



**Chula**  
Chulalongkorn University



# Precision Medicine

**: The Future is Catching Us**

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# 'ปตท.' ลุยนวัตกรรม 'มณีแดง' ด้านชะลอระดับเซลล์ ทดสอบในคนปีนี้ (2566)

July 12, 2022



February 14, 2023



<https://www.bangkokpost.com/business/2346563/ptt-to-commercialise-rejuvenating-dna>

# DNA Science: Y2K Twenty Years On

## In the past

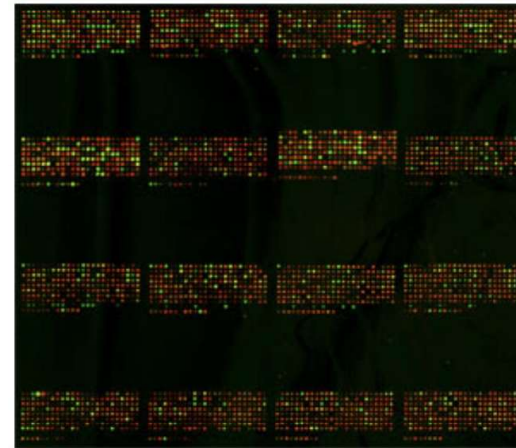


## At present

Arrays



Parallel Sequencing



```
ACTCAGCCCCAGCGGAGGTGAAGGACGTCTTCCCCAGGAGCCG
GTGAGAAGCGCAGTCGGGGGCACGGGGATGAGCTCAGGGGCCCTC
TAGAAAGATGTAGCTGGGACCTCGGGAAGCCCTGGCCTCCAGGT
AGTCTCAGGAGAGCTACTCAGGGTCGGGCTTGGGAGAGGAGGA
GCGGGGGTGAGGCCAGCAGCAGGGGACTGGACCTGGGAAGGGCT
GGGCAGCAGAGACGCCGCCGACCCGCTAGAAGGTGGGGTGGGGAG
AGCATGTGGACTAGGAGCTAAGCCACAGCAGGACCCACAGT
TGTCAGTGTCTTTATCGAGCACCTACTGGGTGTCCCCAGTGTG
CTCAGATCTCCATAACTGGGAAGCCAGGGGCAGCGACACGGTAG
CTAGCCGTCGATTGGAGAACTTTAAATGAGGACTGAATTAGCT
CATAAATGGAAAACGGCGCTTAAATGTGAGGTTAGAGCTTAGAA
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CCGGCGGTGGGGAGGGGAGGGGGTGTGGAATTTGAACCCGGG
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GATAATGGAGCAAGGCTTGAAGGCTAACCTGGGGTGGGGCCGG
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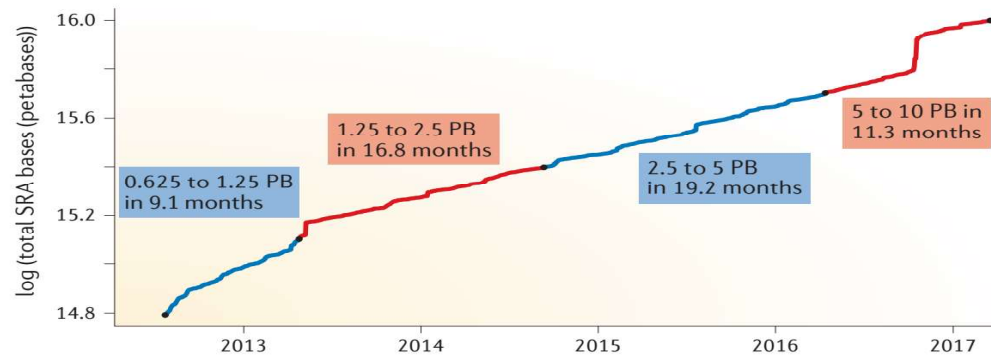
# MinION: A Complete **DNA Sequencer** on a USB



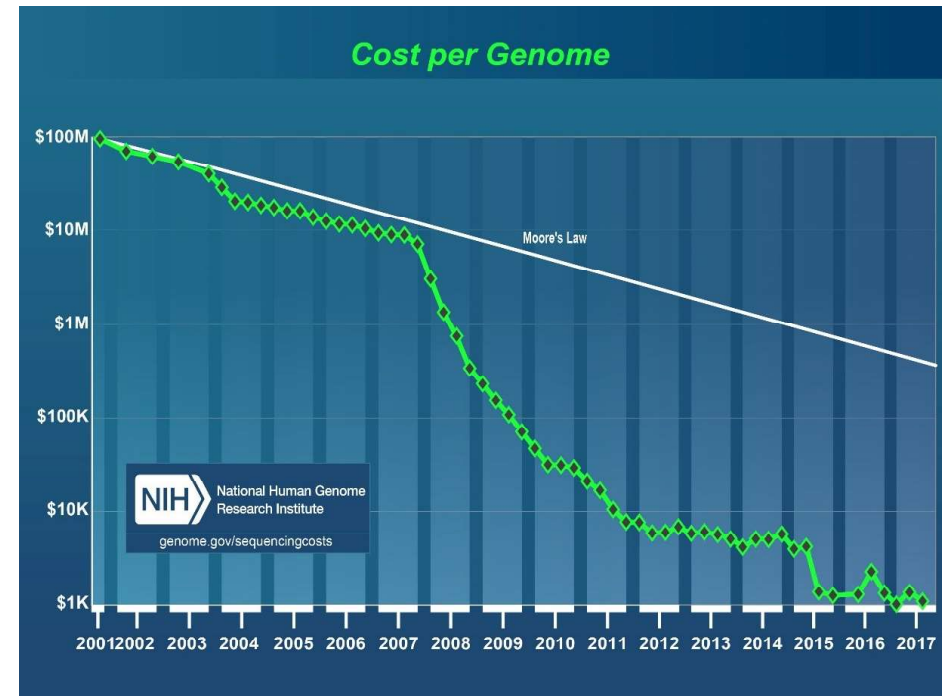
<https://www.genengnews.com/insights/first-nanopore-sequencing-of-human-genome/>

# DNA Sequencing: Big Data in Life Sciences and Genomics

## Factor 1 - Increase databases



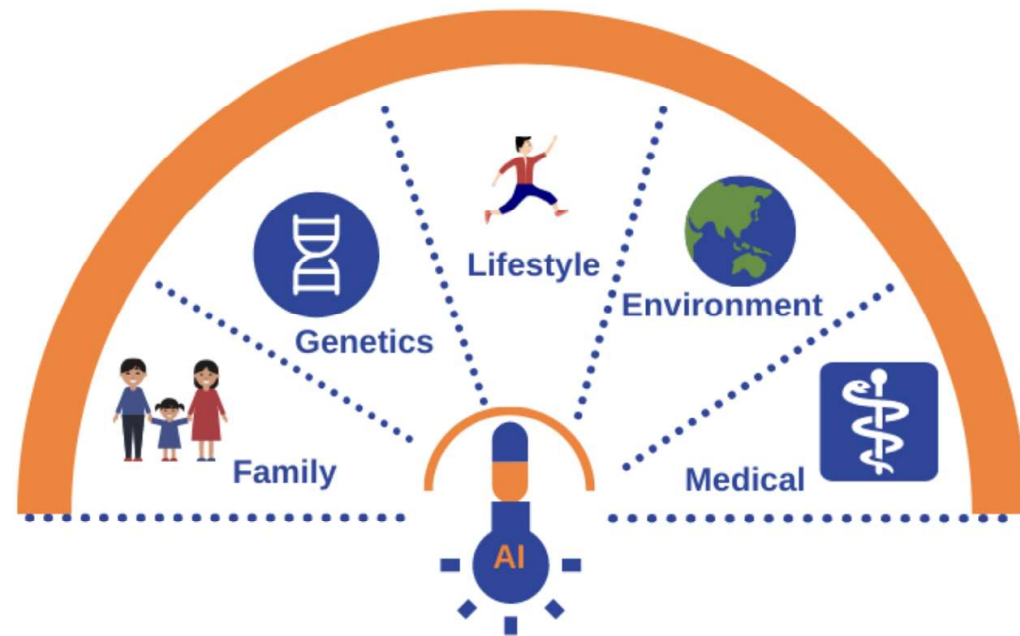
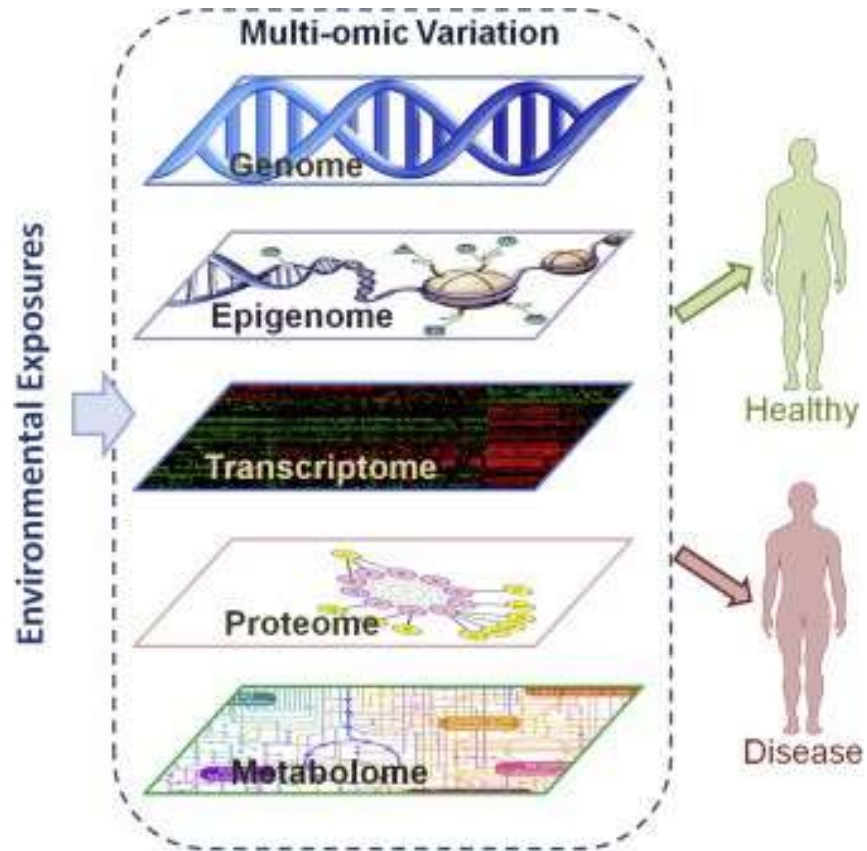
## Factor 2 - Decrease unit cost



E.R. Mardis, Nature (2011), B. Langmead & A. Nellore, Nature Reviews Genetics (2018)

<https://www.genome.gov/27565109/the-cost-of-sequencing-a-human-genome/>

# Precision Medicine : New Normal Era of MEDICINE



<https://blog.crownbio.com/pdx-personalized-medicine>

# Is there a way to bridge the gap between healthspan and lifespan?



## 3 Best Examples of Current Precision Medicine

- Genomic Sequencing Services
- DNA Editing
- Longevity Medicine and Epigenetics

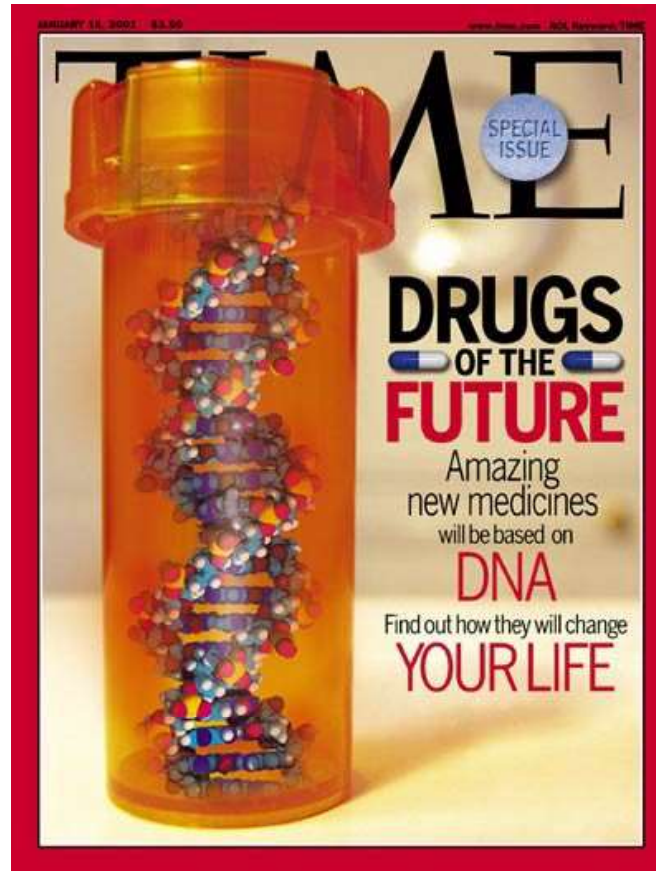
# Healthcare Innovative Platform



- **Smart Drugs**
- **Smart Diagnostics**
- **Smart Medical Devices**
- **Smart Medical Services**

- **Smart Drugs**
- Smart Diagnostics
- Smart Medical Gadget
- Smart Medical Service

## Biologics & Personalized Medicine



January 2001



May 2006

- **Smart Drugs**
- Smart Diagnostics
- Smart Medical Gadget
- Smart Medical Service

# Personalized Medicine



**BiDil**  
isosorbide dinitrate/hydralazine HCl

arbor  
**patient  
DIRECT**  
ArborPatientDirect.com

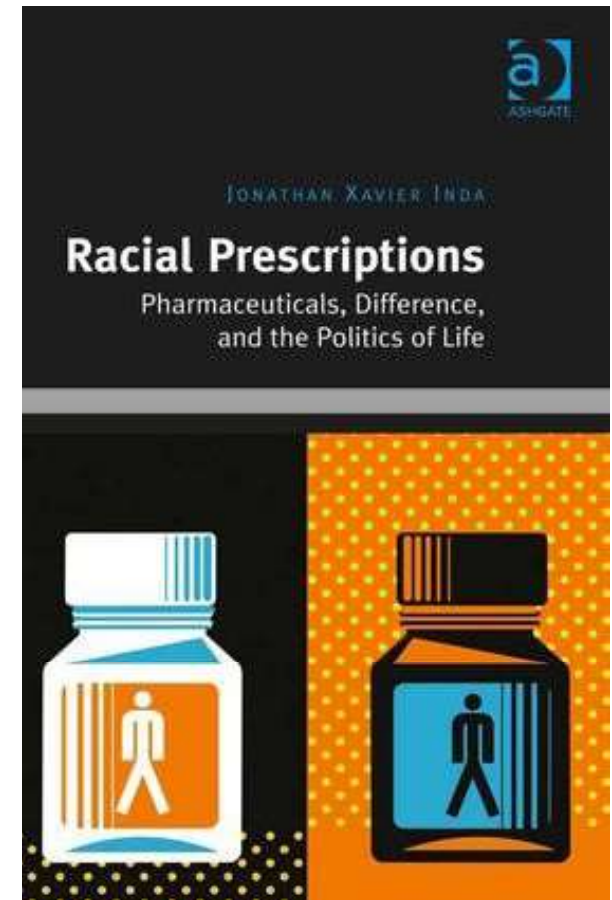
CO-PAY AS LOW AS  
**\$25\***  
Click here to find out how

I am a healthcare provider interested in prescribing BiDil to my patients

I am a patient/caregiver interested in learning about BiDil for African Americans with heart failure

Image of a smiling healthcare provider (doctor) with a stethoscope.

Image of a smiling couple (patient and caregiver) outdoors.



- **Smart Drugs**
- Smart Diagnostics
- Smart Medical Gadget
- Smart Medical Service

## Implanted Drug Delivery System: **Microchip Drug**



**First-in-Human Testing of a Wirelessly Controlled Drug Delivery Microchip**  
 Robert Farra *et al.*  
*Sci Transl Med*, (2012);  
 DOI: 10.1126/scitranslmed.3003276



Researchers from Microchips Inc. say they successfully loaded a microchip with a drug for osteoporosis, implanted it in seven patients and programmed it wirelessly to release doses of the medication.

### Inside Job

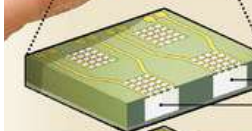
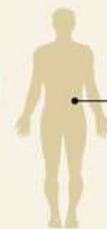
Researchers have implanted microchips and programmed them to deliver doses of medication in seven patients.

#### Microchip implant



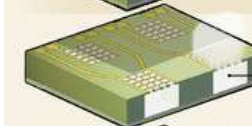
#### How the device works

The device containing the microchip is implanted under the skin, and programmed to be monitored and controlled remotely.

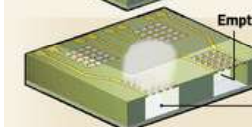


#### Drug reservoirs

At time of implant, drugs are stored in sealed reservoirs.



When electrical current is applied, the membrane sealing the reservoir melts, releasing the drug.



#### Empty

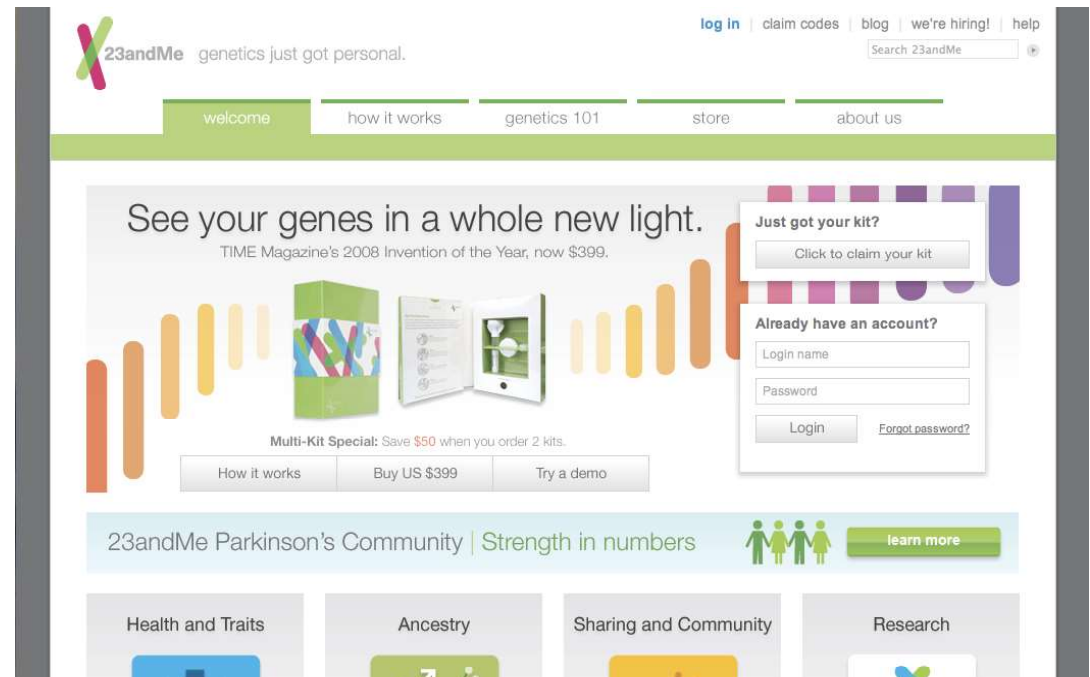
When the drug reservoir is empty, the next dose can be delivered from another reservoir.

Source: MicroChips Inc.

The Wall Street Journal

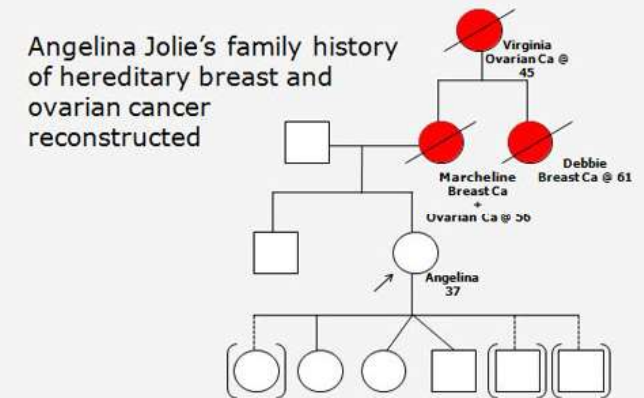
- Smart Drugs
- **Smart Diagnostics**
- Smart Medical Gadget
- Smart Medical Service

# Direct-To-Customer (DTC) Lab Testing



- Smart Drugs
- **Smart Diagnostics**
- Smart Medical Gadget
- Smart Medical Service

## Angelina Effect: -Care Testing (POCT) Lab



- Smart Drugs
- **Smart Diagnostics**
- Smart Medical Gadget
- Smart Medical Service

# Artificial Intelligence (AI) in medicine

## Introducing IDx-DR, your new partner in diabetes care

The first and only FDA authorized AI system for the autonomous detection of diabetic retinopathy

[Learn More](#)

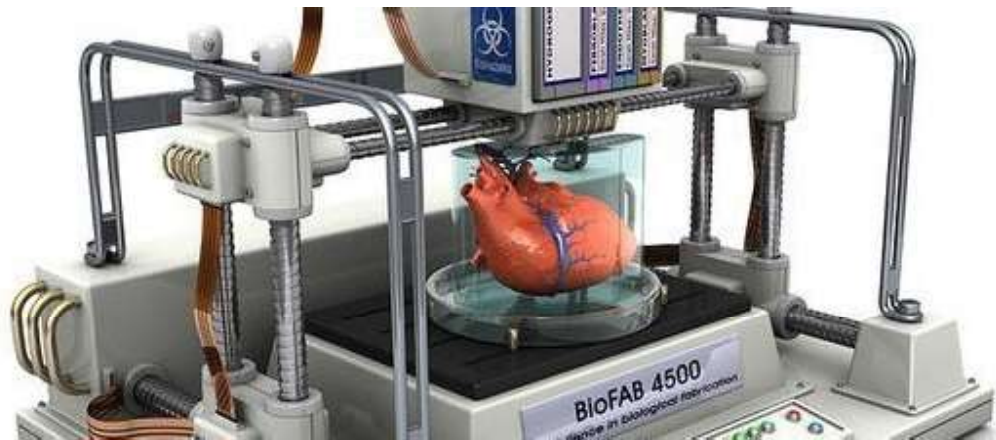
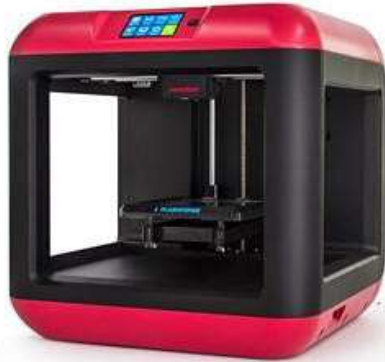
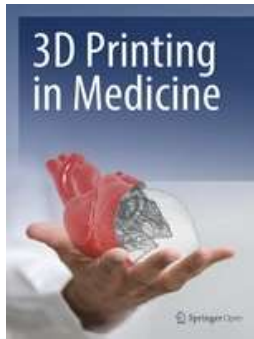
IDx-DR is intended for use to automatically detect more than mild diabetic retinopathy (mtmDR) in adults ages 22 years of age or older diagnosed with diabetes who have not been previously diagnosed with diabetic retinopathy. IDx-DR is indicated for use with the Topcon NW400.



<https://www.healthcare.digital/single-post/2018/04/20/>

- Smart Drugs
- Smart Diagnostics
- **Smart Medical Gadget**
- Smart Medical Service

# 3D Bioprinter in medicine



Source: <https://3dprintingindustry.com>

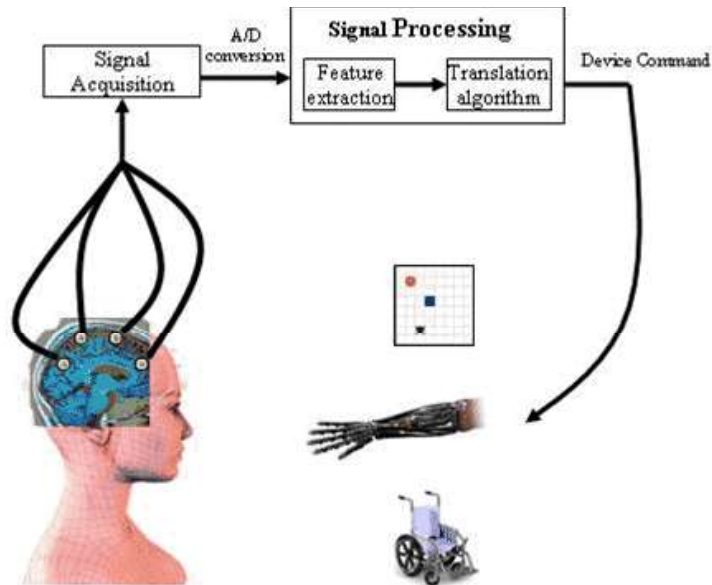
- Smart Drugs
- Smart Diagnostics
- **Smart Medical Gadget**
- Smart Medical Service

# Telemedicine & Vending machine

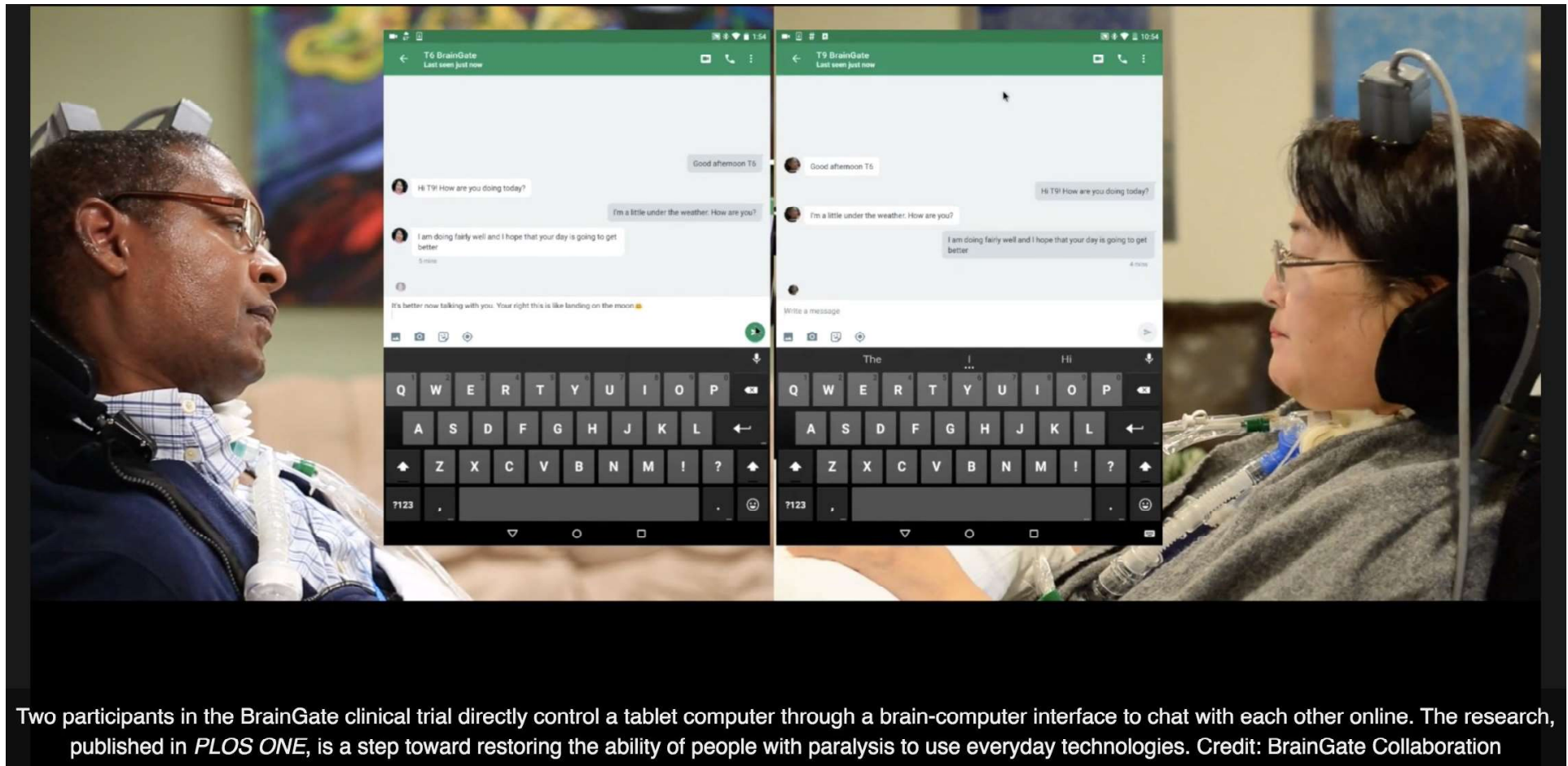


- Smart Drugs
- Smart Diagnostics
- **Smart Medical Gadget**
- Smart Medical Service

# Brain-Computer Interface



# Brain-Computer Interface

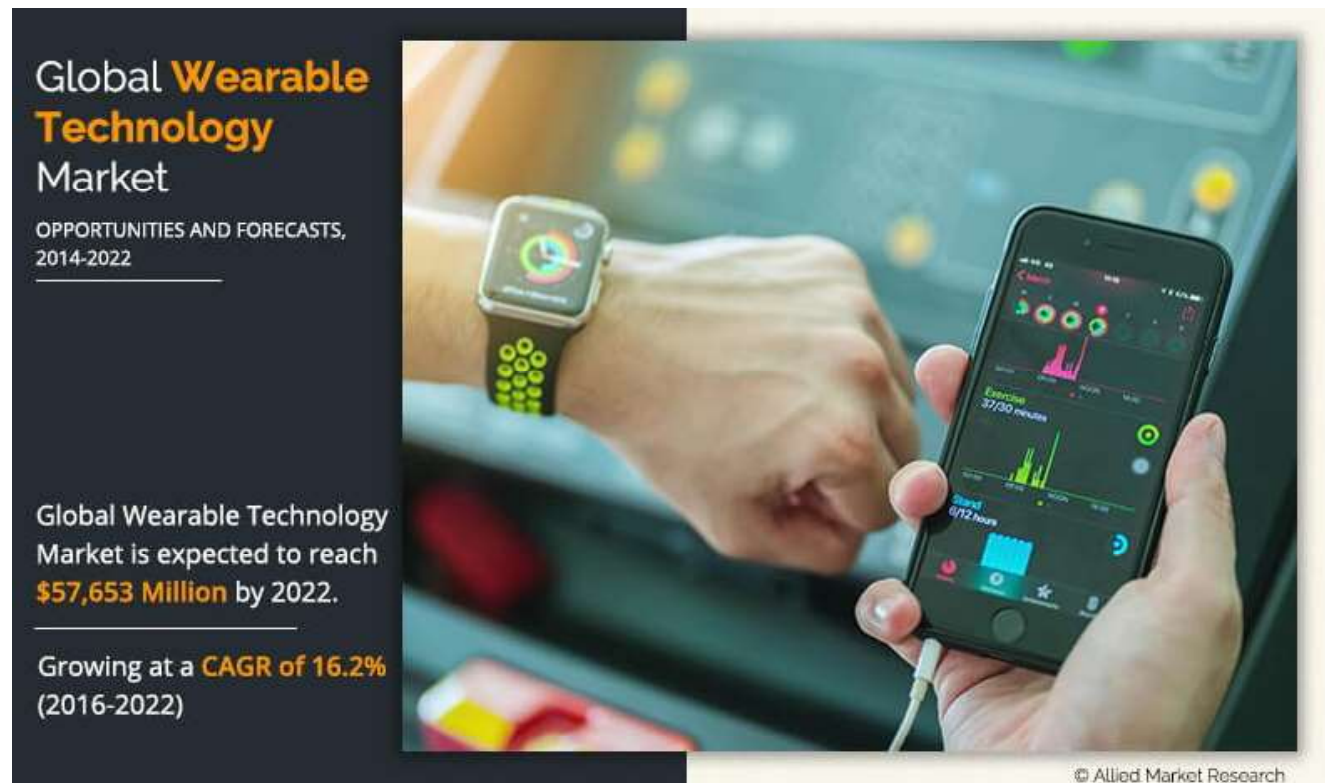


Two participants in the BrainGate clinical trial directly control a tablet computer through a brain-computer interface to chat with each other online. The research, published in *PLOS ONE*, is a step toward restoring the ability of people with paralysis to use everyday technologies. Credit: BrainGate Collaboration

<https://techxplora.com/news/2018-11-brain-computer-interface-enables-people-paralysis.html>

- Smart Drugs
- Smart Diagnostics
- **Smart Medical Gadget**
- Smart Medical Service

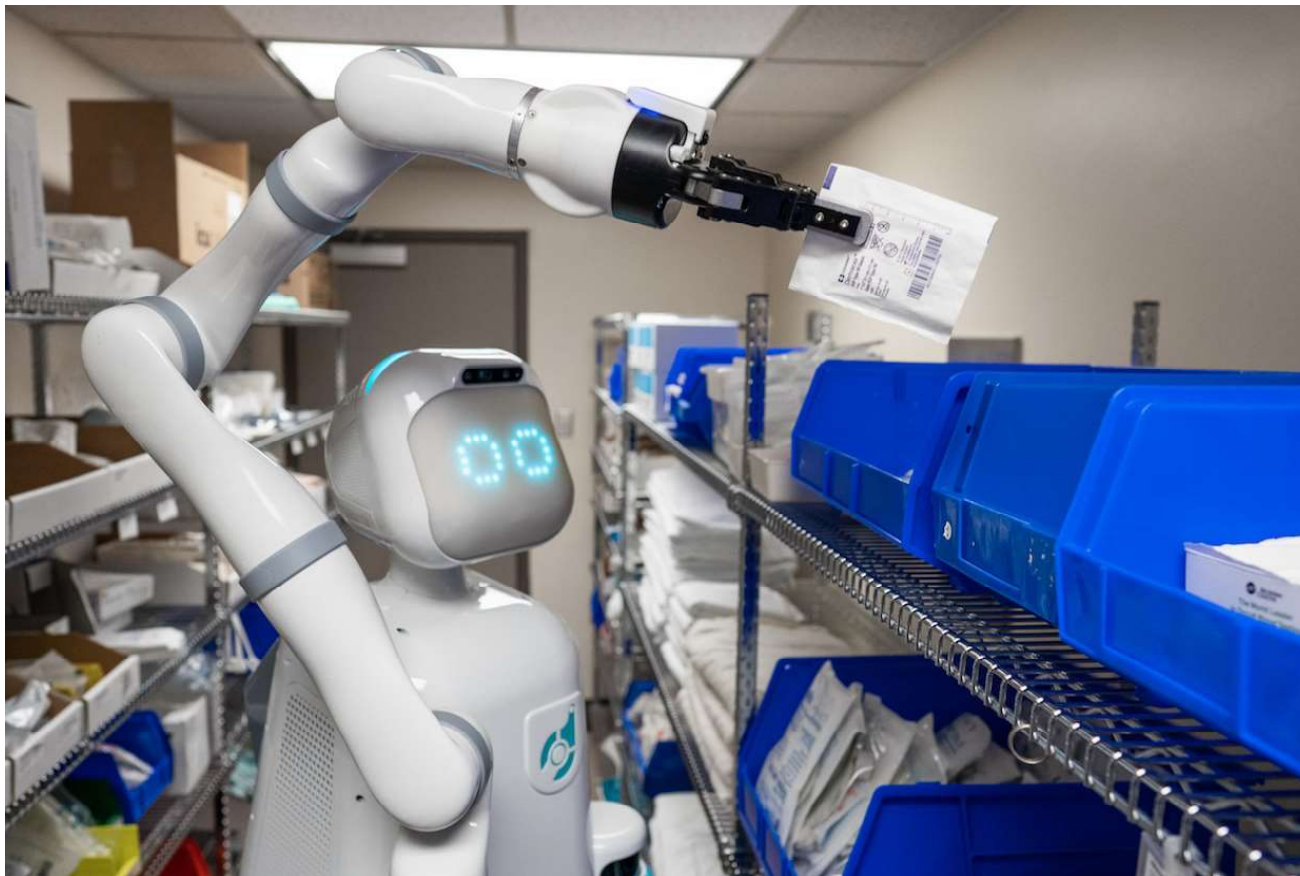
## Wearable devices : Internet of Medical Thing (IoMT)



IoMT

- Smart Drugs
- Smart Diagnostics
- Smart Medical Gadget
- **Smart Medical Service**

# Diligent Robotics



FROM: <https://spectrum.ieee.org/automaton/robotics/medical-robots/how-diligents-robots-are-making-a-difference-in-texas-hospitals>

- Smart Drugs
- Smart Diagnostics
- Smart Medical Gadget
- **Smart Medical Service**

## Diligent Robotics in Texas Hospitals



ABB's YuMi the Next Generation of Collaborative Robot



Moxi, in hospitals in Texas

- Smart Drugs
- Smart Diagnostics
- Smart Medical Gadget
- Smart Medical Service

# Artificial Intelligence (AI) in medicine

## 9 Applications of AI in medicine:

- Online doctor
- AI-based surgical assistance
- Nurse robotics
- Body Scanning
- Receptionist & Admin support
- Health monitoring
- Medical record manager
- Drug manager and creator
- Clinical judgement tool



SOURCE: <https://medicalfuturist.com/top-ai-algorithms-healthcare/>

- Smart Drugs
- Smart Diagnostics
- Smart Medical Gadget
- **Smart Medical Service**

# Augmented Reality (AR) in Medical Education

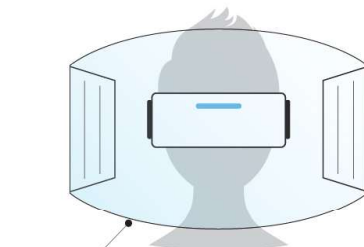
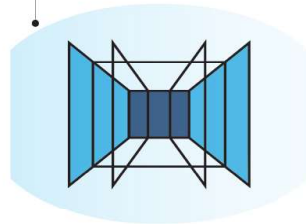
Project  
**Esper**  
An augmented reality project by  
**3D**<sub>4</sub>MEDICAL

- Smart Drugs
- Smart Diagnostics
- Smart Medical Gadget
- **Smart Medical Service**

# Virtual Reality/Augmented Reality/Merged Reality

## VIRTUAL REALITY (VR)

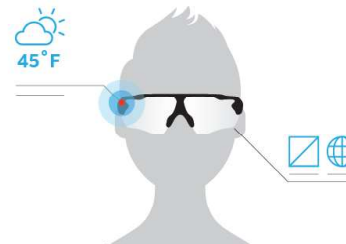
Completely digital environment



Fully enclosed, synthetic experience with no sense of the real world.

## AUGMENTED REALITY (AR)

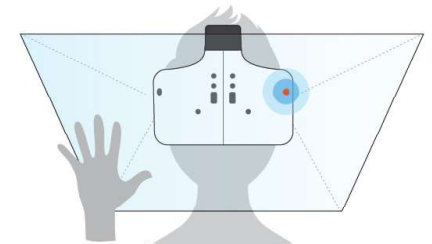
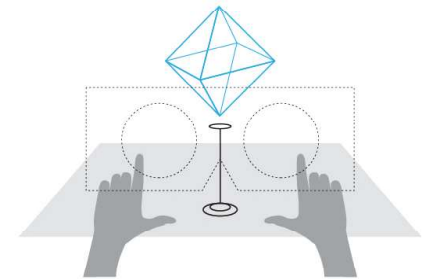
Real world with digital information overlay



Real world remains central to the experience, enhanced by virtual details.

## MERGED REALITY (MR)

Real and the virtual are intertwined



Interaction with and manipulation of both the physical and virtual environment.

Source: [https://img.online-station.net/\\_content/2018/1004/gallery/1538651339.jpg](https://img.online-station.net/_content/2018/1004/gallery/1538651339.jpg)

# Medicine in the 20th Century



rition

Hearing Loss

Diabetes

Arthritis

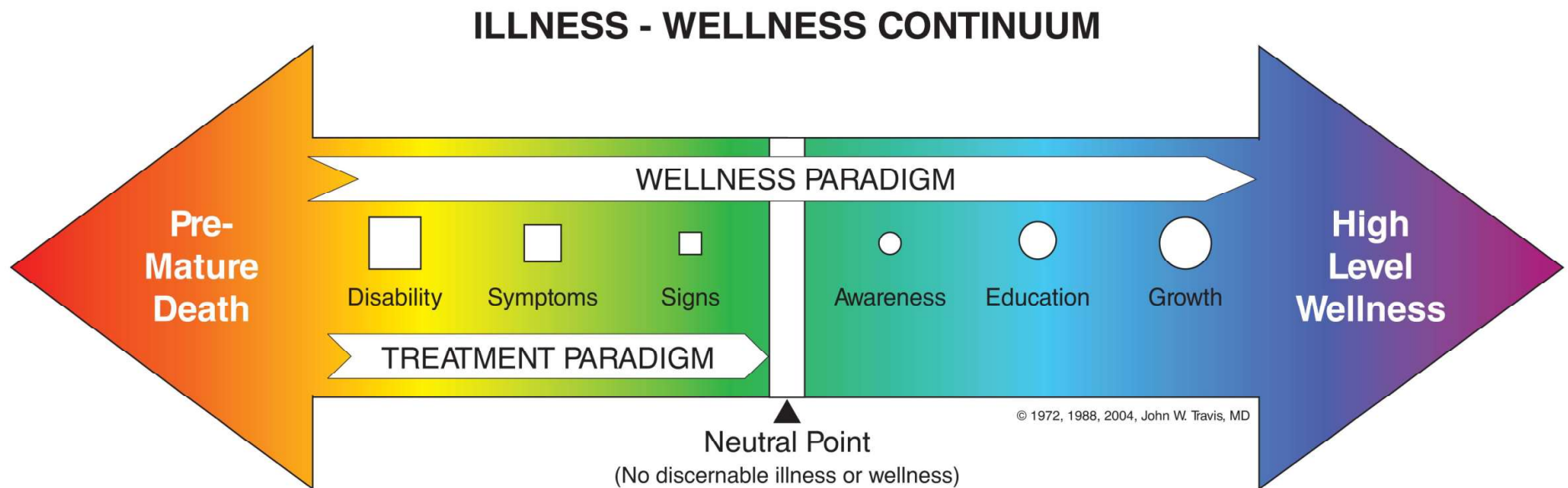
Alzheimer  
Parkinson

Cancer

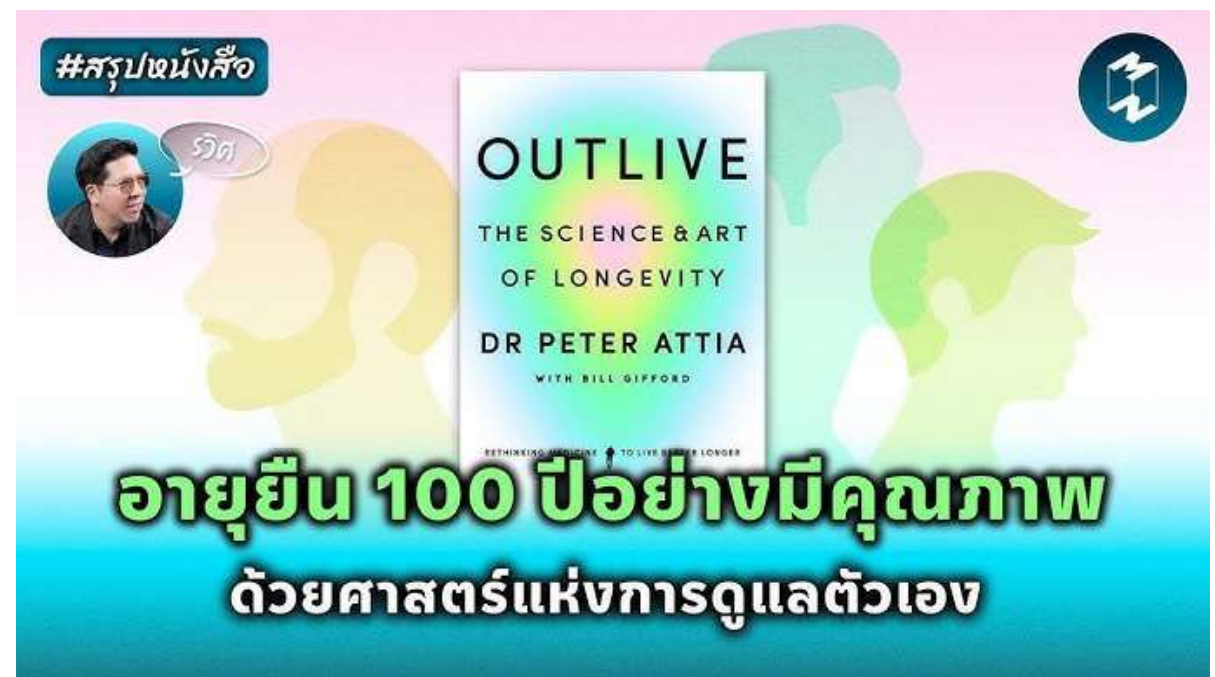
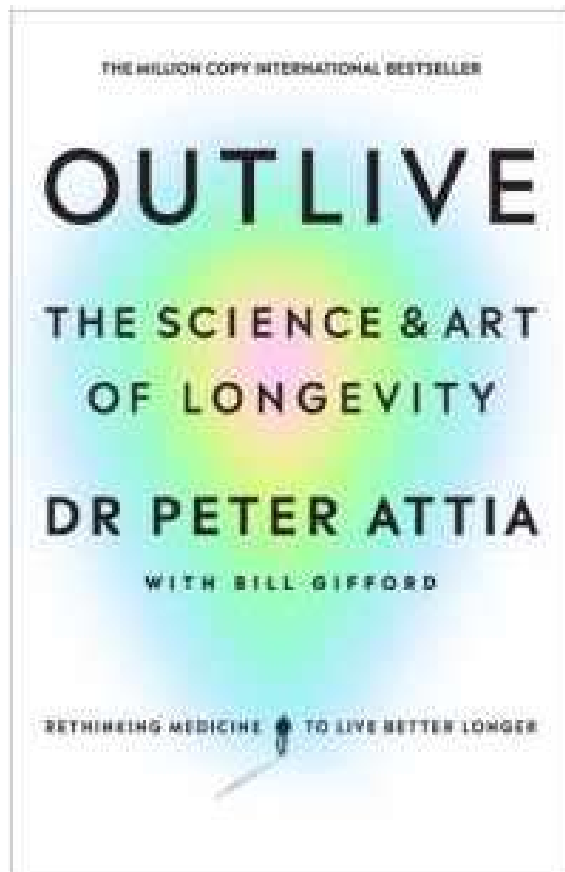
Heart Disease  
and Stroke



# Medicine in the 21st Century

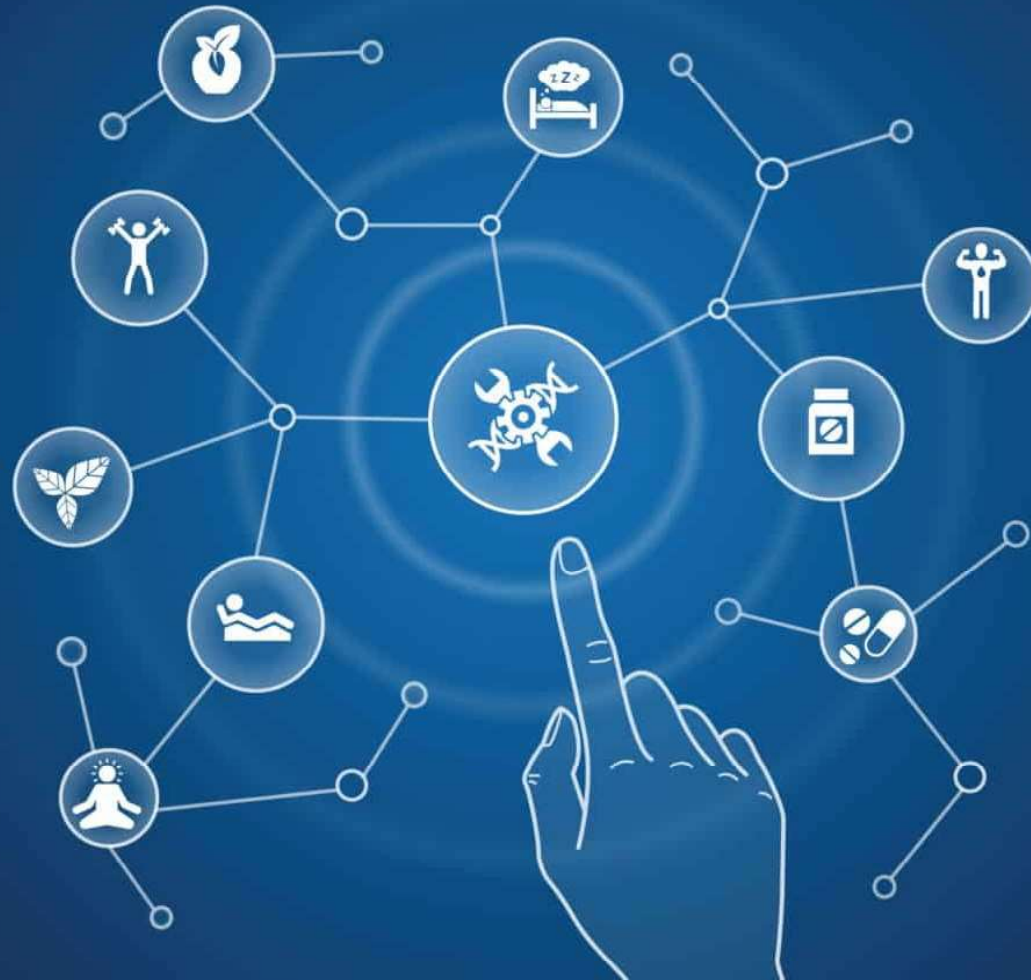


# Outlive: The Science & Art of Longevity

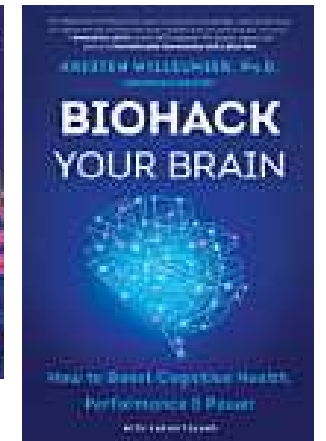
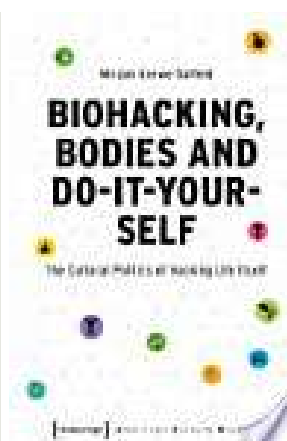
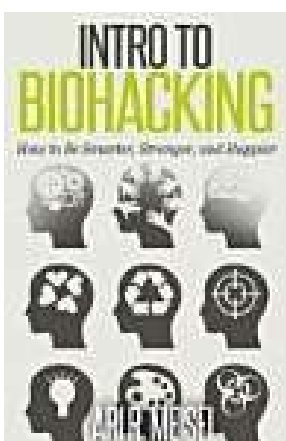
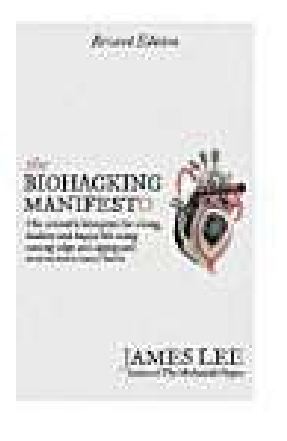
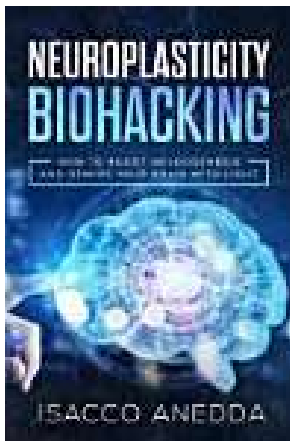
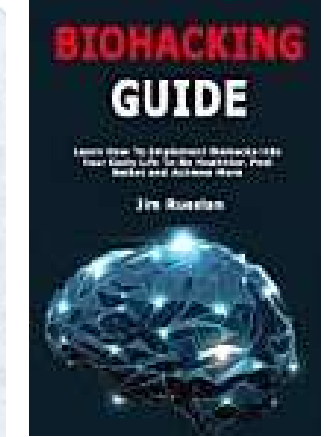
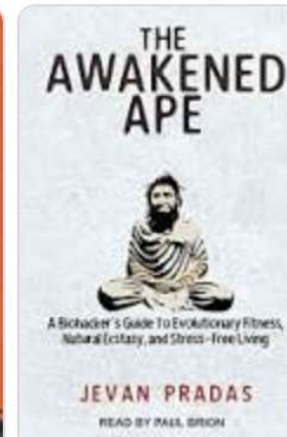
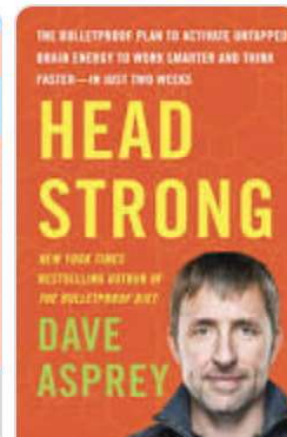
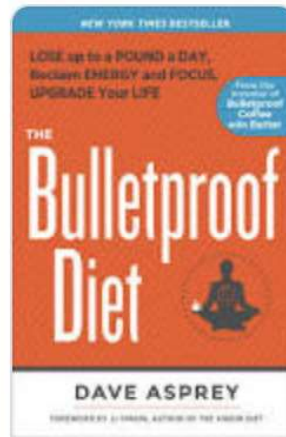
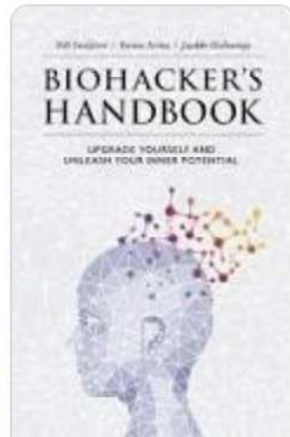


<https://www.youtube.com/watch?v=qeoE0lau4BE>

# BIOHACKING



# Reverse Aging : Biohacking Your Life



เหตุแห่งความชราระดับ เซลล์ 9 ประการ  
9 hallmarks of aging:

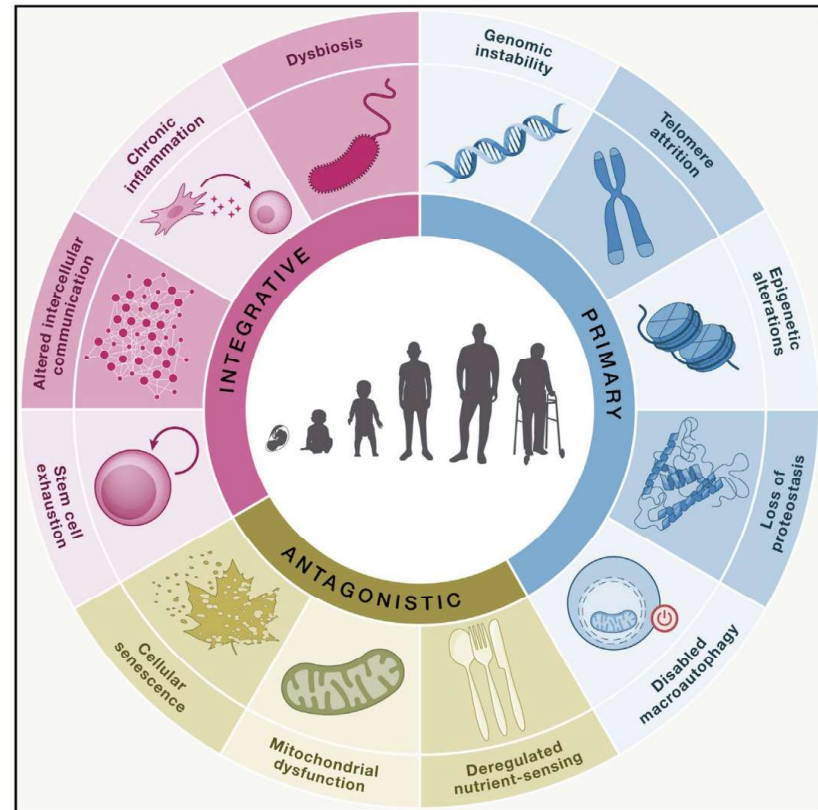
- 1. การสูญเสียเสถียรภาพของจีโนม
- 2. การสีกกร่อนหรือการหดสั้นลงของเทโลเมียร์
- 3. การเปลี่ยนแปลงของภาวะเหนือพันธุกรรม (epigenetic)
- 4. การขาดภาวะสมดุลของโปรตีน
- 5. การลดลงหรือความผิดปกติจากเดิมของ nutrient-sensing
- 6. การเสื่อมสภาพการทำงานของไมโทคอนเดรีย
- 7. การเกิดเซลล์ชราภาพ (cellular senescence)
- 8. การเกิดการลดการทำงานของสเต็มเซลล์
- 9. การเกิดการเปลี่ยนแปลงของการติดต่อสื่อสารระหว่างเซลล์



## เหตุแห่งความชรา 12 ประการ (9 + 3)

### Molecular and Biological Hallmarks of Ageing

- Genomic instability
- Telomere attrition
- Epigenetic alterations
- Loss of proteostasis
- Disabled macroautophagy
- Deregulated nutrient-sensing
- Mitochondrial dysfunction
- Cellular senescence
- Stem cell exhaustion
- **Altered intercellular communication**
- **Chronic inflammation**
- **Dysbiosis**





## Development of CRISPR/Cas9 method for genome editing receives Nobel Prize in Chemistry 2020

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Using the genetic scissors, researchers can edit the genome of practically all living things



© Nobel Prize Outreach. Photo: Bernhard Ludewig  
**Emmanuelle Charpentier**  
Prize share: 1/2



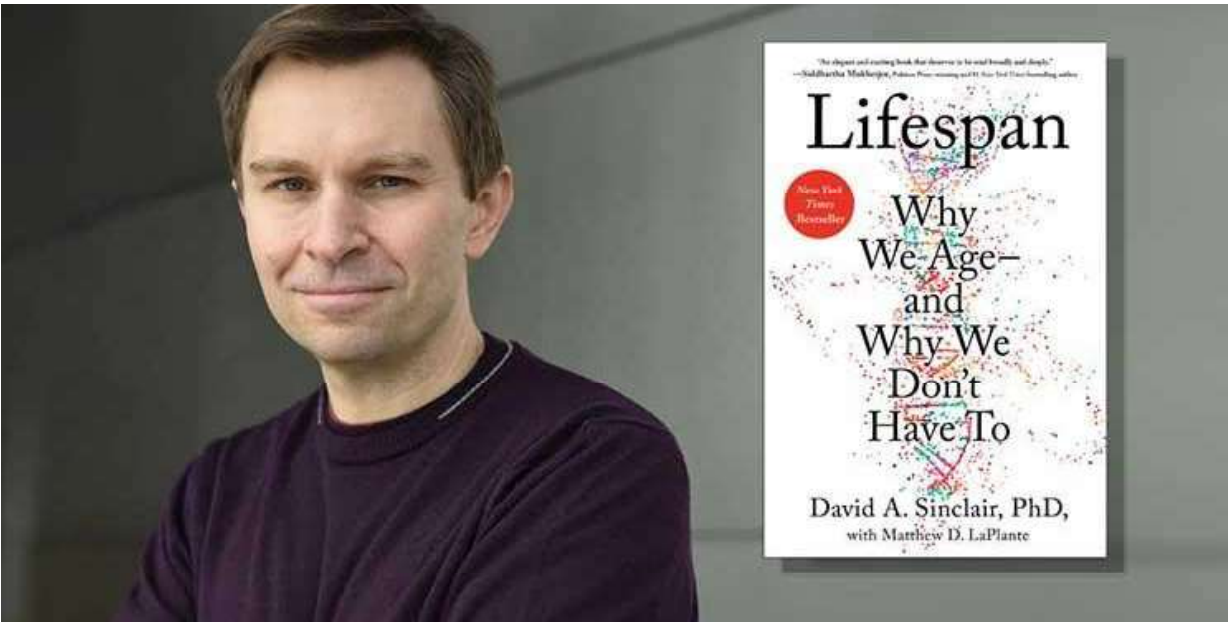
© Nobel Prize Outreach. Photo: Brittany Hosea-Small  
**Jennifer A. Doudna**  
Prize share: 1/2

<https://www.nobelprize.org/prizes/chemistry/2020/popular-information/>

# “Loss of epigenetic information as a cause of mammalian aging”

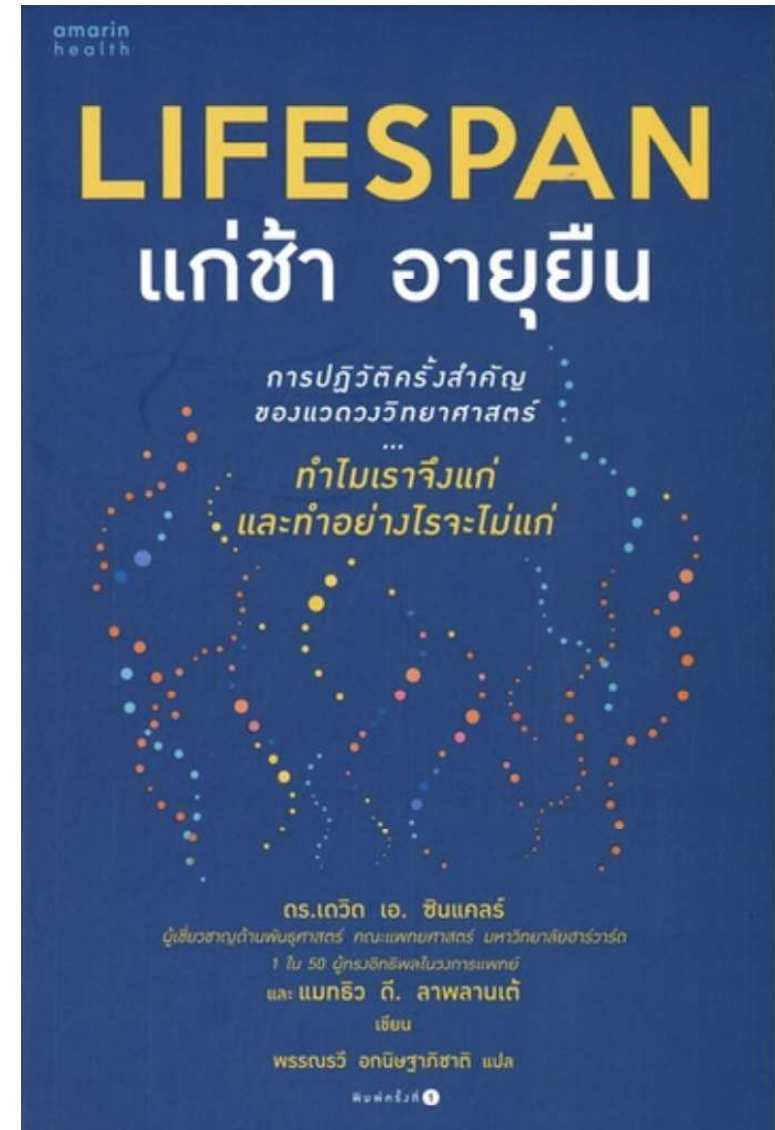


# ศาสตราจารย์ ดร. เดวิด ซินแคลร์

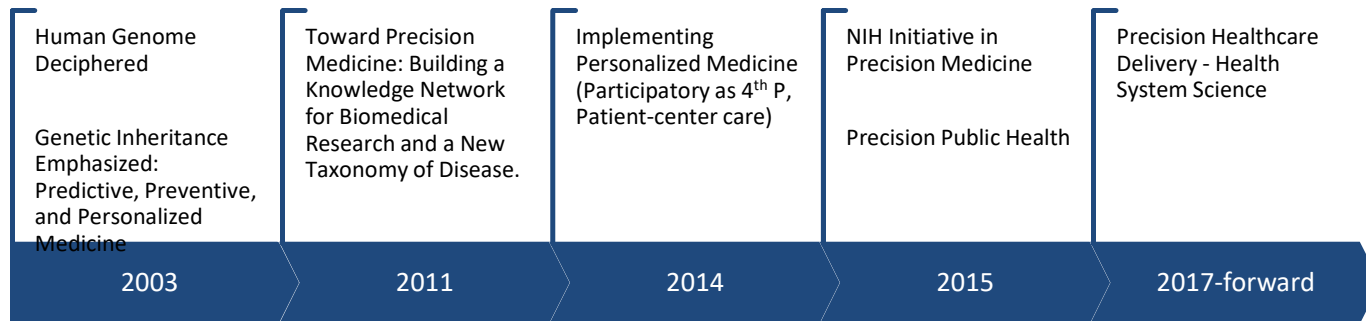


Prof. David A. Sinclair, Ph.D.

- A professor of genetics at Harvard Medical School
- A leading innovator of his generation
- Named by *Time* as “one of the 100 most influential people in the world”



# Healthy Longevity: Summary



**An easy way to embrace healthspan is to remember the 5 Fs:**

**Family**

**Fitness**

**Food**

**Fun**

**Finances**