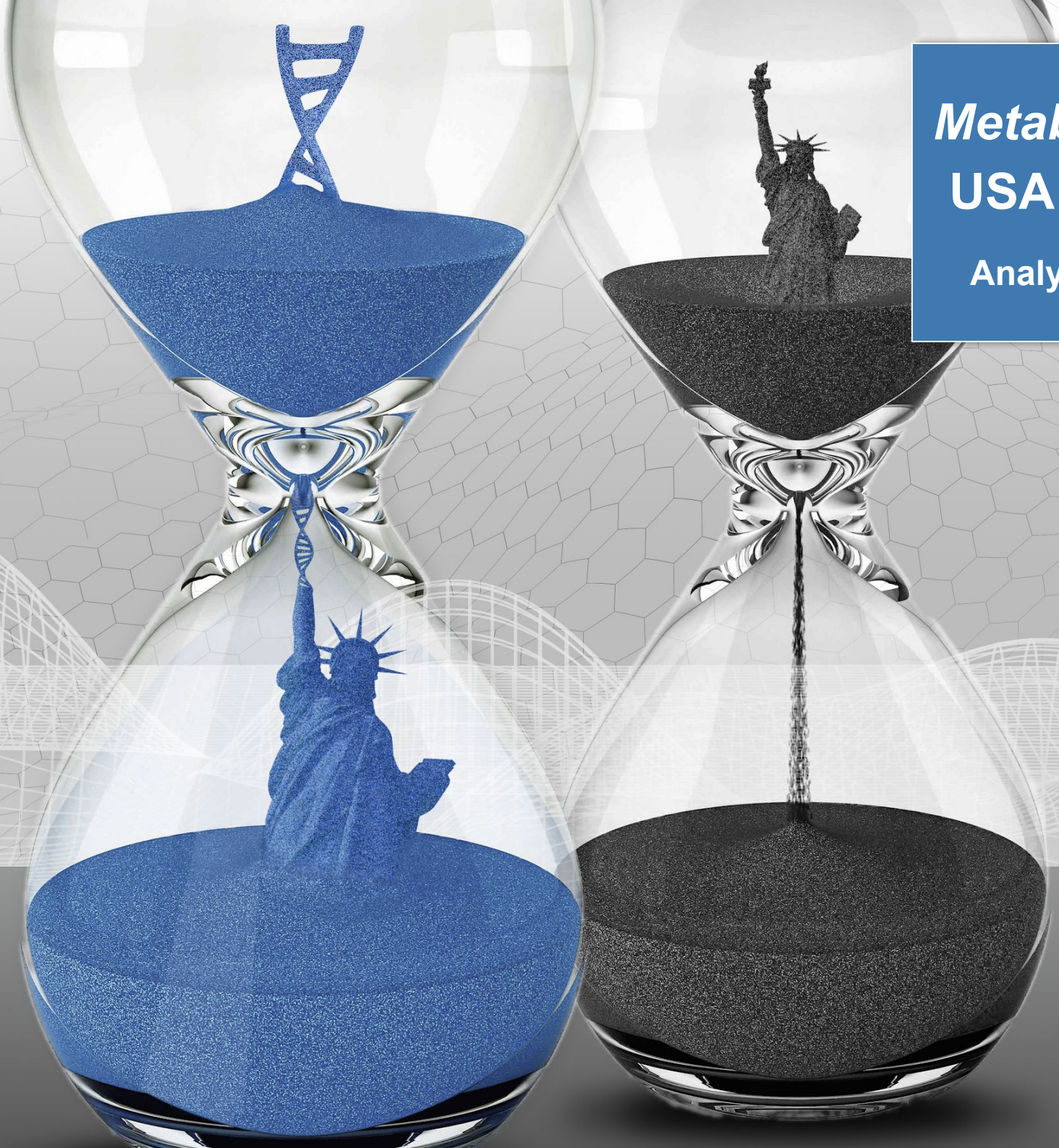
Metabesity and Longevity
USA Special Case Study

Analysis and Policy Implications



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United States: Metabesity and Longevity

Analysis and Policy Implications

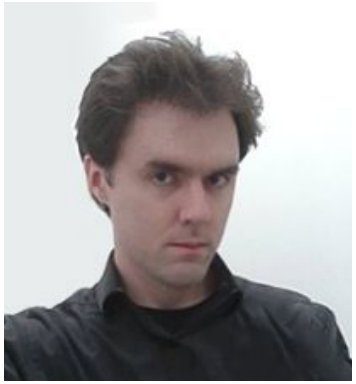
Contributors to the Report

Dmitry Kaminskiy is Managing Partner of Deep Knowledge Ventures and Founder of Longevity.Capital. An innovative entrepreneur and investor active in the DeepTech, he is a frequent speaker on the topics of AI and longevity at conferences organized in London by *The Economist* "Aging Societies and The Business of Longevity," *Financial Times* "Global Pharmaceutical and Biotechnology Conference," as well as several others at Oxford and Cambridge Universities. He is actively involved in the work of the All-Party Parliamentary Group (APPG) for Longevity in the UK Parliament, now serving as co-director of the APPG secretariat, overseeing the APPG's international longevity cooperation development division and is supervising all of the APPG's activities related to the concept of establishing Centres of Artificial intelligence for Preventive Medicine and Longevity in the UK.

Kate Batz is a Managing Partner of Longevity.Capital and Director of Strategy and Business Development at Deep Knowledge Ventures and Aging Analytics Agency, supervising activities in the United States. She is an experienced corporate attorney licensed to practice law in California and New York, with an extensive sales and marketing background. At the beginning of her career, Kate was involved with international litigation when she worked for a former Pennsylvania state senator. As a corporate attorney, Kate worked with several Fortune 500 clients. Compelled by the paradigm-shifting advances in science and technology in the fields of aging and longevity, Kate enthusiastically joined Deep Knowledge Ventures Group.

Contributors to the Report

Franco Cortese is Deputy Director of Aging Analytics Agency. He has co-authored of over a dozen scientific papers on the topics of longevity, ageing and biogerontology in peer-reviewed journals including Scientific Reports (Nature Publishing Group), Journal of Gerontology Series A, Frontiers in Genetics, Aging, Oncotarget and others. He was also part of the team behind the proposal that promoted the World Health Organization to add an extension code for “ageing related” (XT9T) during their ICD-11 revisions in 2018. He served as a Trustee of the Biogerontology Research Foundation during 2017, and as its Deputy Director from 2016 - 2018.

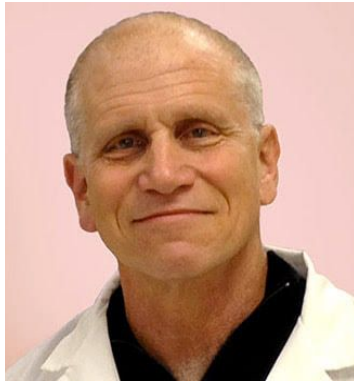


Ian Inkster is senior analyst of Aging Analytics Agency. Ian Inkster has worked across multiple biotech companies since 2009, with an emphasis on giving definition to the rejuvenation biotechnology industry. He had a hand in the SENS Research Foundation since its inception, and his previous role was a public relations officer for Deep Knowledge Ventures. Ian Inkster is also active as communication consultant, specialising in equivocal or original concepts in politics and technology.

Breanna Deutsch became passionate about the relationship between policy and longevity while working as a staffer on Capitol Hill in both the U.S. House of Representatives and the U.S. Senate. She believes that informing Congress and regulators about the importance of prioritizing longevity in healthcare policy is critical in creating a path for life-changing treatments to make their way through the regulatory system and into the hands of the public. Breanna received a B.A. in American Studies from Scripps College and a M.S. in corporate communications from Georgetown University.

Contributors to the Report

Dr. Alexander Fleming is Founder and Executive Chairman of Kinexum. He is also Chief Medical Officer of Tolerion. Dr. Fleming's regulatory and technical expertise has been requested in numerous international settings. At the US Food and Drug Administration from 1986 to 1998, Dr. Fleming was responsible for the therapeutic areas of diabetes, other metabolic and endocrine disorders, growth and development, nutrition, lipid-lowering compounds, and reproductive indications. He was assigned from FDA to the World Health Organization from 1991-92. Dr. Fleming coined the term "metabesity," which refers to the constellation of cancer, cardiovascular and neurological diseases, diabetes, and the aging process itself, all of which share common metabolic root causes and potential preventive therapies.



Dr. Michael Zemel is founder and CSO of NuSirt Biopharma. At NuSirt, he developed and ran the discovery R&D program in metabolic health, focused on energy-sensing and development of therapeutics for diseases of aging and over-nutrition, leading to clinical-stage asset development in obesity, diabetes, and NASH. Dr. Zemel is also a preclinical and clinical development, project management, and regulatory affairs consultant at Kinexum. Previously, Dr. Zemel was Professor of Nutrition and of Medicine at the University of Tennessee from 1990-2012, where his work focused on energy sensing, muscle-fat cross-talk, and regulation of adipocyte metabolism. Prior to the University of Tennessee, he served on the faculties of Endocrinology and of Nutrition at Wayne State University and as Research Endocrinologist at the VA Medical Center associated with Wayne State from 1980-1990. He founded NuSirt Biopharma in 2007.

Contributors to the Report

Thomas Seoh is President and CEO of Kinexum, a strategic advisory firm that provides regulatory, clinical, CMC, and other translational guidance for life science product development. He is an entrepreneur/executive who has held senior leadership positions in public and private pharmaceutical, biotech and medical device companies for over 25 years. Thomas subsequently served in leadership positions of medical device startups developing an ex vivo liver dialysis device, a novel mechanical thrombectomy device for Deep Vein Thrombosis and stroke and a state-of-the-art neurocatheter, and a plant-based skin substitute wound dressing. He has served on industry-university advisory boards at Johns Hopkins School of Medicine and the University of Maryland Baltimore County.

Jennifer Zhao is an Associate at Kinexum, a strategic advisory firm providing guidance on regulatory, clinical, and other translational matters for life science product development. She has experience in small molecule synthesis, having written an undergraduate thesis on the synthesis of pyrroloindole ring systems. Previously, Jennifer interned at Close Concerns, a healthcare informatics company specialized in diabetes and obesity. She is interested in applying her research, communicational, and problem-solving experience to explore and make an impact on the pharmaceutical and healthcare industries. Jennifer holds a BA in Biological Chemistry from Dartmouth College, where she graduated magna cum laude in 2018. She will attend the UNC Eshelman School of Pharmacy as a PharmD candidate as part of the class of 2024.

Overview

I. Metabesity, Longevity and Health

Metabesity names the major chronic diseases, cancer and the aging process itself, all which share common metabolic roots and therefore can be collectively targeted. They comprise the most prevalent and costly degenerative conditions afflicting US citizens today. When metabolism is impaired or stressed, we age. Together with overnutrition and sedentary lifestyle, aging is a major risk factor for these diseases. Thus, the most effective and economic approaches to healthcare will necessarily involve the prevention of costly chronic diseases by intervening against their shared metabolic roots as early as possible, to prevent rather than to have to treat them.

II. The GAP Between USA Health and Wealth: High Healthcare Expenditure, Low Health-Adjusted Life Expectancy (HALE)

Despite having one of the highest rates of healthcare spending, the United States is a complete outlier in terms of life expectancy at birth, Health-Adjusted Life Expectancy ("HALE"), and healthcare efficiency. Other developed countries are maintaining a much higher state of Healthy Longevity with much lower rates of healthcare spending. This is not due to inherent genetic differences - the USA is simply not implementing adequate policies and practices to utilize their healthcare dollars in effective ways.

III. The Needed Shift from Sick Care to Preventive Medicine then Precision Health, then Economic Prosperity

As the population ages, sick care will become increasingly expensive and ineffective. The USA needs to rapidly implement a broad-based shift from treatment to population-wide prevention. An array of tools are available ranging from simple digital-supported education to precision health approaches, using deep diagnostics and prognostics in combination with biomarkers of aging. These tools can both reveal and confirm effective interventions and guide their optimal selection for the individual. The aim is to thereby delay the onset of disease with as minimal intervention as possible, as early as possible. Synergies of Longevity research, P4 medicine and Artificial Intelligence have the potential to enable rapid and widespread policy and infrastructural transformation of healthcare in America to quickly boost National Healthy Longevity (healthspan). However, this can only be possible with sufficient public and private commitment at every level and step.

IV. Policy Implications: National Government Strategy to Narrow the GAP Between Life Expectancy and HALE

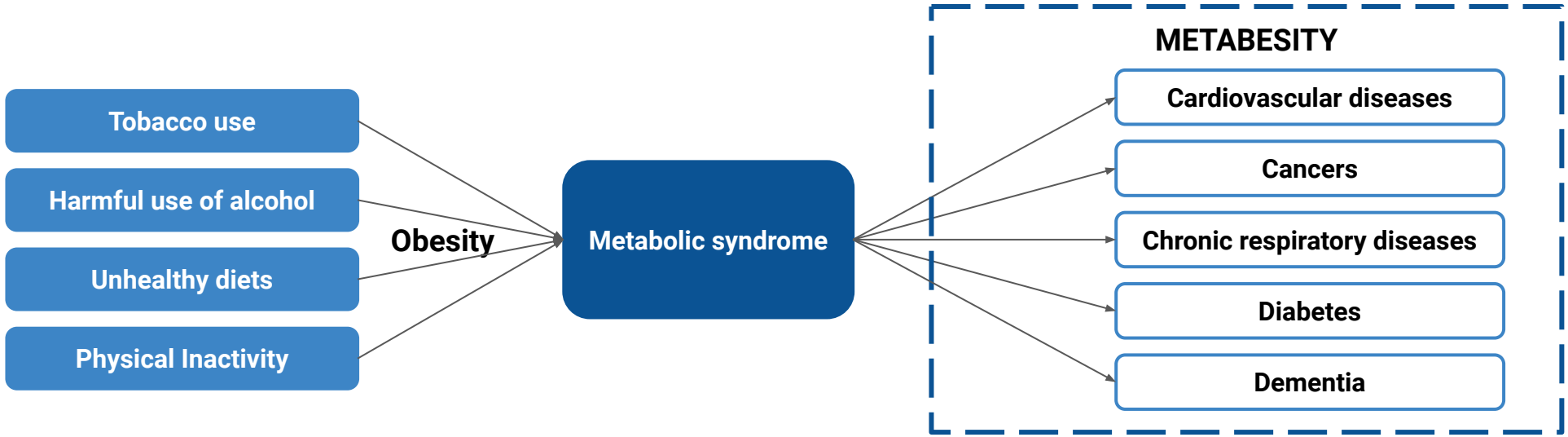
The United States holds the greatest share of the multi-trillion dollar global Longevity economy and the majority share of global Longevity Industry companies and players. It also has one of the highest rates of healthcare expenditures. While the US has all the resources necessary to become a global leader in Longevity, Preventive Medicine and Precision Health, and of National Healthy Longevity, it lacks such prioritization among government and private healthcare stakeholders. A cohesive strategy is lacking for enabling the Longevity Industry, AI, and Preventive Medicine to work in synergy, rather than in discoordination. The USA's low HALE and large gap between HALE and life expectancy is not for lacking scientific knowhow,. The need is for policies to apply the science.

Influence of Age on the Prevalence and Components of Metabesity and the Association with Mortality Risk Factors

Noncommunicable diseases (NCDs), also known as chronic diseases, tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behavior factors. Such diseases have common metabolic roots, and their interconnection can be called **"metabesity."**

The main types of NCDs are cardiovascular diseases (such as heart attacks and stroke), cancers, chronic respiratory diseases (such as chronic obstructive pulmonary disease and asthma) and diabetes. These conditions are often associated with older age groups. Among age-related changes are also dementia and severe memory loss that are considered to be not part of the normal aging process.

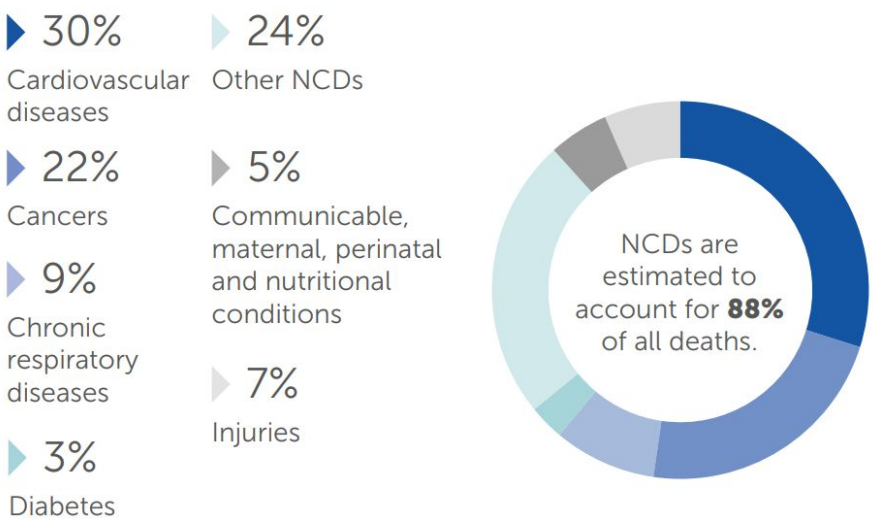
The prevalence of NCDs are considered to be a "**slow motion disaster.**" Noncommunicable diseases are driven by forces that include unplanned urbanization, globalization of unhealthy lifestyles and population aging. Unhealthy diets and a lack of physical activity may show up in people as raised blood pressure, increased blood glucose, overweight and obesity. These are called "metabolic risk factors" and can lead to cardiovascular disease, the leading NCD with regard to premature deaths. All risk factors of NCDs lie in non-health sectors, requiring collaboration across all of government and all of society to combat them.



Risk Factors of Premature Deaths in the United States

Risk Factor	National Target Set	Indicator	2016
Harmful use of alcohol	✓	Total alcohol per capita consumption, adults aged 15+ (litres of pure alcohol)	10
Physical inactivity	✓	Physical inactivity, adults aged 18+ (%)	43
Salt/Sodium intake	✓	Mean population salt intake, adults aged 20+ (g/day)	9
Tobacco use	✓	Current tobacco smoking, adults aged 15+ (%)	21
Raised blood pressure	✗	Raised blood pressure, adults aged 18+ (%)	16
Diabetes	✗	Raised blood glucose, adults aged 18+ (%)	9
Obesity	✓	Obesity, adults aged 18+ (%)	37
		Obesity, adolescents aged 10-19 (%)	21

Proportional Mortality in the United States



Source: World Health Organization | Country Statistics

Two Opposite Trends:
Slowdown in Life Expectancy and Surge in Health Care Costs

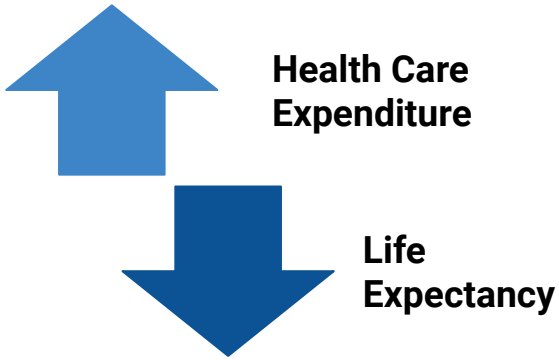
The average life expectancy in the US has been on the decline for three consecutive years.

A baby born in 2017 is expected to live to 78.6 years, which is down from 78.7 years in 2016, according to data from the Centers for Disease Control and Prevention's National Center for Health Statistics.

The last three years represent the longest consecutive decline in the American lifespan at birth since the period between 1915 and 1918, which included World War I and the Spanish Flu pandemic, events that killed many millions worldwide.

Before the recent decline, life expectancy had been steadily rising in the US — which is to be expected of an advanced nation, particularly one that spends more money per citizen on health care than any other country. But high health care expenditure does not indicate better health care coverage and improved care delivery system. Health care in the US is about twice as expensive as it is in any other developed country. The cost of this financial burden for every household because of lost wages, higher premiums, taxes and additional out-of-pocket expenses is huge.

Even with all this money being spent on health care, the World Health Organization ranked the US 37th in health care systems, and The Commonwealth Fund placed the US last among the top 11 industrialized countries in overall health care.



Source: CNBC

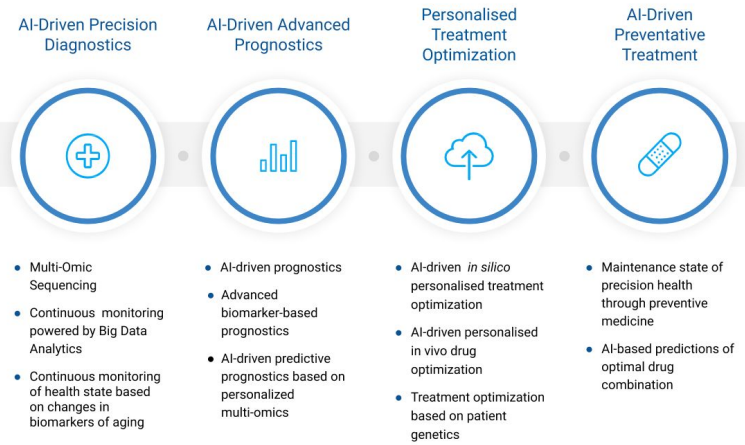
Policy Implications: National Government Strategy to Narrow the Gap Between Life Expectancy and HALE at Birth

A degree of government initiative can always be found behind any ecosystem for cross-sector collaboration between industry, academia and non-profits focused on longevity. For instance, in Switzerland it is the job of the Swiss Federal Administration to maintain and develop as good a framework as possible for biomedical research and technology, and at the same time to enable its citizens to benefit physically from the achievements of biomedicine and offer them affordable access to the latest biomedical products. It is responsible for the legal framework (for example, in relation to human research, therapeutic products, cancer registers and e-patient dossiers) and is charged with ensuring that the health care system remains high-quality, effective and affordable.

Despite its *laissez faire* political tradition, it is not unprecedented for the United States to rapidly develop government programs for building synergies that combine old sciences into revolutionary new technologies. On the cusp of the "moon shot," for example, the prerequisite sciences for interplanetary travel – rocketry, Newtonian physics, mathematics and basic astronomy were already centuries-old. It was the added enhancements of precision and predictiveness, brought about by digitization, with substantial government initiative, commitment and funding thrown in, which opened the doors to another world. Likewise, from this point on, advancing the longevity industry (including tackling metabesity) is less a matter of improving its constituent sciences and technologies, and more a matter of enhancing its precision through data aggregation. This is a far cry from the alternative priority of investing in basic research into "frontier technologies" in the hope of remote future breakthroughs which, though potentially revolutionary, are still decades away from fruition.

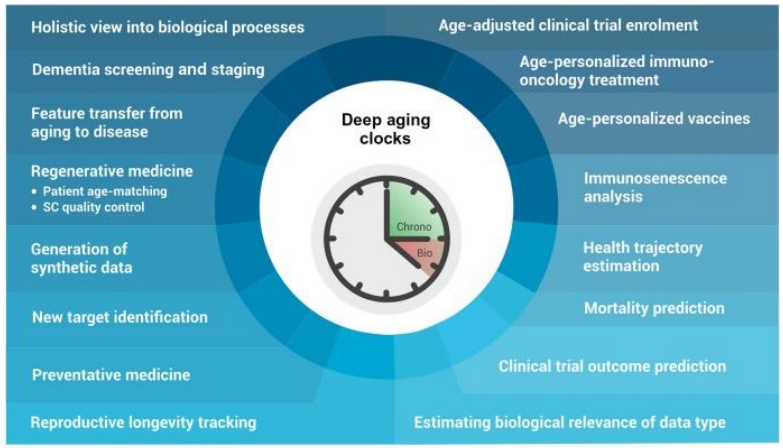
The USA holds the greatest share of the multi-trillion dollar global longevity economy and the majority share of global longevity industry companies and players. It also has one of the highest rates of health care expenditure. The nation therefore has all the resources necessary to become a global leader in longevity, preventive medicine and precision health, and national healthy longevity. Yet it lacks prioritization of these objectives by the federal government, and a strategy to unite the activities of its longevity industry, AI, and preventive medicine to work in synergy, rather than in discoordination. America's low HALE and high gap between HALE and life expectancy at birth is not a scientific problem, but a policy issue.

Accelerating the Development of Precision Health through AI



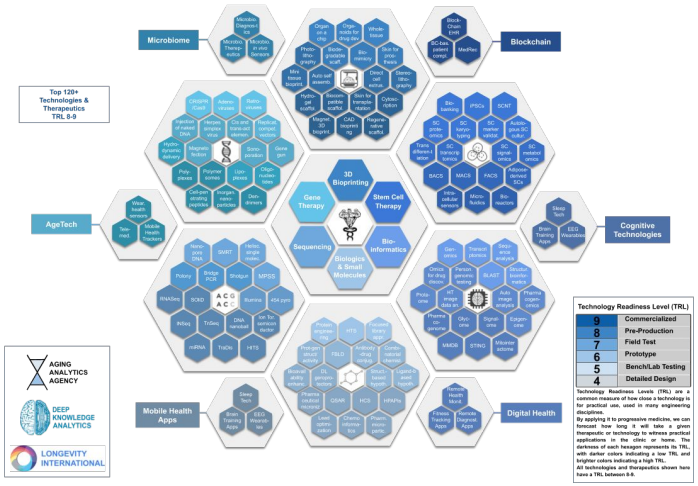
The intensive application of AI to all stages of longevity and preventive medicine R&D has the potential to rapidly accelerate the clinical translation of both validated and experimental diagnostics, prognostics and therapeutics, to empower patients to become the CEOs of their own health through continuous AI-driven monitoring of minor fluctuations in biomarkers, and to accelerate the rapid development of the global longevity industry to scale.

Trends in Pharmacological Sciences



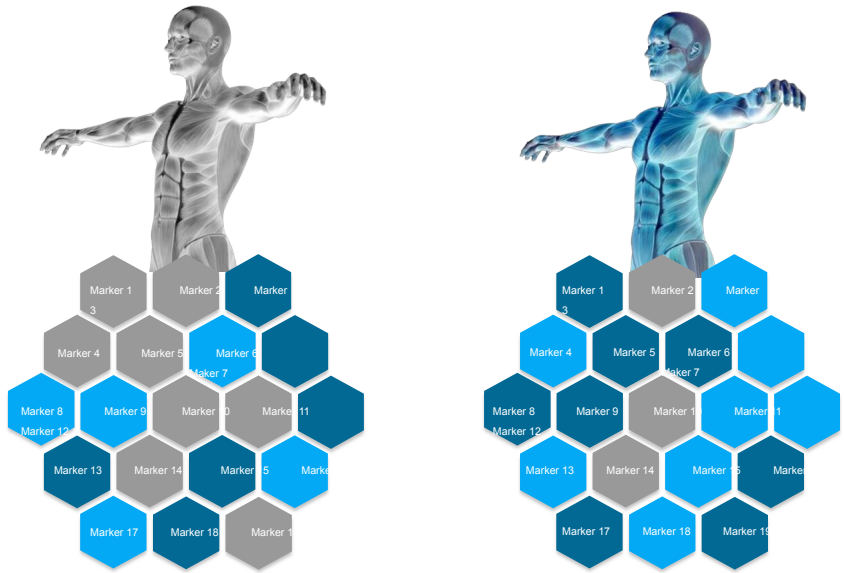
The ongoing shift toward diverse and actionable biomarkers of aging is described at length in [a recent scientific article](#) by Alex Zhavoronkov, CEO of Insilico Medicine.

The Business of Progressive Medicine 2019: Practical Applications



The quantitative and tangible assessment of technologies, methods, therapies and companies within the longevity space necessitates the use of novel approaches to technological, scientific and industry benchmarking, utilizing methodologies like Technology Readiness Levels (TRLs), which use the expertise of science and technology professionals to assess the market-readiness of products and services, and forecast when their clinical translation will become a reality.

Biomarker Panel



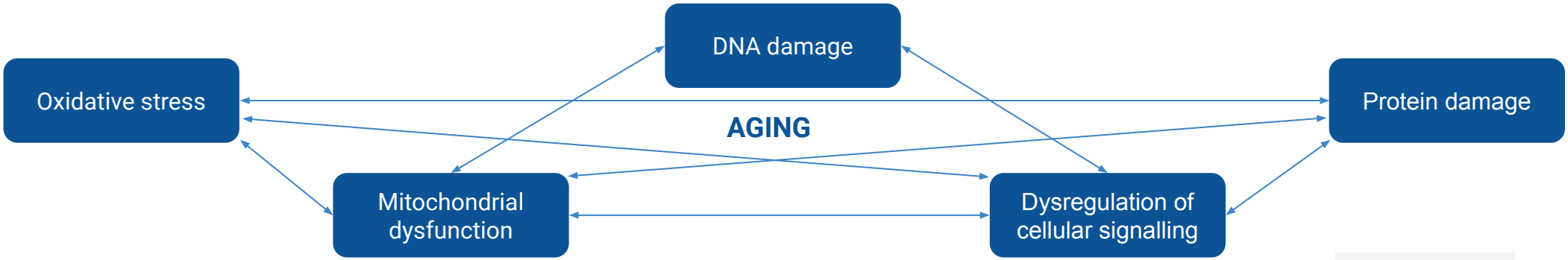
What is Metabesity?

What is Metabesity?

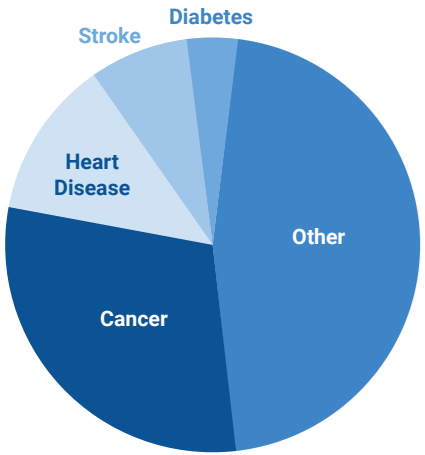
Our metabolism comprises all of the chemical reactions that help keep our bodies alive. Factors such as resting metabolic rate ("RMR"), thermic effect of food ("TEF"), exercise and non-exercise activity thermogenesis ("NEAT") all work together in a coordinated manner in order to maintain good health. Most of the major diseases of our time (including diabetes, cardiovascular and neurodegenerative diseases, and cancer) have common metabolic roots, and thus may be susceptible to common solutions. This constellation of interconnected diseases can be called **"metabesity."**

Metabolic syndrome has long been recognized as an important risk factor for cardiovascular disease, and its prevalence has been increasing. More recently, metabolic syndrome and other forms of metabolic dysfunction have been linked to other conditions including dementia, cancer, and the aging process. The term "metabesity" was coined by Dr. Alexander Fleming.to reflect the broader impact of metabolic dysfunction on these major diseases.

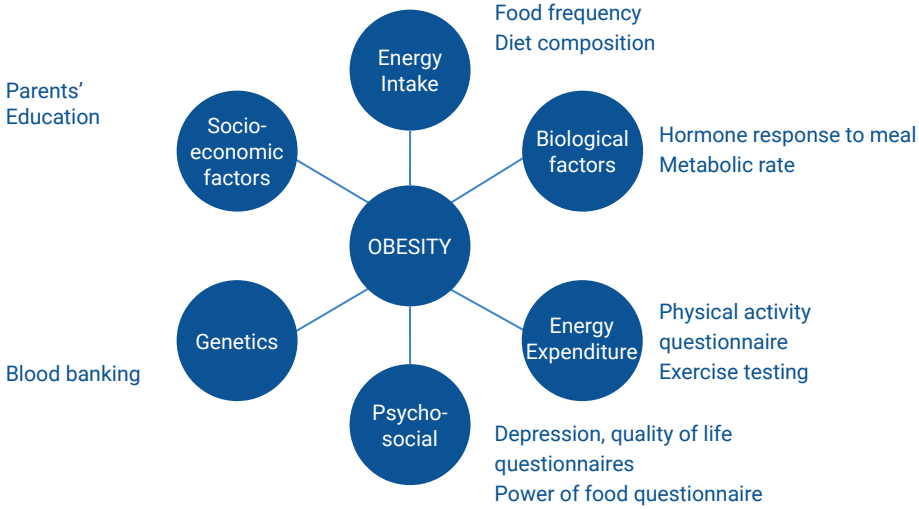
> *"Scientific evidence has been accumulating over recent decades that major non-communicable diseases of aging, such as diabetes, cardiovascular diseases, neurodegenerative disease and cancer, have common metabolic roots, and thus may be susceptible to common solutions."*
>
> Dr. Alexander Fleming, Founder and Executive Chairman of Kinexum, and Chief Medical Officer of Tolerion, a biotechnology company developing disease-modifying treatments for type 1 diabetes and other autoimmune diseases.

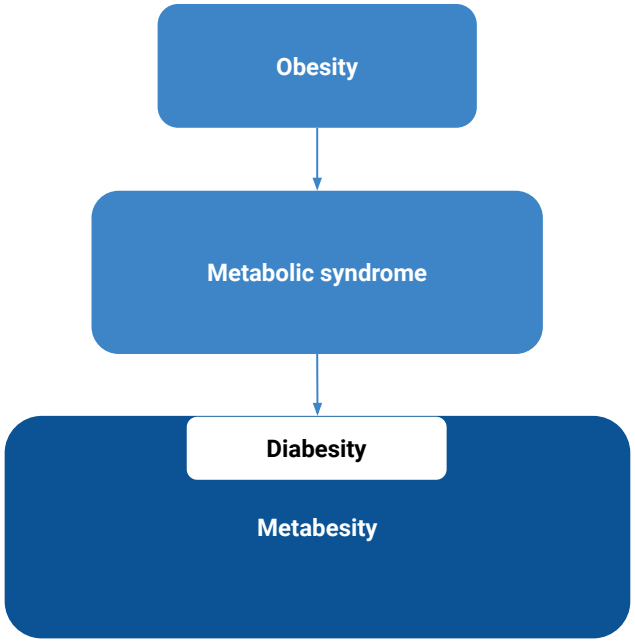


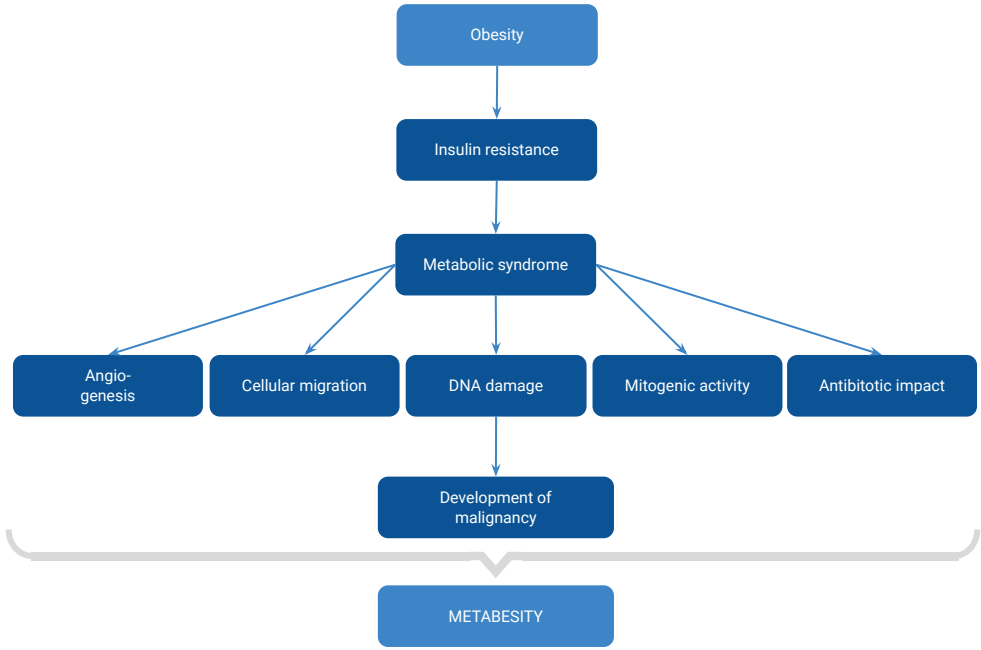
Causes of Death



Over 50% of deaths are from obesity-related chronic diseases







Source: Institute for Health Metrics and Evaluation

United States: Top Risk Factors (I)

- Metabolic risks
- Environmental/occupational risks
- Behavioral risks

2007 ranking		2017 ranking		% change 2007-2017
Tobacco	1	1	High body-mass index	22.4%
Dietary risks	2	2	Tobacco	-3.1%
High body-mass index	3	3	Dietary risks	9.8%
High fasting plasma glucose	4	4	High fasting plasma glucose	26.5%
High blood pressure	5	5	High blood pressure	11.9%
High LDL	6	6	Drug use	67.0%
Drug use	7	7	Alcohol use	15.9%
Alcohol use	8	8	High LDL	-1.4%
Air pollution	9	9	Impaired kidney function	23.2%
Impaired kidney function	10	10	Occupational risks	7.4%
Occupational risks	11	11	Air pollution	-5.0%

United States: Top Risk Factors (II)

2007 ranking		2017 ranking		% change 2007-2017
Ischemic heart disease	1	1	Ischemic heart disease	4.3%
Alzheimer's disease	2	2	Alzheimer's disease	30.8%
Lung cancer	3	3	Lung cancer	9.6%
Stroke	4	4	Stroke	11.0%
COPD	5	5	COPD	22.4%
Lower respiratory infect	6	6	Lower respiratory infect	17.1%
Colorectal cancer	7	7	Chronic kidney disease	37.4%
Diabetes	8	8	Colorectal cancer	13.9%
Chronic kidney disease	9	9	Diabetes	2.5%
Cirrhosis	10	10	Drug use disorders	163.1%
Drug use disorders	11	11	Cirrhosis	29.6%

Source: IHME

Connections Between Longevity, Metabesity and Disease

Links Between Longevity, Metabesity and Disease

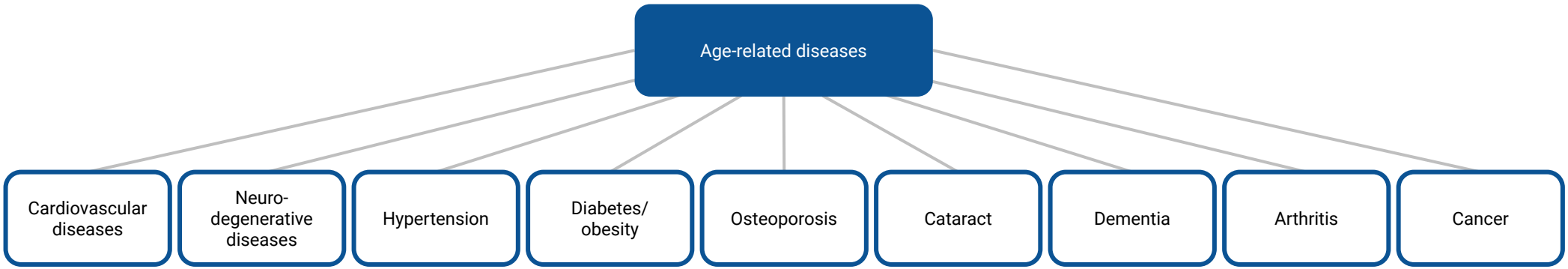
Aging itself is largely a metabolic condition. As we get older, the day-to-day operations of metabolism inflict damage on human cells and organs. Moreover, as this damage accumulates, metabolism itself is thrown into disarray, and these things are no longer coordinated with each other, causing metabolism to malfunction further and inflict more damage.

Among the many signs of metabolic discoordination is a buildup of visceral fat, which may be partly a symptom and partly a cause of aging.

It is well known that carrying excess visceral fat tissue increases risk of age-related diseases, shortens life expectancy, and raises lifetime medical expenditure. For example, excess visceral fat tissue adds to the presence of senescent cells, causing chronic inflammation via several age-associated changes. The more fat tissue, the worse the outcome – even being moderately overweight rather than obese still produces a negative impact on long-term health.

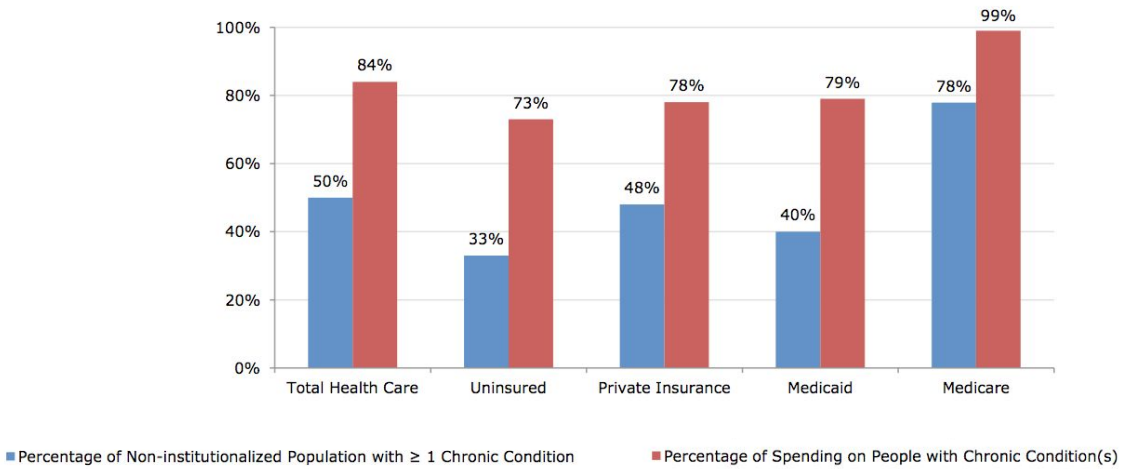
Aging, therefore, along with diabetes, cardiovascular and neurodegenerative diseases, and cancer, is itself an additional component of metabesity. It is also well known that the Western diet and lifestyle similarly contribute to the same metabolic dysfunction and to signs of premature aging.

Given how intimately connected aging, metabesity and disease are, seeking to address the metabolic roots of various diseases might also lead us to discover methods for improving the aging process itself, with positive ramifications for everything from obesity to arthritis.



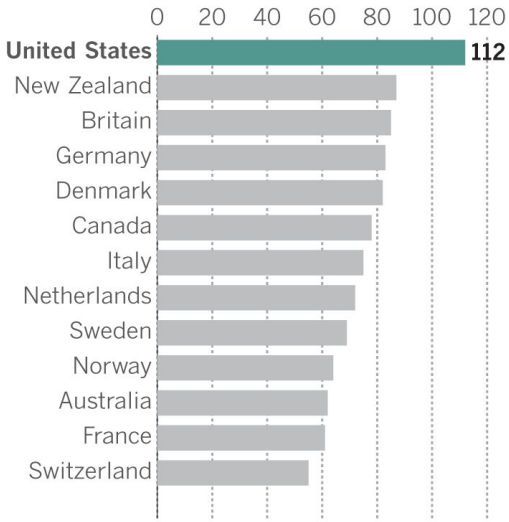
Source: ResearchGate

People with Chronic Conditions Account for 84% of National Health Care Dollars and 99% of Medicare Spending



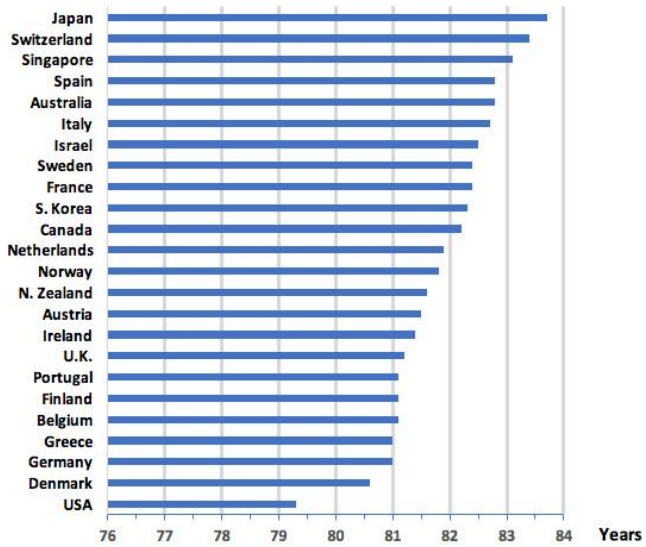
Sources: Medical Expenditure Panel Survey, 2006 and Robert Wood Johnson Foundation, Chronic. Care: Making the Case for Ongoing Care, February 2010

Number of deaths per 100,000 from preventable diseases or complications had adequate health care been available (2013)



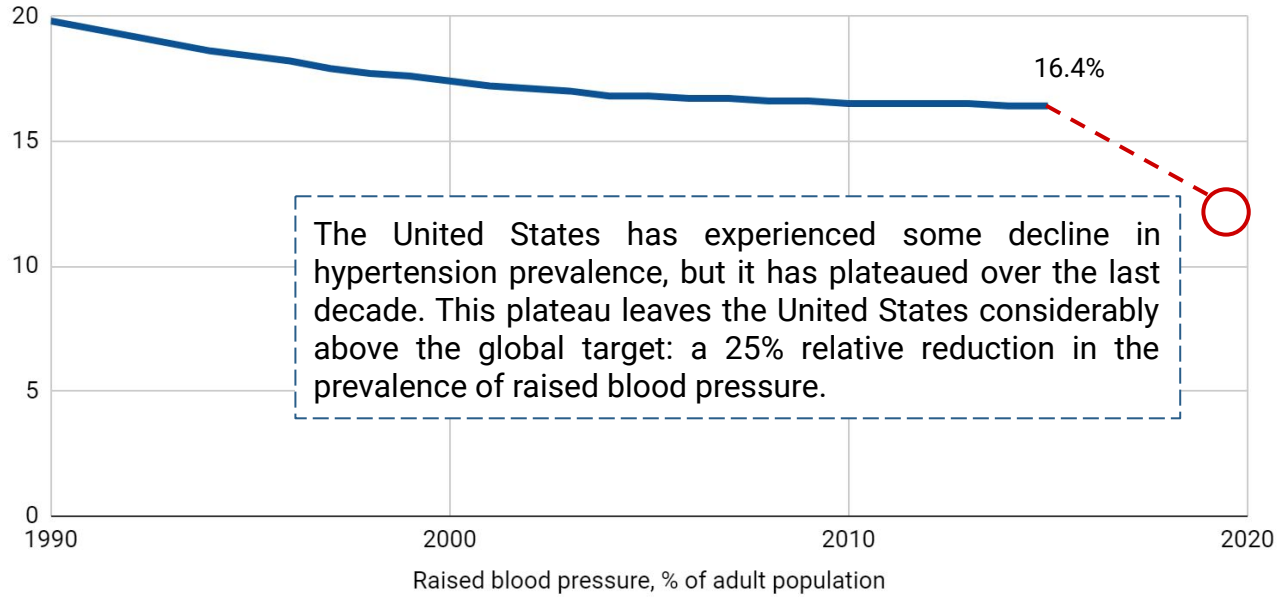
Source: America's Health Rankings | AHR

Life expectancy at birth (2016)

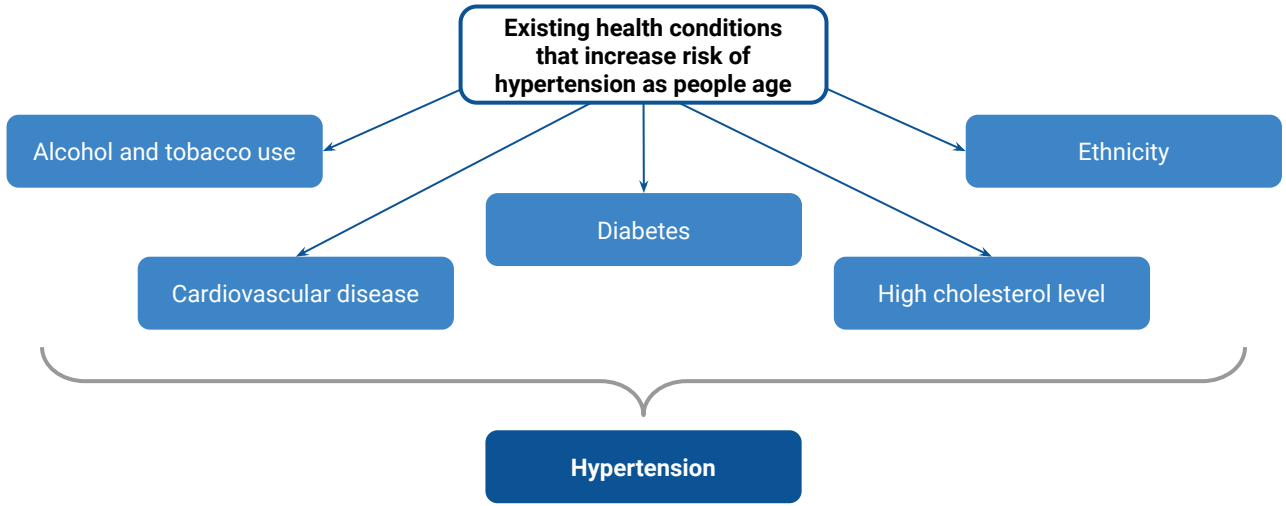


Source: Los Angeles Times

In the United States 16.4% of adults have high hypertension (SBP≥140 or DBP≥90). Men are 1.2 times more likely than women to have high hypertension.



The United States has experienced some decline in hypertension prevalence, but it has plateaued over the last decade. This plateau leaves the United States considerably above the global target: a 25% relative reduction in the prevalence of raised blood pressure.

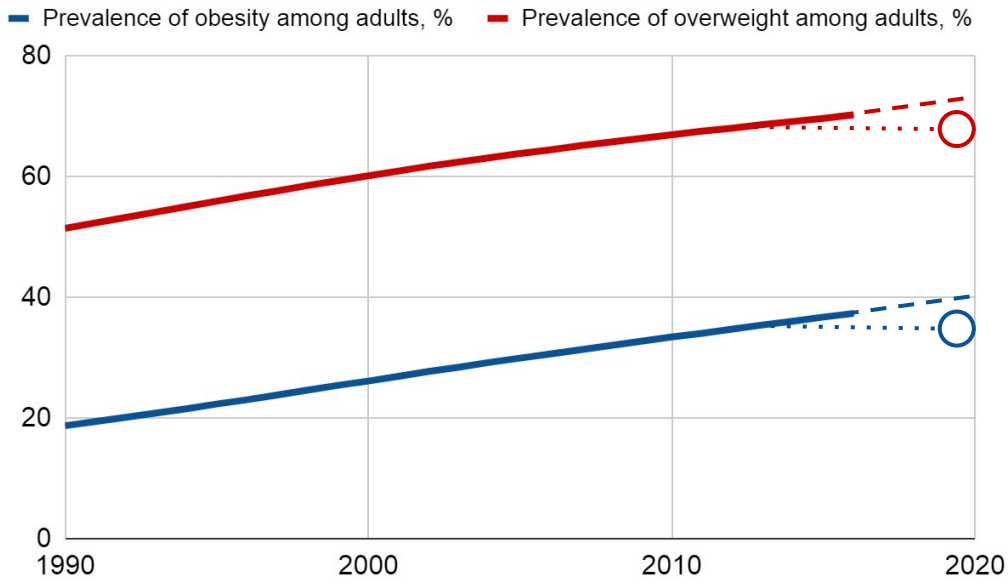


Source: World Health Organization | Risk Factors

The WHO and OECD indicate that the US has the greatest prevalence of obesity among high-income countries. Over a third of the US is obese, compared to just over a fifth on average in comparable countries.

OECD Rank (Global Rank)	Country	% of Adult Population that is Obese
1 (12)	**United States**	**36.2**
2 (17)	Turkey	32.1
3 (22)	New Zealand	30.8
4 (26)	Canada	29.4
5 (27)	Australia	29.0
6 (28)	Mexico	28.9
7 (32)	Chile	28.0
8 (33)	United Kingdom	27.8
9 (41)	Hungary	26.4
10 (44)	Israel	26.1

Current trends of increase in obesity across the United States deviates from the global target of the noncommunicable diseases action plan 2015-2020 to halt the rise in obesity



Multiple studies demonstrate that obesity reduces lifespan, with a loss of 9-13 years of life for individuals with BMI >35. It is possible that health and life expectancy gains could be even greater if it was not for the increasing prevalence of extreme obesity.

Prevalence of More Extreme Obesity

- The most robust estimates of the association between BMI and mortality suggest that the mortality risk from excess body weight increases from a BMI of 25 but is not substantial until BMI exceeds 32–35. The Global BMI Mortality Collaboration demonstrates evidence of a 31% increase in risk of premature death for every 5 BMI unit increase over 25, with an overall increased mortality risk of 45% for stage 1 obesity and 94% for stage 2 obesity.

Reversal of Relationship in Old Age

- In old age, those of low body weight are at a higher risk of disability (limitations to activities of daily living) and mortality. The relationship between obesity and health appears to reverse in old age.

Source: World Health Organization | Risk Factors | Journal of Obesity | The Global BMI Mortality Collaboration

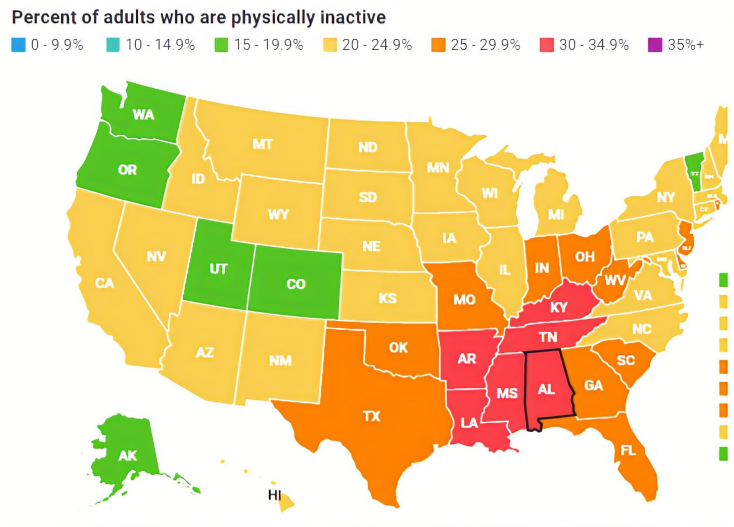
In the United States, prevalence of insufficient physical activity among adults equals 40% of the age group 18+ years. The share of American women who are physically inactive is more than 1.51 times that of men.

Insufficient physical activity is one of the 10 leading risk factors for global mortality.

People who are insufficiently physically active have a 20–30% increased risk of all-cause mortality.

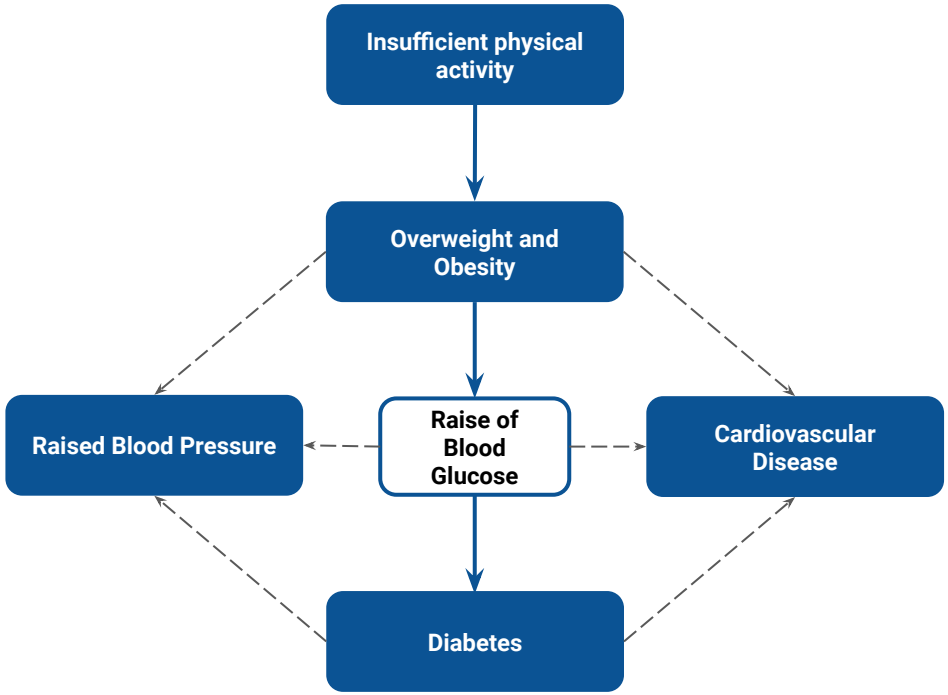
Insufficient physical activity is a key risk factor for noncommunicable diseases (NCDs), such as cardiovascular diseases, cancer and diabetes.

Adults aged 65 and over reported the highest prevalence of physical inactivity (32.1%) followed by adults aged 45 to 64 and younger adults aged 18 to 44.



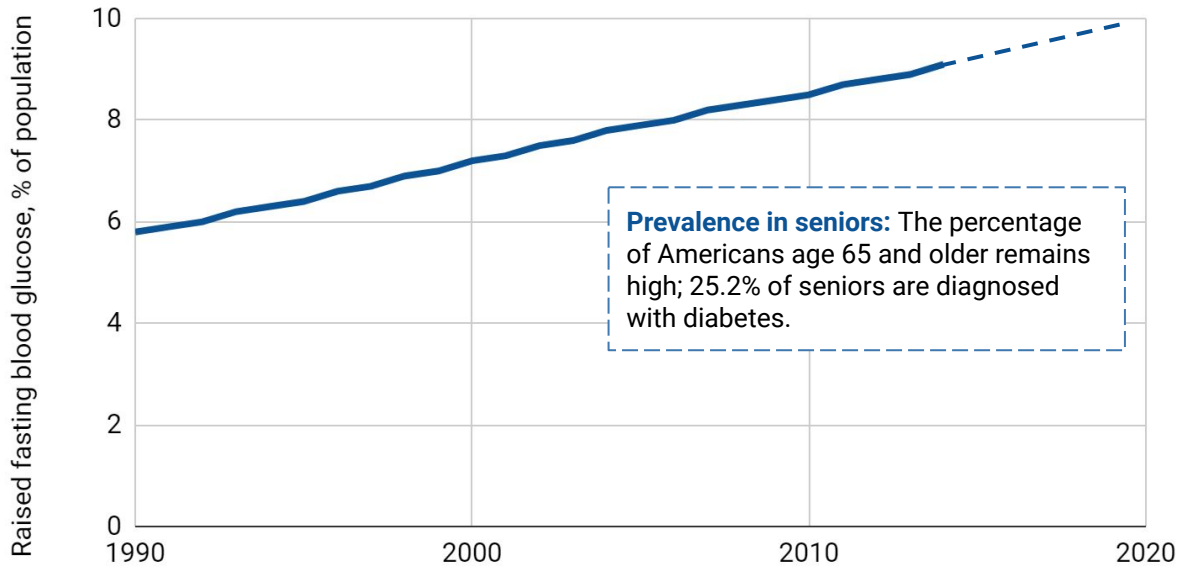
Sources: Behavioral Risk Factor Surveillance System and The State of Obesity

The United States, as a WHO Member State, has agreed to reduce insufficient physical activity by 10% by 2025.

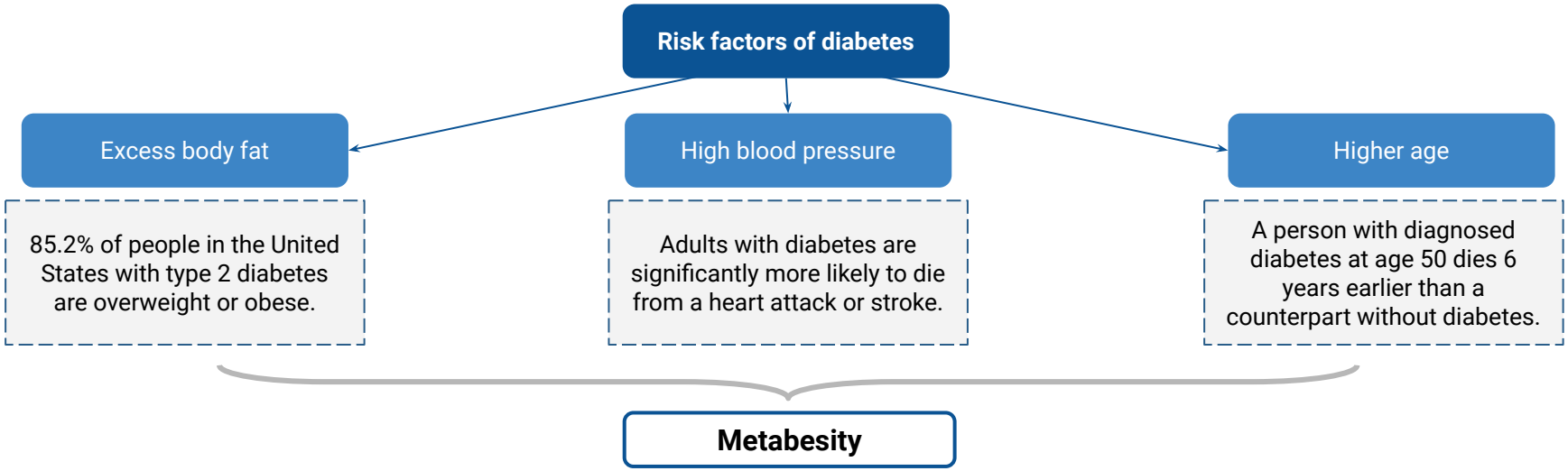


Source: World Health Organization | Risk Factors | The State of Obesity

In the United States, adults with raised fasting blood glucose (≥7.0 mmol/L or on medication) account for 9.4% of respective age group. Men are 1.18 times more at risk for raised fasting blood glucose than women.



Diabetes remains the 7th leading cause of death in the United States



Source: World Health Organization | Risk Factors ADA

The Burden of Cancer in the United States

In 2018, an estimated 1,735,350 new cases of cancer will be diagnosed in the United States, and 609,640 people will die from the disease.

Approximately 38.4% of men and women will be diagnosed with cancer at some point during their lifetimes (based on 2013–2015 data).

The number of cancer survivors is expected to increase to 20.3 million by 2026.

The most common cancer (listed in descending order according to estimated new cases in 2018) is breast cancer.

Cancer mortality is higher among men than women (196.8 per 100,000 men and 139.6 per 100,000 women).

Estimated national expenditures for cancer care in the United States in 2017 were $147.3 billion.

Source: National Cancer Institute

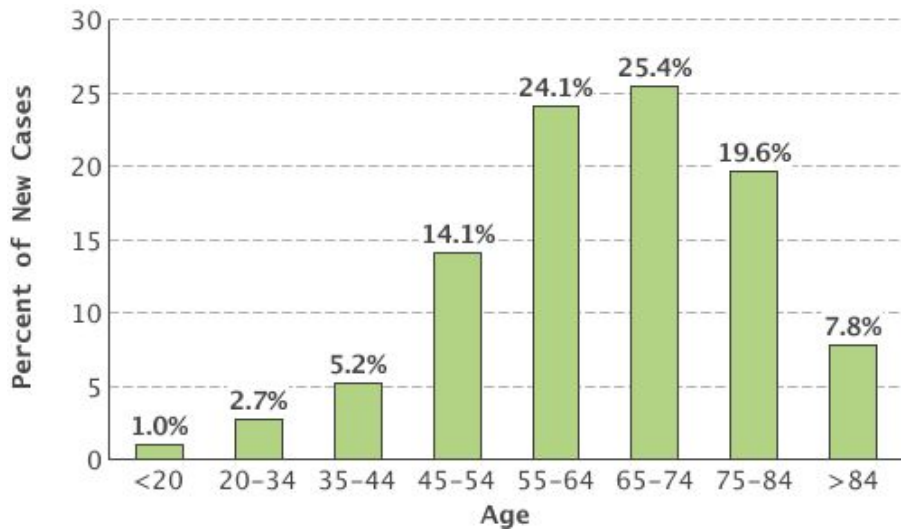
In the United States, the overall cancer death rate has declined since the early 1990s.

1991 ➤ 2015

The overall cancer death rate in the United States fell by

↓ 26%.

Advancing age is the most important risk factor for cancer overall, and for many individual cancer types.

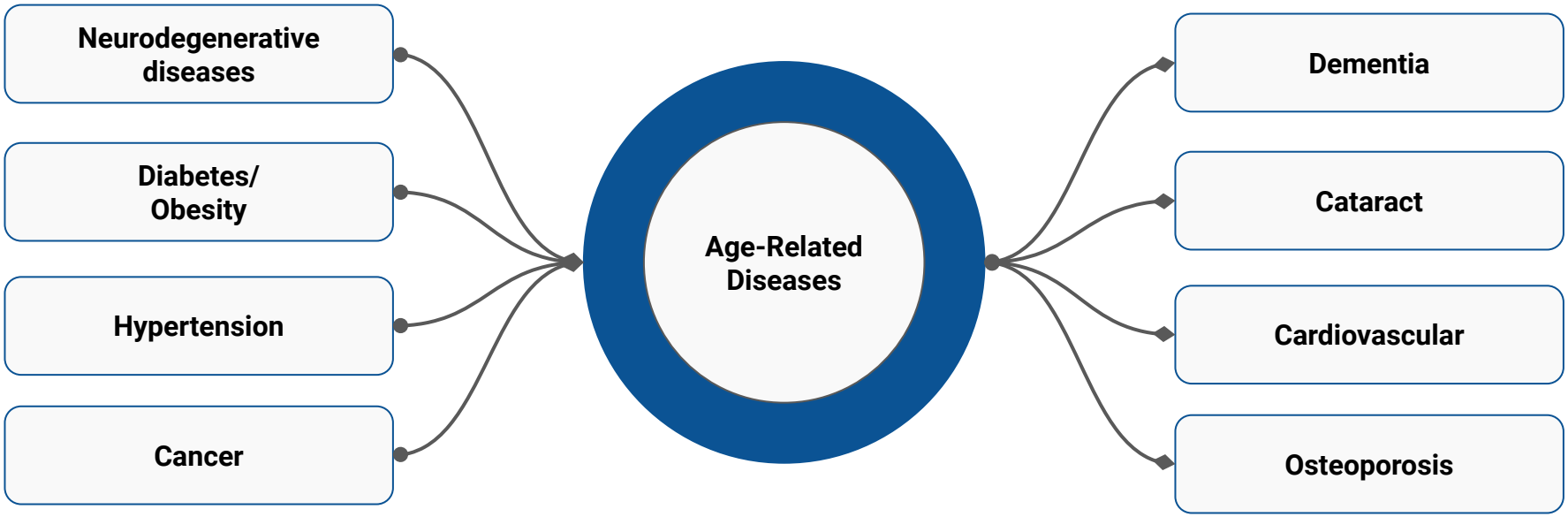


Links Between Longevity, Metabesity and Disease

Of all the major health threats to emerge, none has challenged the very foundations of public health so profoundly as the rise of chronic noncommunicable diseases. Heart disease, cancer, diabetes, and chronic respiratory diseases, once linked only to affluent societies, are now global, and the poor suffer the most. These diseases share four risk factors: tobacco use, the harmful use of alcohol, unhealthy diets, and physical inactivity. These are called modifiable risk factors that can lead to cardiovascular disease, the leading NCD in terms of premature deaths. This constellation of interconnected diseases can be called **"metabesity."**

All risk factors of NCDs lie in non-health sectors, requiring collaboration across all of government and all of society to combat them.

The prevalence of the metabesity, a cluster of cardiovascular risk factors associated with obesity and insulin resistance, is dramatically increasing with aging.



The Disease Burden and Its Implications

The implications for health systems and the care they provide are profound, calling for a change in the mindset of public health. The traditional approach to health that relies on the biomedical model, which focuses on the cure of individual diseases, is inadequate. The essential emphasis on prevention requires a greater reliance on the social and life sciences.

In several countries, the management of diabetes alone absorbs up to a third of the entire health budget. The average cost of newly approved treatments for various cancer indications is $120,000 per person per year, suggesting that advanced cancer treatment is becoming unaffordable for even the richest countries in the world. For instance, the American Diabetes Association (ADA) released new research on March 22, 2018, estimating the total costs of diagnosed diabetes have risen to $327 billion in 2017 from $245 billion in 2012, when the cost was last examined. This figure represents a 26% increase over a five-year period.

These high costs, in turn, have four implications:

- They underscore the ethical imperative of fairness in access to life-saving and health-promoting interventions.
- They make the need for systems of social protection more sharply obvious.
- They make prevention the cornerstone of the global response.
- They make it clear that no country in the world can hope to “spend its way out” of the NCD crisis by investing in treatment services alone.

The greatest challenge arguably falls on the way health systems are designed and services are delivered. Prevention faces two main barriers:

- Most doctors worldwide are trained to diagnose, treat, and cure diseases, but not to prevent them. Incentive schemes in many health care settings reflect that emphasis.
- The risk factors for these diseases – tobacco use, the harmful use of alcohol, unhealthy diets, and physical inactivity – lie in non-health sectors and are strongly influenced by the behaviors of powerful economic operators.

Source: World Health Organization | Noncommunicable diseases

America’s Large Gap between Wealth and Health: High Health Care Expenditures and Low Health-Adjusted Life Expectancy

America's Large Gap Between Wealth and Health: High Health Care Expenditures and Low Health-Adjusted Life Expectancy

The US currently has a significant gap between its healthy-adjusted life expectancy (HALE) of 70 years and life expectancy at birth of 77 years, compared to a gap of 4 years in Singapore (78 years and 82 years, respectively). Its life expectancy at birth ranks 25th globally, yet its health care expenditures are the highest among all developed countries.

The situation in the US does not stem from the developed state of its science, technology or medicine. Rather, it is rooted in policy. This report seeks to analyze specific policy initiatives that can enable the US to turn its health deficit around.

The United States exhibits the following conditions that warrant establishing policy solutions for metabesity:

- High health care spending relative to HALE (the desired end product of health care). The US spends about twice of what other high-income nations do on health care and exhibits the lowest life expectancy and one of the largest gaps between its unadjusted and health-adjusted life expectancies at birth.
- The large gap between HALE and life expectancy at birth generally within the United States. HALE is a measure of population health that takes into account mortality and morbidity – it adjusts overall life expectancy by the amount of time lived in less than good health.
- The high prevalence in the US of many diseases rooted in metabesity. A study found that 34% of US adults in government health surveys conducted between 1999 and 2006 had some form of metabolic syndrome, up from 29% in similar surveys done between 1988 and 1994. The researchers estimate that about 50 million US adults had metabolic syndrome in 1990 compared to 64 million in 2000. According to researchers, the number of Americans with metabolic syndrome between 1999 and 2006 was about 68 million. In general, it was established that the rise in metabolic syndrome was primarily due to growing rates of abdominal obesity and high blood pressure.

Source: Reuters: Business & Financial News, US & International Breaking News

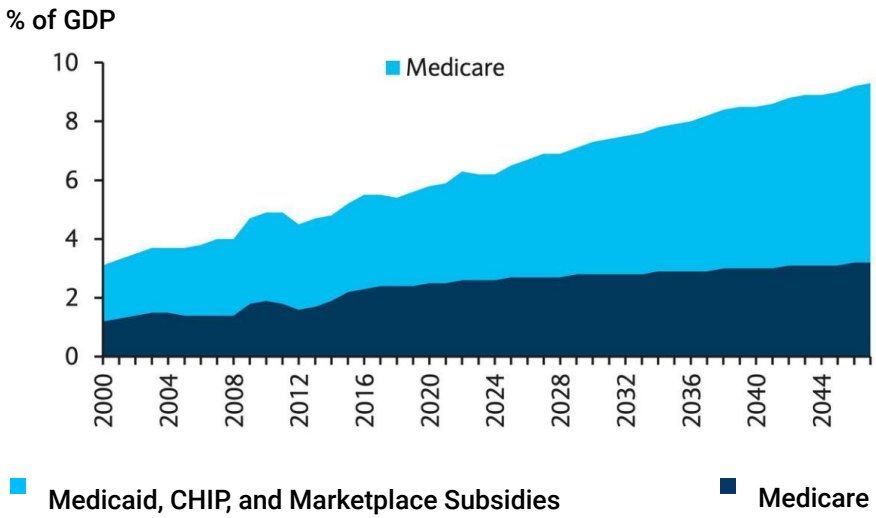
USA: Key Aging & Longevity Statistics

Life Expectancy	Both sexes life expectancy (2019)	79.4 years
	Male life expectancy (2018)	77.0 years
	Female life expectancy (2018)	81.9 years
GDP	GDP per capita, current prices (2018)	64.77 thousand ($)
	GDP per capita, PPP (2018)	64.77 thousand ($)
	GDP, current prices (2018)	20.494 trillion ($)
Population Aging	Rate of population aging	3 (2007-2017)
	Aged over 65 (2018)	15.6%
	Age dependency ratio (2017)	23%
Health Care Efficiency	Health expenditure (2017)	17.2% of GDP
	Health expenditure per capita (2017)	10.209 thousand ($)
	Health care efficiency score (2018)	29.6
Retirement	Total # retired	50,204,174
	Retired people proportion	15%
	Normal retirement age (Man/Woman)	66 years/66 years
	Early retirement age (Man/Woman)	62 years/62 years

Longevity Initiatives

- Age of relevant government-led longevity initiatives: **55 years**
- **288** of WHO age-friendly cities and communities
- **Master Plans** on state level:
- **6** initiatives focused on non-medical improvement of quality of life
- **1** initiative focused on preventive medicine and health care approaches
- **2** initiatives involve research or R&D of medicines that directly impact aging

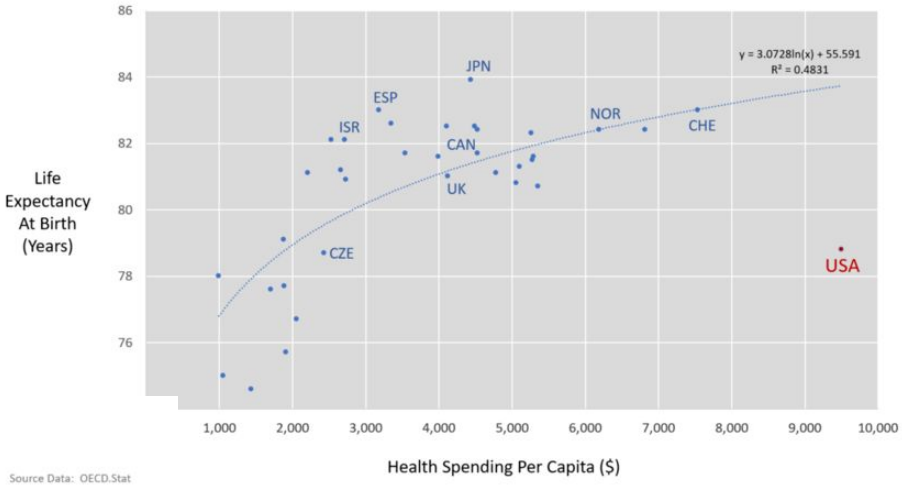
Federal spending on health care has increased substantially over the past several decades. Health spending growth has outpaced growth of the United States economy.



Life expectancy increases with increase in GDP per capita. The wide variation in the life expectancies for countries with high GDP per capita would be due to health care policy and health status of the population.

Sources: World Economic Outlook | Geoba.se - Life Expectancy

Relation between life expectancy at birth and health spending per capita shows that life expectancy at birth increases at a decreasing rate with respect to health care spending per capita.

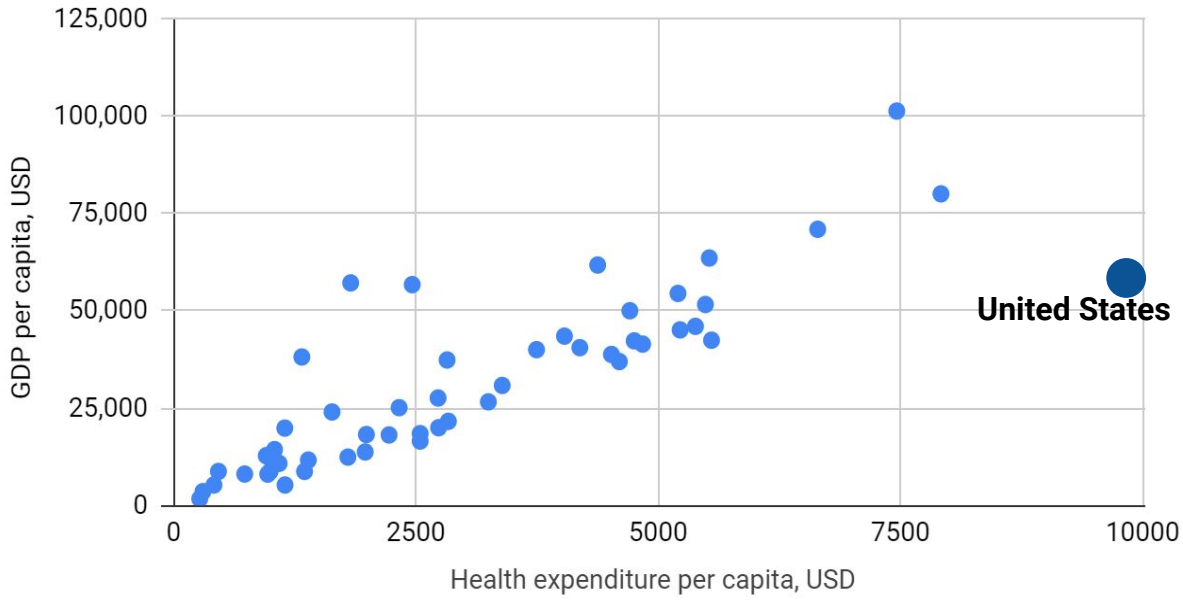


Source: OECD Statistics

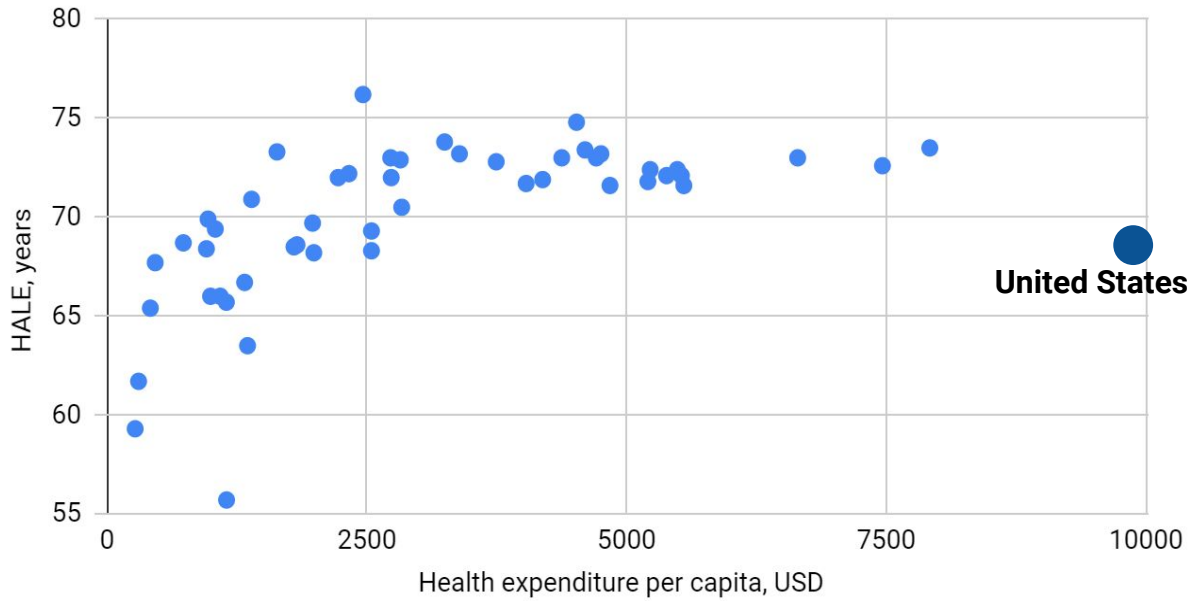
Health-Adjusted Life Expectancy (HALE), used here as a measure of healthy longevity, is the average number of years an individual can expect to live free of chronic age-related disease.

Source: GHO Life expectancy and HALE

Wealthy countries like Norway, Switzerland, Luxemburg, and Sweden tend to spend more per person on health care and related expenses than lower income countries such as India, Brazil, South Africa and Indonesia. However, even as a high-income country, the US spends more per person on health than comparable countries.

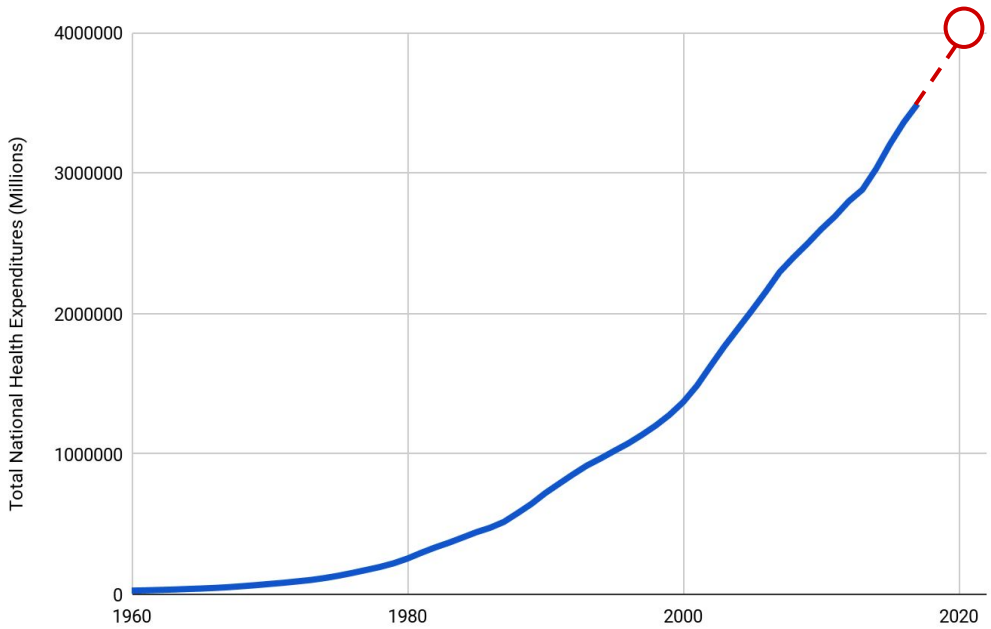


The most evident difference in effectiveness of government expenditures on health care is between the United States and Singapore. These countries are approximately of the same level of wealth, but lower health care spending per capita in Singapore contributes to higher Health Adjusted Life Expectancy (HALE) compared to the United States.

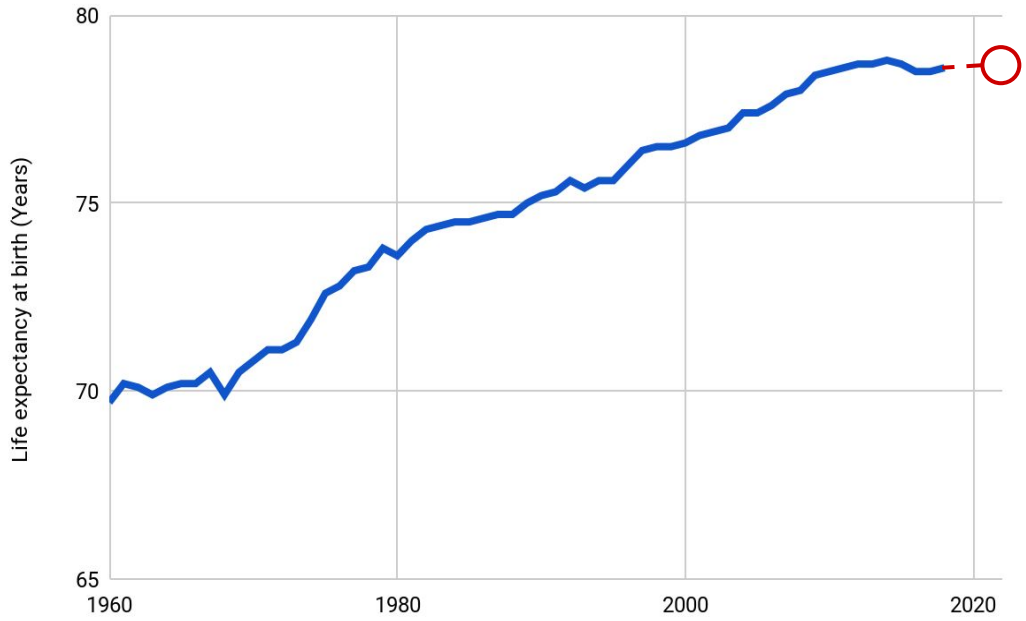


Source: OECD WHO

In the United States, there has been a rapid increase of total national health expenditure (millions $) over time. In 2017, this figure reached an enormous value of almost 3.5 trillion dollars. There is a trend of further expenditure increase in this field.

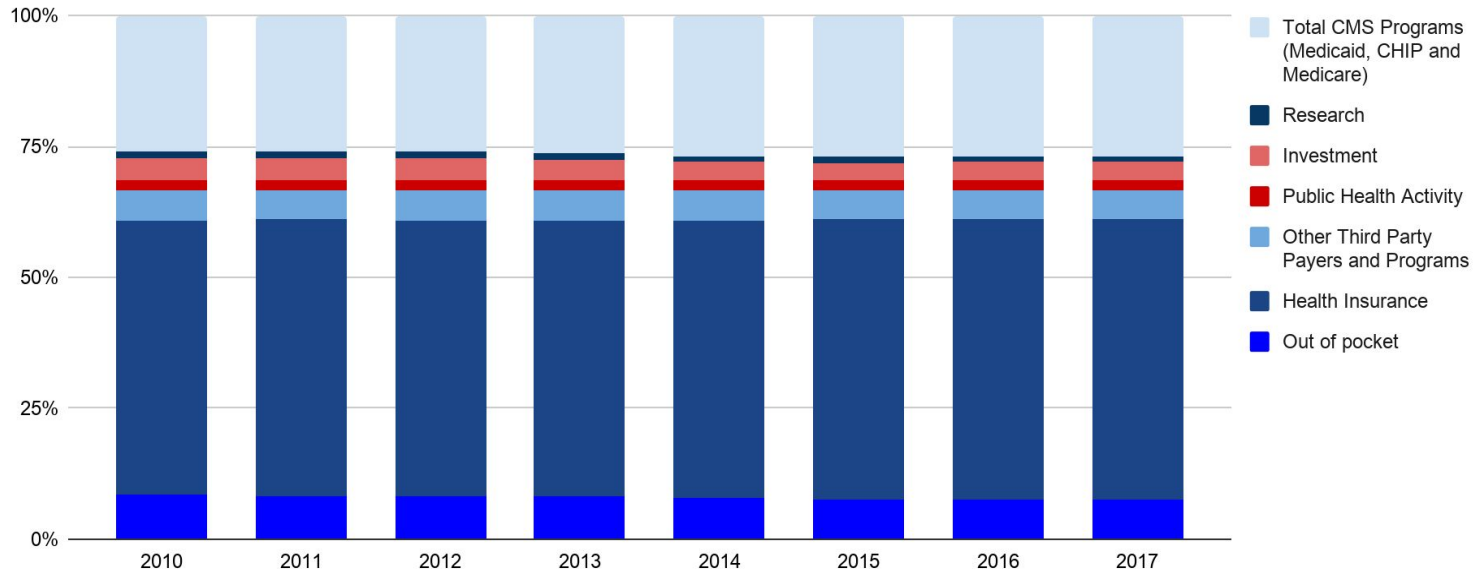


Despite the increasing total national health expenditure, there is an opposite trend in life expectancy at birth (years). The amount of decrease in life expectancy is less alarming than the fact that addiction and a decline in the emotional wellbeing of Americans have contributed significantly to decrease of the average length of life in the United States.

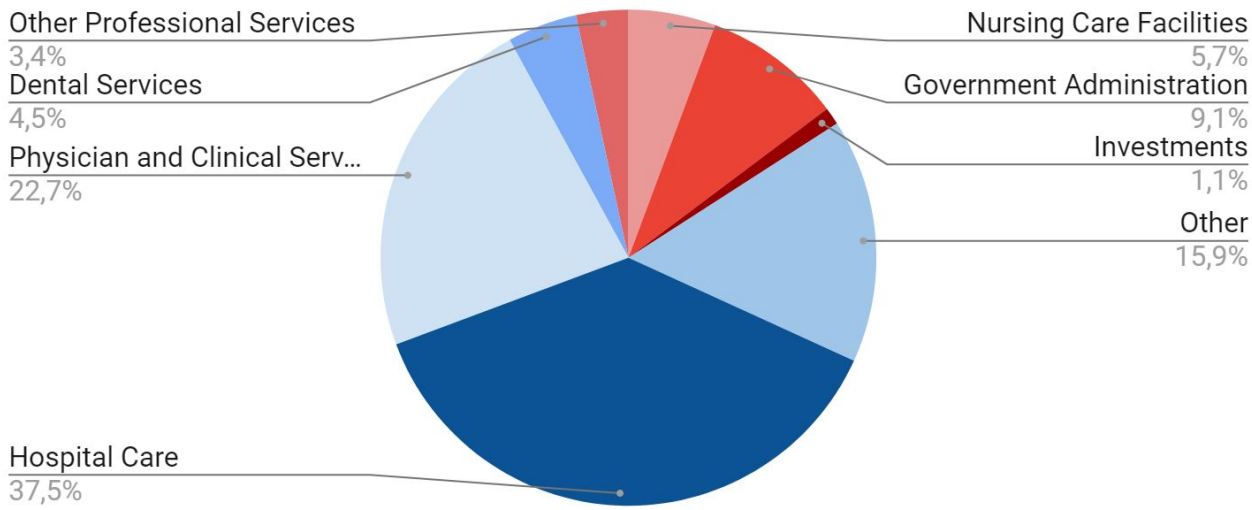


Source: The World Bank CMS.gov

In the United States, the structure of health care expenditures by sources of funding is stable during previous years. The growth of total health care expenditures is proportional to growth of all types of financing. Health insurance contributes the most (53.7%) toward total health care expenditures in 2017.



Where the United States Health Dollar ($3.5 trillion in 2017) Went



Source: CMS.gov

Federal Health Care Financing

The US spends more on health care than any other country, and a large share of that spending comes from the federal government. Federal health spending has grown significantly over the past several decades and is projected to grow in the future. Most federal health care resources go toward financing the following: Medicare, Medicaid, the tax exclusion for employer-sponsored health insurance, and the exchange subsidies established under the Affordable Care Act.

Medicare

Medicare is the largest federal health care program, serving 58 million elderly and disabled people at a gross cost of $702 billion in 2017 and a net cost of premiums of $591 billion. Medicare consists of three programs: Part A covers hospital and inpatient care, Part B covers physician and outpatient care, and Part D covers prescription drugs.

Medicaid and CHIP

Medicaid is a state-run and jointly-financed health insurance program serving lower-income residents. Medicaid provides benefits for both acute and long-term care, covering nearly 100 million people over the course of a year. The Children's Health Insurance Program (CHIP) is a similarly structured program that covers almost 10 million children in a given year.

Exchange Subsidies and Other Spending

This category includes subsidies for insurance purchased on the exchanges, veterans' health care provided through the Department of Veterans Affairs, and health care for active-duty military and their dependents. Both military health care and veterans' health care are discretionary programs.

The Employer-Sponsored Health Insurance Exclusion and Other Tax Benefits

The tax code also provides several subsidies for health care and insurance. By far the largest is the exclusion for employer-provided insurance. Other tax subsidies totaled about $25 billion in 2017. The largest of these benefits is the medical expense deduction, available only to taxpayers who itemize their deductions and have medical expenses that exceed 7.5 percent of their income (or 10 percent after 2018).

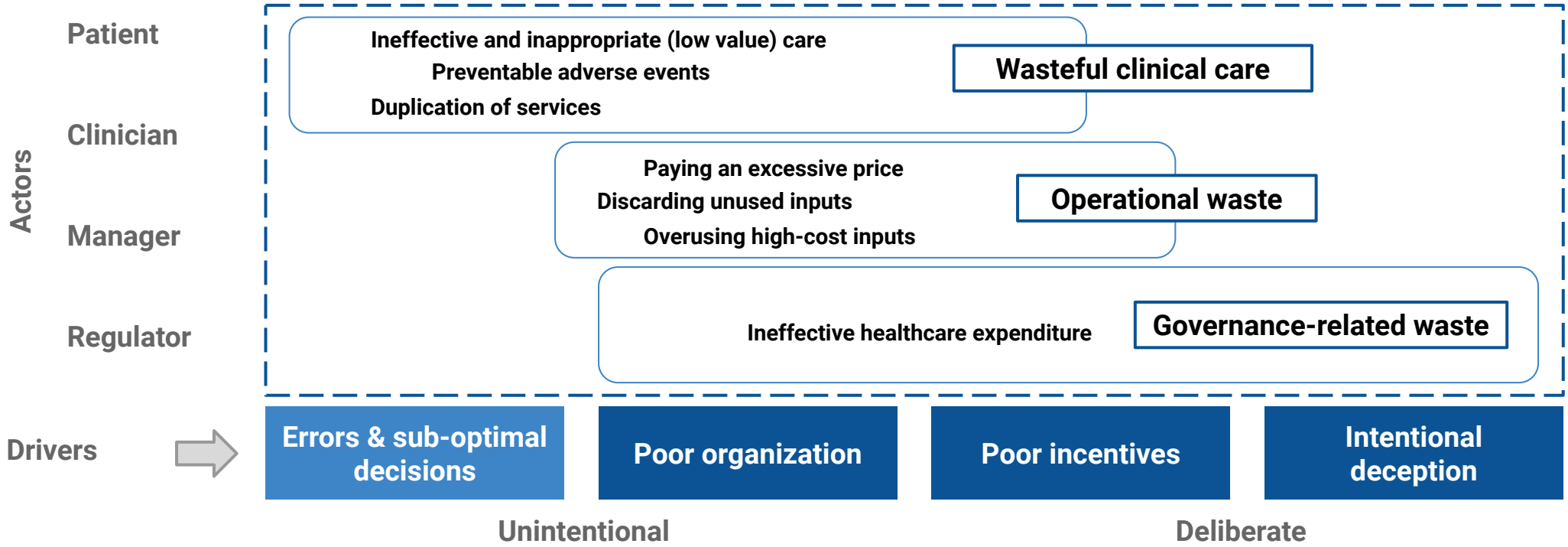
Source: CRFB

Wasteful Health Care Spendings

Health expenditure is rising in the United States as in most OECD countries. Yet, a considerable part of this health expenditure makes little or no contribution to improving people's health. In some cases, it even results in worse health outcomes. The United States could potentially spend significantly less on health care with no impact on health system performance or on health outcomes.

Behavioral root causes of wasteful health care spendings include the following:

- imperfect knowledge and cognitive biases;
- poor management, organization and coordination;
- incentives misaligned with system goals.



Source: OECD

Why the Health Care System is So Expensive in the United States

1. Administrative Costs
About one quarter of health care cost is associated with administration, which is far higher than in any other country.

2. Drug Costs
Another major difference in health costs between the US and every other developed nation is the cost of drugs. In most countries, the government negotiates drug prices with the drug makers, but when Congress created Medicare Part D, it specifically denied Medicare the right to use its power to negotiate drug prices.

3. Defensive Medicine
Another big driver of the higher US health insurance bill is the practice of defensive medicine. A 2010 Gallup survey estimated that $650 billion annually could be attributed to defensive medicine. Everyone pays this with higher insurance premiums, and out-of-pocket costs, as well as taxes that go toward paying for governmental health care programs.

4. Expensive Mix of Treatments
US medical practitioners also tend to use a more expensive mix of treatments. According to a 2019 OECD report, 17.1% of the United States' GDP was spent on health in 2017. More people in the US are treated by specialists, whose fees are higher than primary-care doctors when the same types of treatments are done at the primary-care level in other countries.

5. Wages and Work Rules
Wages and staffing also drive up costs in health care. Specialists are commanding high reimbursements, and the over-utilization of specialists through the current process of referral decision-making drives health costs even higher.

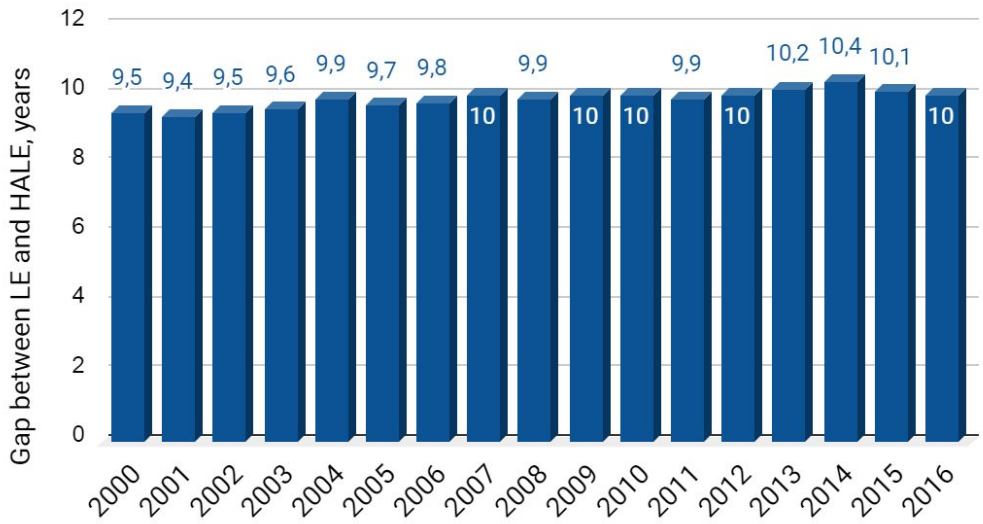
6. Branding
Providers who can demand the highest prices are the ones who create a brand everyone wants. In some markets, the prestigious medical institutions can name their price.

Source: Consumer Reports

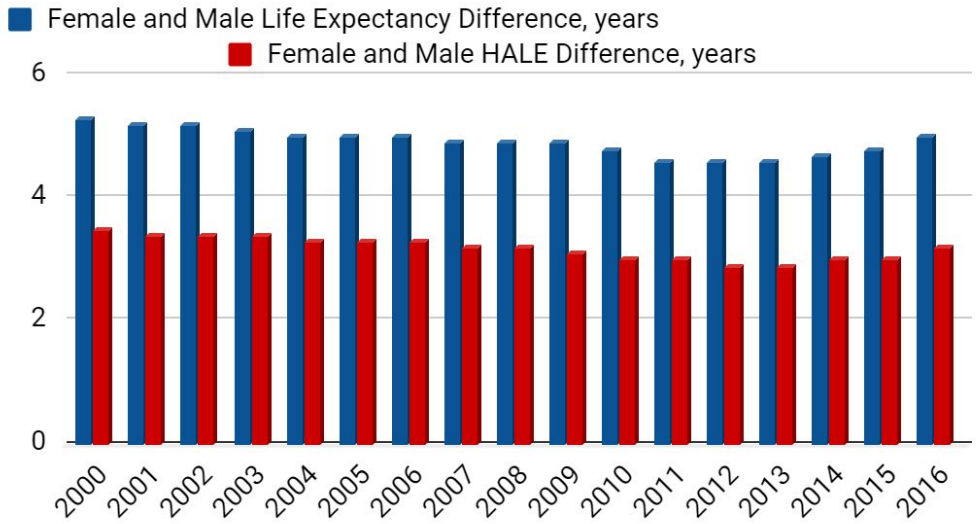
Healthy Life Expectancy – Compared of US States

US States with Longest *Healthy* Life Expectancy	US States with Shortest *Healthy* Life Expectancy
1. Minnesota - 70.3 healthy years	50. West Virginia - 63.8 healthy years
2. Hawaii - 70.1 healthy years	49. Kentucky - 64.3 healthy years
3. California - 69.9 healthy years	48. Oklahoma - 64.5 healthy years
4. Washington - 69.1 healthy years	47. Alabama - 64.6 healthy years
5. Vermont - 69 healthy years	46. Mississippi - 64.9 healthy years

Trends in Gap Between Life Expectancy and Health-Adjusted Life Expectancy



The difference in life expectancy at birth between white men and women declined from 5.3 years longer lives for women in 2000 to 4.7 years in 2013. Since 2014, the difference has begun to rise.



The average life expectancy in the US has been on the decline for three consecutive years since 2014.

Indicators	Absolute change (years)		
	2000-2005	2005-2010	2011-2016
Life Expectancy at birth	0.7	1.1	-0.3
Healthy life expectancy at birth	0.5	0.8	-0.4
Life Expectancy at age 60 years	0.7	0.9	0
Healthy life expectancy at age 60 years	1	0.6	0.1

Source: World Health Organization | Risk Factors | Business Insider

United States: Life Expectancy (LE), Causes of Death & Disability, Risk Factors – Global Comparison

Country	LE at Birth	Healthy LE at Birth	Health Expenditures per Capita	Top 10 Causes of Death	Top 10 Causes of Disability	Top 10 Risk Factors Driving Death and Disability
Singapore	82.9	76.2	$2,280	**1.** IHD **2.** Lower resp. infections **3.** Alzheimer's **4.** Stroke **5.** Lung cancer **6.** Colorectal cancer **7.** Hypertensive heart disease **8.** Chronic kidney disease **9.** Liver cancer **10.** Self-harm	**1.** Low back pain **2.** Headache disorders **3.** Depression **4.** Falls **5.** Diabetes **6.** Neck pain **7.** Neonatal disorders **8.** Age-related hearing loss **9.** Anxiety disorders **10.** Other musculoskeletal	**1.** Dietary Risks **2.** Tobacco **3.** High blood pressure **4.** High fasting plasma glucose **5. High BMI** **6.** High LDL **7.** Occupational risks **8.** Air pollution **9.** Impaired kidney function **10.** Malnutrition
Japan	84.2	74.8	$3,733	**1.** Alzheimer's **2.** IHD **3.** Stroke **4.** Lower resp. infections **5.** Lung cancer **6.** Colorectal cancer **7.** Stomach cancer **8.** Chronic kidney disease **9.** COPD **10.** Pancreatic cancer	**1.** Low back pain **2.** Age-related hearing loss **3.** Falls **4.** Depression **5.** Headache disorders **6.** Stroke **7.** Diabetes **8.** Neck pain **9.** Alzheimer's **10.** Oral disorders	**1.** Tobacco **2.** Dietary risks **3.** High blood pressure **4.** High fasting plasma glucose **5. High BMI** **6.** Occupational risks **7.** High HDL **8.** Impaired kidney function **9.** Air pollution **10.** Alcohol use
Spain	83.1	73.8	$2,354	**1.** IHD **2.** Alzheimer's **3.** Stroke **4.** COPD **5.** Lung cancer **6.** Colorectal cancer **7.** Lower resp. infections **8.** Chronic kidney disease **9.** Diabetes **10.** Cirrhosis	**1.** Low back pain **2.** Headache disorders **3.** Depression **4.** Diabetes **5.** Neck pain **6.** Age-related hearing loss **7.** Falls **8.** Anxiety disorders **9.** Other musculoskeletal **10.** COPD	**1.** Tobacco **2.** High fasting plasma glucose **3.** High blood pressure **4. High BMI** **5.** Dietary risks **6.** Alcohol use **7.** High HDL **8.** Occupational risks **9.** Air pollution **10.** Impaired kidney function
Switzerland	83.3	73.5	$9,818	**1.** IHD **2.** Alzheimer's **3.** Stroke **4.** Lung cancer **5.** COPD **6.** Falls **7.** Colorectal cancer **8.** Lower resp. infections **9.** Chronic kidney disease **10.** Hypertensive heart disease	**1.** Low back pain **2.** Headache disorders **3.** Diabetes **4.** Neck pain **5.** Depression **6.** Falls **7.** Anxiety disorders **8.** Age-related hearing loss **9.** COPD **10.** Other musculoskeletal	**1.** Tobacco **2.** High fasting plasma glucose **3.** Dietary risks **4. High BMI** **5.** High blood pressure **6.** Occupational risks **7.** Alcohol use **8.** High LDL **9.** Air pollution **10.** Impaired kidney function
France	82.9	73.4	$4,026	**1.** Alzheimer's **2.** IHD **3.** Stroke **4.** Lung cancer **5.** Colorectal cancer **6.** Lower resp. infections **7.** COPD **8.** Falls **9.** Breast cancer **10.** Pancreatic cancer	**1.** Low back pain **2.** Headache disorders **3.** Depression **4.** Falls **5.** Anxiety disorders **6.** Age-related hearing loss **7.** Neck pain **8.** Diabetes **9.** Other musculoskeletal **10.** Oral disorders	**1.** Tobacco **2.** Dietary risks **3.** Alcohol use **4.** High blood pressure **5.** High fasting plasma glucose **6. High BMI** **7.** Occupational risks **8.** High LDL **9.** Air pollution **10.** Impaired kidney function
USA	**78.5**	**68.5**	**$9,536**	**1.** IHD **2.** Alzheimer's **3.** Lung cancer **4.** Stroke **5.** COPD **6.** Lower resp. infections **7.** Chronic kidney disease **8.** Colorectal cancer **9. Diabetes** **10.** Drug use disorders	**1.** Low back pain **2.** Headache disorders **3.** Diabetes **4.** Drug use **5.** Depression **6.** COPD **7.** Anxiety disorders **8.** Neck pain **9.** Other musculoskeletal **10.** Age-related hearing loss	**1. High BMI** **2.** Tobacco **3.** Dietary risks **4.** High fasting plasma glucose **5.** High blood pressure **6.** Drug use **7.** Alcohol use **8.** High LDL **9.** Impaired kidney function **10.** Occupational risks

Source: World Health Organization

Projections: US Health Care Costs to Rise, Life Expectancy to Plummet

US **health expenditures** are projected to grow at an average annual rate of 5.5% during 2018–27 and represent **19.4% of gross domestic product in 2027**. During that period, prices for health care are projected to grow 2.5% per annum – faster than during the last decade. Among the major payers, annual spending growth in Medicare (7.4%) is expected to exceed that in Medicaid (5.5%) and private health insurance (4.8%).

Although expected life span will rise globally in 2040, the United States, despite the projected increase in its health care spending, is expected to further plunge in life expectancy rankings in 2040 – from 43rd place to 64th – the largest decrease for a country defined as high income. With a projected lifespan of 79.8 years (just 1.1 years increase), the US will sit behind countries including the United Kingdom, Colombia, Japan, Costa Rica, Saudi Arabia and Turkey. China's global ranking is projected to rise from 68th to 39th place.

The underlying study projected a **significant increase in deaths from noncommunicable diseases**, including diabetes, chronic obstructive pulmonary disease, chronic kidney disease, lung cancer, and worsening health outcomes linked to obesity. The top 5 health drivers that explain most of the future trajectory for premature mortality are high blood pressure, high body mass index, high blood sugar, tobacco and alcohol use, and air pollution. However, the future is not preordained; adequately addressing these drivers by health systems will be key to progress or stagnation.

2040 Rank	2040 Projected LE	2016 Rank & LE
1. Spain	85.8	82.9 (4th)
2. Japan	85.7	83.7 (1st)
3. Singapore	85.4	83.3 (3rd)
4. Switzerland	85.2	83.3 (2nd)
5. Portugal	84.5	81 (23rd)
6. Italy	84.5	82.3 (7th)
7. Israel	84.4	82.1 (13th)
8. France	84.3	82.3 (8th)
9. Luxembourg	84.1	82.2 (10th)
10. Australia	84.1	82.5 (5th)
39. China	81.9	76.3 (68th)
64. USA	**79.8**	**78.7 (43rd)**

Source: Peterson-Kaiser Health System Tracker

The Shift from Sick Care to Preventive Medicine

The Shift from Sick Care to Preventive Medicine

The biotechnological tools and funding necessary to directly intervene in metabesity already exist. The question that remains is the degree of personalization, precision, prevention, and patient participation involved in their application. The current state of medicine and health care is currently being disrupted by a shift away from "one-treatment-fits-all" blockbuster drugs and towards P4 (Personalized, Precision, Preventive and Participatory) medicine: optimized disease prevention and applying drugs long before the underlying pathology develops into actual chronic disease. This increasing precision would allow for a series of increasingly smaller micro-doses as technology advances.

This medicine consists of the leading edge of advanced biomedicine already at the level of practical, real-world implementation and use. The “preventive” focuses on maintaining a state of good health, and implicitly decreasing the probability of disease development through periodic health monitoring, and the application of treatments. The “personalized” and “precision” refer to the drugs and treatments that will be designed and applied using precise, individually-tailored methods of dosing, cocktail compositions of micro-dosages, and efficient methods of delivery. The “participatory” refers to the increasingly active role that patients are taking in managing their own health. Its high degree of complexity necessitates not only innovative frameworks for general benchmarking and forecasting, but also the general assessment of its technologies’ and therapies’ basic safety and efficacy. This starts with development of biomarker panels for aging as a means of evolving effective P4 strategies.Vast amounts of data aggregation and analysis are required to identify predictive markers. Data aggregating for biomarkers of aging (rather than biomarkers of disease) is particularly difficult, as by definition it has to be gathered from healthy disease-free populations (e.g., data that distinguished the young from the even younger) rather than from among the health data of hospital populations. Furthermore, as the scope of P4 medicine broadens in the coming years, the number of biomarkers and technologies involved will increase rapidly to the thousands.

Identifying a vast number of biomarkers will eventually require the aggregation of incomprehensibly large volumes of data, making the implementation of P4 medicine infeasible with conventional computation. AI is the indispensable tool for overcoming this limitation, and is already in use in longevity-progressive states such as the UK, Switzerland and Singapore.

The Shift from Sick Care to Preventive Medicine

With the aging of the population and an increase in the proportion of older persons, the shift in the burden of disease towards chronic conditions has accelerated. And chronic diseases are responsible for 7 out of 10 deaths. These rates are expected to increase significantly over the next two decades, particularly due to the obesity epidemic.

Increases in the prevalence of chronic disease are outstripping reductions in acute infectious diseases. Such epidemiologic evolution demands a focus on public health and prevention.

For years, the United States has approached public health backwards. The health care system has been set up to treat people after they are sick rather than keeping them well in the first place.

Yet economic and technological factors dating from the early 20th century remain strong barriers to effective disease prevention. A key feature of the system is its use of a piecemeal, task-based system that reimburses for “sick visits” aimed at addressing acute conditions or acute exacerbations of chronic conditions.

Economic incentives encourage overuse of services by favoring procedural over cognitive tasks and specialty over primary care. Prevention is the most effective, common-sense way to improve health and reduce health care costs in the United States.

Steps that should be taken to put prevention first in the health care system

Advance and modernize the nation’s public health system

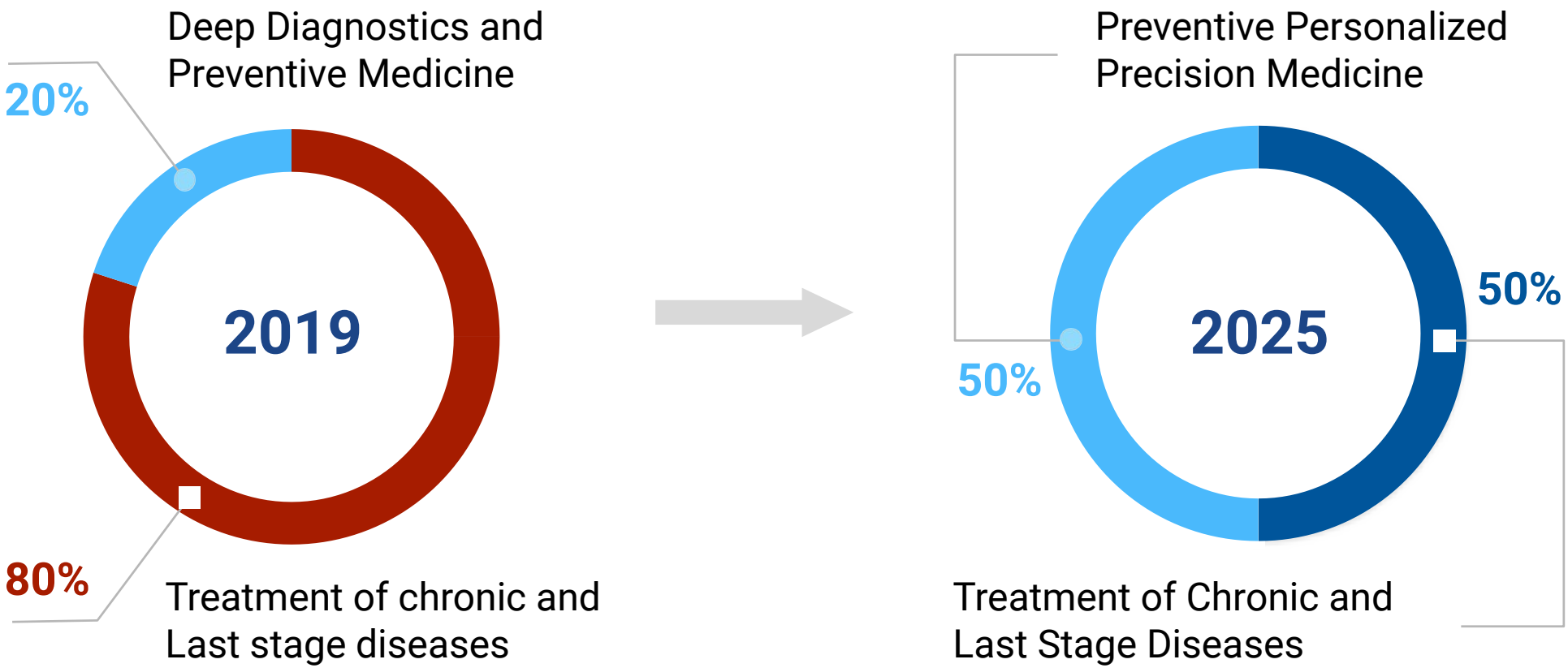
Build partnerships within and outside the health field

- Partnering with health care payers, including both public and private insurers
- Partnering with health care providers, including expanding health care models
- Partnering with sectors beyond the healthcare system, including drawing the connection between all facets of society and health

Source: NCBI Huffpost

Paradigm Shift from Treatment to Prevention

AGING ANALYTICS AGENCY



Preventive Care Can Lower Health Care Costs

As humans live longer, chronic disease has emerged as not only a leading cause of death, but an expensive one. One in three adults worldwide suffer from two or more chronic conditions, and the United States alone spends the equivalent of almost 18% of GDP on health care. Mental illness also compounds chronic disease, making it much more expensive.

Rising health care costs make it clear that the current reactive care model is unsustainable. The United States needs a new approach that shifts away from “sick care” to a model of empowering overall health and wellness, providing patients with access to proactive care that identifies risk and manages chronic disease early to prevent escalation and deterioration.

Preventive care helps lower health care costs in America by preventing diseases before they require emergency room care. Hospital care is expensive, making up one-third of all health care costs in America. The number of emergency room visits has increased from 115 million in 2005 to 150 million in 2016. One out of every five adults goes to the emergency room each year.

A reason behind this phenomenon is that many adults use the emergency room as their primary care physician. Almost half of them (46.3%) went because they had no other place to go for health care. That is especially true for the uninsured. The cost of emergency room care for the uninsured can be extremely high.

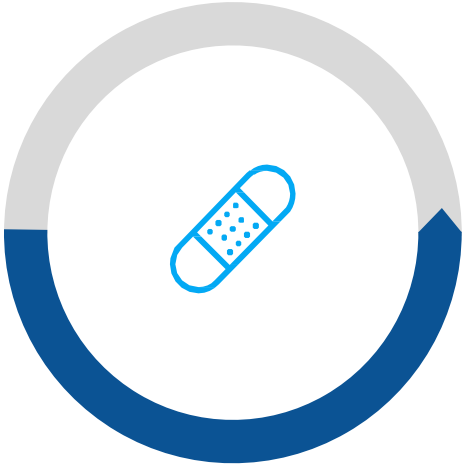
The four leading causes of death are caused by preventable chronic diseases. These diseases are heart disease, cancer, chronic obstructive pulmonary disease (COPD), and stroke. Heart disease and strokes are primarily caused by poor nutrition and obesity. Lung cancer, the most common type, and COPD are primarily caused by smoking. Obesity is also a risk factor for other common forms of cancer.

Even before they reach emergency room status, these chronic diseases are expensive to treat. Half of adult Americans have a chronic illness, but they are responsible for 85% of health care costs. They cost an extra $7,900 each, five times more than costs of a healthy person.

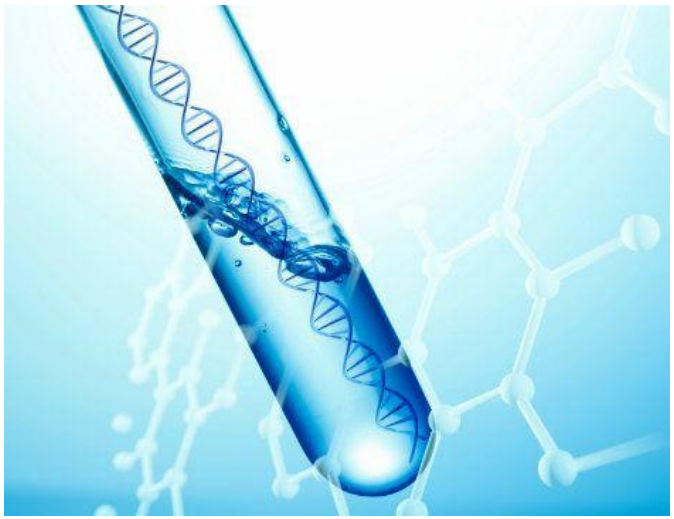
Source: The Balance

Preventive Treatment

AGING ANALYTICS AGENCY



- Gene therapies
- Cell therapies
- Tissue engineering
- Small molecules & biologics
- Natural mimetics of validated geroprotectors (e.g. metformin, rapamycin)
- Genetically engineered cell therapies
- 3D bioprinting
- Microbiome engineering



The Patient Protection and Affordable Care Act in the United States

The Affordable Care Act (ACA) has an effective preventive care plan. It should be followed by any national health care reform plan that aims to lower costs and improve clinical outcomes. It requires insurance companies, Medicare, and Medicaid, to provide preventive care services for free. The ACA seeks to lower emergency room visits through prevention. That is why it required everyone to have insurance. That would allow them to seek treatment for their illnesses before they became a crisis. Now that the requirement has been lifted, health care costs will probably rise faster.

Preventive care is the best way to lower the nation's Medicaid costs. That program reimburses hospitals for all unpaid emergency room treatment. It's cheaper to pay for preventive care than a trip to the hospital.

The strategy appears to be working. In 2018, a Health Affairs study found states that expanded Medicaid saw a 40% increase in the number of prescriptions filled for diabetes drugs. States that didn't expand Medicaid expansion saw no increase. A Centers for Disease Control and Prevention study revealed that each diabetic patient who is treated saves $6,394 in hospital costs.

Preventive Care Services

- **Maternity and Newborn Care**
- **Mental and Behavioral Health Treatment**
- **Services to help people with injuries, disabilities, or chronic conditions**
- **Lab tests**
- **Pediatric care**
- **Prescription drugs**

Source: The Balance

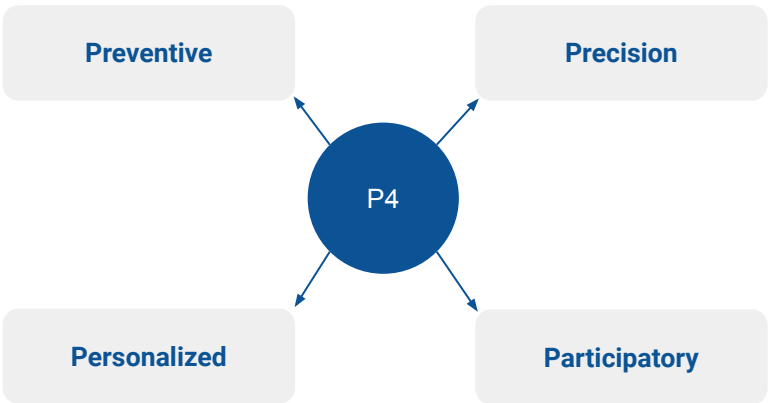
The Shift from Preventive Medicine to Precision Health

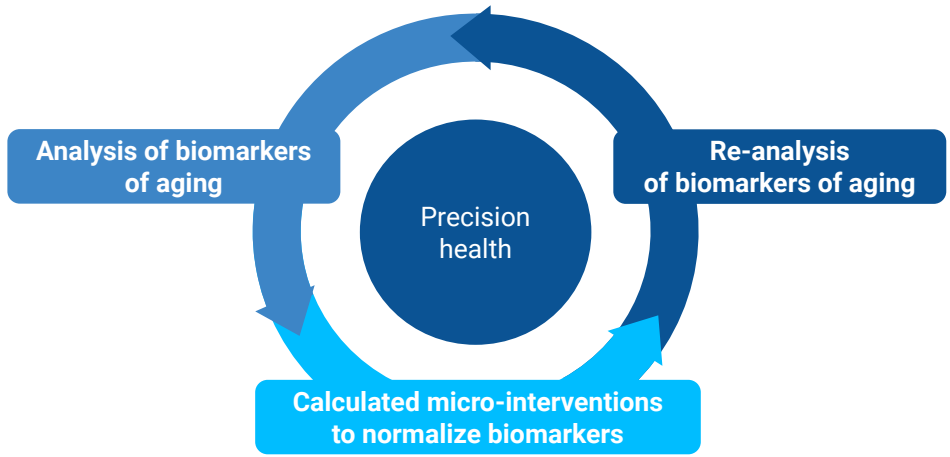
The Shift from Preventive Medicine to Precision Health

This shift from treatment to prevention is ultimately leading to a coming age of precision health, where patients are empowered with the tools necessary to become the CEOs of their own health, through the application of P4 medicine in response to continuous monitoring of fluctuations in biomarkers of aging for the maintenance of the optimal state of health until the very end of life. “Precision health” denotes the continuous stabilization of health and the maximum obtainable maintenance of a young biological age via the routine application of micro-interventions in response to ongoing fluctuations in biomarkers of aging and health.

The high degree of complexity associated with precision medicine, the development of biomarker panels for aging to determine what P4 technologies are effective, and the role of AI in achieving this means that progress in creating a comprehensive system of precision health is less of a biotechnology problem (which requires us to wait on biotech breakthroughs), and more of a data mining, analysis and management issue.

This, in turn, makes it a government problem to some extent, as only government-led initiatives would be capable of providing the necessary infrastructure for such a project on a national level. In other words, the future rate of progress in solving the metabesity crisis (which plays a pivotal role in the future of HALE), relies on a certain amount of government coordination.



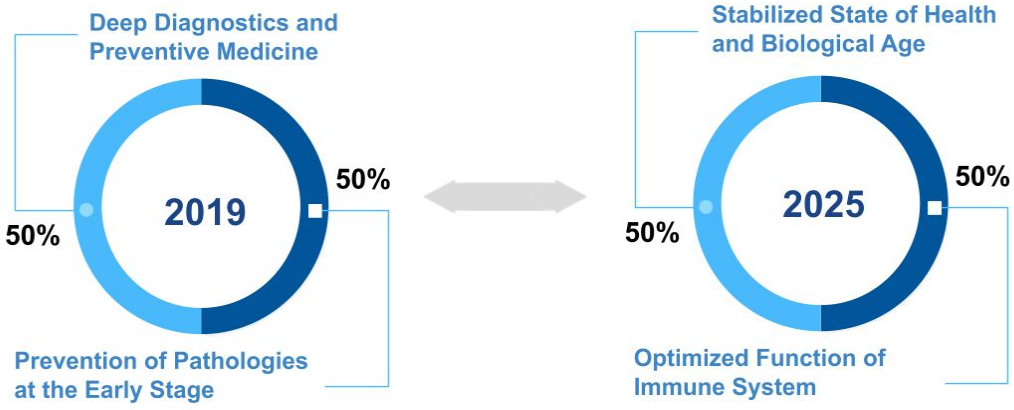


Advanced Areas P4 Medicine

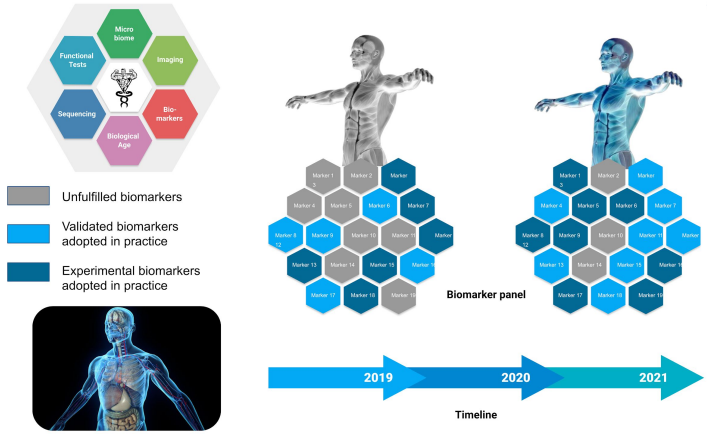
Constant growth in medicine leads the clinics to the need for choosing some areas to maximize their impact of treatment. It highly impacts the methods they use and the diseases they treat. The most advanced areas can be split into such categories as:

- **Personalized Diagnostics.** Mostly it uses different "-omic" fields in rational design approaches to provide a cost-effective alternative to expensive and time-consuming laboratory tests in order to assist health care personnel with disease diagnosis decisions.
- **Personalized QALY & HALE Estimation.** HALE is a tool to integrate or unite the public health focus on geographic populations and the clinical focus on individual patients, and can be used to explain and assess the effects of interventions on individual patients and on populations. QALY is a generic measure of disease burden, including both the quality and the quantity of life lived.
- **Personalized Biomarker Analysis.** Personalized analysis of traceable biomedical substances used for tracking the patient's state. Biomarkers reflect core pathologic mechanisms that enable the identification and characterization of initial injuries and the secondary pathological cascades, as well as determining the risk or progression of a disease and the susceptibility of the disease to a given treatment.
- **Personalized Prognostics.** An approach in diagnostic based on precision. It uses multi-omic sequencing, non-invasive continuous monitoring, multi-modal total-body imaging, 3D integration of cross-sectional tissue and organ imaging, and whole-body and organ-specific biological age calculation based on biomarkers.
- **Personalized *in vivo* & *in silico* drug testing.** Implementation of the personalized approach in drug testing.
- **Preventive Therapies.** Therapies that consists of measures taken for disease prevention, as opposed to disease treatment. Disease prevention relies on anticipatory actions that can be categorized as primal, primary, secondary, and tertiary prevention.

The New Frontier - from Precision Medicine to Precision Health

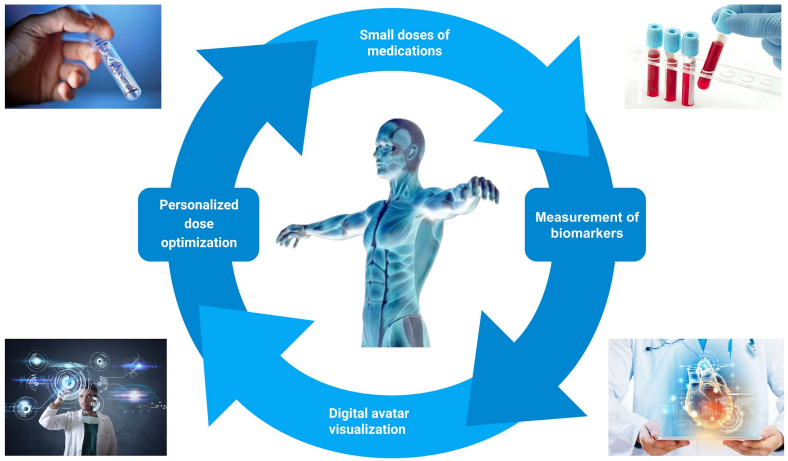


Development of "Minimum Viable" and "Most Comprehensive" Panels of Biomarkers of Aging



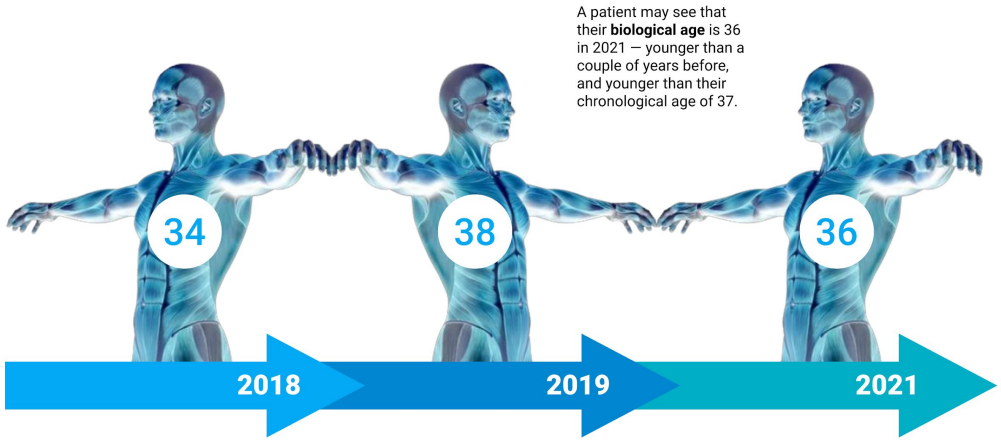
As the precision health industry is grown and developed to scale, we will see an increasing emphasis on the creation and validation of a wide diversity of biomarkers of aging come into use, which will enable the extension of healthspan and the maintenance of optimal health for the majority of citizens' lifespans via continuous, AI-empowered monitoring of fluctuations in personalized biomarkers of aging.

Precision Diagnostics: New Intervention



Not only do new methods of standard industry benchmarking and forecasting need to be developed to combat the issues of overcomplexity and multidimensionality in the longevity industry, but new methods of testing the basic safety and efficacy of longevity and precision health diagnostics, prognostics and therapeutics need to be adapted as well, moving away from the use of model organisms, towards a more human-centric approach.

Precision Diagnostics



Gathering aging biomarkers means collecting data which marks the difference between healthy people only (e.g., between the young and even younger), with no traces of any officially recognized diseases. The continuous monitoring of small changes in such biomarkers, and the continuous and commensurate micro-adjustment of treatments in response, allow for some de facto reversal of biological age.

Overview of the Progressive Model of P4 Medicine Platform

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Healthy lifespan extension and aging processes reversal to a young state

01

Access to advanced preventive restorative medicine technologies

- Safe testing of novel therapies on individual`s stem cells, skin and other organs

02

Personalized longevity programs

- Personalized diagnostics, prognostics and therapeutics
- Virtual human body for health monitoring

03

Health management by world leading experts

- Continuous health monitoring by the world leading experts

Personalization and precision of diagnostics, prognostics and treatment for individual patients.

Global Government Policy and Precision Medicine

In view of its potential and the high expectations and promises for global health, it is not surprising that worldwide numerous national initiatives have been launched over the past decades to foster the development of personalized health. For example, as early as 1999 the Estonian government decided to create a population-based biobank that has the right "to collect, store and use biological samples and phenotype information for genetic research and is further expected to use the results to improve public health." Since this innovative and future-oriented decision, Estonia has reached further milestones towards personalized medicine, including the development of a nationwide technical infrastructure that allows for secure electronic exchange of medical information, as well as accessibility of medical data from hospitals, primary care physicians and pharmacies in a strictly regulated manner.

Meanwhile, other countries with universal health care and comprehensive medical registers have developed similar precision medicine programs on a national scale, including Denmark, France, the Netherlands, Sweden and the United Kingdom. The UK government mandated the Department of Health to initiate the 100,000 Genomes Project, whose goal is to sequence 100,000 genomes from National Health Service (NHS) patients by the end of 2017 and thereby " create an ethical and transparent program based on consent, to bring benefit to patients and set up a genomic medicine service for the NHS, to enable new scientific discovery and medical insights."

On the European level, the International Consortium for Personalized Medicine (ICPerMed) was established following the PerMed project funded by the European Union's 7th Framework Programme (FP7). The consortium is composed of over 30 European and international partners representing ministries, the European Commission, and funding agencies. ICPerMed aims to position Europe as global leader in personalized medicine research by providing a platform where members can exchange and coordinate research and funding activities at the European level and later at the global level.

Outside the Europe, China announced the launch of the "China Precision Medicine Initiative" in March 2017, with an estimated budget of US$9.2 billion over 15 years, indicating that China is about to take the global lead in precision/personalized medicine.

The United States and P4 Medicine

The fourth "P" in P4 Medicine is "participatory," which refers to the increasingly active role that patients are taking in managing their own health, culminating in a situation in which citizens are empowered with the tools, approaches and services capable of enabling continual micro-adjustments to their behavioral, lifestyle and therapeutic regimens in response to continuous AI-empowered monitoring of micro-changes in biomarkers that measure state of health and predict risk of diseases long before their actual onset and progression.

Furthermore, its high degree of complexity necessitates not only innovative frameworks for general benchmarking and forecasting, but also for the general assessment of its technologies' and therapies basic safety and efficacy. The role of AI in achieving this is already remarkably apparent, especially in places such as the UK, USA, Switzerland and Singapore. For example, we have seen proactive efforts by the UK government, through both its AI Industrial Grand Challenge and aging Industrial Grand Challenge, to rapidly apply AI to preventive medicine, advanced biomedicine and digital health, and the recent establishment of the All-Party Parliamentary Group for Longevity, where Aging Analytics Agency was proactively involved.

Precision Medicine Initiative (PMI – renamed "All-of-Us") was launched in the USA in 2015. As part of its objectives, the initiative aims to create a voluntary national research cohort of 1 million participants to provide better treatments for cancer via the identification of genomic drivers, to modernize the regulatory landscape, and to partner with relevant private and public actors. This initiative has highlighted the importance of public participation in research and has reinforced the idea of partnership with research participants as a driver of the initiative. Progress in metabesity hereafter is both a biotechnology problem, and a data mining, analysis and management problem. This, in turn, makes it a government problem to some extent, as only government-led initiatives would be capable of providing the necessary infrastructure for such a project on a national level. In other words, the future rate of progress in solving the metabesity crisis (which plays a pivotal role in the future of HALE), relies on a certain amount of government coordination.

Utilizing the Strength of Artificial Intelligence in the United States for Rapid Progress in AI for Precision Health and Longevity

Utilizing Strength of United States in Artificial Intelligence (AI) Industry for Rapid Progress in AI for Precision Health and Longevity

The United States already possesses a large share of the global longevity economy's basic resources. Not only is it home to a huge scientific base, it is also a world leader in AI in health care, with America's top 5 hospitals all possessing machine learning capabilities. However, these resources are not optimally assembled to provide a framework for the P4 ecosystem, which would be necessary to make inroads into tacking metabesity.

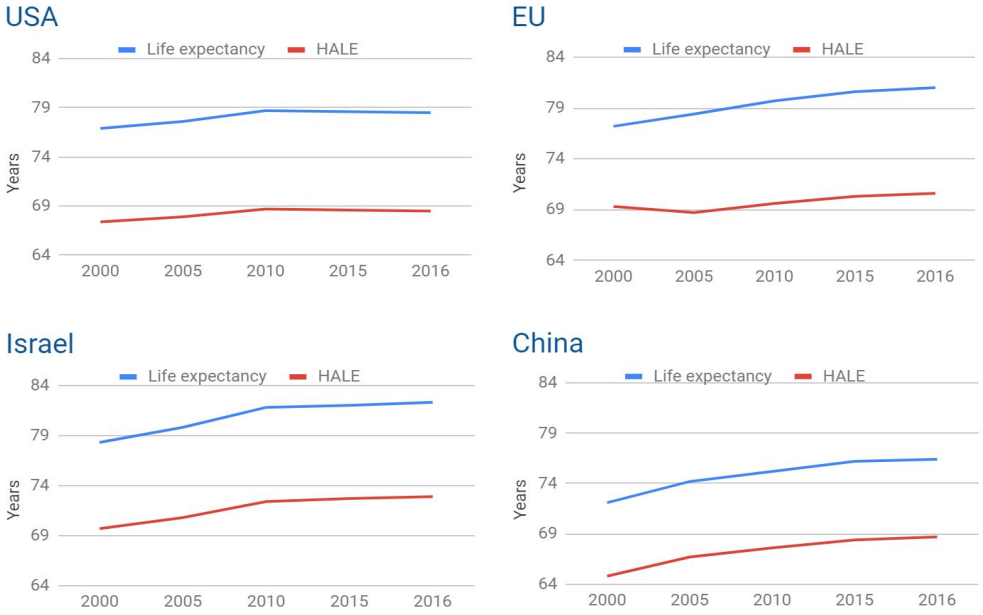
The United States is the birthplace of biotechnology and AI, encompassing Silicon Valley and several AI hospitals within its borders, but this offers it little competitive advantage for precision health as long as there is no national strategy for integrating these resources together. America also has a very strong AI in the health care industry and has heavily prioritized the development of its AI industry more generally on a national level, but its efforts in the specific realm of AI for preventive medicine is comparatively lacking.

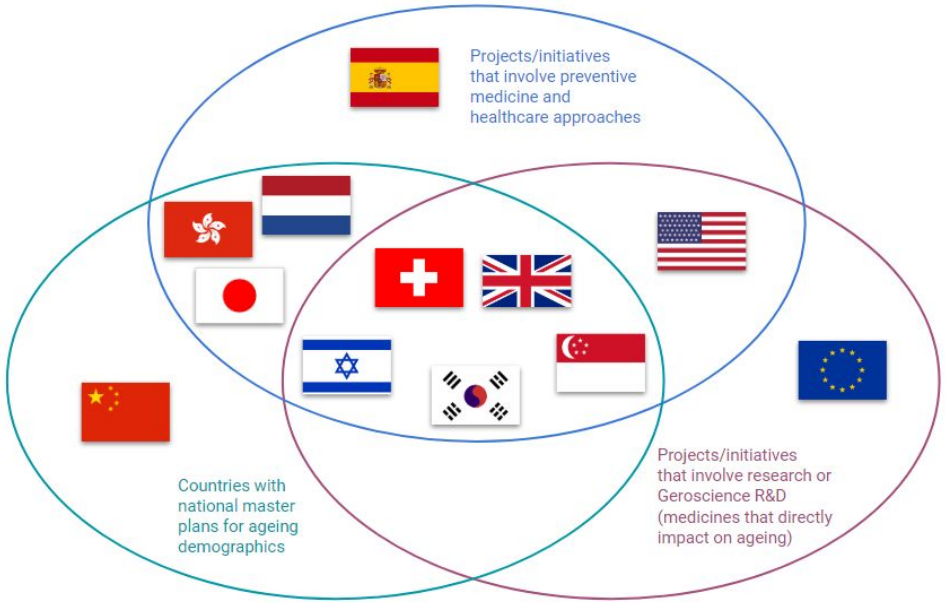
Other nations are already seizing this initiative. British parliamentarians are discussing the establishment of AI centers for longevity across the country. We are seeing initiatives for a preventive medicine approaches to aging across the globe, from the UK's **Genomic Medicine Service**, and **Swiss Personalised Health Network.**

If a nation many times larger than Switzerland or the UK, such as the United States, were to do the same, and direct its resources toward solutions for metabesity and aging, for which there is ample incentive in the USA to address, and which is linked to innumerable medical issues negatively influencing the USA's HALE, even despite its high standard of living, it could revolutionize global health care, greatly accelerate biomedicine, and ignite the emerging global longevity industry.

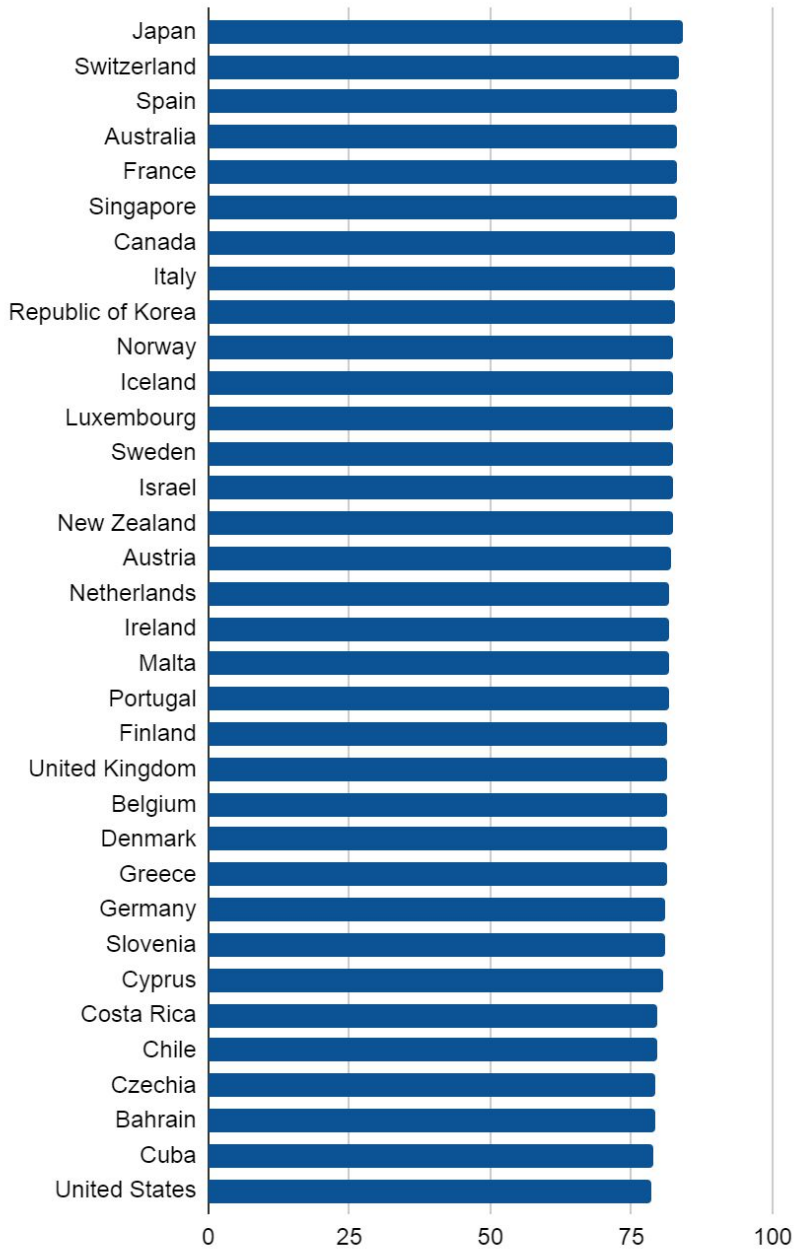
In the next few years, several technologically advanced small technocratic states will emerge as global competitors in the development of integrated longevity industry ecosystems, some of which will focus on specific sectors tuned to their unique strengths, while others will seek to create fully integrated hubs encompassing the entire multifaceted scope of the longevity industry. Whether the US will embrace this wave of change remains to be seen – what is clear, however, is that the nation's future health and wealth depend upon it. With its strong domestic longevity industry and strengths in AI, the US could quickly become a global leader in the application of AI for longevity, preventive medicine and precision health.

Health-Adjusted Life Expectancy vs. Life Expectancy (2000-2016)





Countries with longest life expectancy (2016)



Source: WHO

USA Government-led Longevity Initiatives Level of Comprehensiveness

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Financial Reform

ACL Strategic Plan

National Master Plan on Aging

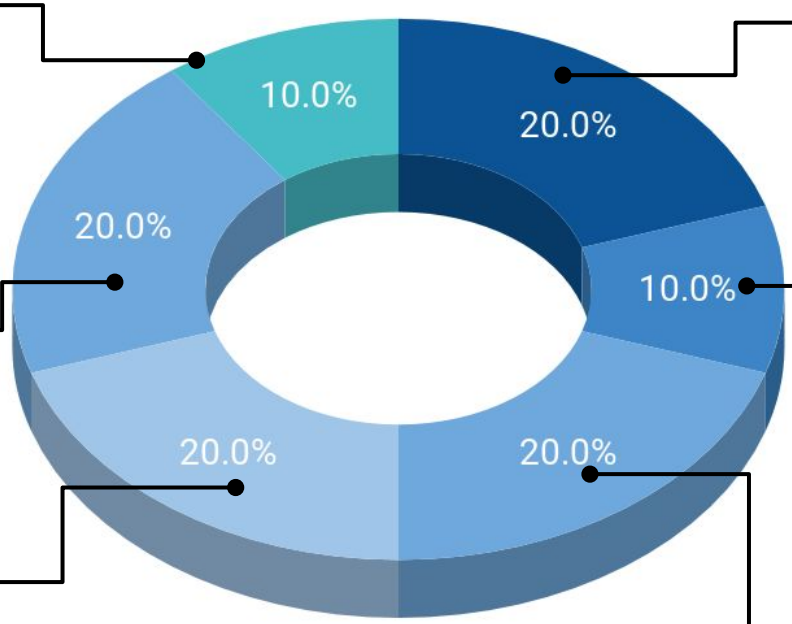
State Plan on Aging

CIAIP

Elderly Health Care Vouchers

Medicaid

Affordable Care Act



Healthy Aging: Lifestyle and Fitness Programs

Healthy Aging Program

GO4Life

Non-medical Initiatives

Feeding America

Geroscience R&D

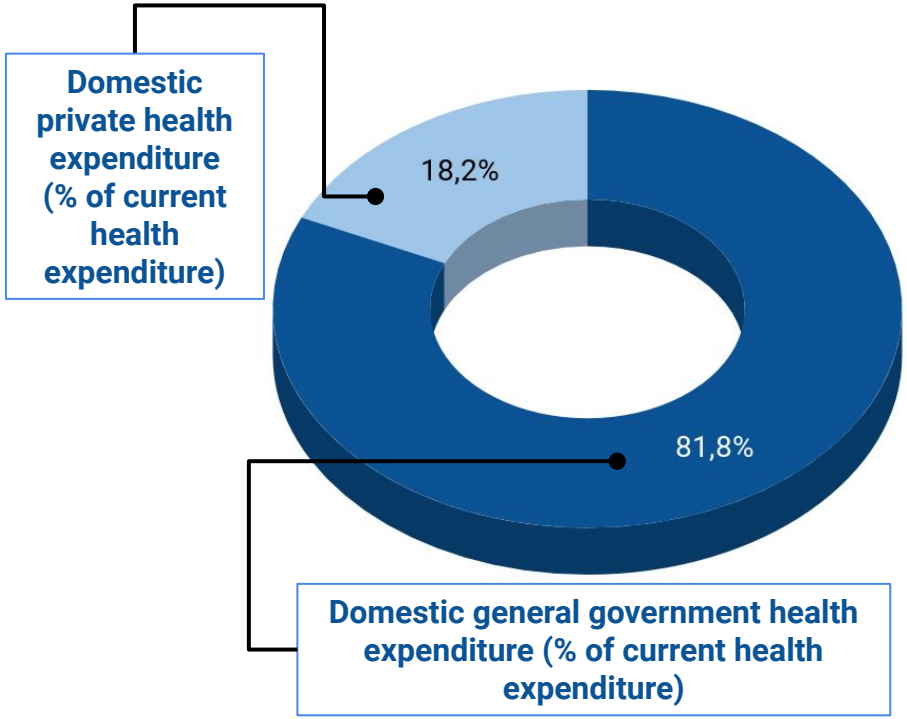
Building Our Largest Dementia (BOLD) Infrastructure for Alzheimer's Act

NIH National Institute on Aging: Aging Well in the 21st Century

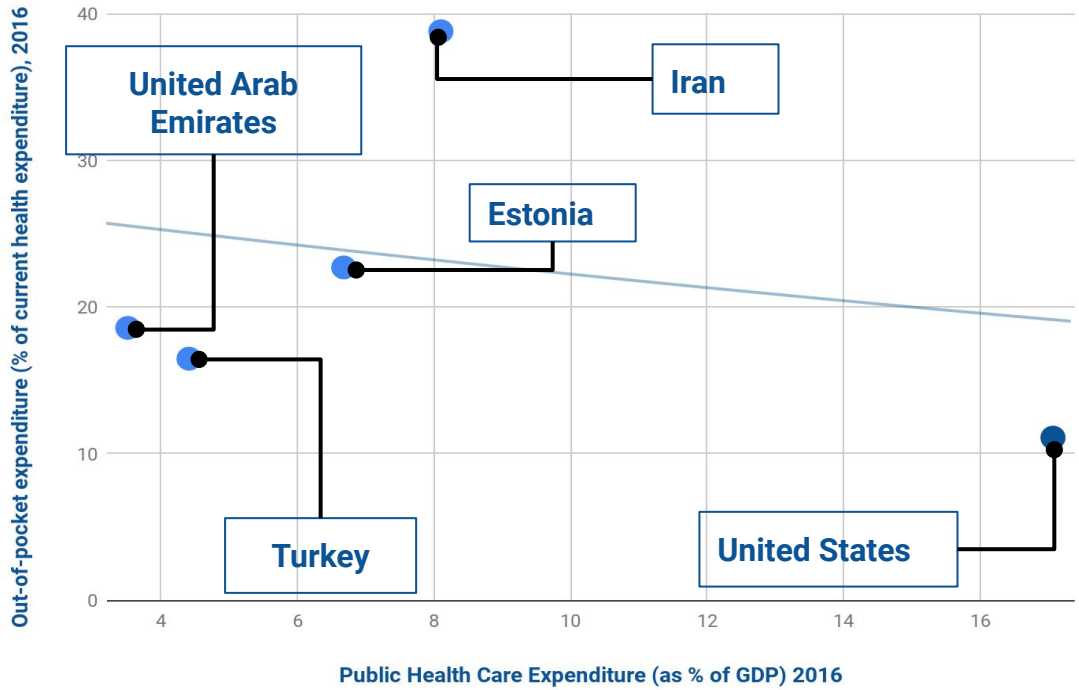
Underrepresented Initiatives

Preventive Medicine	AgeTech	Longevity Industrial Strategy	Continuing Education

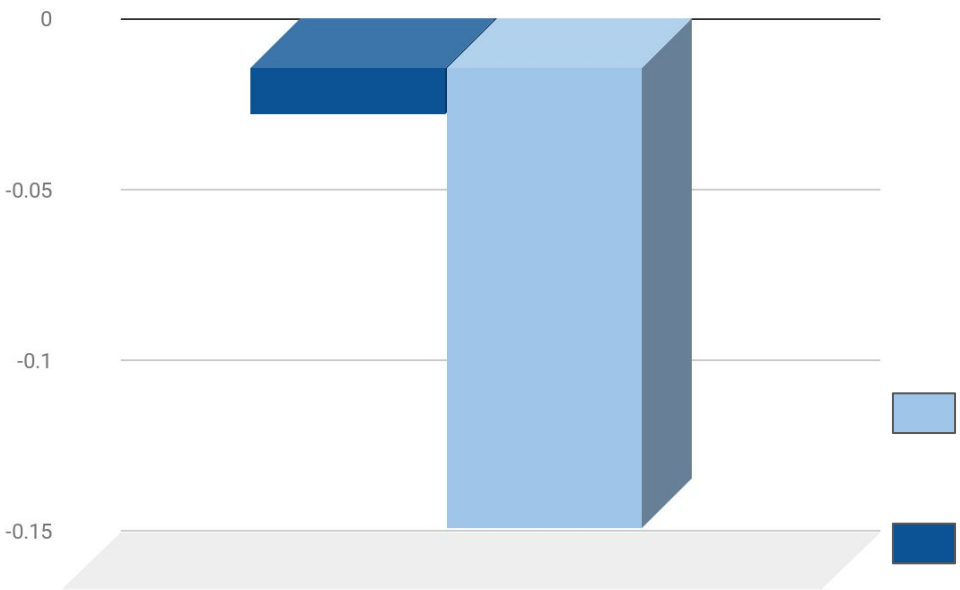
Current Healthcare Expenditure



Countries with Low HALE and Life Expectancy and High Gap



Effectiveness ratios



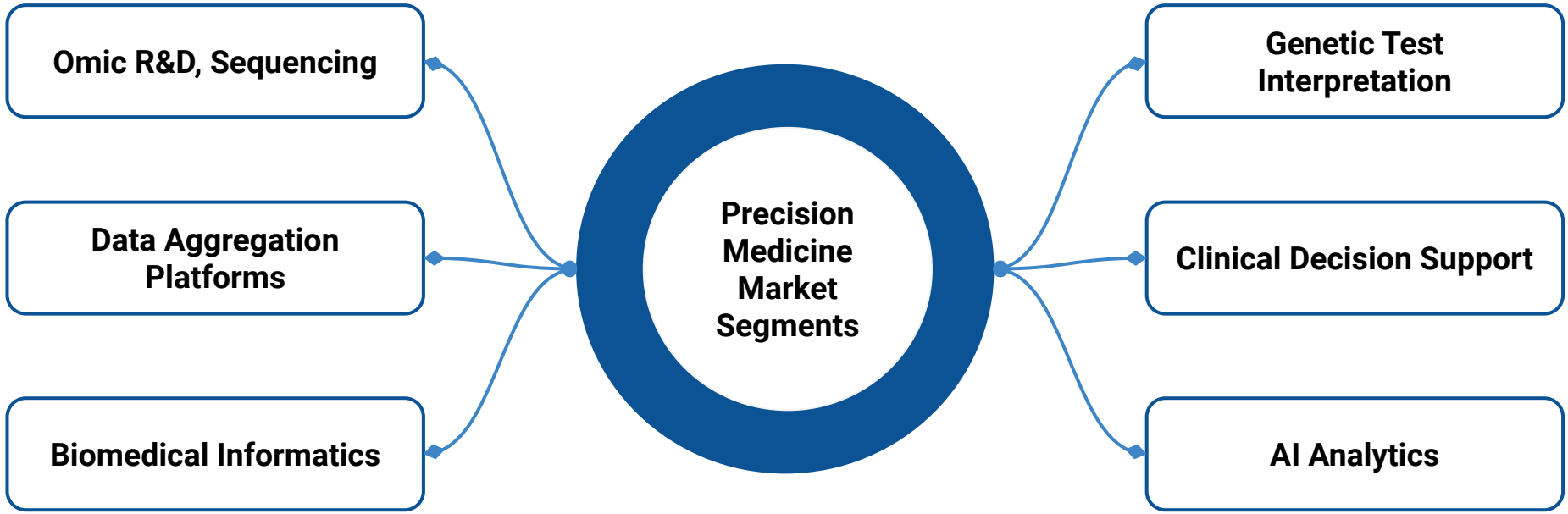
In order to improve their National Healthy Longevity and Health-Adjusted Life Expectancy (HALE) the government of United States should prioritize the development of a competitive Longevity Industry Development Plan, prioritize Healthy Longevity as a major national priority item, improve health insurance for poor population to reduce income-based healthcare inequalities, and allocate more healthcare dollars to preventive medicine, early diagnosis of disease, healthy lifestyle programs, and Artificial Intelligence for preventive medicine in particular.

HALE and Life Expectancy Difference CAGR (6 years)/Current health expenditures per capita (current US$), CAGR (6 years)

HALE CAGR (6 years)/Current health expenditures per capita (current US$), CAGR (6 years)

Precision Medicine: New Insights

Metabolomics, proteomics, microbiomics and beyond are offering substantially more biological data and insights on unique trajectories of diseases. Furthermore, we are now seeing market penetration of wearables grow significantly, which raises the possibility for more precise behavioral data, and medical-grade vital signs monitoring offers even more analytical opportunities to assess risk and monitor the progression of chronic diseases. Additionally, the growing number of social determinants that data analytics incorporates would improve our ability to match patients with not only appropriate interventions, but broader care pathways and social supports. More granular data means more finely tuned ways of performing risk stratification for assignment to different care regimens.



Source: Chilmark Research

Precision Diagnostics

AGING ANALYTICS AGENCY

Digital avatar visualizes a combination of biomarkers and other diagnostic results

Collect your data today:

- Blood samples
- Biomarker analysis
- Database of personal biomedical data stored on blockchain

Future benefits:

- Data driven analysis of biomarkers dynamics over time
- Analyse the changes in your digital avatar
- Personalized interventions

AI for Precision Health: New Data

Translating the tremendous growth in data into clinical insights falls into the hands of AI (artificial intelligence)/ML (machine learning) platforms. The rapid growth in investment in AI and cloud computing are beginning to create the foundations for the precision health market of the future.

However, the rapid growth of data sources and types of data does not automatically translate into improvements for the clinician and patient at the point of care. The burden of work in managing this huge influx of data is growing. There is little doubt that AI and the cloud will bring a great deal of computational power to health systems.

There are a number of limitations in the current health IT (Information technologies) and EHR (electronic health record) infrastructure that make the clinical realities of PM challenging.

- **The Sync 4 Science (S4S)** program that is part of the **PMI (Precision Medicine Initiative)** in the United States is utilizing SMART on FHIR to integrate data from EHRs and the All of Us Research Program. There is also a lack of storage space, but perhaps even more importantly, integrating genetic test reports that can be 20 pages long in the context of clinical decision support has not been an easy task. Making genetic data clinically actionable can be difficult when the science has significant degrees of uncertainty.
- **The eMERGE Network** across over a dozen academic research centers has been making a great deal of progress in recent years in addressing the challenge of integrating genomic data into EHRs. Some of the remaining issues include how to best handle genetic knowledge that may also impact a patient's family who may need to be tested for similar genetic conditions. As new insights in basic science emerge, the meaning of test results in the past can change over time. This can result in very different conclusions from the original context when the test was taken and create uneasy clinical encounters for patients and clinicians.

Source: Chilmark Research

AI for Precision Health in the United States: Challenges and Limitations

While scientific knowledge relevant to precision medicine has increased substantially in recent years, **translating these findings** into the clinic to truly transform patient care remains difficult. Considerable time and further research will be necessary to effectively utilize these findings in a clinical setting. More broadly, the considerable genetic heterogeneity that exists within the US population will also complicate the characterization of patient groups for which new treatment approaches are efficacious.

Focusing too strongly on technology and research detracts from more basic determinants of population health, such as socioeconomic or geographic disparities, environmental improvements (e.g., clean water), or other factors that have little to do with genetics but may lead to far more measurable improvements in public health. In fact, genetic factors are often not the primary cause of many chronic diseases, including cancers. As policymakers pursue new opportunities in precision medicine, they should therefore consider that the greatest gains may still be more likely to come from public health initiatives related to non-genetic factors, such as diet, exercise, smoking cessation, weight loss, or other population-level preventative interventions, than from laboratory breakthroughs or precision medicine.

Where advances in precision medicine occur, **the most measurable benefits may be different in kind from what some might expect**. It is true that medicines targeted to a molecular defect affecting only a subgroup of people can in some cases provide meaningful health benefits.

However, as explained by the Food and Drug Administration, medicines that are tailored to a subset of patients go hand in hand with companion diagnostics that can tell health care providers which patients are likely to benefit from particular precision medicine interventions and which are not. Because approved drugs can be offered to all patients whose conditions correspond to the approved indication (or even prescribed for off-label indications), the benefit conferred by companion diagnostics lies not with those who are determined to be likely responders, but with those patients deemed unlikely to respond who are spared the costs, false hopes, and potential side effects of undergoing an ineffective treatment.

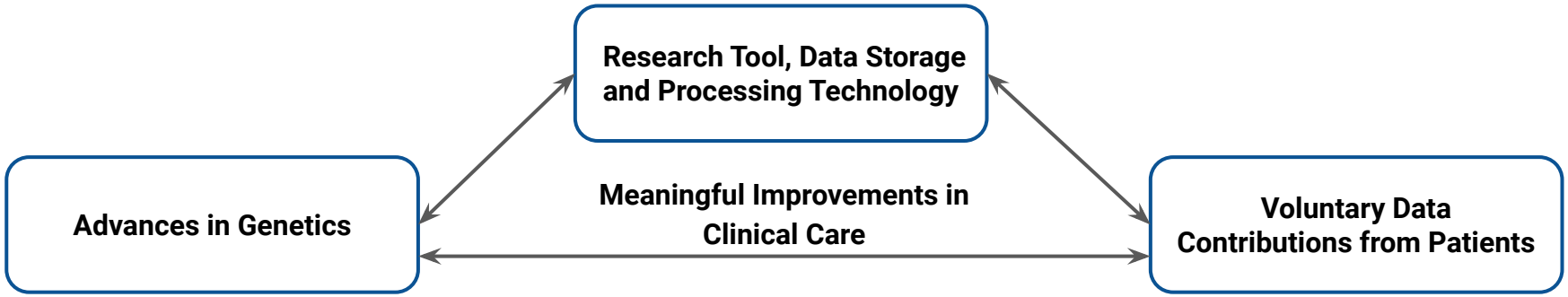
Source: HealthAffairs

AI for Precision Health in the United States: Progress and Opportunities

The Human Genome Project, successfully completed in 2003, provided the molecular backdrop against which scientists can unravel the genetic determinants of disease. Since the Human Genome Project, the **cost of whole genome sequencing has fallen** from tens of millions of dollars to around $1,000 per genome today – even more quickly than would be predicted under Moore's law, which in the field of computer science describes a doubling of computing power approximately every two years. CRISPR-Cas9 may perhaps have the greatest effect on precision medicine in the near future by enabling genetic defects to be edited out of the genome and resulting in the elimination of diseases with defined genetic abnormalities.

The rapid development of computer and laboratory technologies has also transformed the context of the Precision Medicine Initiative. Nearly a half century of advances according to Moore's law means that computers have orders of magnitude more processing power than they did when Nixon was in office, providing the power to analyze the prodigious volumes of data generated from DNA sequence analysis or electronic patient health records.

Voluntary data contributions from patients via mobile phone applications or from wearable devices can be used to help clarify relationships between diseases on the one hand, and environmental, behavioral, and genetic factors on the other. Laboratory technologies, such as next generation sequencing, have also lead to an "omics" era, where not only genomics, but transcriptomics, epigenomics, proteomics, metabolomics, and microbiomics data can be generated in real time, enabling researchers to study for the first time the effect of multi-omics on disease pathogenesis.



Source: HealthAffairs

National Health Deficit in USA is Basically a Policy Problem

National Health Deficit in USA is Basically a Policy Problem

In 2019 the US government's deficit **increased to $120 billion** in July, fueled by increases in spending on health care, according to data released by the Treasury Department.

This represents a further encroachment of the global so-called "Silver Tsunami," the economic devastation being inflicted by the aging population.

The United States spends more on health care than any other country in the world, and a large share of that spending comes from the federal government. **In 2017, US spent about $3.5 trillion**, or 18 percent of GDP, on health expenditures – more than twice the average among developed countries. Of that $3.5 trillion, $1.5 trillion is directly or indirectly financed by the federal government. In other words, the federal government in the US dedicates resources equal to nearly 8% of the economy toward health care. By 2028, it is estimated that these costs will rise to $2.9 trillion, or 9.7 percent of the economy. Over time, these costs will continue to grow and consume an increasing share of federal resources.

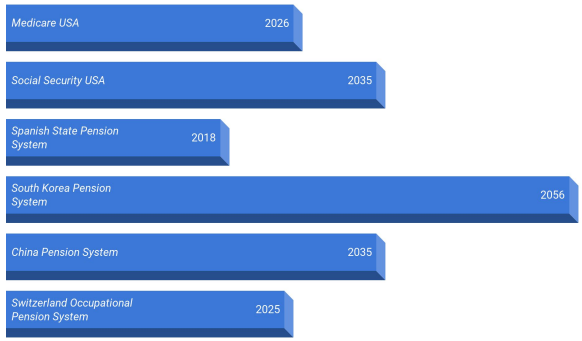
Yet compared to other countries, the United States also has one of the least preventive, least government-coordinated approaches to health care. As a result, it has little to show for this in terms of HALE, or in terms of the ~10-year gap between HALE and life expectancy at birth. However, the United States already has the human expertise, the capital, companies and research institutions to reverse this situation entirely.

What is needed now is the political will to develop a national strategy that assembles existing health care resources in a way that addresses the underlying metabolic roots of obesity and age-related diseases. This will be a major topic at Targeting Metabesity 2019 in Washington DC in October, where relevant industry participants will gather. It is hard to imagine another topic with a similar potential to muster bipartisan support for a trifecta of 'wins': improved quality and quantity of life for our growing elderly; trillions in taxpayer savings in public health care costs, net of entitlement benefits; and trillions in economic growth from the enlarged market of active, alert elderly consumers of goods and services. We do not believe it hyperbole to think that healthy longevity is one of the biggest and most leveraged health care challenges and opportunities of this century.

The United States spends a disproportionate amount on health care, comparing to Singapore, but HALE is relatively low

Singapore	United States
HALE: 76.2	HALE: 68.5
HALE GAP: 6.7	HALE GAP: 10.0
Life Expectancy: 82.9	Life Expectancy: 78.5
Healthcare Efficiency Rank: #2	Healthcare Efficiency Rank: #25
Healthcare Spending: 4.5% GDP	Healthcare Spending: 18% GDP

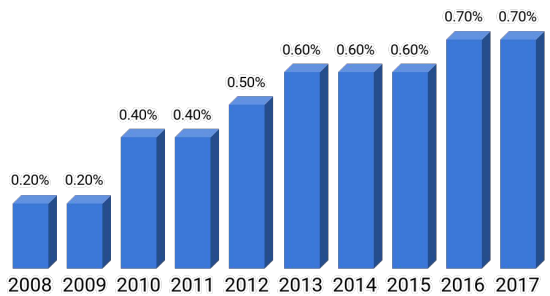
Insolvency Predictions for Government-Funded Schemes



Sources:

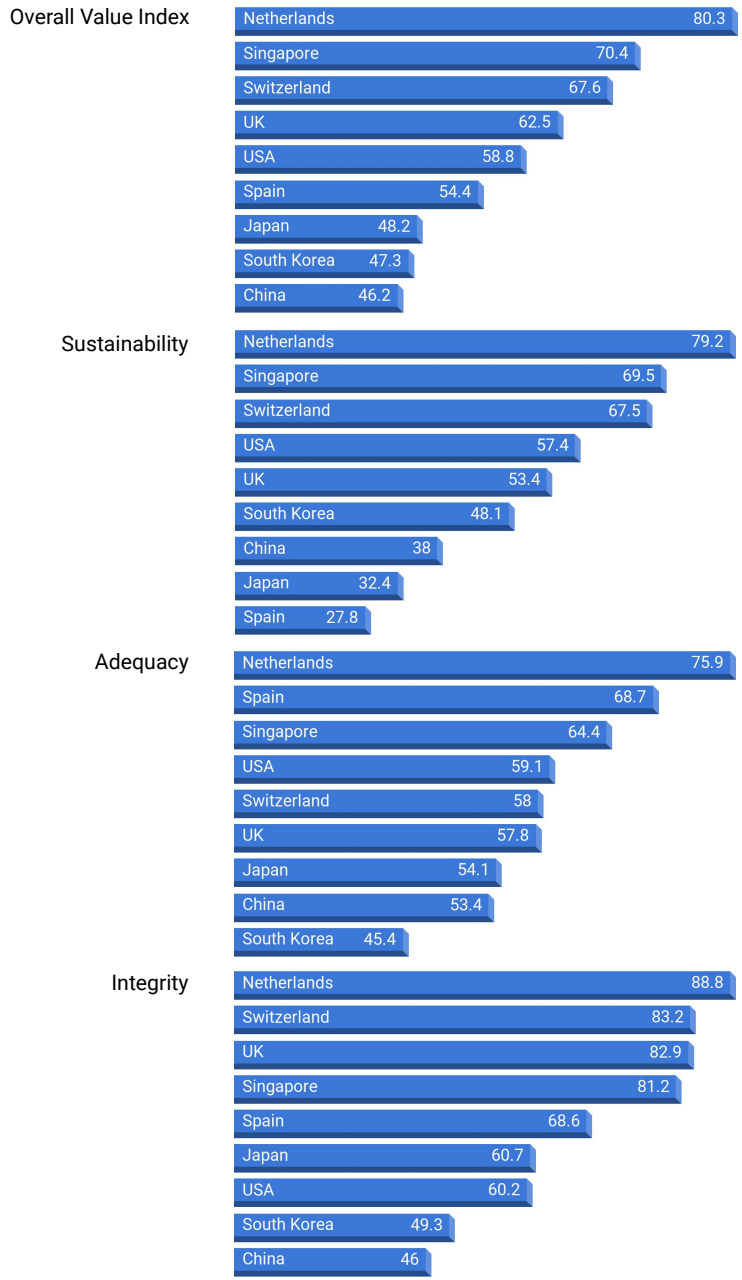
- Bloomberg
- MishTalk
- TheDiplomat
- Reuters
- Financial Times

USA Age Dependency Annual Dynamic



Source: World Bank Data

Countries with longest life expectancy, 2015



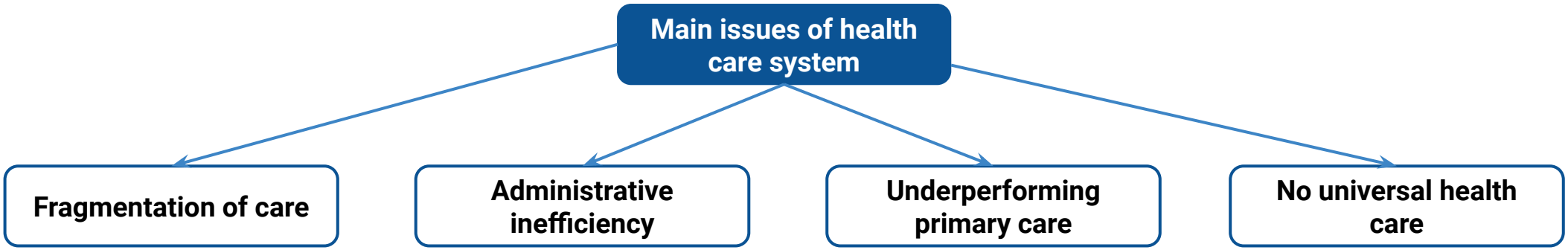
Source: Mercer Global Pension Index

Health Care System in the United States

Health care is subject to extensive regulation at both the federal and the state level. Under this system, the federal government cedes primary responsibility to the states under the McCarran-Ferguson Act. Essential regulation includes the licensure of healthcare providers at the state level, the testing and approval of pharmaceuticals and medical devices by the US Food and Drug Administration (FDA), and laboratory testing.

Health care facilities in the United States are largely privately owned. American citizens obtain health insurance through their employers, independently through private purchase, or through government-based programs. Some low-cost and cost-free health care services exist through non-profit organizations, charities, and publicly funded programs. However, international visitors should always carry their insurance when they visit the United States. The cost of treating a serious emergency can be catastrophically high.

The United States is home to some of the best hospitals and research facilities in the world. Their top treatment hospitals include the Mayo Clinic, the Cleveland Clinic, Johns Hopkins Hospital, UCLA Medical Center, and Massachusetts General Hospital. The United States is also considered one of the best destinations in the world for cancer care, cardiac care, and orthopedic medicine. In major cities, there's a wide range of public and private hospitals, surgery centers, urgent care clinic, and specialty clinics. In smaller communities, care options are more limited and may include everything from a county hospital, a community care clinic run by nurse practitioners, to telehealth services.



Source: International Insurance | MIT Medical

World Health Organization General Recommendations on Longevity Strategy

UN: 2015 World Population Aging Report

Governments need to design innovative, multisectoral policies and services for the elderly, including housing, employment, health care, infrastructure and social protection. This ensures the well-being and socio-economic integration of seniors while maintaining the fiscal solvency of pension and health care systems. **Recommendations:**

Expand and ensure solvency of pension systems to guarantee basic income security in old age for all

Health care systems must adapt to the needs of seniors, adequately diagnosing and treating age-related conditions

Enact policies that promote lifelong health and emphasize preventive care to prevent or postpone age-related disability

Prepare for a growing need for long-term care, both home-based and facility-based

Eliminate age-related employment discrimination, promote the recruitment of and flexible employment opportunities for the elderly

Facilitate access to microcredit, provide subsidies and other incentives for senior self-employment

Include seniors in public policy processes

Improve seniors' access to public services in urban and rural areas

Help to bridge the digital divide of seniors through technology training programs and learning hubs tailored to their needs

WHO: Global Strategy on Aging and Health

Strategic Objective 1: Commitment to Action on Healthy Aging: establish national frameworks for action on Healthy Aging; strengthen national capacities to formulate evidence-based policy; combat ageism and transform understanding of aging and health.

Strategic Objective 2: Developing Age-Friendly Environments: foster seniors' autonomy and enable their societal engagement; promote multisectoral action.

Strategic Objective 3: Aligning Health Systems to the Needs of the Elderly: orient health systems around intrinsic capacity and functional ability; develop and ensure affordable access to quality senior-centered care and integrated clinical care; ensure a sustainable and appropriately trained, deployed and managed health workforce.

Strategic Objective 4: Developing Sustainable and Equitable Systems for Long-Term Care: establish and continually improve a sustainable and equitable long-term care system; build workforce capacity and support caregivers; ensure the quality of person-centered and integral long-term care.

Strategic Objective 5: Improving Measurement, Monitoring and Research on Healthy Aging: agree on ways to measure, analyze, describe and monitor healthy aging; strengthen research capacities and incentives for innovation; research and synthesize evidence on healthy aging.

Source: Global Strategy and Action Plan for Aging and Health | 2015 World Population Aging Report

Comparison of Singapore and the United States: What the US Health Care System Can Learn

1. Healthier Population

Singapore is an island city-state of around 5.8 million without rural or remote areas. Everyone lives close to doctors and hospitals. Citizens there have much less poverty than one might see in other developed countries. Rates of smoking, alcoholism and drug abuse, as well as obesity rates, are relatively low. All of this predisposes the country to better health and consequently lower health spending.

2. Use of policy tools simultaneously

A concerted use of different tools promote complementarities that are unavailable when used in isolation. For example, instead of running hospitals in traditional command-and-control ways, the Singaporean government uses its ownership rights to force them to compete with each other and with private hospitals for users' funds, with the objective of promoting customer focus and operational efficiency on their part. Its ownership also makes it easier for the government to force them to disclose information on costs and clinical outcomes.

3. Cost-efficiency

The government in Singapore decides where and when the private sector can operate. In the United States, the opposite situation is true. The private sector is the default system, and the public sector comes into play only when the private sector does not want to. In Singapore, the government strictly regulates what technology is available in the country and where. It makes decisions on what drugs and devices are covered in public facilities. It sets the prices and determines what subsidies are available.

4. Large focus on delivery of care

Singapore gets a lot of attention because of the way it pays for its health care system. Primary care, which is mostly at low cost, is provided mostly by the private sector. About 80 percent of Singaporeans get such care from about 1,700 general practitioners. Polyclinics have been designed to process as many patients as quickly as possible. The government encourages citizens to use their online app to schedule appointments, see wait times and pay their bills.

Source: The New York Times | The Healthcare System in Singapore

Comparison of Singapore and the United States: What the US Health Care System Can Learn

5. Public health initiatives

Government control applies to public health initiatives. For example, when Singaporean officials began to worry about diabetes, they acted. School lunches have been improved. Regulations have been passed to make meals on government properties and at government events healthier. In the United States, the American Academy of Pediatrics and the American Heart Association recently called on policymakers to impose taxes and advertising limits on the soda industry, but that is merely guidance. In Singapore, campaigns have encouraged drinking water, and healthier food choice labels have been mandated. The country, with control over its food importation, even got beverage manufacturers to agree to reduce sugar content in drinks to a maximum of 12 percent by 2020.

6. Combination of public ownership, market competition, and price transparency

Public ownership allows the Ministry of Health to directly acquire operational information from public hospitals and respond with appropriate directives as necessary. This is particularly relevant in health care as the governance failures are multi-faceted and deeply intertwined and hence cannot be addressed in isolation.

Singapore's health care system shows that an **combination of conservative and liberal ideas in health care** is possible. Unlike in the US, where the government's main role is to manage insurance programs, Singapore's government controls and pays for the health care system itself – many hospitals belong to the public sector, a majority of doctors work predominantly for the state, and the government subsidizes many medical bills directly. Singapore made progress relatively inexpensively (with lower health spendings) in infant mortality and increased life expectancy. It did so in part through better vaccinations, better sanitation, bette public schools, and public campaigns against tobacco.

The United States should not implement single payer system as in the United Kingdom. We would recommend limiting the policy critique to lack of prioritization and the need for a national policy which provides **strategic prioritization, clarity and direction consistent with the healthcare system that currently exists** in the US, to make fragmentation the drive of health status improvements.

Source: The New York Times | The Healthcare System in Singapore

Focus on Health Status of Elderly

As the length of life and number and proportion of older persons increase, a central question is how to improve health status and minimize premature death rate related to metabolic risks.

A focus on national-level health status and its temporal trajectory is critical for several reasons. Health status is one of the most important indicators of well-being, and it predicts a large proportion of societal expenditures on health and social services for the elderly. Health status depends on individual lifestyle factors, social and community networks, general socioeconomic, cultural and environmental conditions. Health status is also reciprocally affected by social and political policies and programs.

Relationship of Public-Sector Programs and Policies to Health Services for Older Persons

Sector	Relation to the Provision of Health Services for Older Persons
Housing	• Provision of suitable-quality housing, both in the community and within institutions, to sustain health. • Reconstruction of housing to accommodate disabled older persons.
Public Health	• Creation of prevention and health promotion programs that affect older persons. • Viewing vaccination as a lifelong priority, to help people remain active and productive for as long as possible. • Improve medication management of health status information.
Education	• Training of all levels of health professionals in special skills related to the problems of older persons.
AgeTech	• Provision of increasingly complex mechanical and electronic devices for the treatment and rehabilitation of older persons.
Urban Design	• Location of housing for older persons so as to optimize access to health, nutritional, recreational, and social services.
Transportation	• Provision of public transportation and facilitation of personal transport to enhance mobility and its social outcomes.
Socialization	• Development of socialization activities for elderly to handle stress better, social activities lead to important increases in cardiovascular health and an improved immune system.

Source: The Health of Aging Population

Improving Quality While Containing Costs

Holding the healthcare industry to a higher standard. America's healthcare system is world-renowned for developing advanced treatments. Apart from advanced research, however, it is important to provide effective, low-cost treatments that work, triggering unnecessary treatments and higher costs down the line.

Stop focusing on "sick care." Health care leaders must shift the nation's "sick care" approach to care that is preventive and comprehensive.

Making health care safer for patients. Experts say that medical errors are the third most common cause of death in America.

Holding health insurers accountable. By focusing on insurers' payment strategies and quantitative goals and results, closer scrutiny of health insurers can drive systemic reforms to improve safety, increase care coordination, boost prevention, and bring down costs for consumers and small businesses.

Comprehensive prescription drug reform. America's prescription drug development and patent system should be focused on the research into needed breakthrough therapies for life-threatening conditions. The savings from overhauling the patent system — which gives pharmaceutical corporations immense pricing power — can be reinvested in research into high-priority therapies.

Price transparency for health care services. The least that can be done about rising health care costs is making sure consumers can get prices for services or treatment upfront to allow for more informed decisions about value, encourage price competition that could help keep costs in check, and create accountability for unreasonably high-cost providers.

Preserving competition. Studies show consolidation between hospital systems, health insurers, pharmaceutical corporations often leads to higher prices and worse service.

A public option health plan. Providing Americans under 65 with the option of buying into Medicare or Medicaid could provide consumers with a cheaper alternative to commercial health insurance and ensure that there are coverage options for consumers who lose their employer-based coverage.

Tackling Wasteful Spending on Health

Wasteful Health Care Expenditures	Tackling Issues
Clinical Care	◆ Development of robust information systems to identify low-value care ◆ Creation of reporting and learning systems of adverse events ◆ Patient-reported measures to receive value and safety from the perspective of care recipient ◆ Adherence to clinical guidelines and protocols can be encouraged by audits and feedback ◆ Behavior change campaigns ◆ Financial incentives and nudges in form of disinvestments
Operational Care	◆ Payments and financial incentives to promote day-surgery ◆ Behaviour change for providers and patients through clinical guidelines and disease management ◆ Promotion of self-management by patients and education campaigns
Government Care	◆ Acting in the detection, prevention and response to fraud in the delivery and financing of care ◆ Proactively seek to identify problem areas (data mining, campaigns targeted at specific types of care susceptible to abuse ◆ Combat inappropriate business practices
Strategies to reduce waste can be summed up as: stop doing things that do not bring value, and swap when equivalent but less pricey alternatives exist.	

Source: OECD

Maintain America's Leadership in Biomedical Innovation

America has a history of being a leader in biomedical innovation. The United States is home to many of the world's leading scientists, hospitals, research organizations and institutes of higher education. Both the nation's human talent and investment in the sciences have led to the countless medicines and medical treatments that have made life in America – and around the world – longer and healthier.

Government maintains the competitive marketplace in the US to encourage continued medical innovation. The US leads globally in the development of new treatments and cures. For example, Americans can access cancer medicines about two years earlier on average than patients in other developed countries such as the UK, Germany and France.

Government grants have been essential to America's medical achievements. Researchers who reviewed the 100 most commonly prescribed drugs in the US found that 93 percent had benefited from NIH funding. The percentage is even higher for new drugs. From 2010 to 2016, 97 percent of new drugs that made it through the approval process were grounded in science that received funding from the NIH.

Government grants allow researchers to pursue treatments driven by the public's interest, not by short-term profit. Private funding has become increasingly important in the advancement of biomedical innovation, including in the field of aging. However, when researchers rely exclusively on private funds, they can become pigeonholed to the desired direction and cannot freely pursue their scientific interests. Additionally, many of America's most life-saving and life-changing drugs require years or decades of research and clinical trials, which investors tend to be weary of getting involved in.

America is in danger of losing its place as the world's number one medical innovator. Overall, funding for the NIH has sloped downward since 2003, dropping by 11 percent in real dollars as of 2018. This has impacted researchers' access to grants. In 2003, around 30 percent of grant proposals received funding, by 2015 that percentage had declined to 15 percent. At the same time, global competitors, including China, have ramped up their focus on biomedical research. If this trend continues, scientists may choose to pursue scientific research beyond America's borders.

Source: University of Michigan | Futurity | Cell Chemical Biology

Prioritize Federal Grants on Aging Research

Aging is the leading factor in America's most fatal diseases but receives minimal attention from the government. Despite the profound implications aging drugs could have on Americans' HALE, researchers attempting to answer questions surrounding the biology of aging receive less than one percent of the United States total medical research budget. As noted by Harvard geneticist David Sinclair, "aging disables 93 percent of people over the age of 50, but in 2018 the NIH spent on aging less than a tenth of what was spent on cancer research."

Federal grants must prioritize research into the study of the biology of aging. The grants that are awarded for aging research are often not focused on answering the fundamental questions about the causes of aging. In 2018, the NIA received $3.5 billion in additional grant funds. However, only three percent of these dollars were allocated to study the biology of aging. The overwhelming majority was committed to Alzheimer's research. While Alzheimers' is a devastating disease and deserving the attention of scientific minds, curing it would only add an estimated 19 days to an individual's life. Treating the biological causes of aging would presumably cure Alzheimer's and all other age-related diseases.

"Aging disables 93 percent of people over the age of 50, but in 2018 the NIH spent on aging less than a tenth of what was spent on cancer research".

David A. Sinclair, Professor in the Department of Genetics and co-Director of the Paul F. Glenn Center for the Biology of Aging at Harvard Medical School.

"I think that there is nothing more important than longevity research in this life."

Alex Zhavoronkov, Chief Executive Officer of Insilico Medicine, an artificial intelligence company dedicated to extending human productive longevity and transforming every step of the drug discovery and development process through excellence in biomarker discovery, drug development, digital medicine, and aging research.

Source: Fightaging | Nature | Nautilus

Encourage Industry to Develop Healthspan Products through Regulatory Innovation

Aging must be designated as a treatable condition

The FDA only considers potential drug candidates that aim to treat a particular disease. Since aging is not designated as a "disease," drugs that target multiple age-related conditions do not have a clear regulatory path and therefore are not being developed as such.. Instead, researchers focusing on addressing one of the nine hallmarks of aging, including senescent cells and mitochondrial health, must direct their research and clinical trials toward targeting age-related diseases already recognized by the FDA, such as cancer and Alzheimer's. America is not alone – not one nation has recognized aging as a disease. Progress in this area was made when the World Health Organization included aging in its "International Classifications of Diseases."

Classifying aging as a treatable condition will lead to increased scientific interest and funding in the aging field

There is little incentive for young scientists or eager entrepreneurs and investors to dedicate their careers or resources to combating aging when the condition they are aiming to treat is not recognized by the regulatory body that must approve their potential drug. By legitimizing aging as a condition, additional money will naturally flow to the aging field and will be followed by bright scientific minds keen on making truly life-changing discoveries. If America does not take the lead in this regard, it risks losing some of its most capable scientists to competing countries that have made treating aging a leading priority.

Defining standardized preclinical and clinical approaches by the Food and Drug Administration (FDA) will facilitate the development of products aimed at preventing age-related conditions

An overriding goal of FDA should be to partner with developers in identifying and confirming the effectiveness of products that increase healthspan--the portion of life free of major chronic diseases. For developers to invest in trials that will provide the necessary evidence to approve these products will require clarity of expectations and sufficient incentives to warrant the investments.

Encourage Development of Healthspan Products and Interventions through Public Policy and Private Sector Support

(1) Plan and implement developmentally appropriate programs in school-aged environments, encourage social media responsibility to maintain social network and develop inclusive society for elderly.

(2) Declaration of national interest/a national goal to promote research, development, and approval of drugs, devices, and other interventions that can extend healthspan.

(3) Legislated incentives to spur funding of research, clinical development, and commercialization of products aimed at increasing healthspan, possibly styled after the Orphan Drug Act and the 21st Century Cures Act.

(4) Enable patient-centered care with information technology systems. Most healthcare providers have focused on enhancing billing, revenue, and documentation, rather than closely tracking the health, wellness, outcomes, and cost of individual patients throughout the care delivery. Embracement of technology in health care will lead to personalization and improvement of the quality of medical care through close coordination between patients, caregivers, and professionals.

(5) Legislated incentives to provide transparent and readily available information on quality and cost. Hospitalists need to work collaboratively with their hospital systems to collect and widely report on quality and cost metrics for the patients they serve.

(6) Move to a life-course perspective in tackling the rising epidemic of “metabesity.” Initiate strategies to improve the health of the nation, promote the importance of focusing on socio-demographic factors to ensure delivery of healthy newborns and decrease the burden of behavioral factors such as insufficient physical ability, overweight, alcohol abuse, smoking. This will stimulate policy initiatives that supplement income and improve educational opportunities, housing prospects, and social mobility as income is strongly associated with morbidity and mortality in the United States.

Legislation to promote development of interventions (drug, device and other) to accelerate healthy longevity should attract bipartisan support, benefit everyone, save money and create new business opportunities for our economy, and promote U.S. leadership in one of the biggest global public health and economic opportunities of this century.

Key Players: Research Hubs and Influencers

40 Research Hubs

Aging Intervention Foundation	Albert Einstein College of Medicine	Beckman Institute for Cancer and Aging	Berkeley Center on the Economics and Demography of Aging	BioHub
Buck Institute for Research on Aging	Calibr	Center for Digital Innovation	Center for Research & Education on Aging (CREA)	Center On Aging & Health
Cooper Institute	Gladstone Institutes	Glenn Center for Research on Aging	J. Craig Venter Institute	Learning & Longevity Research Network
Life Span Institute	Maximum Life Foundation	Milken Institute Center for the Future of Aging	National Foundation for Cancer Research	National Institute on Aging

40 Research Hubs

NHLBI	QB3	Rand Center for Study of Aging	Salk Institute in San Diego	Sanford Burnham Prebys Medical Discovery Institute
Scripps Research	SENS Research Foundation	SRI International Center for Health Sciences	Stanford / VA / NIA Aging Clinical Research Center	Stanford / VA Alzheimer's Research Center
Stanford Center on Longevity	The Longevity Research Institute	UC San Diego Health Sciences Center for Healthy Aging	UCLA Division of Geriatrics	UCLA Longevity Center
UCLA-Easton Center - Mary S. Easton Center	UCSF Memory and Aging Center	USC Leonard Davis School of Gerontology	USC Longevity Institute	West Health Institute

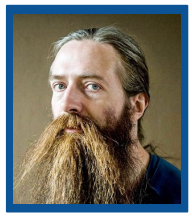
70 Longevity Influencers


Alan Trounson

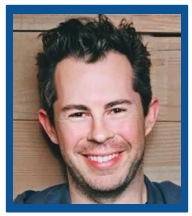

Alexander Fleming


Ana Maria Cuervo

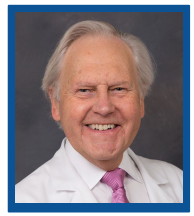

Arielle Burstein

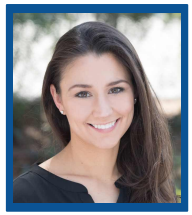

Aubrey de Grey


Bill Andrews

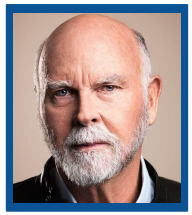

Bill Maris


Bimal Shah


Brian Leyland-Jones


Caitlin Lewis


Charles Stacey


Craig Venter


Cynthia Kenyon


David Kekich

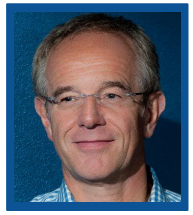

David Sinclair


Dennis Purcell


Diana Dooley


Elizabeth Blackburn


Eric Topol


Eric Verdin

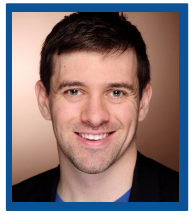

Gary Gibbons


George Martin

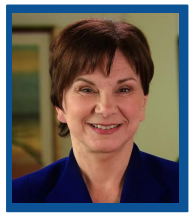

Gordon Lithgow


Hal Sternberg


James Kirkland


James Peyer

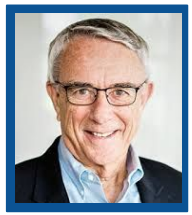

James Williamson


Janet Woodcock


Jeffrey Berkowitz


Jennifer Ligibel


Joan Mannick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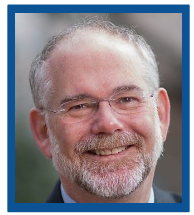
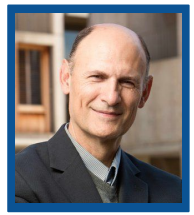
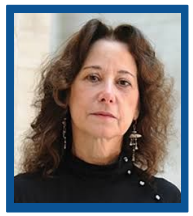

John Buse

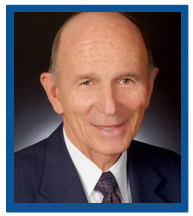

Joseph Rodrigues


Juan Carlos Belmonte

70 Longevity Influencers

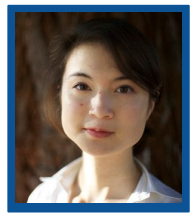

Judith Campisi


Karen Tracy


Kenneth Cooper


Kris Verburgh


Laura Carstensen


Laura Deming


Leonard Guarente


Lucy Rose


Matt Kaeberlein


Michael Kope

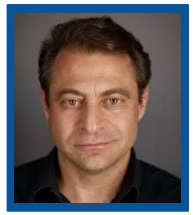

Michael West


Michael Zemel


Nir Barzilai

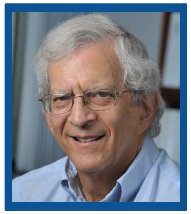

Patricia Olson


Paul Knoepfler

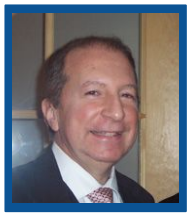

Peter Diamandis


Pinchas Cohen


Remy Gross III


Richard Hodes


Ronald Demos Lee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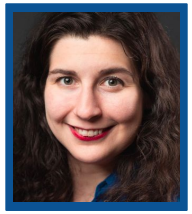

Sarah Constantin


Sree Kant


Stephanie Lederman

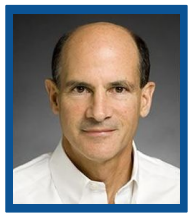

Steve Horvath


Susan Mayne


Suzana Petanceska


Terdema Ussery II

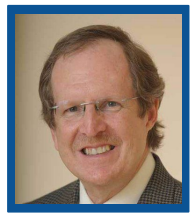

Thomas Okarma

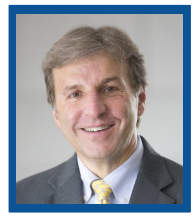

Thomas Rando


Thomas Seoh


Vadim Gladyshev


Vittorio Sebastiano


W. Keith Hoots


William Cefalu

Conclusions

I. The prevalence of NCDs are considered to be a "slow motion disaster."

Noncommunicable diseases (NCDs), also known as chronic diseases, tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behavioral factors. Such diseases have common metabolic roots, and their interconnection can be called **"metabesity."**

II. All risk factors of NCDs lie in non-health sectors, requiring collaboration across all of government and all of society to combat them.

Noncommunicable diseases are driven by forces that include unplanned urbanization, globalization of unhealthy lifestyles and population aging. Unhealthy diets and a lack of physical activity may show up in people as raised blood pressure, increased blood glucose, overweight and obesity. These are called metabolic risk factors that can lead to cardiovascular disease, the leading NCD in terms of premature deaths.

III. The United States life expectancy at birth ranks 25th in the world, and yet its health care expenditures are the highest among all developed countries.

US health expenditures are projected to grow at an average annual rate of 5.5% during 2018–27 and represent 19.4% of gross domestic product in 2027. Although expected life span will rise globally in 2040, the United States, despite the projected increase in its health care spending, is expected to further plunge in life expectancy rankings in 2040 – from 43rd place to 64th – the largest decrease for a country defined as high income.

IV. Preventive care is the best way to lower the United States health care costs.

The United States needs a new approach that shifts away from "sick care" to a model of empowering overall health and wellness, providing patients with access to proactive care that identifies risk and manages chronic disease early to prevent escalation and deterioration.

Conclusions

V. This shift from treatment to prevention is ultimately leading to a coming age of precision health.

"Precision health" denotes the continuous stabilization of health and the maximum-obtainable maintenance of a young biological age via the routine application of micro-interventions in response to ongoing fluctuations in biomarkers of aging and health.

VI. Utilizing strength of the United States in artificial intelligence industry leads to meaningful improvements in medical care.

Translating the tremendous growth in data into clinical insights falls into the hands of AI (artificial intelligence)/ML (machine learning) platforms. The rapid growth in investment in AI and cloud computing are beginning to create the foundations for the precision health market of the future. But apart from advanced research it is important to provide effective, low-cost treatments that work, triggering unnecessary treatments and higher costs down the line.

VII. Tackling wasteful spending on health in clinical care, operational costs and administrational expenditures.

Acting in the detection, prevention and response to fraud in the delivery and financing of care, development of robust information systems to identify low-value care, combat inappropriate business practices, launching of patient-reported measures to receive value and safety from the perspective of care recipient can lead to decrease in inefficiency of health care system. In general, strategies to reduce waste can be summed up as: stop doing things that do not bring value and swap when equivalent but less pricey alternatives exist

VIII. A focus on national-level health status and its temporal trajectory is critical.

Health status is one of the most important indicators of well-being, and it predicts a large proportion of societal expenditures on health and social services for the elderly. It depends on individual lifestyle factors, social and community networks, general socioeconomic. Health status is also reciprocally affected by social and political policies and programs.

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TARGETING METABESITY 2019
15-16 October 2019 | Washington, DC, USA

Link to the Report: https://aginganalytics.com/longevity-and-metabesity-usa

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AGING ANALYTICS AGENCY is the world's premier provider of industry analytics on the topics of longevity, precision preventive medicine and economics of aging, and the convergence of technologies such as AI and digital health and their impact on health care. The company provides strategic consulting services in fields related to longevity, and currently serves as the primary source of analytics for the specialized hybrid hedge fund Longevity.Capital, as well as the UK All-Party Parliamentary Group for Longevity.

TARGETING METABESITY 2019 focuses on shifting the emphasis from treatment to prevention, and going beyond managing individual diseases to extending healthy lifespan. Gathering will be stellar speakers and participants from science and medicine, government regulation and policy, health care organizations, industry (drugs, devices, nutritional, and digital products), capital markets, patient advocacy, and other fields, held this year at the Carnegie Institution for Science in Washington, DC, 15-16 October 2019.