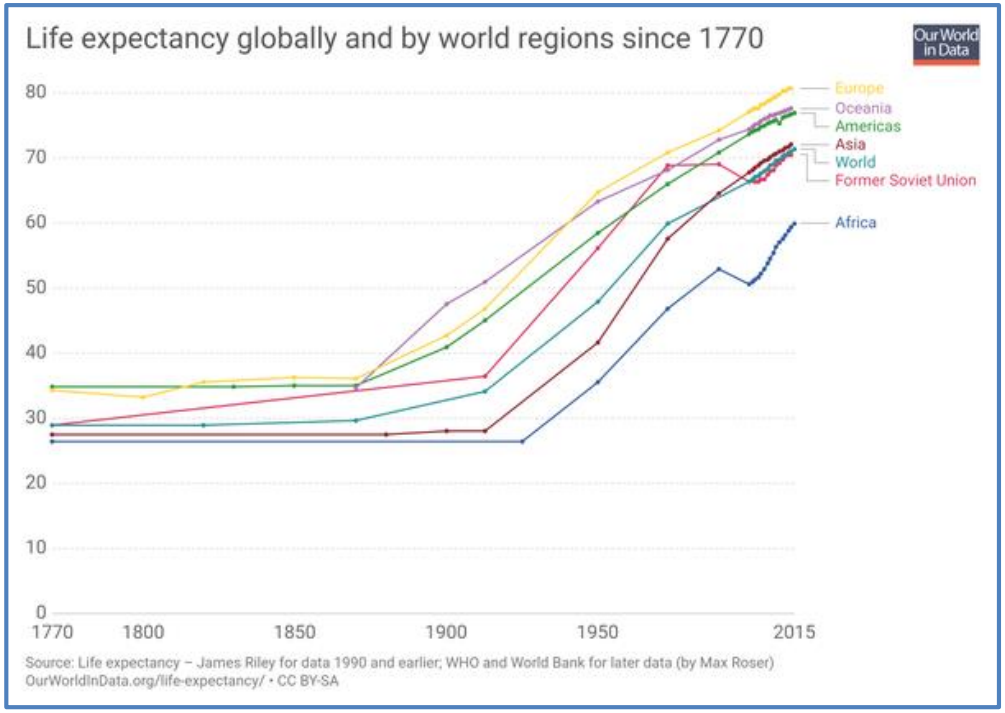
Life Expectancy-Globally



Severe Discrepancy between Africa and the western world in time of change, and recent maximal life expectancy.

4. Demographic changes

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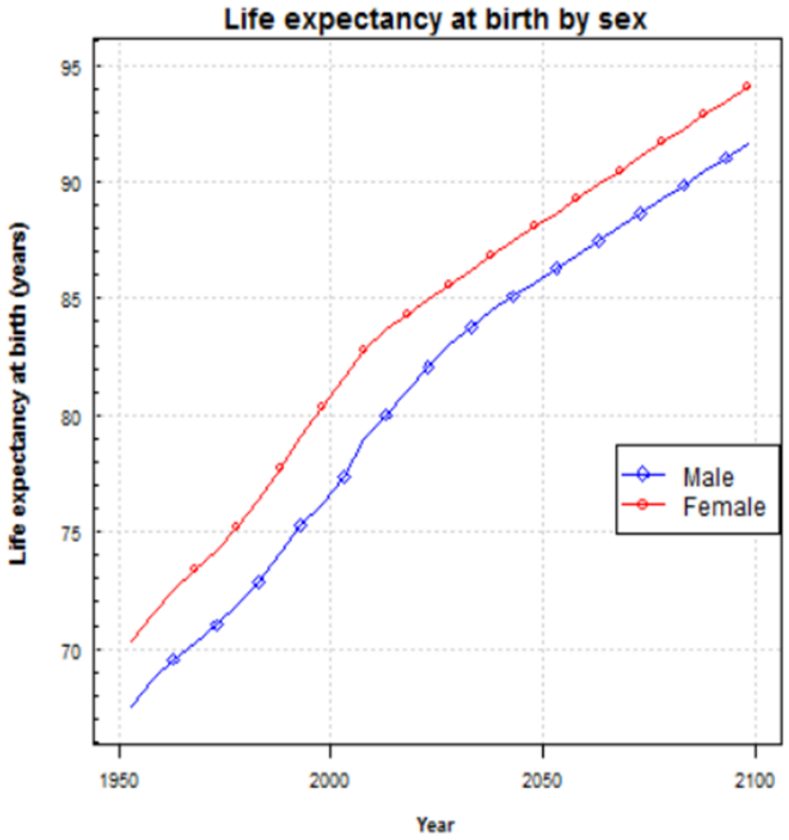
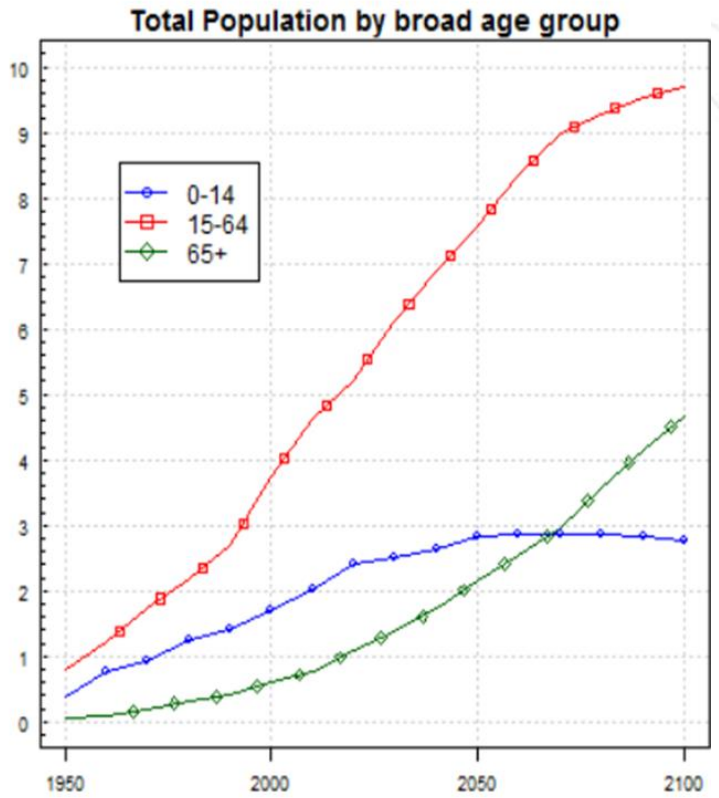
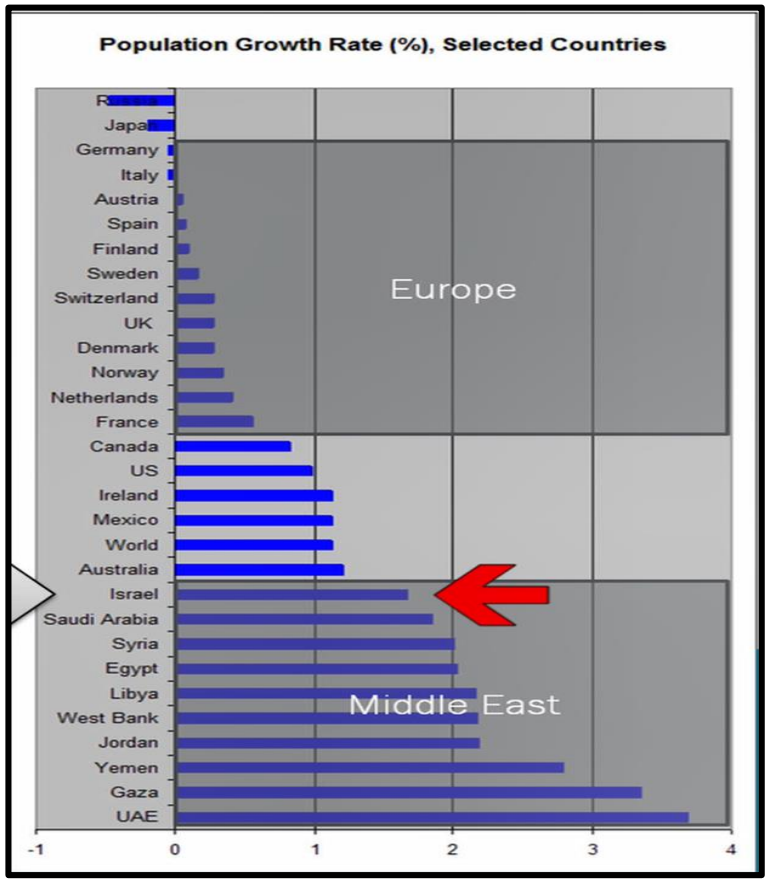
Trends in life expectancy:

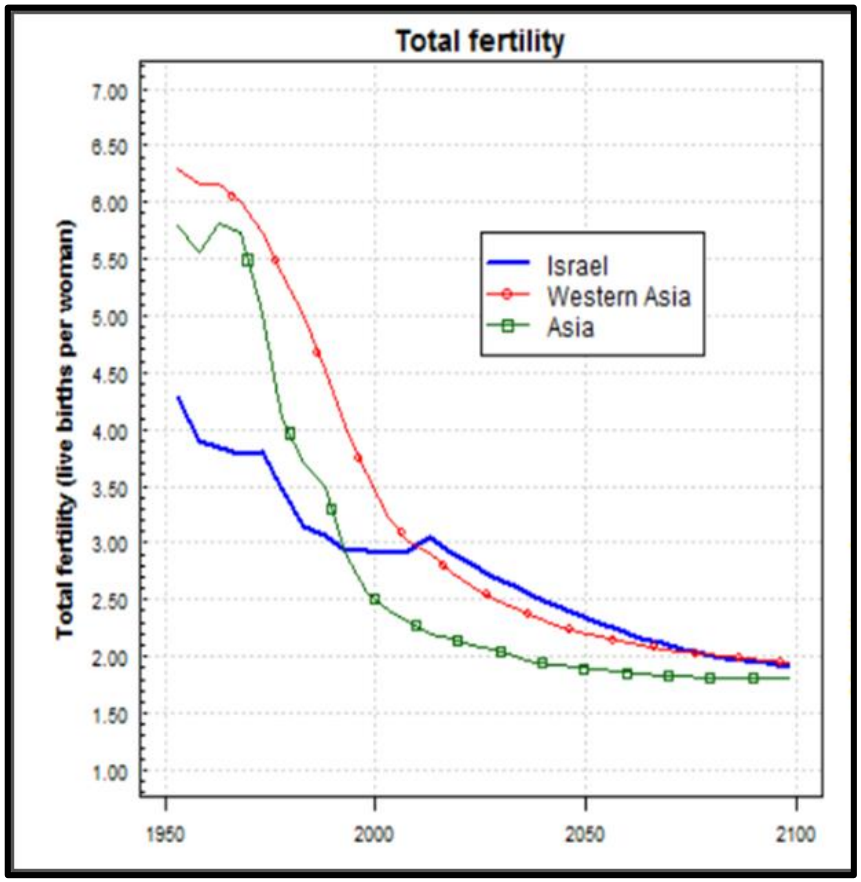
Life Expectancy & Aging -Israel





Population Growth Rate (Fertility)





4. Demographic changes

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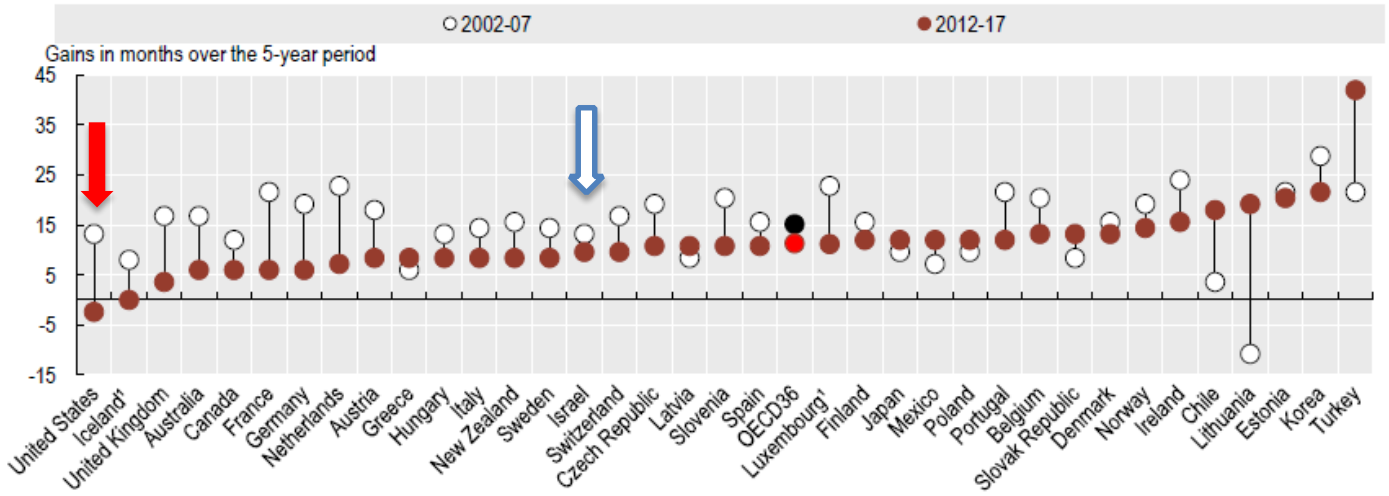
Trends in life expectancy:

Figure 3.2. **Slowdown in life expectancy gains, 2012-17 and 2002-07**



1. Three-year average.
Source: OECD Health Statistics 2019.

StatLink https://doi.org/10.1787/888934014840

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5. Future illness

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Causes of Mortality

FIGURE 2. The 10 leading causes of death as a percentage of all deaths — United States, 1900 and 1997

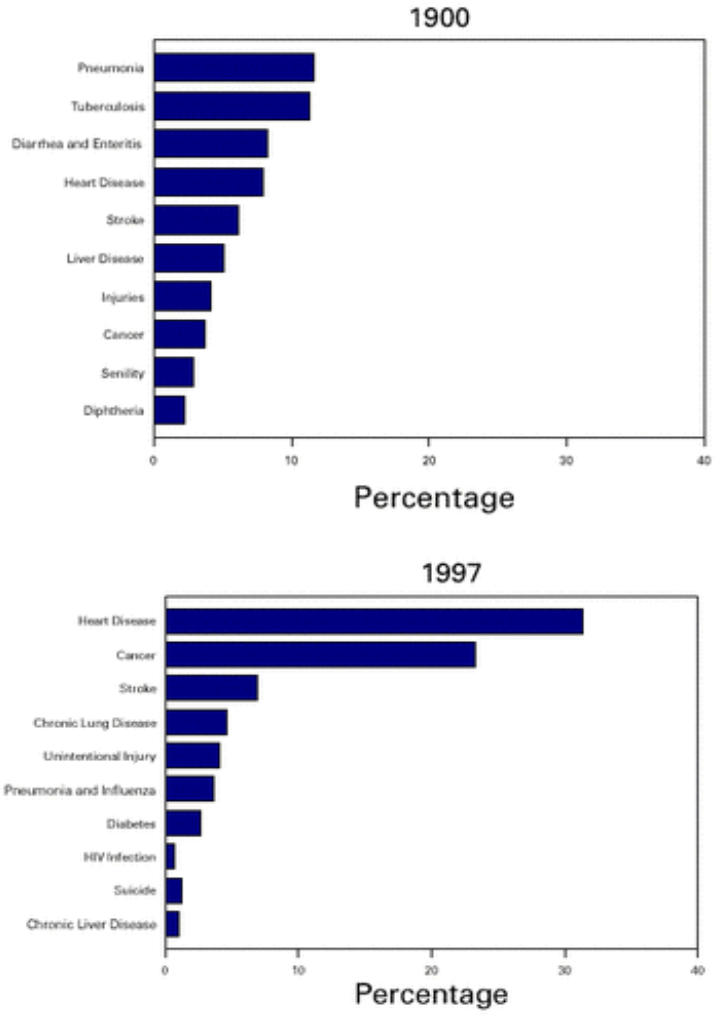
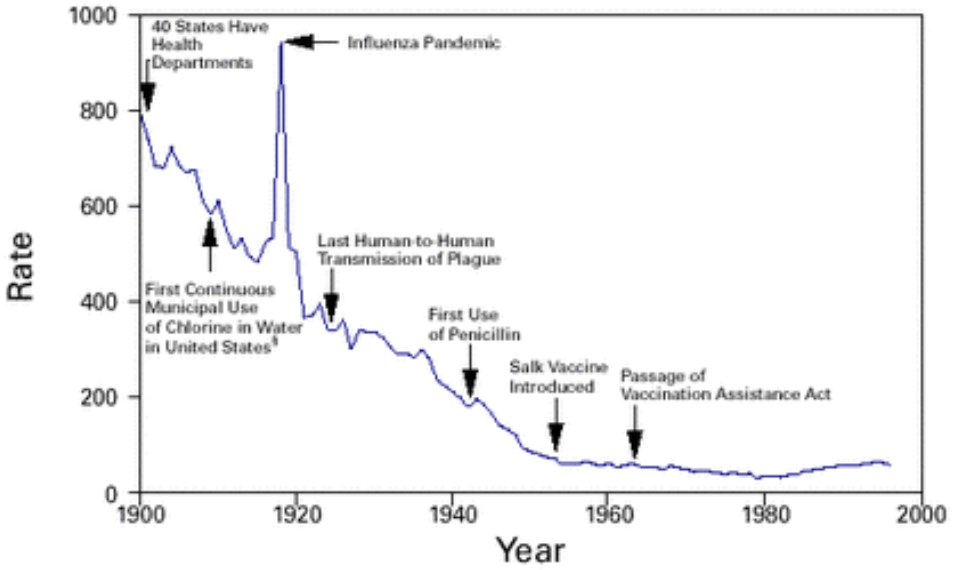


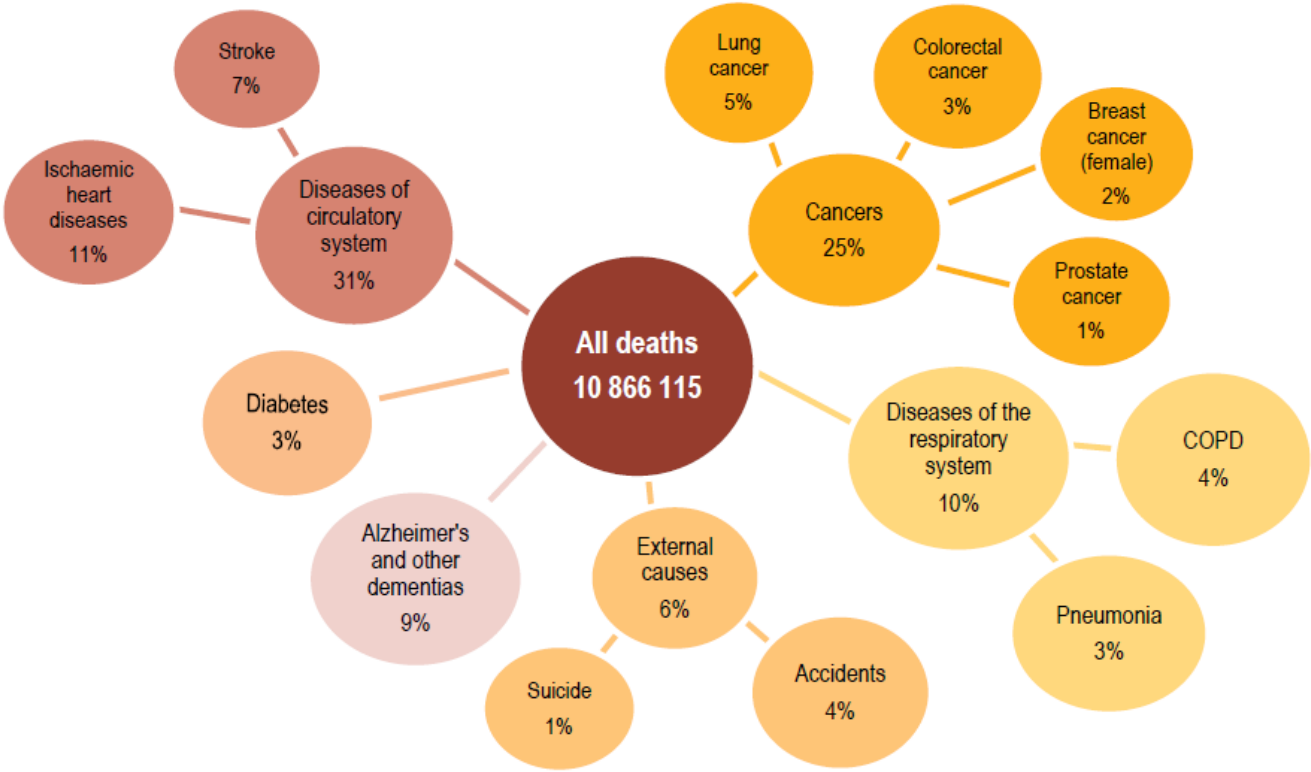
FIGURE 1. Crude death rate* for infectious diseases — United States, 1900–1996†



*Per 100,000 population per year.
†Adapted from Armstrong GL, Conn LA, Pinner RW. Trends in infectious disease mortality in the United States during the 20th century. JAMA 1999:281;61–6.
§American Water Works Association. Water chlorination principles and practices: AWWA manual M20. Denver, Colorado: American Water Works Association, 1973.

Causes of Mortality-2017

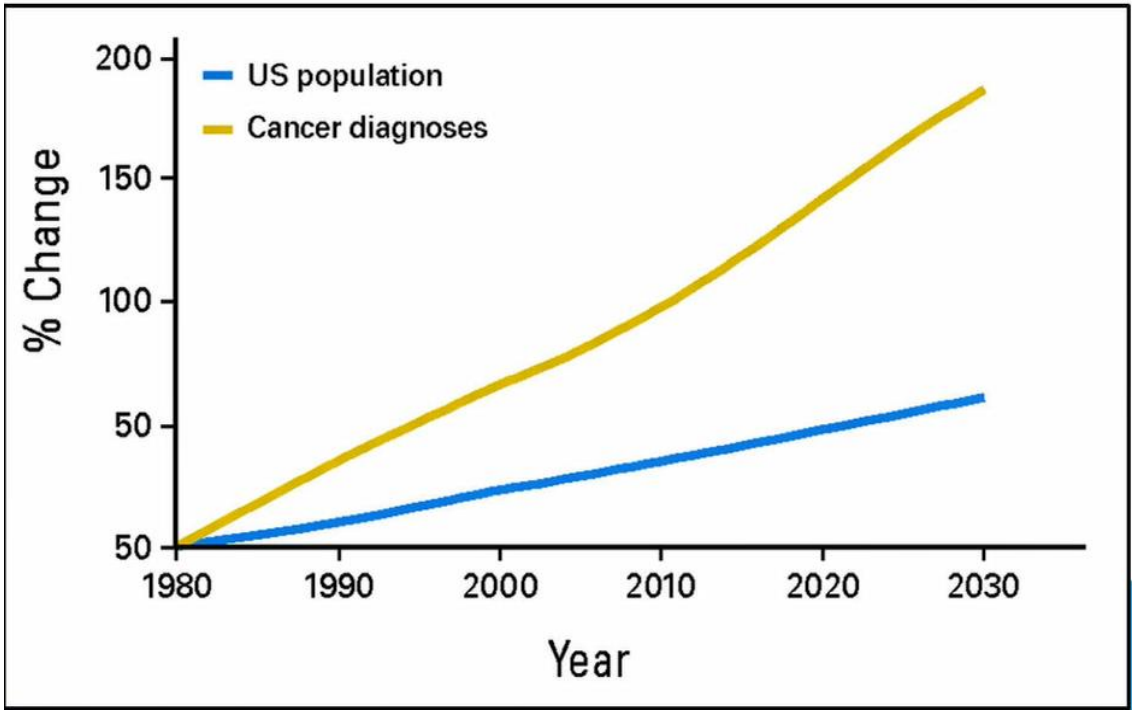
Figure 3.7. **Main causes of mortality across OECD countries, 2017 (or nearest year)**



5. Future illness

Cancer

HISTORIC AND PROJECTED GROWTH IN THE US POPULATION AND ALL INVASIVE CANCERS BY 1980 TO 2030



5. Future illness

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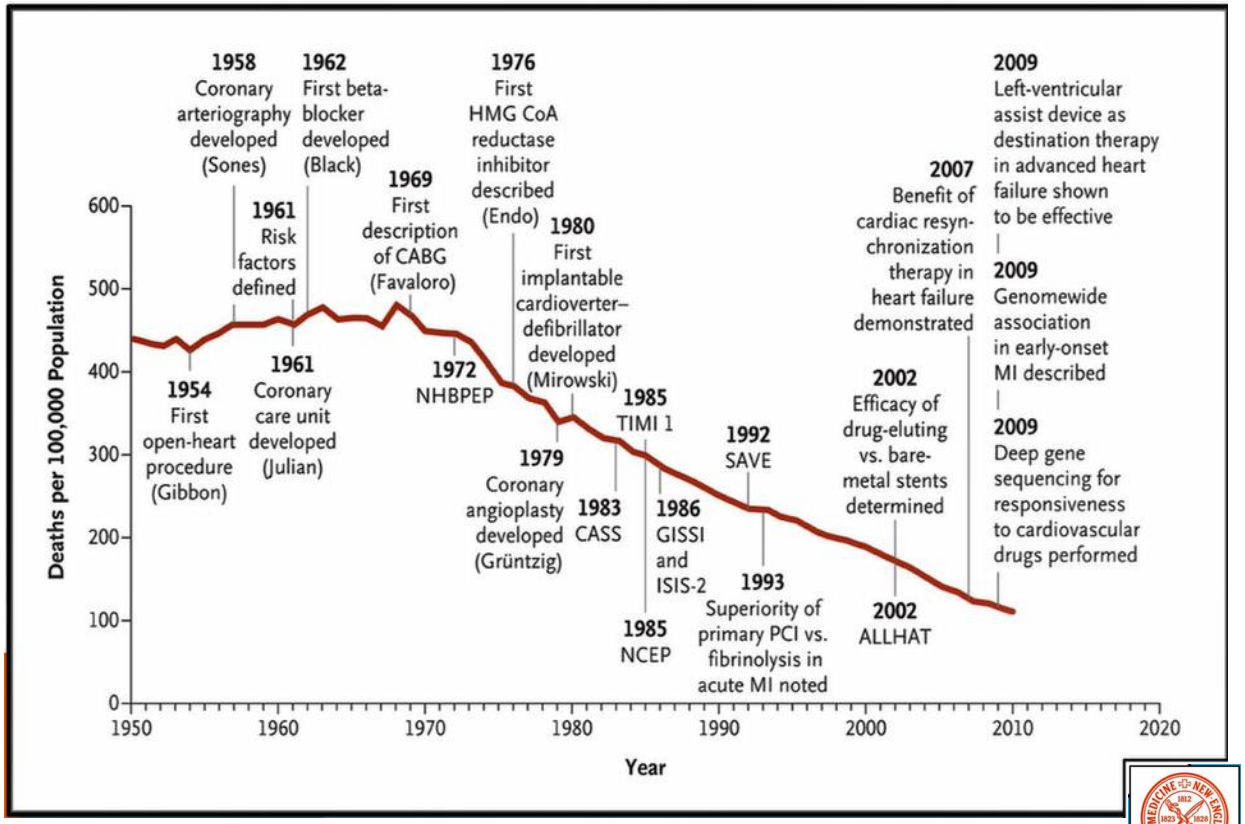
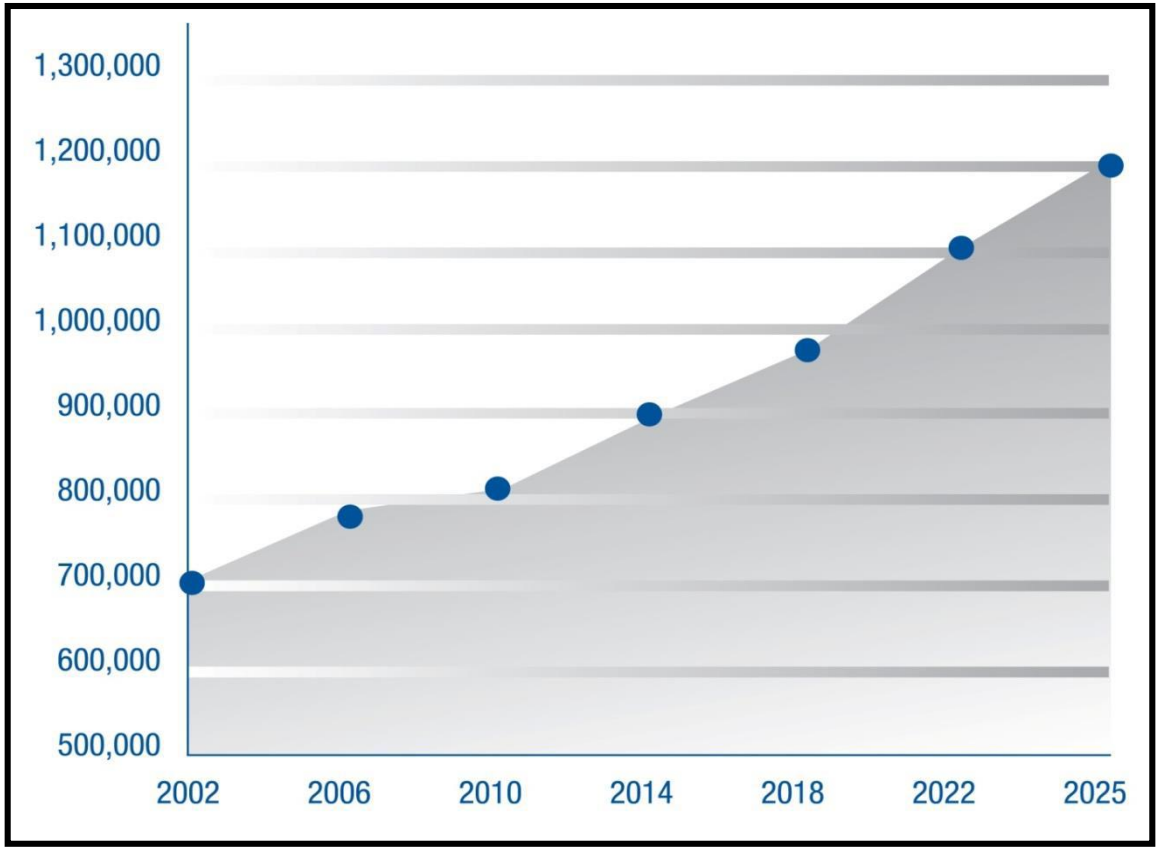
Cardiovascular Diseases

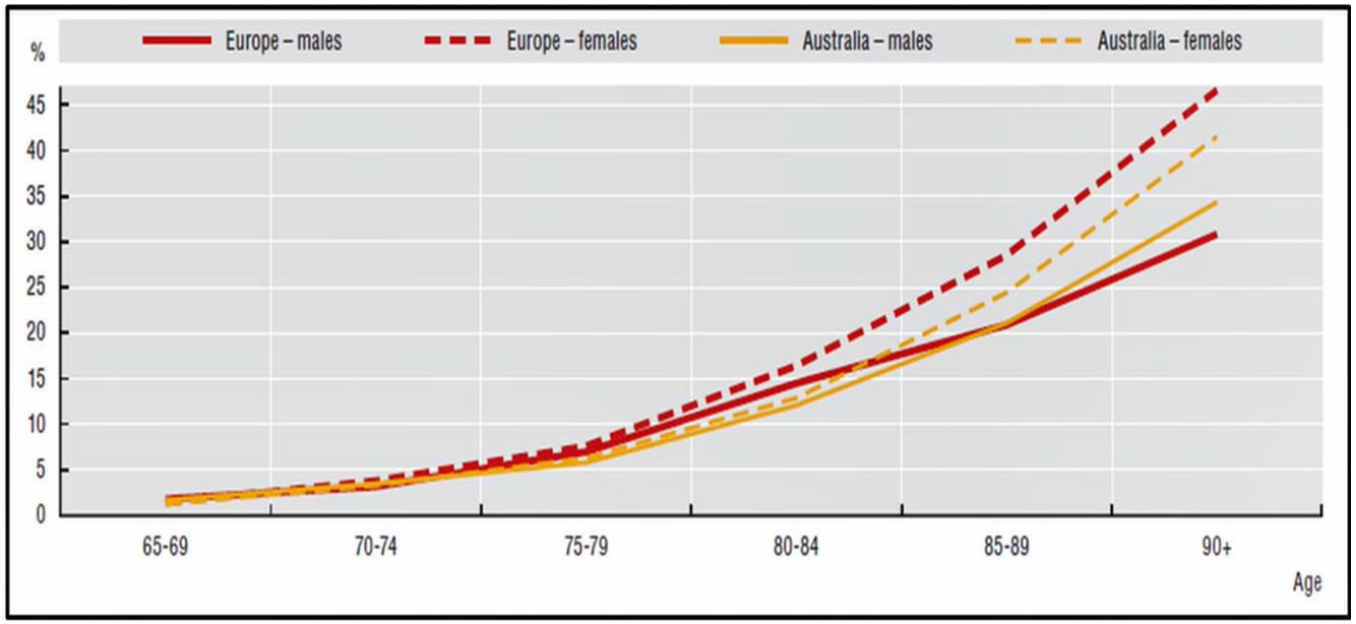


5. Future illness

Projected of Strokes in US 2002-2025



Dementia



AGE-RELATED PREVALENCE OF DEMENTIA IN EUROPE AND AUSTRALIA (2009) F>M

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Preface

- Most world healthcare systems are organized of **2 major care locations**:
  - Community-based care
  - Hospital-based care
- Up to 50 years ago the **hospital-care** was regarded as the **significant and important one** for population health and attracted most resources
- C**ommunity-based** care has **emerged recently** as the **leading** cause for the improvement of care delivery and outcome

Why Community Medicine?

- Highly accessible
- Preferred by patients
- Personal acquaintance
- Case management capacity
- Choice of specialists
- Shorter waiting time for procedures and surgeries
- Lowers hospital burden
- Better cost-effectiveness ratio
- Can deal with >90% of clinical issues

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Hospitals

- **Deliver the best and up-to-date care**
  (The most academic & professional physicians, cutting-edge technology, multidisciplinary approach).

However

- Highly expensive
- Overloaded
- Unsafe
- Do not have and will never have the capacity to serve all health needs of the population:
  - Human resources
  - Financial resources

Community and hospital services in Modern Healthcare Systems:

Community services:

- Primary care
- Ambulatory Specialty care
- Ambulatory surgery
- Home hospitalization
- Diagnosis
- Primary rehabilitation

Hospital Services:

- Emergency care
- Intensive Care
- 24/7 Observation and treatment
- Sophisticated/expensive diagnosis
- Sophisticated/expensive/risky ambulatory procedures

6. Hospitals and community

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Trends in Healthcare

- Care at the hospital is expensive
- Care at the hospital is unsafe
- Care at the hospital is not patient centered

→ Care will be pushed out of hospitals to the home

→ Hospitals will get smaller with fewer "real" beds and more "virtual" beds

→ Hospitals will provide mostly:
- Intensive care
- Complex surgery
- Specialized services

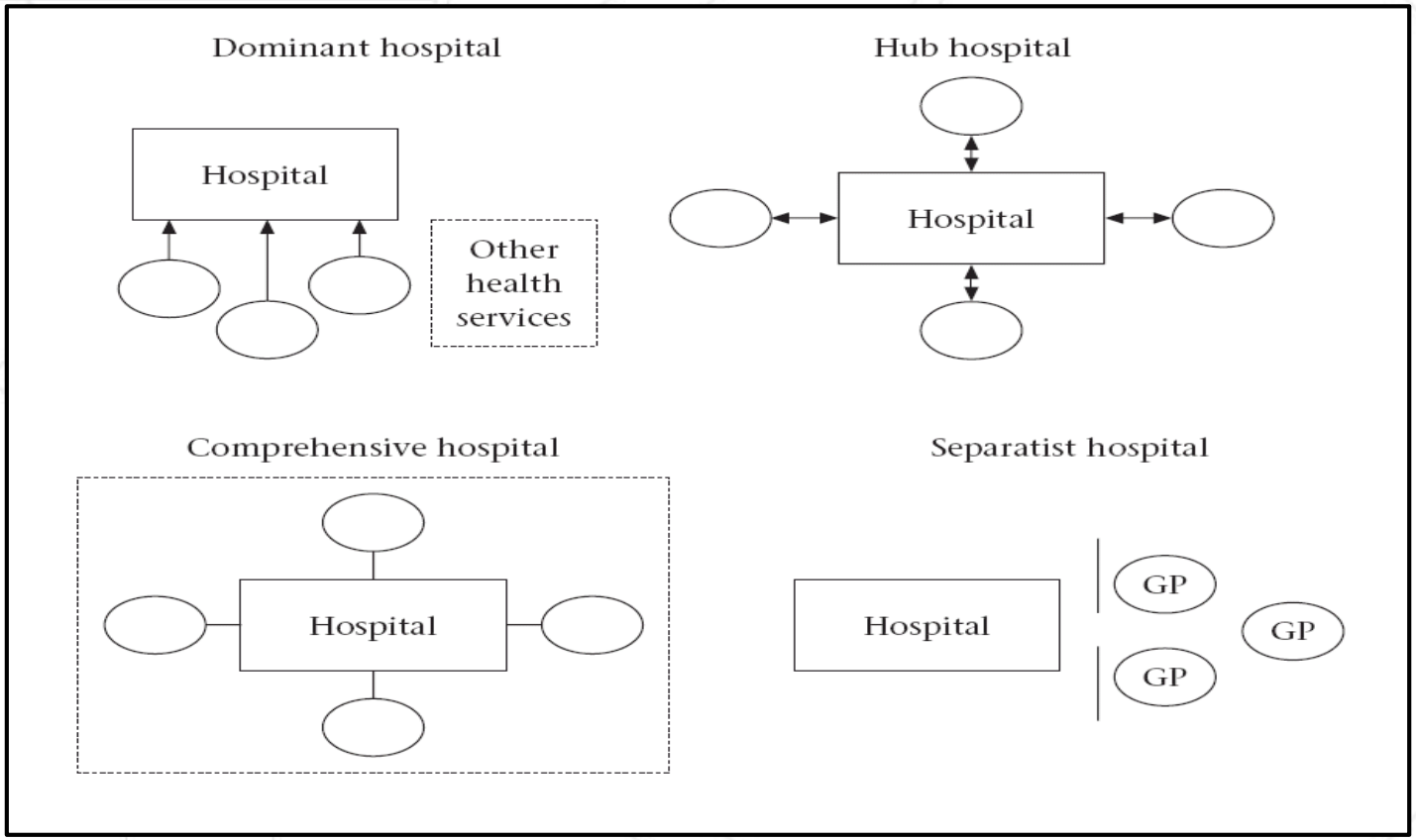
Digital Health

→ Redesign of hospitals

→
- Optimizing clinical processes and patient flow
- Enhancing patient and provider experience
- Emphasis on predict and prevent disease with precision cure and rehab

6. Hospitals and community

Organization **models** of the health care system which combine hospitals and community:



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The **Current** Organization of the **Israeli** health care system

Primary Care

- 4 Community Health Funds
- Primary care & specialists

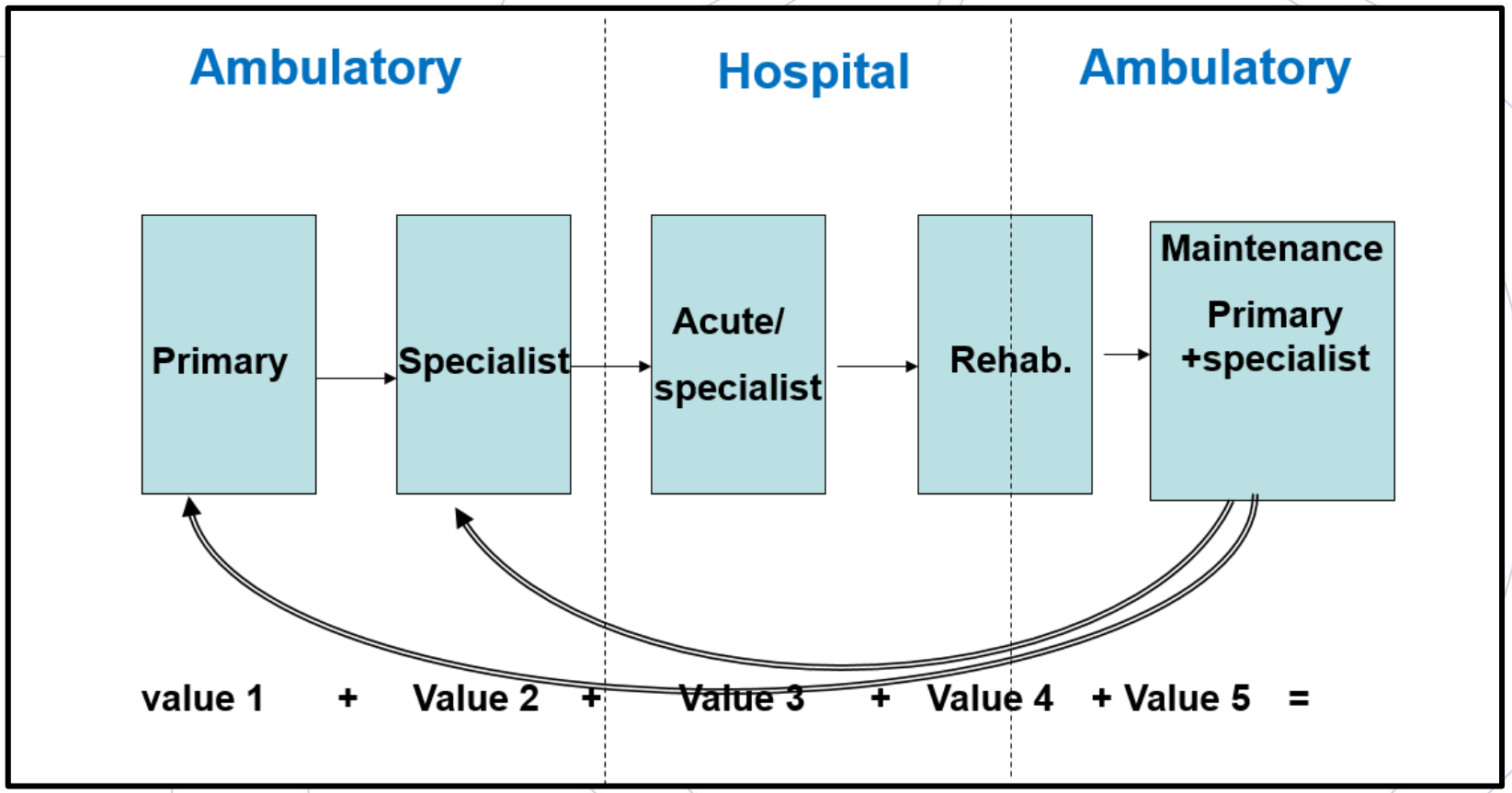
Hospitals

- Government
- HFs
- Other public
- Private

A Barrier

6. Hospitals and community

Optimal Care flow through hospital community interfaces



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7. Sociological and cultural aspects

- **The new generation of physicians.**

- **Privacy in the era of Facebook and the social networks.**

- **Responding to public demands – from needs to desires.**

Doctor's strike

7. Sociological and cultural aspects

- From professional autonomy to regulated practice.


חוזר המנהל הכללי

משרד הבריאות

ה' תמוז, התשע"ח
18 יוני 2018
מס': 11/2018

הנדון: כללים להתקשרויות בעלות אופי מסחרי של מוסדות הבריאות
סימוכין: חוזר המנהל הכללי מס' 2/2010 מיום: 9.2.2010

- The effect of media on the public & the professionals.


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BMJ 2006 ; 333 doi: http://dx.doi.org/10.1136/bmj.39003.640567.AE (Published 30 November 2006)
Cite this as: BMJ 2006;333:1143

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8. Spirit and summary

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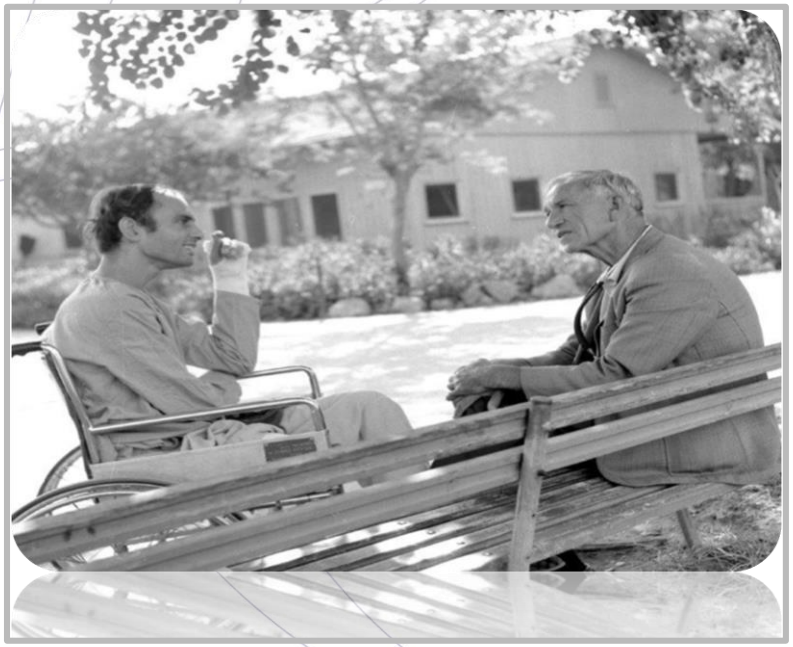
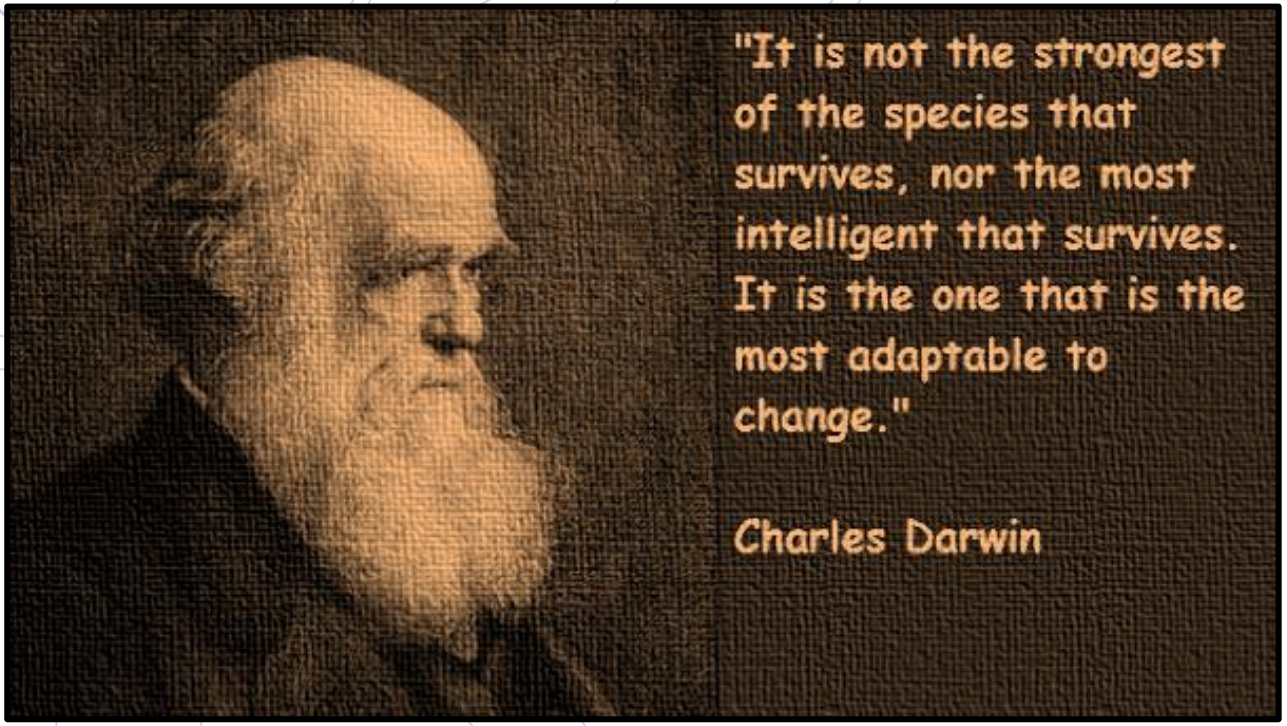
What has not changed?

- Being understanding, empathic, human.
- The risk of egotism and vanity.



The End


"It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is the most adaptable to change."
Charles Darwin

Thank You!!

Prof. Eldad Katorza MD, MSc, MBA

Director of Gertner Institute for Epidemiology & Health policy Research

Director of Arrow Project for Young Investigators

Sheba Medical Center, Tel-Hashomer, Israel

Sackler School of Medicine, Tel Aviv University

Eldad.katorza@sheba.health.gov.il

052-6668484