



台灣健康產業發展新方向

兼論基因編輯與幹細胞應用

Prof. Chung-Liang Chien (錢宗良)
College of Medicine, National Taiwan University
Institute for Biotechnology and Medicine Industry

現職：

國立臺灣大學醫學院解剖學暨細胞生物學研究所教授
社團法人國家生技醫療產業策進會執行長



學歷：

臺灣大學動物學系學士 (1980-1984)
臺灣大學醫學院解剖學研究所碩士 (1986-1989)
美國哥倫比亞大學醫學院病理學博士 (1989-1995)

經歷：

日本東京大學醫學院客座研究員 (1999)
臺灣大學醫學院學生事務分處主任 (2008-2014)
臺灣大學醫學院國際事務中心主任 (2009- 2012)
臺灣大學醫學院副院長 (2011- 2014)
中華民國解剖學會理事長 (2010- 2014)
臺灣幹細胞學會理事長 (2013-2017)
行政院科技會報辦公室副執行秘書 (2012-2014)
國光生物科技股份有限公司監察人(公股代表) (2012-2014)
亞太經合會生命科學創新論壇(APEC-LSIF)委員會委員(2013-2016)
行政院科技部政務次長 (2014-2016)



社團法人國家生技醫療產業策進會 (IBMI)

Established Year: 2002

·Board of Members: Government Officials/ Leaders from Academia and Medical Centers/ Industrialist



Founded by the former president of the Legislative Yuan of Taiwan, Mr Jin-Pyng Wang, IBMI is an independent, not-for-profit organization voicing Taiwan-based health care industry, promoting interdisciplinary collaborations through its global platform, and creating policy dialogues between public and private sectors. On top of that, IBMI is also a trusted awarding and certification body to health care providers and an incubator to health care startups in areas of novel technologies, services and innovations.



Founder
Jin-Pyng Wang

Former president of
the Legislative Yuan,
Taiwan



President
Chi-Huey Wong

Scripps Family
Chair Professor of
the Scripps Research
Institute



Vice President
Barry Lam

Chairman & CEO
Quanta Group



Vice President
Pan-Chyr Yang

Academician of
Academia Sinica



Vice President
Chang-Hai Tsai

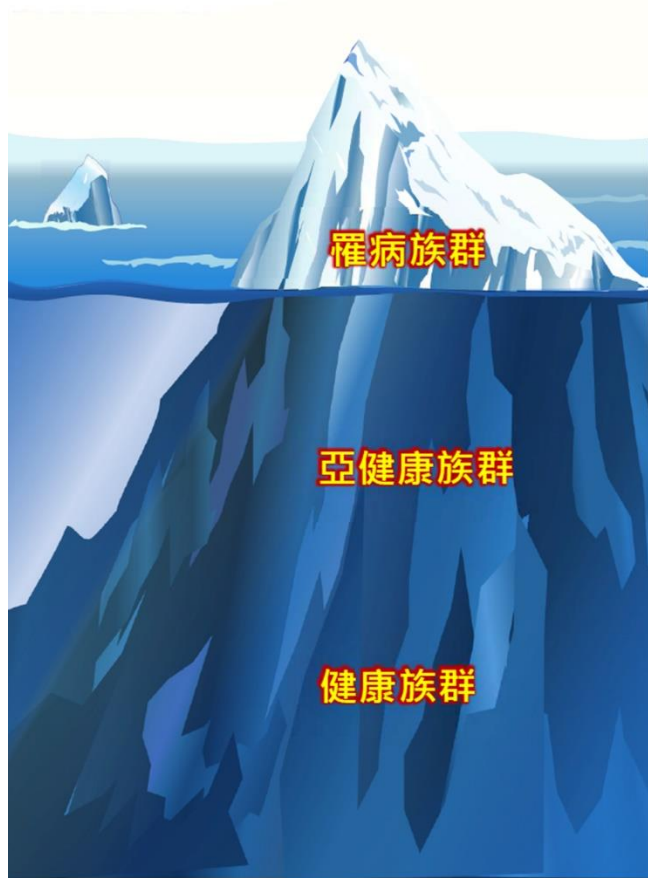
Chairman of the
Board of China
Medical University &
Health Care System



Supervisor
Wei-Jao Chen

Professor Emeritus,
Department of
Surgery, National
Taiwan University
College of Medicine

精準醫學與精準健康： 誰是未來大健康產業的藍海？



罹病族群

亞健康族群

健康族群

Precision Medicine 精準醫學

精準診斷: NGS 基因定序、液體活檢、AI 輔助
診療、POC 檢測、數位影像設備等

精準治療: 標靶藥物、細胞治療、免疫治療、
粒子治療、手術機器人等

醫療照護: 智慧醫院、智慧病房、智慧照護等

Precision Health 精準健康

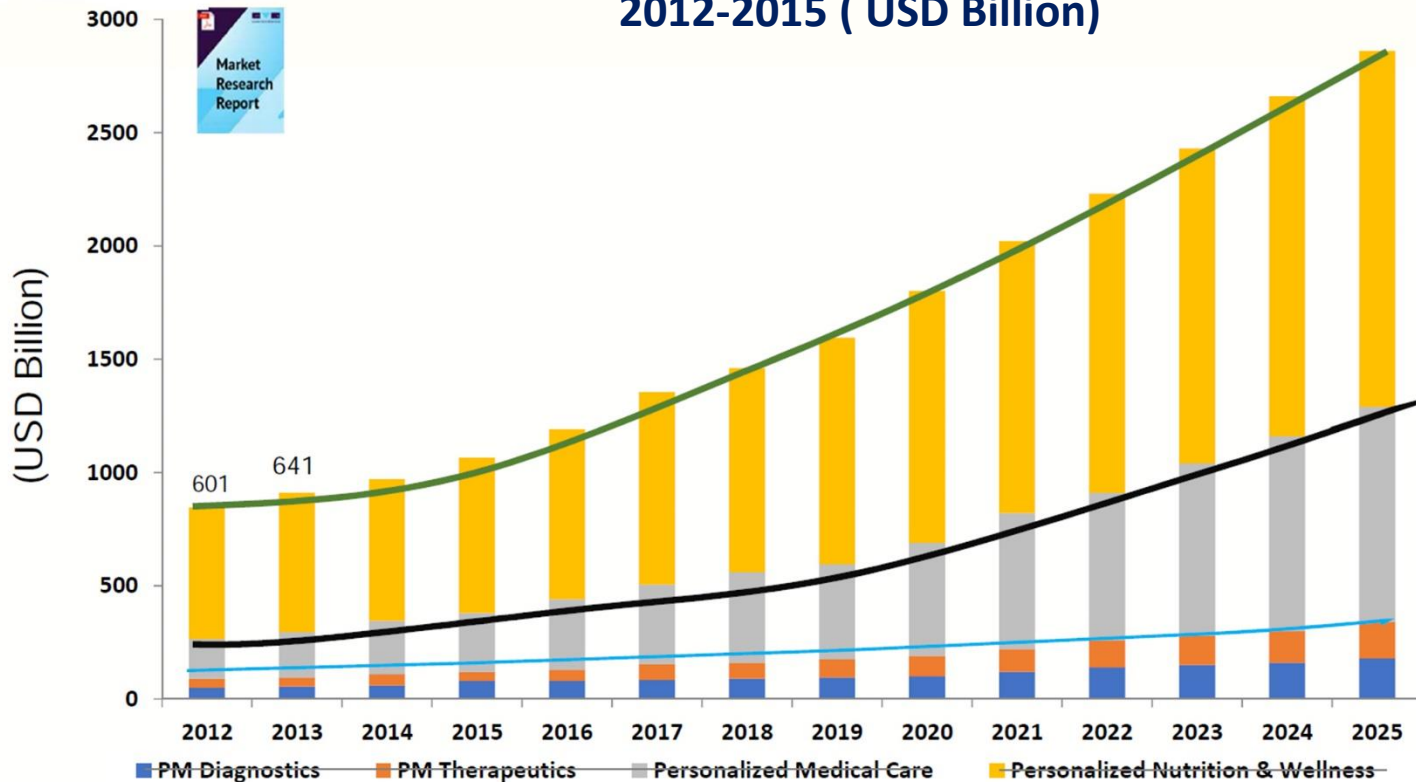
風險評估: 風險基因、行為模式、家族病史

精準篩檢: 精準個人化健檢、AI 輔助早期檢測、
居家篩檢、智慧遠距諮詢等

健康促進: 生活習慣、環境調適、個人化飲食、
營養和運動、腸道菌相、居家及穿戴
式健康管理裝置等

Global Precision Healthcare Market 精準健康產業之市場預測

2012-2015 (USD Billion)



精準醫療

健康福祉

Advantages of Taiwan Medicine



Outstanding Healthcare Insurance System

- ❖ 99.6 % of Taiwan's 23.57 million people covered under the government-run National Health Insurance (NHI)
- ❖ Good accessibility-The NHI has a very high approval rate among Taiwanese people



High Quality Healthcare Services

- ❖ Out of 200 of the largest hospitals in the world, 14 are in Taiwan.
- ❖ Taiwan ranks third, just after the USA and Germany, in terms of medical service quality.
- ❖ shorter wait times for beds in large hospitals and medical centers



World-class Health Database

- ❖ National Health Insurance Research Database has been collected for more than 25 years (Since 1995).
- ❖ Medical centers with complete medical record and imaging data

Advantages of Taiwan ICT industry



Most concentrated industry clusters

- ❖ World's densest and most technologically advanced semiconductor production base.
- ❖ The Major Procurement Center for Global ICT Companies & Buyers



Strong ICT manufacturing capabilities

- ❖ **Rich manufacturing experience and outstanding technologies**
- ❖ The heart of the world's tech supply chain, offering high-quality products from IC design, semiconductor, to electronics.



Rapid Commercialization

- ❖ Ranked 1st in Worldwide Major ICT product market share for more than 10 products
- ❖ **High levels of hardware/software integration capability for flexible production and rapid commercialization**

Taiwan's ICT Sector in Healthcare

Precision Healthcare Industry

	Mobile health	Medical equipment	Smart hospital	Gene/cell therapy	Biomedicine	
Companies						
Product pipelines	<ul style="list-style-type: none"> ■ Tele-healthcare ■ IoT solutions ■ Wearables ■ Health management 	<ul style="list-style-type: none"> ■ X ray/ultrasound ■ Micro CT ■ Surgical robots ■ Capsule endoscopy ■ Hemodialyzer ■ Pathology/AI Image ■ Vital sign monitor 	<ul style="list-style-type: none"> ■ Smart ward/operating room ■ Surgical VR ■ AI solution ■ HMS ■ EMR / EHR ■ Medical display 	<ul style="list-style-type: none"> ■ DNA sequencer ■ DNA microarray ■ Protein & genetic testing ■ CTC system ■ Cellular therapy 	<ul style="list-style-type: none"> ■ AI chip ■ Biochip for gene sequencing ■ RF & Wireless chip ■ Biosensor ■ Display component ■ Organic semiconductor 	
Areas of application						

產業掌握翻轉醫療與健康科技的關鍵技術



Taiwan's Leading ICT Players are actively diversifying businesses into healthcare Industry.



Smart Hospital, Medical Robot, AI/ IoT Solutions, Imaging, Diagnostics, Home care & rehabilitation, Gene Sequencing, Cell Therapy, etc.



No. 24 of Fortune Global 500
No. 1 of EMS Providers Global



No. 432 of Fortune Global 500
No. 5 of EMS Providers Global



Top 10 Electronic ODM Global
Top 3 manufacturers of TFT-LCD



Quanta Computer
No. 354 of Fortune Global 500



No. 404 of Fortune Global 500
No. 1 of NB manufacturer Global



One of leading Industrial
Computer Providers Global



Top 3 Manufacturers of
AMD Graphics Cards



One of Leading EMS-ODM
Manufacturers Global



No. 5 of Best Laptop Brands 2018



No. 4 of PC manufacturer Global
No. 4 of Best Laptop Brands
2018



Top 3 DLP Projector
Manufacturer
One of Leading LCD Backlight
Module Manufacturers Global



One of Leading Smartphone
Brands Global



Top 3 ODD manufacturers
Top 10 EMS Providers Global



World's leading smartphone
camera lens supplier



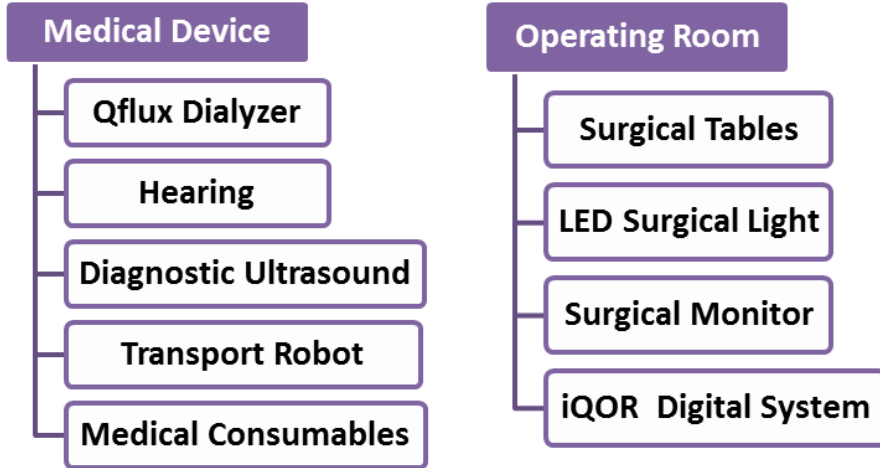
One of leader in power and
thermal management solutions
in the world



中華電信
Chunghwa Telecom

One of the Largest
Telecommunications Services
Taiwan

Featured Products



Solutions

Smart Operation Room



ODM / OEM of Medical Device

Other Smart Healthcare Solutions

Fitness System

Smart Wearables

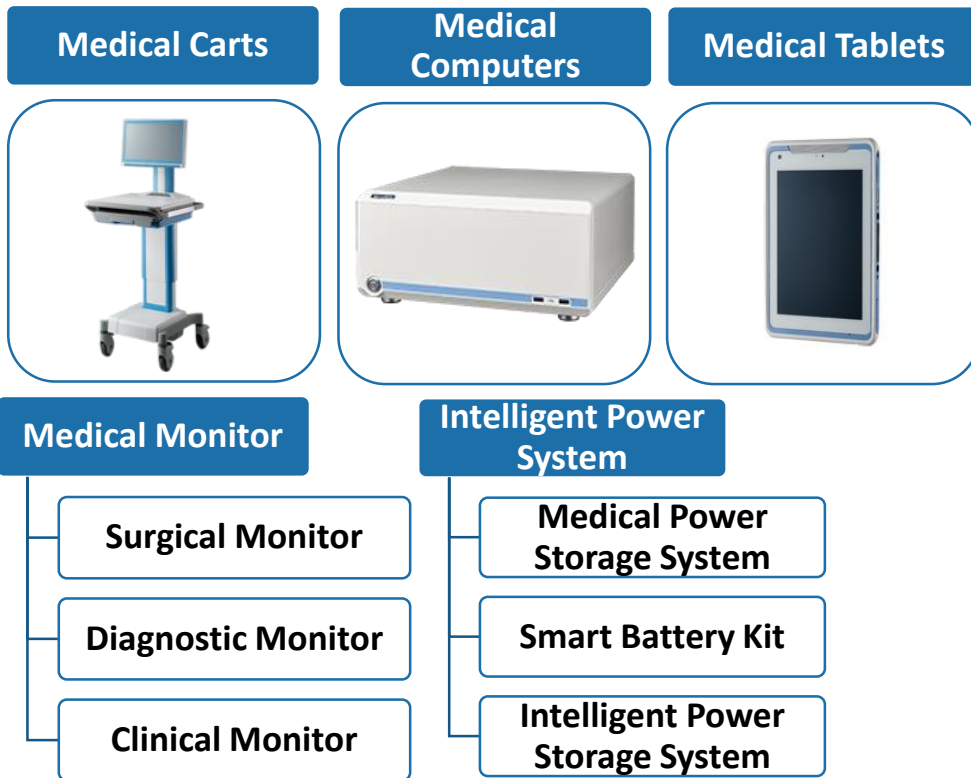
Smart Ward

Health Management System

Long-Term Care Monitoring Solution

Smart Hospital Solutions

Featured Products



Medical Workstation

Smart Ward

Smart Clinic

Smart Nurse Station

Medication Administration

Telehealth Applications

Taiwan leading hospitals are expanding their productivity from building smart hospital...



彰化基督教醫院
CHANGHUA CHRISTIAN HOSPITAL



員林基督教醫院
Yuanlin Christian Hospital



U.S. Green Building Council
LEED Gold Level Certification on
Dec, 2015

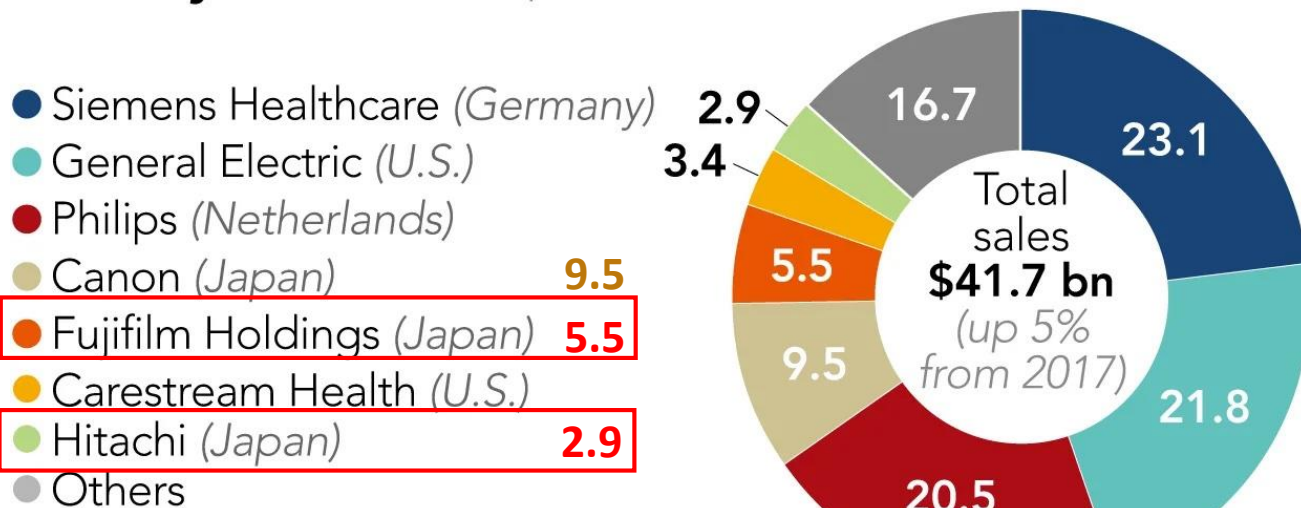


ICT Players launch
products and solutions:

- ◆ Smart Nurse Station
- ◆ Smart Ward
- ◆ Smart Clinic
- ◆ Smart Counter
- ◆ Smart Dialysis
- ◆ Smart Operation Room
- ◆ Multimedia interaction
- ◆ Accompany robot
- ◆ Logistics Management



Diagnostic imaging equipment global market share by sales (2018, in percent)

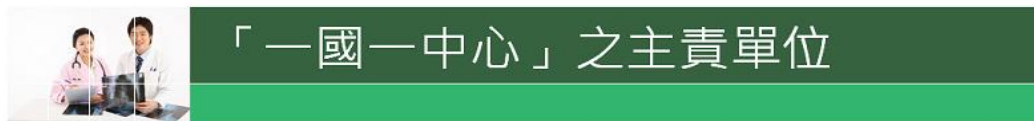


Source: Evaluate **8.4 + 9.5 = 17.9 (Japan)**

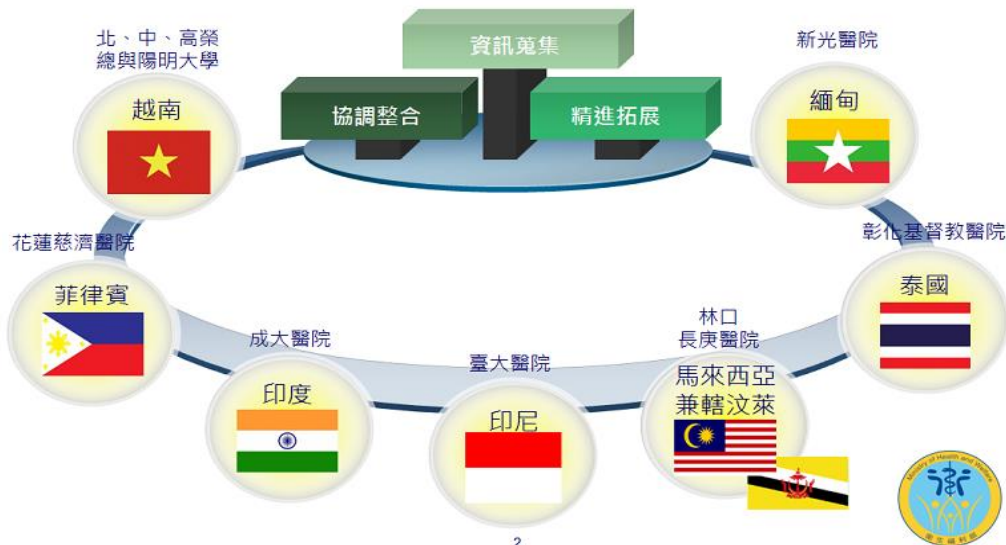
2月18日，富士表示：「兩家企業合併後，會將各自影像處理和人工智慧軟體和日立超音波、MRI 結合，**打包販售給醫療機構**。」 **To provide the total solution!**

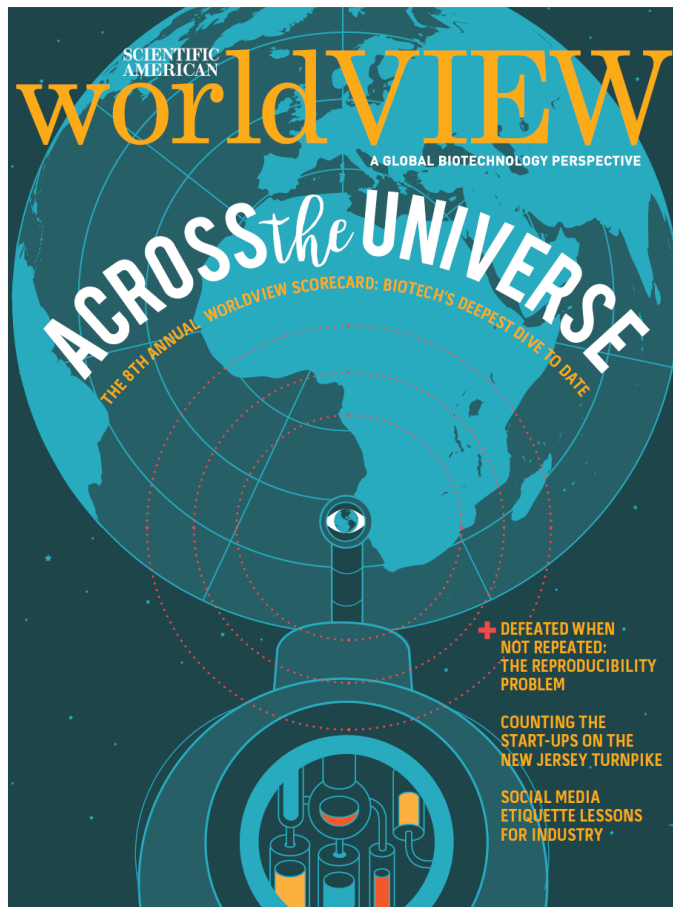
- ❑ Taiwan has become the most important exporting Smart Hospital Solution country in Asia.
- ❑ Offer total solutions to assist Asia countries to build smart hospitals or improve hospital management effectiveness.

- Thailand (彰基)
- Malaysia (長庚)
- India (成大)
- Vietnam (榮總)
- Indonesia (台大)
- Philippine (慈濟)



透過委託具醫學中心量能之機構，在當地執行一國一中心計畫。

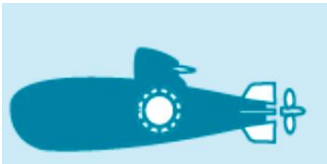




2016 & 2020 Scientific American

WORLDVIEW SCORECARD

-  PRODUCTIVITY
-  IP PROTECTION
-  INTENSITY
-  ENTERPRISE SUPPORT
-  EDUCATION/WORKFORCE
-  FOUNDATIONS
-  POLICY & STABILITY



Enhanced with a new guidebook and region-specific ratings, the 2016 Scorecard ventures deeper than ever to track down the latest in biotech innovation

Taiwan,

Country Rank
23 / 54

2020

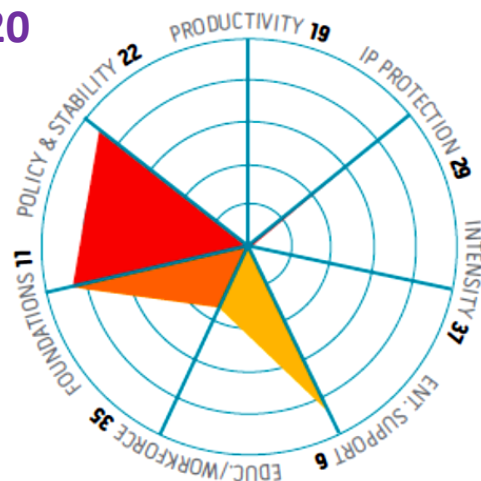
SAWV SC rank: 23

Population: 23,359,928

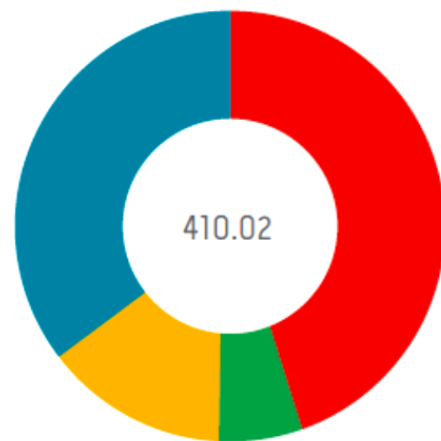
GDP: 489

R&D/GDP: 0

With an overall average of 22.4 on the SC, Taiwan's ranking of 23rd in 2016 is just about on par, and it performs even better on the *Nature Index 2015 Global*, with an 18th place overall ranking and its National Taiwan University landing in the top 100. Moreover, Taiwan advertises its biotechnology capabilities through international events, including BioTaiwan 2016. This will be the 14th annual event, and it will include presentations from companies around the world, as well as one-on-one partnering, seminars and workshops. A large exhibition is also expected, including more than 1,200 booths from 600 companies. On



August 20, 2015, *Taiwan Today* reported, "A wide-ranging development plan targeting Taiwan's biotechnology-based economy is set to kick off next year, according to Premier Mao Chi-kuo." The report continued: "Focusing on agriculture, biomedicine, food, health care and medical instruments, the 10 year initiative will potentially expand the scale of the local bioeconomy to



NT\$4 trillion (US\$123.2 billion) in 2026." With respectable scores on the SC's Foundations and Enterprise Support categories, Taiwan's commitment to innovation is clear. Like many other countries, however, **Taiwan's Education/Workforce category** shows room for improvement.

2016 Scientific American Worldview -A Global Biotechnology Perspective

Asian Countries' Performance

Country	Global Ranking	Productivity	IP Protection	Intensity	Enterprise Support	Education/ Workforce	Foundations	Policy & Stability
Singapore	2	---	8.3	3.8	9.2	4.5	6.6	9.6
Hong Kong	11	0.0	7.1	1.6	8.6	1.6	6.7	9.0
Japan	15	0.1	9.2	0.6	4.5	3.6	7.9	8.0
Taiwan (Score/Rank)	23	0.0/19	5.8/29	0.1/37	7.0/6	2.6/35	6.9/11	7.2/22
South Korea	24	---	5.6	0.6	4.8	3.9	8.3	6.3
Malaysia	27	---	5.5	1.1	8.0	2.1	4.9	5.9
China	41	0.1	4.7	0.6	4.5	1.3	4.0	2.9
Thailand	45	---	2.3	3.0	3.4	2.7	3.0	1.8
India	49	0.0	4.3	0.8	3.5	0.2	1.6	2.0

Source: 2016 Scientific American Worldview



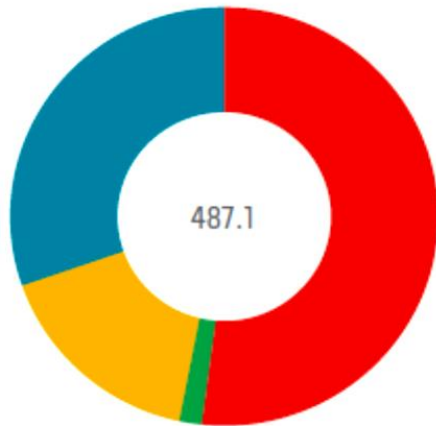
Singapore

SAWV SC rank: 2
 Population: 5,567,301
 GDP: 298
 R&D/GDP: 2

Singapore can boast a top 10 finish throughout the SC's history, and a top five finish in every year except 2011. It also scores well on other measurements: 15th for output in the *Nature Index 2015 Global*, with more than half of the publications in chemistry; and fifth on the 2015 BCI index, which stated: "Singapore has relatively strong

capabilities in R&D and manufacturing, with most of the necessary regulatory frameworks and safeguards in place and in line with international best practices." In part, ongoing investment in science and technology explains Singapore's high ranking. On January 12, 2016, for example, *ScienceInsider* reported, "The government of Singapore has announced that it plans to spend [US\$13.2 billion] on research and development between 2016 and 2020." In addition, the National University of Singapore opened a US\$25 million synthetic biology center on September 30, 2015. Other news reveals the allure of Singapore as an international leader in science. For instance, Rockefeller University plant molecular biologist Nam-Hai Chua announced plans to move his research—exploring plant RNA's impact on drought tolerance—to Singapore's Temasek Life Sciences Laboratory. Indeed, Singapore is a go-to country for biotechnology research, as well as for R&D in general.

Country Rank
 2 / 54
 2020



In part, ongoing investment in science and technology explains Singapore's high ranking.

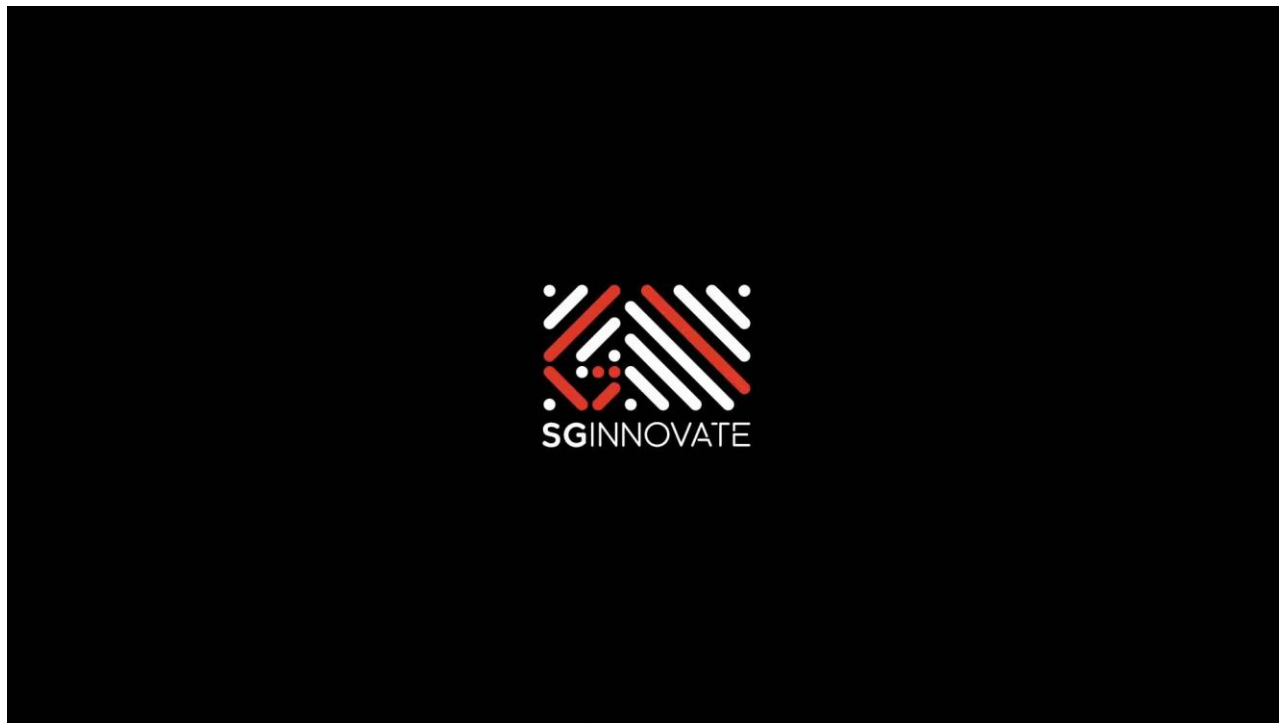
The top-ranked countries in *Government effectiveness* are [Singapore](#), [Switzerland](#), and [Finland](#).

新加坡：非常積極推動生技產業國際鏈結，已成功扮演亞太地區領頭羊的角色。針對國際華人健康市場之拓展，臺灣是可以嘗試與新加坡合作，創造雙贏的機會。

The top-ranked countries in *Regulatory quality* are [Singapore](#), [Australia](#), [Canada](#), [Finland](#), [Hong Kong](#), [New Zealand](#), and the [United Kingdom](#). Source data from *Scientific American Worldview* (<http://www.saworldview.com>)



2019年5月23日新加坡
Medtech Connect 論壇



SGInnovate interview: <https://youtu.be/3ktQSyfe7n0>

Thailand

Country Rank

45 / 54

SAVV SC rank: 45

Population: 67,741,401

2020

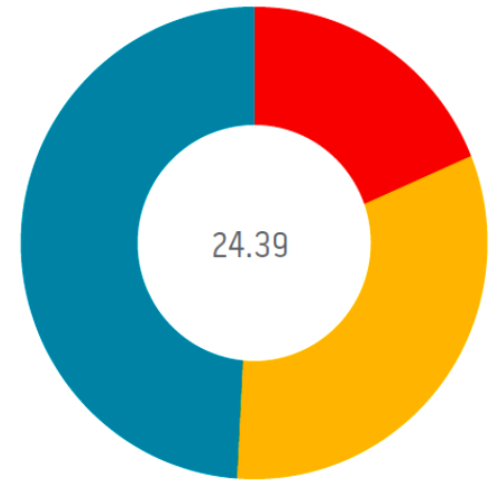
GDP: 387

R&D/GDP: 0.39

Between 2014 and 2016, Thailand bounced around the 40s in the SC rankings—from low to high and back to the mid-40s. Even so, this is a far better showing than its bottom-of-the-list performance in 2013. Similarly, Thailand ranked 42nd on the *Nature Index 2015 Global*. On the plus side, its National Biotechnology Policy Framework aims to push the country much higher as an international force in the industry. In particular, that framework seeks to improve biotechnology education and training. Among the SC categories, Thailand already performs the best in Education/Workforce, and the government's plans



could improve that capability even more. Experts are applauding Thailand's efforts so far, and express tempered optimism about its future prospects. A September 2015 USDA GAIN Report stated: "Thailand made some progress in 2015 on laying out a draft regulatory framework on adopting agricultural biotechnology. Thai biotech proponents are likely to gain more support from



policy makers in both government and parliament. However, it may take a few years to revoke a ban on biotech field trials in the country." Like many other countries that perform poorly on the SC, Thailand needs to drastically improve its IP Protection, as well as its reputation in the SC category of Policy & Stability. A strong biotechnology industry must do well in these areas.

泰國：是臺灣可與合作共同拓展國際生技產業的夥伴。特別在農業食品生技與國際醫療服務領域，或將有助營造互利共贏之機會。

The top-ranked countries in *Talent retention* are [Saudi Arabia](#), [Thailand](#), and [Chile](#).

Source data from *Scientific American Worldview* (<http://www.saworldview.com>)



2019年7月10日生策會到泰國曼谷，受泰國醫材公會邀請演講，介紹 Taiwan Healthcare Plus



2019年7月11日參加彰化基督教醫院籌劃在曼谷東協醫材展上舉辦的臺灣醫材產品說明會

India

Country Rank

49 / 54

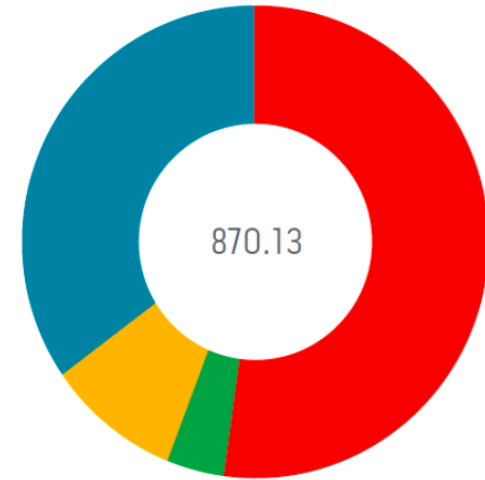
SAVV SC rank: 49

Population: 1,236,344,631 2020

GDP: 1,877

R&D/GDP: 0.82

If effort alone equated with success in biotechnology, India might top the SC and other indices. At the end of 2015, India released a new National Biotechnology Development Strategy, and some of its key goals included generating biotechnology products, increasing bio-manufacturing and producing biofuels. In fact, Shell India Markets plans to build a biofuel plant in Bangalore. Its 13th place ranking on the *Nature Index 2015 Global* suggests that some of India's efforts are paying off. Also, on January 8, 2016, an online article from *Nature Biotechnology* reported: "Most new companies emerging in the GM field are based in the United States and in Asia,



especially India, whereas public developers of the technology are appearing in India and China." Nonetheless, the 2015 BCI described India as facing a "struggling ability to compete," and noted: "India possesses the foundation and potential for becoming a hub of biopharmaceutical innovation—but currently faces several major structural barriers to moving up

from the bottom ranks in biomedical competitiveness. Local executives particularly noted the presence of major regulatory deficiencies and bottlenecks and very limited coverage of medicines, even with costs driven down. In addition, they highlighted major gaps in India's biopharmaceutical IP protection that render the system overall ineffective."

印度：在國際產業市場佈局上是不容忽視的人口大國，特別是與人密切相關的健康產業。與印度還算友善的臺灣可仿效日本模式，先投資在人才，再拓展未來廣大的市場。

India scored 0.03/10, in *Productivity* which places it 17th of the 54 countries studied. India was tied with [Finland](#) and [Ireland](#) and [Taiwan](#).

India scored 0.77/10, in *Intensity* which places it 26th of the 54 countries studied. India scored ahead of [China](#) and [Austria](#).

Source data from *Scientific American Worldview* (<http://www.saworldview.com>)



2019年5月14日 參加印度經貿訪問團在Bangalore的招商活動。並參與竹科管理局在Bangalore主辦的Taiwan-India Medical Cooperation Forum.

印度理工學院海得拉巴校區

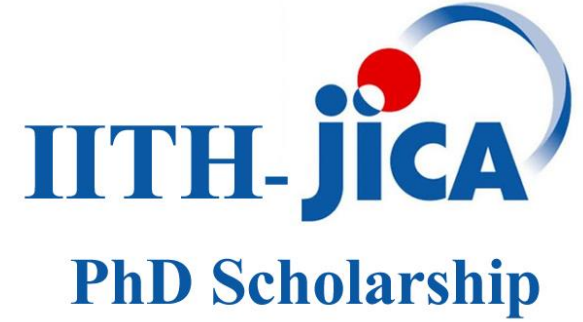
Indian Institute of Technology

Hyderabad is a public technical and research university located in Sangareddy district, Telangana, India.



भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

Japan International Cooperation Agency



Dr. Harsh Vardhan is an Indian [Otorhinolaryngologist](#) and the incumbent **Minister of Health and Family Welfare, Minister of Science and Technology** and **Minister of Earth Sciences**.

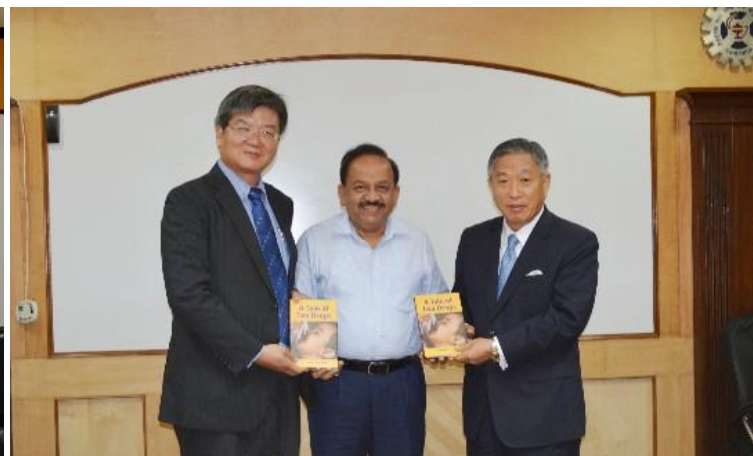
Dr. Harsh Vardhan was elected to the office of [Chairperson of Executive Board of the World Health Organization](#) from May 22, 2020.



A Tale of Two Drops



Dr. Harsh Vardhan



2015-07-20 科技部錢宗良次長及田中光大大使拜會印度科技部長 Hon. Harsh Vardhan。Hon. Vardhan部長並於會中致贈著作” A Tale of Two Drops”予錢次長及田大使。



Dr. Guljit Chaudhri Chief, Managing Director of Innonation, ABLE (Association of Biotechnology Led Enterprises)

Guljit started her career with international business, strategic alliances including joint ventures and domestic marketing of pharmaceuticals.

India: one of the observers of ICH*.

*The International Council for Harmonization of Technical Requirements for Pharmaceuticals for Human Use (ICH)



2019-05-17 拜訪 Invest Inida, 邀請 Dr. Guljit Chaudhri 來台參加 EXPO



2019-12-05 Dr. Guljit Chaudhri 來台參加Taiwan Healthcare EXPO

印度在全球仿製藥市場佔據主導地位，2017年/18年度(4-3月)藥品出口規模達到173億美元，包括對美國和歐盟的出口。其中對中國的出口僅佔1%。



2018年7月18日，中國國務院總理李克強就電影《我不是藥神》引發輿論熱議作出批示，要求有關部門加快落實抗癌藥降價保供等相關醫療改革措施。

Bring together & Link together!



2019 MEDTEX Summit Asia- Global Initiatives, Opportunities and Go-To-Market Strategies



173,705+

Visitor Counts

(1F 82,851; 4F 90,854)

Expo Recap ▶

23,600+

Professionals

2,800+

International Professionals

International Delegations



28 Industry Association



52 Hospital & Medical Institutes

1200+
Attendees

**MED
 TEX** Med x Tech Summit Asia

12

Medical Conferences

Healthcare EXPO · TAIWAN 台灣醫療科技展



106,769+



參觀人次



23,800+
國內專業人士



19,800+
國內一般民眾



30 位
國際產業協會



1,800 位
重磅會議論壇



教育部生醫產業與新農業跨領域人才培育計畫

Training Program for Interdisciplinary Talents of Biomedicine and New Agriculture

2020台灣醫療科技展-種子教師培訓說明會

針對精準醫學、智慧醫材、健康福祉、精準農業四大領域種子教師導覽培訓

種子教師將協助同學參觀展會，獲得產業見習之機會。

參與種子教師導覽之同學，將獲得主辦單位提供產業見習時數證明

歡迎各領域教師帶領同學參觀台灣醫療科技展！

培訓對象

本計畫各領域推動中心及夥伴學校計畫主持人及各校有興趣之教師

培訓時間

109.11.16 (一) 下午14:00-16:00

培訓地點

臺灣大學醫學院 101講堂 (台北市仁愛路一段一號)

種子教師報名方式 (截止日期11.06)

有完成報名者將獲得主辦單位提供
種子教師導覽手冊及VIP展會導覽證



說明會報名連結

需產業見習時數之同學請洽各校種子教師，由種子教師統一報名，以取得入場參觀證



計畫報名：893人
自由報名：463人

2020 Healthcare[®] EXPO · TAIWAN
台灣醫療科技展

全台最大 健康派對

宅健人·動健康大賽

Health x Sport x Gaming



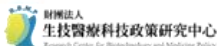
醫師聊健康 名醫黃金陣容健康解惑

健康振興券 健康黑科技最新產品

Read more



Healthcare[®] 2021.12.02-12.05 EXPO · TAIWAN 台灣醫療科技展



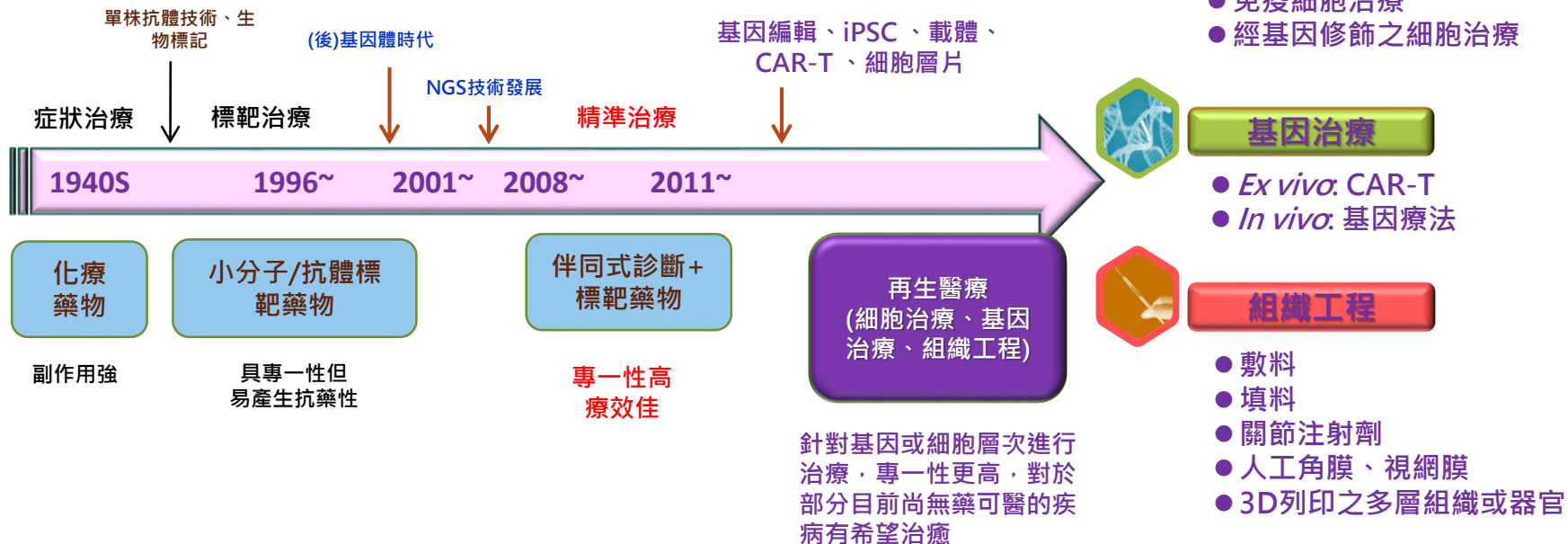
Please Book your 2021 calendar



更多2020展會亮點影片

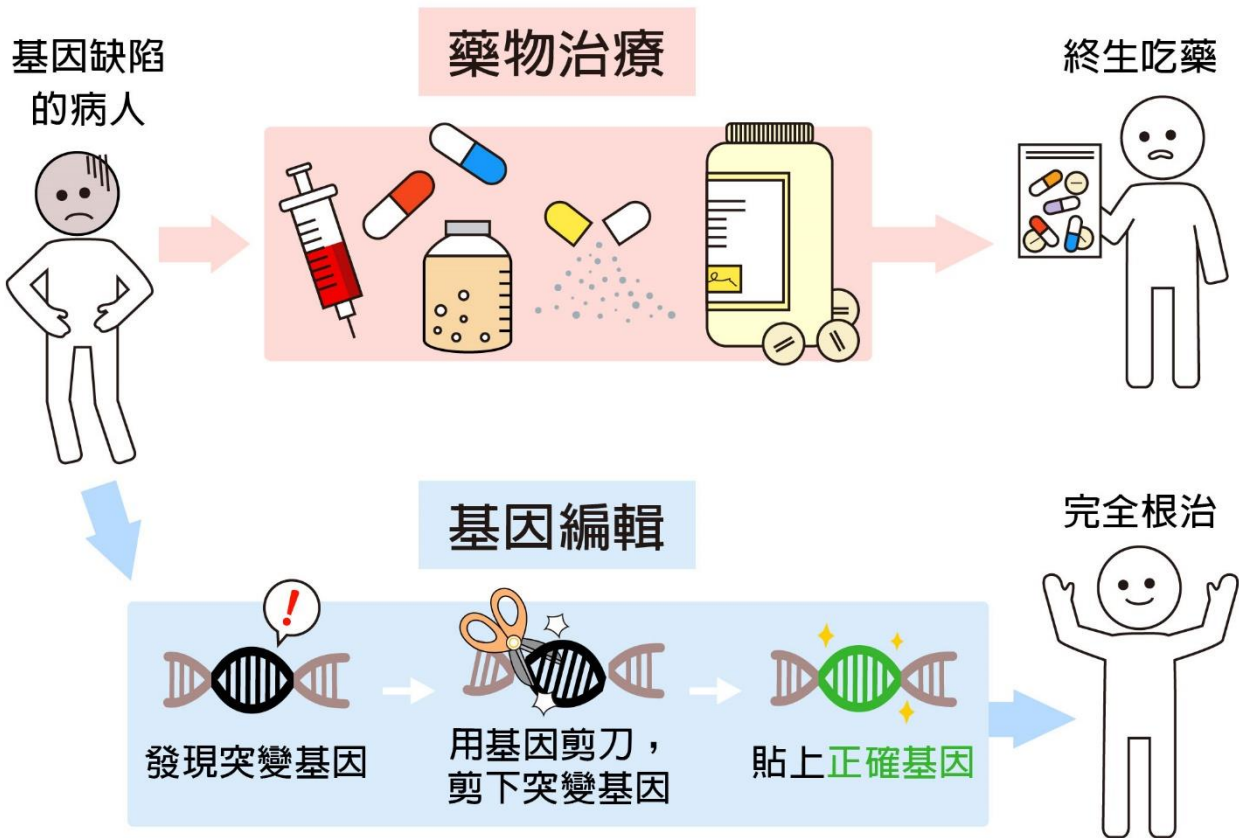
兼論基因編輯與幹細胞應用

全球再生醫學發展趨勢 新興技術驅動治療策略之演進



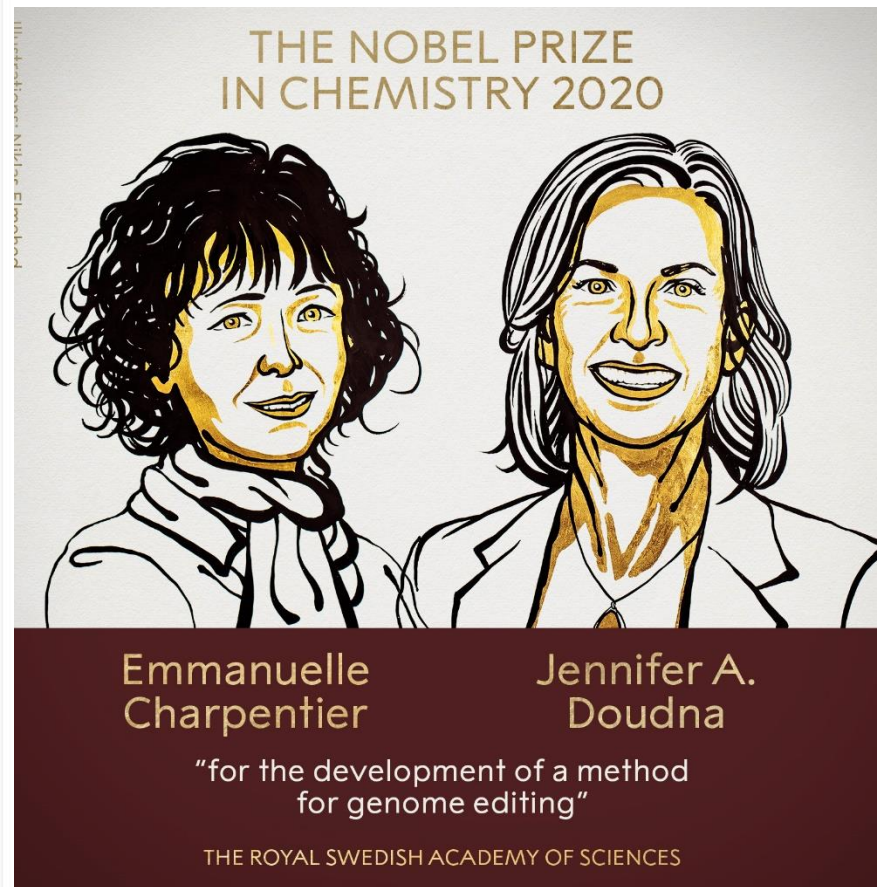
資料來源：DCB 產資組 ITIS 研究團隊整理 (2019.03)

基因編輯(Gene Editing)應用在基因治療



2020 Chemistry Laureates Emmanuelle Charpentier and Jennifer Doudna discovered one of gene technology's sharpest tools: the CRISPR/Cas9 genetic scissors. Using these, researchers can change the DNA of animals, plants and microorganisms with extremely high precision.

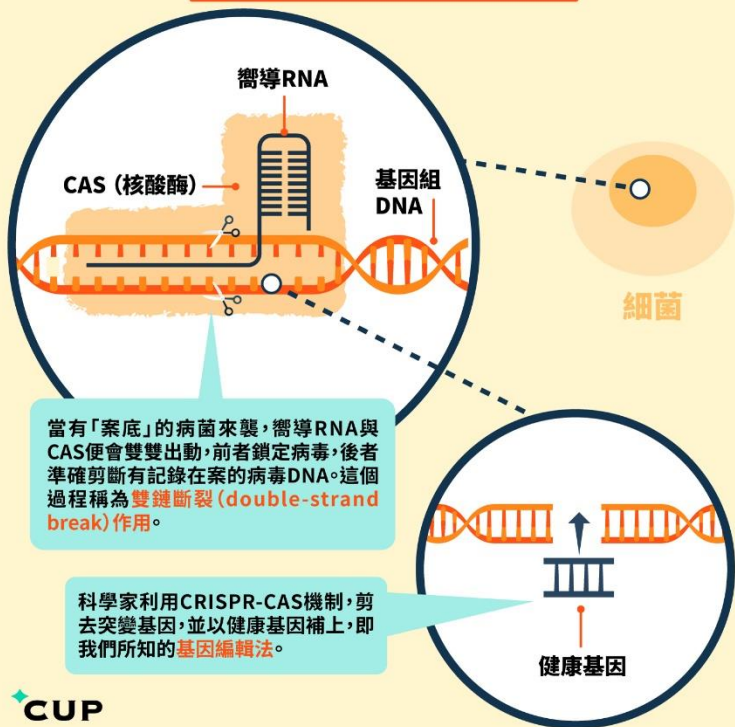
#NobelPrize



基因編輯 (Gene Editing)

CRISPER-CAS 如何做

圖解 CRISPR-CAS



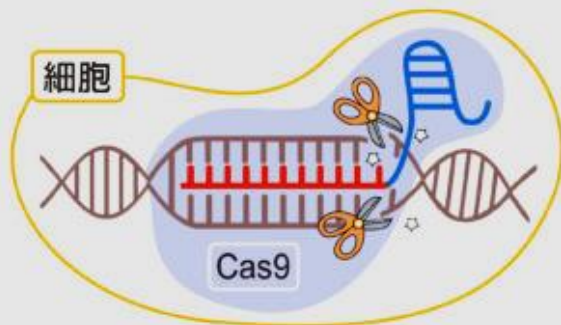
CUP

CRISPR 如何工作

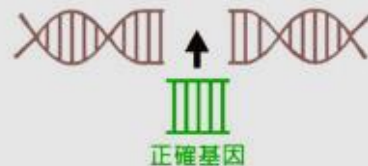
- 1 製作引導 RNA，紅色是與 DNA 互補的序列，藍色部分讓 Cas9 可以「抓住」RNA。



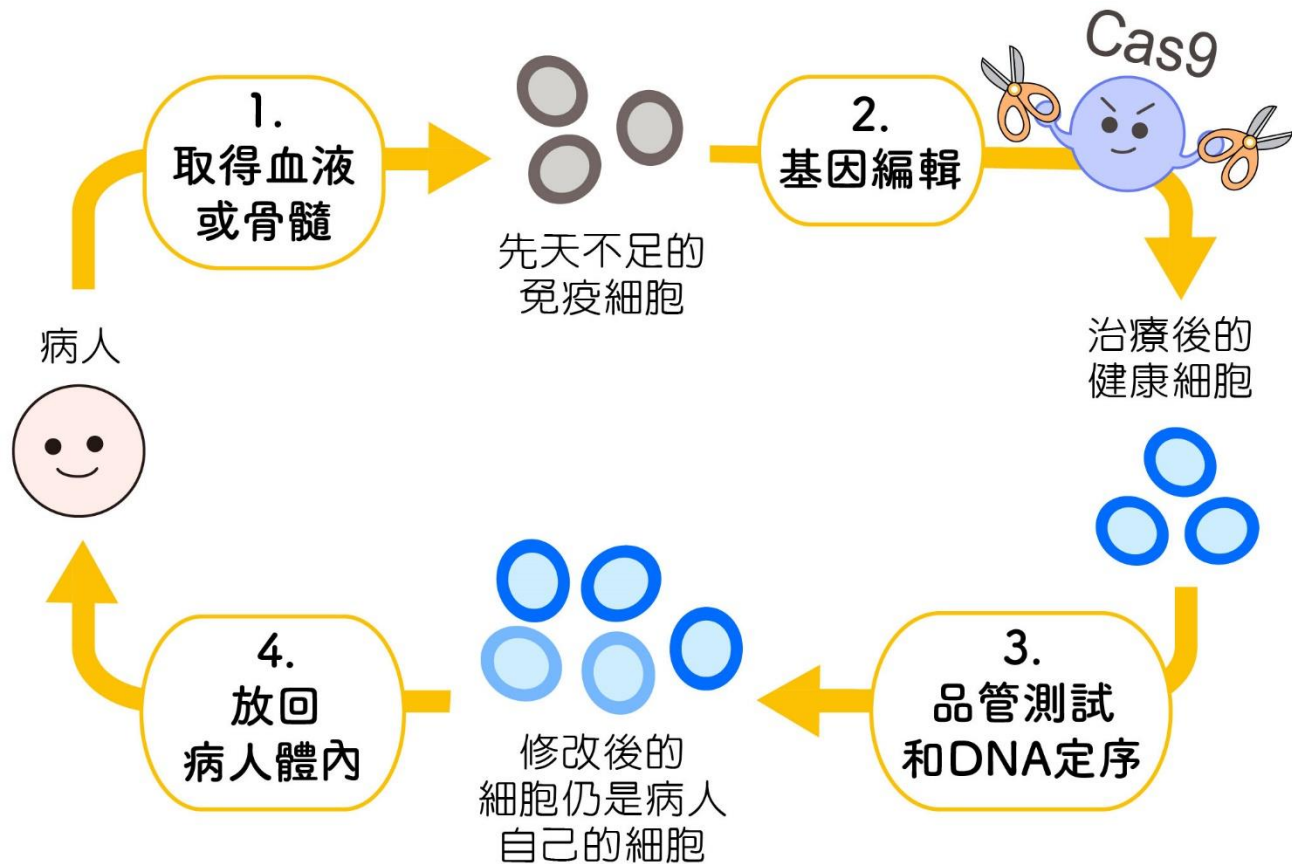
- 2 Cas9 和引導 RNA 進入細胞，引導 RNA 找到互補的 DNA 序列，由 Cas9 剪開。



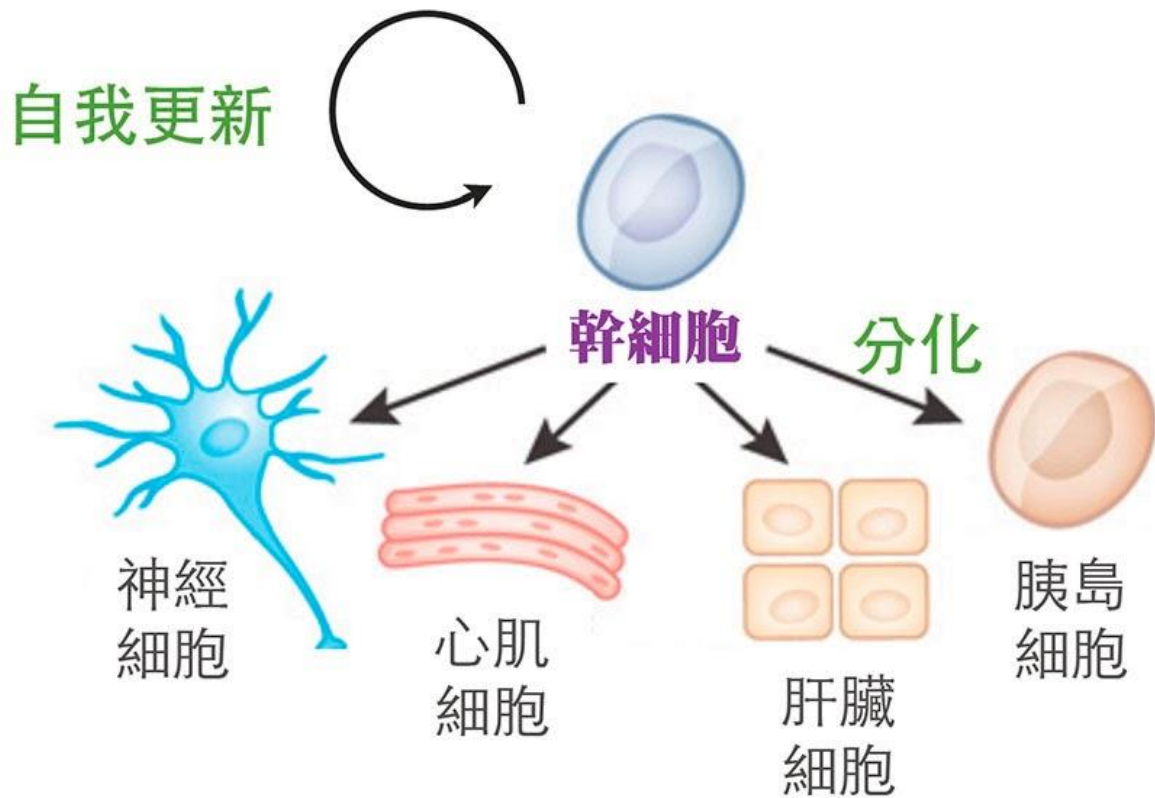
- 3 送入正確的基因，就有機會黏貼在斷口處。



基因編輯(Gene Editing)應用在基因治療

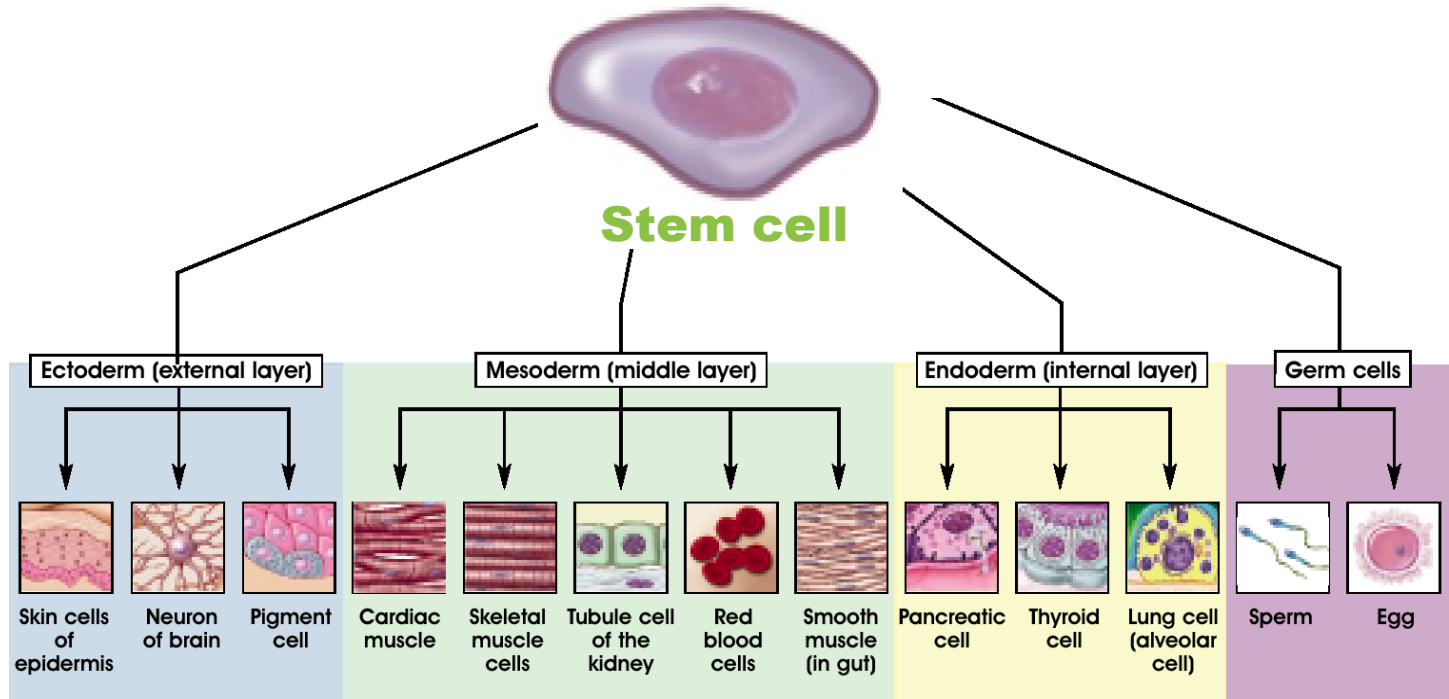


幹細胞 (Stem cells)



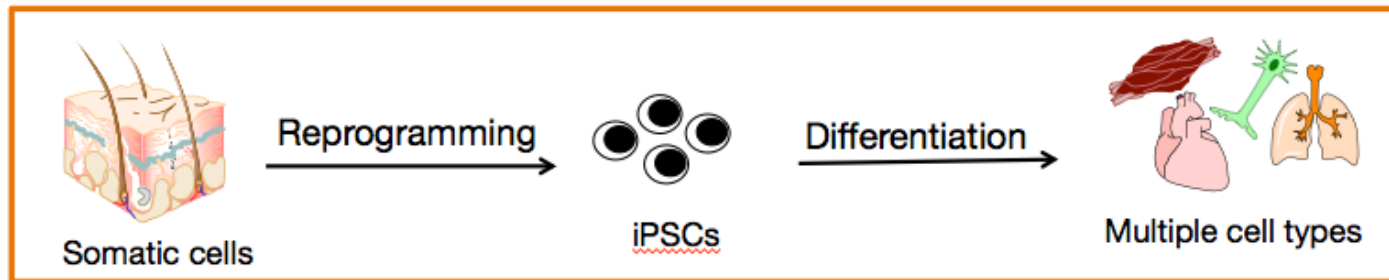
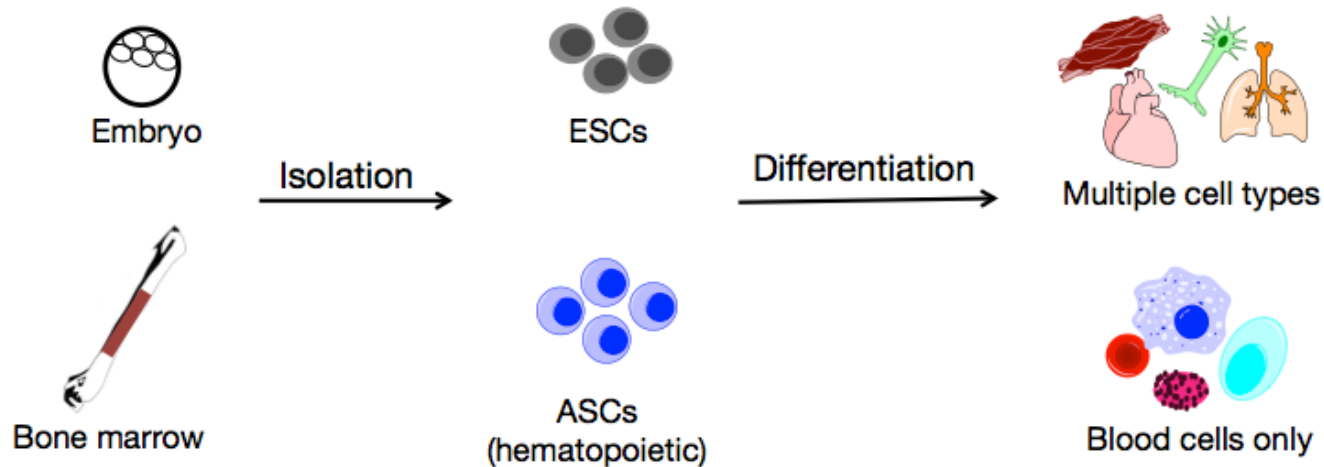
Cell differentiation

With combination of growth differentiation factors



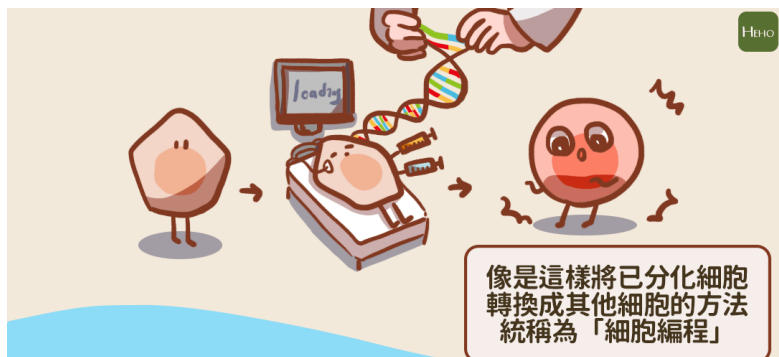
Starter Guide to induced Pluripotent Stem Cells (iPSCs)

Part 1: A renaissance in regenerative medicine



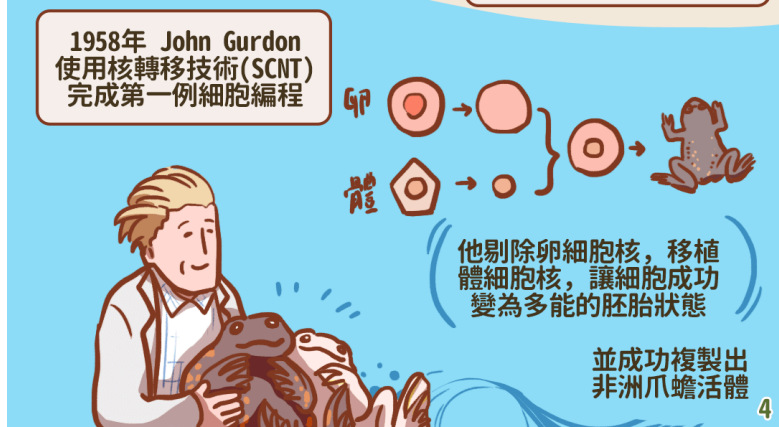
The Nobel Prize in Physiology or Medicine 2012

Sir John B. Gurdon, Shinya Yamanaka



像是這樣將已分化細胞轉換成其他細胞的方法統稱為「細胞編程」

1958年 John Gurdon 使用核轉移技術 (SCNT) 完成第一例細胞編程



他剔除卵細胞核，移植體細胞核，讓細胞成功變為多能的胚胎狀態

並成功複製出非洲爪蟾活體

4



Photo: Creative Commons
Attr: 2.0 Generic license

Sir John B.
Gurdon



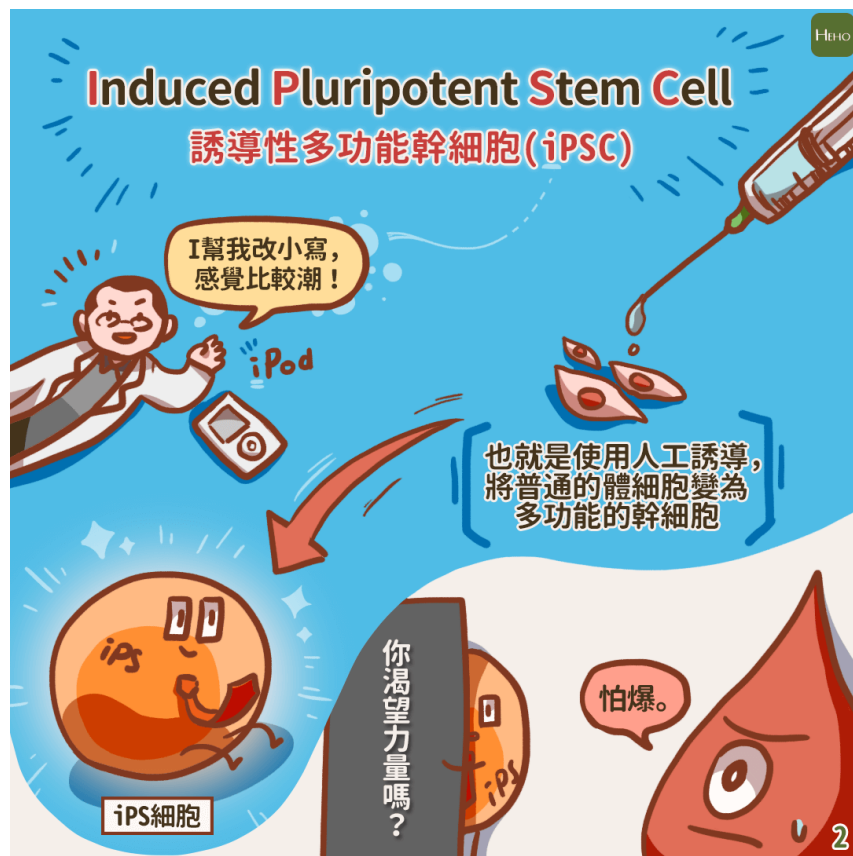
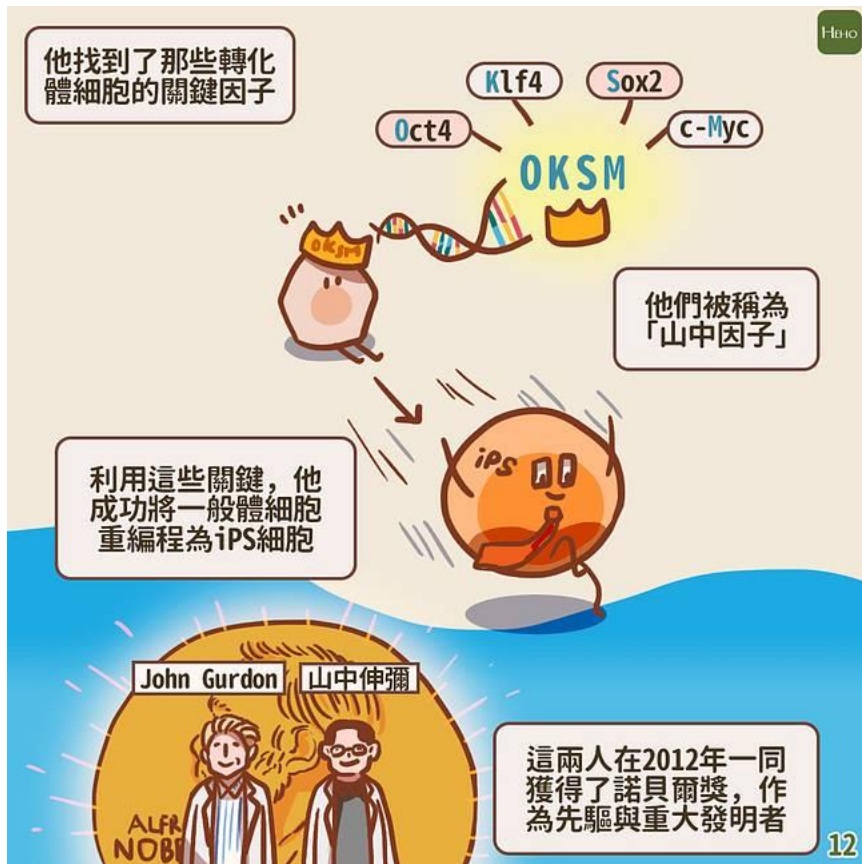
Photo: Gladstone
Institutes/Chris Goodfellow

Shinya
Yamanaka

The Nobel Prize in Physiology or Medicine 2012 was awarded jointly to Sir John B. Gurdon and Shinya Yamanaka "for the discovery that mature cells can be reprogrammed to become pluripotent"

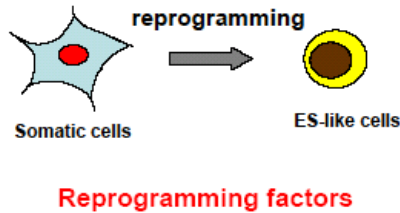
誘導性多能潛幹細胞 (日譯：萬能幹細胞)

Induced Pluripotent Stem Cells (iPS cells)

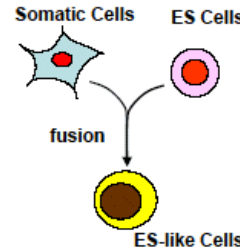




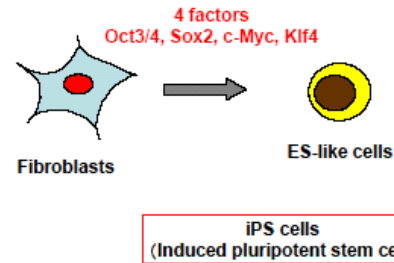
ES-like Cells by Reprogramming



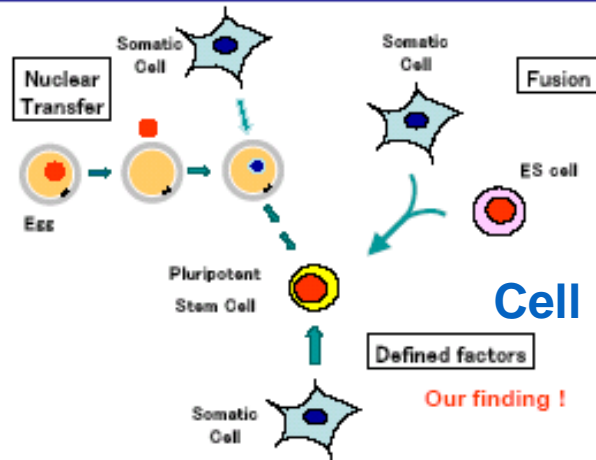
Reprogramming Factors Do Exist



Evaluation of Candidates

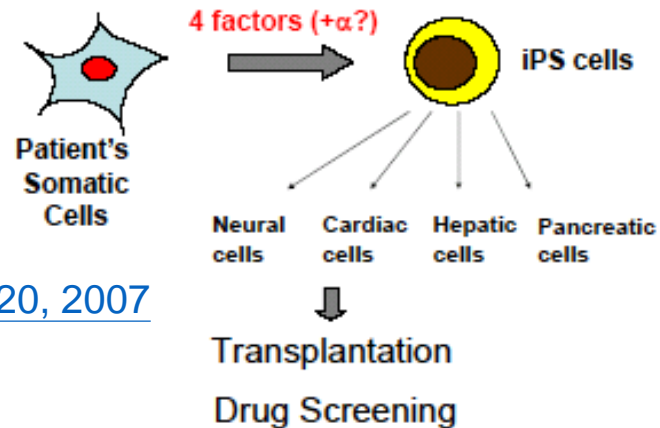


Comparison to Other Methods



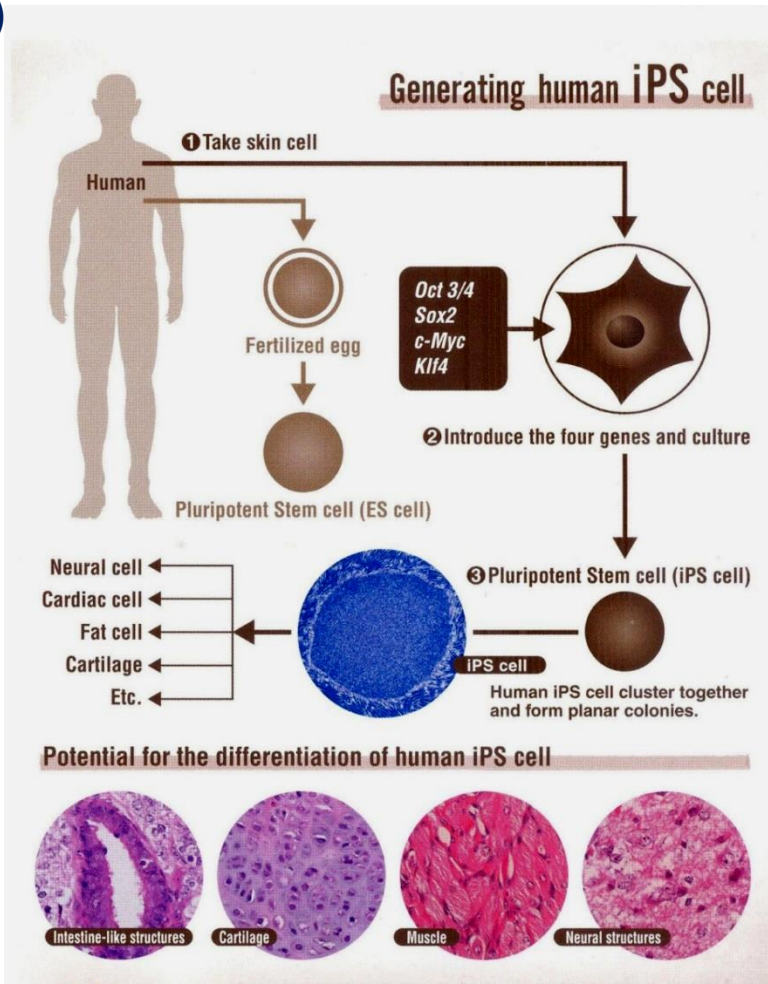
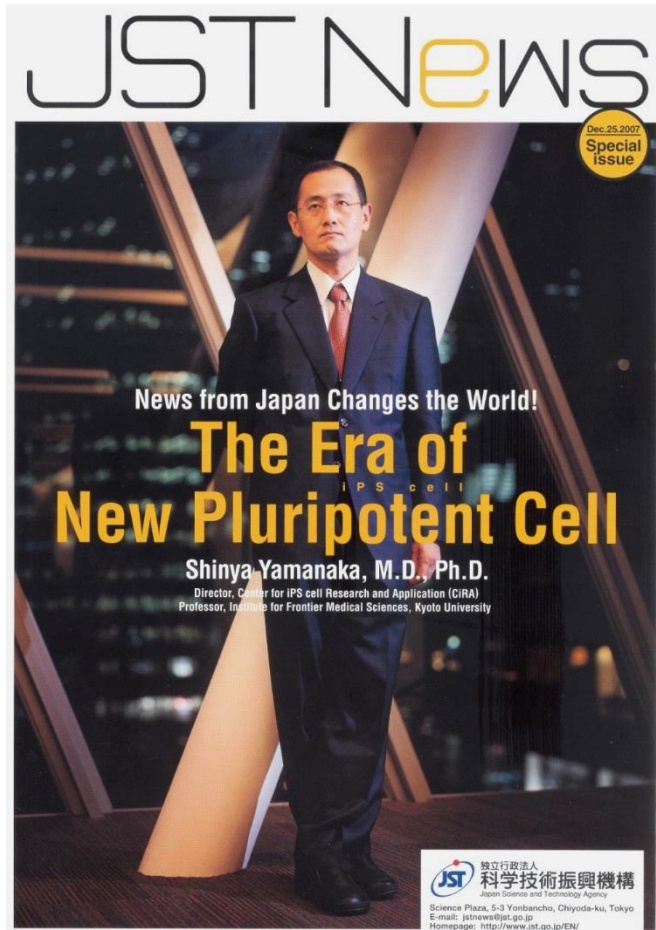
Cell Nov. 20, 2007

Future Plans



JST 科學技術振興機構 2007年iPS特別報導

(Japan Science and Technology Agency)



iPS cells vs. Tumor cells

レトロウイルスベクターは、細胞のDNAに組みこまれる(1~5)

レトロウイルスベクターが細胞の中に侵入し、運んできた遺伝子がDNAに組みこまれるメカニズムを1~5で示した。レトロウイルスベクターがもつ遺伝物質はDNAではなくRNAであり、細胞の中でDNAにつくりかえて(3)から、細胞のDNAに組みこまれる。このとき、組みこまれる位置はランダムに決まるので、細胞にとって重要な遺伝子が、ベクターの組みこみによって破壊される可能性もある。

レトロウイルスベクター

1. レトロウイルスベクターが細胞にたどりつく

2. RNAを細胞内に放出する

3. RNAの遺伝情報をもつDNAを合成する

4. レトロウイルスベクター由来のDNAが、核のDNAに組みこまれる

5. 組みこまれた位置にあった遺伝子は、分断されるなどしてはたらしを失う

線維芽細胞

iPS細胞(人工多能性幹細胞)

無事に多能性幹細胞になったとしても……
初期化因子がはたらし、無事にiPS細胞になったとしても、レトロウイルスベクターはDNAの中に組みこまれる。これが原因となって、移植してからしばらく時間をおいたちに、あるとき突然がん化がおきる可能性はゼロではない。レトロウイルスベクターを用いた遺伝子治療には、実際に過去にそうした事例がおきている。さらに、ES細胞もiPS細胞も、そのまま体内に移植すると「テラトーマ(奇形腫)」とよばれる一種の腫瘍をつくる性質がある。iPS細胞を実際の移植医療に応用するには、これらのがん化や腫瘍化をおさえる手段を確立することが欠かせない。

がん細胞

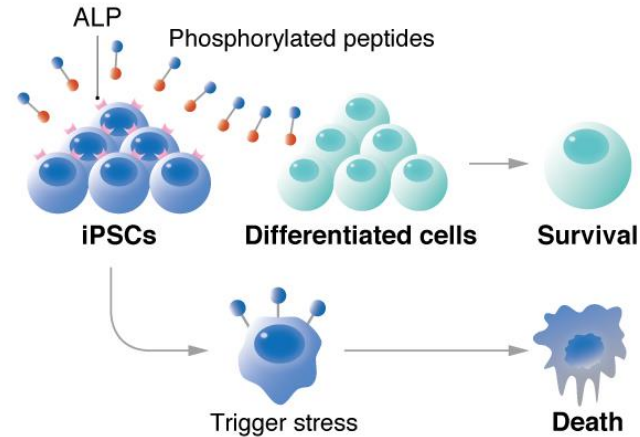
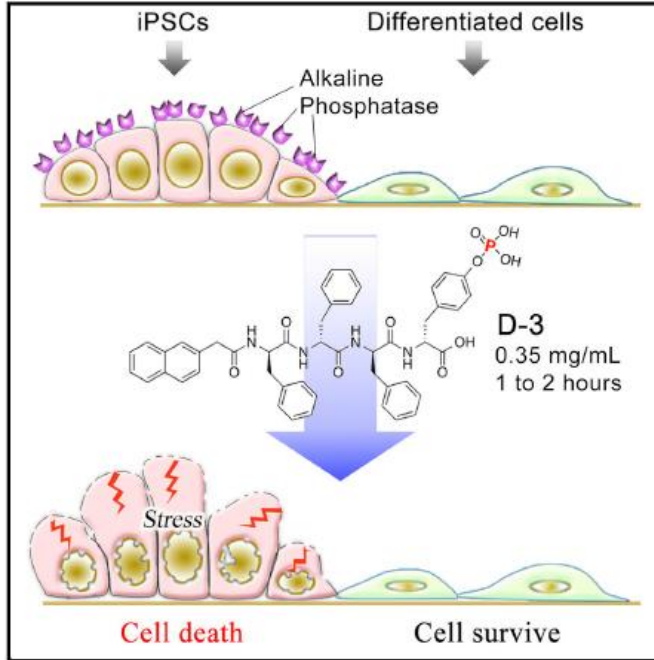
主に遺伝子の異常によって、細胞が本来のはたらしを失い、むやみに増殖しつづけるだけの存在になってしまったものを「がん細胞」という。がん細胞が多数集まったものが「がん(悪性の腫瘍)」である(くわしくは70~75ページ)。

細胞のがん化を引きおこす可能性がある

レトロウイルスベクターが組みこまれた位置の近くに、細胞の秩序を守る遺伝子があり、それがこわれることがある。あるいは、普段はたらしがおさえられているはずの「がん遺伝子」(それがはたらくと細胞のがん化するような遺伝子:c-Mycは有名ながん遺伝子である)が近くにあり、それが取りか覚める可能性がある。これらは細胞のがん化を引きおこす原因になる。

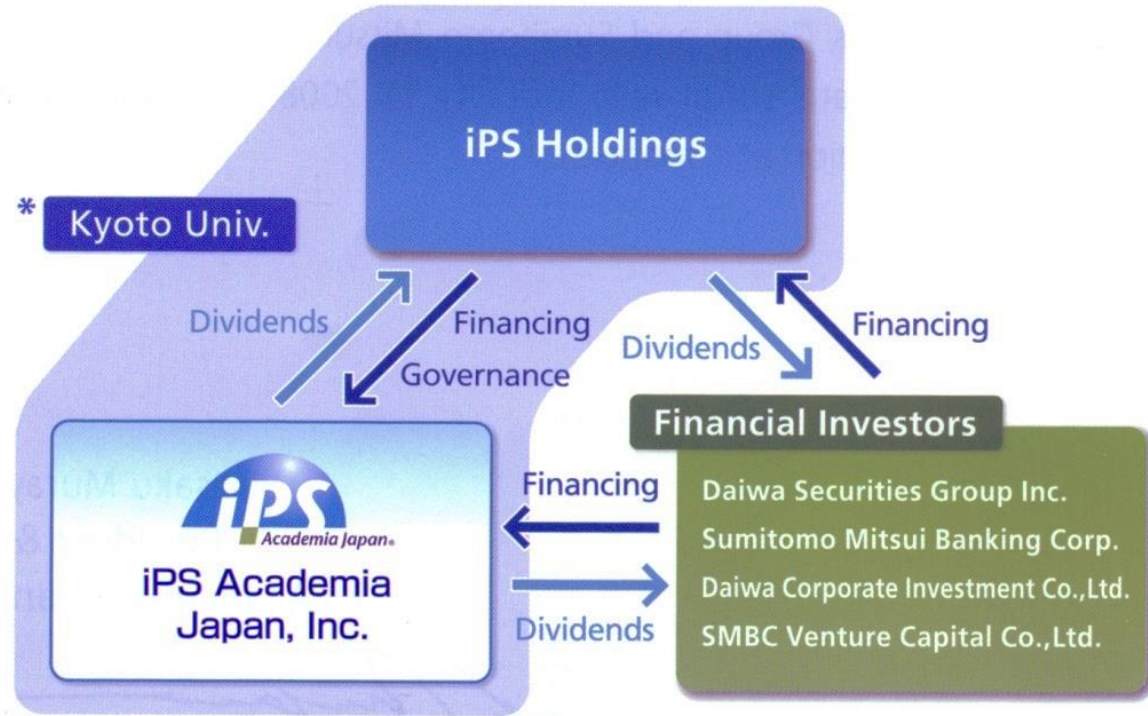
がん(がん細胞のかたまり)

Safer stem cell therapies



Efficient, Selective Removal of Human Pluripotent Stem Cells via Ecto-Alkaline Phosphatase-Mediated Aggregation of Synthetic Peptides. (Kuang *et al.*, *Cell Chemical Biology* 2017)

Investment Framework



*iPS Academia Japan, Inc. was established in Kyoto on June 25, 2008 to contribute to healthcare through the transfer of research results and technology relating to induced pluripotent stem (iPS) cells, which had been developed by Prof. Shinya Yamanaka of Kyoto University and his colleagues.

List of Licensees :

Entities in Japan

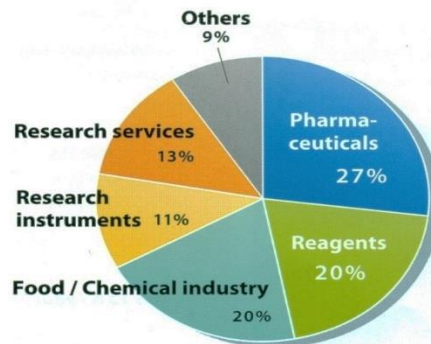


Entities in other countries



Licensees by industry

Pharmaceutical companies and reagent companies amount to nearly 50%. Thus, the expansion of iPS cell technology in bio-industry is currently prominent, and the iPS cell technology will further expand since new participants from research instrument manufacture are increasing.



幹細胞跨領域及再生醫學應用

- 奈米生醫材料：細胞分化及細胞毒性測試
- 生物反應器與組織工程
 1. 生物反應器(Bioreactor): 幹細胞之標準化量產
 2. 組織工程: 人工器官(Artificial Organs)
- 幹細胞治療與再生醫學應用
 1. 神經退化疾病與神經損傷 (Neural stem cells)
 2. 軟骨修復與再生 (Chondroblasts and 3D reconstruction)
 3. 血液腫瘤之細胞療法 (Hemopoietic stem cells)
 4. 心肌梗塞之細胞療法 (Cardiomyoblasts)
 5. 糖尿病之細胞療法 (Pancreatic islet cells)



2018-2019 年國際再生醫療最新進展

美國

2019年2月，美國Fate Therapeutics 以iPS分化的NK細胞治療晚期實體癌病患的第一期臨床試驗開始，2019年4月進行第一次安全性評估，患者無明顯副作用。

2019年4月，美國賓州大學以CRISPR基因編輯技術搭配CAR-T細胞療法治療兩位癌症患者。

日本

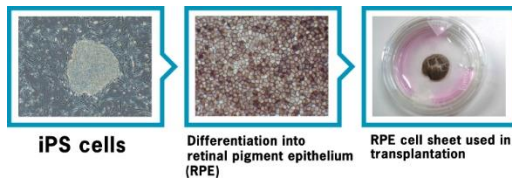
2018年5月，大阪大學澤芳樹 (Sawa Yoshiki) 教授利用患者自體細胞分化培養之心肌層片治療心臟衰竭。

2019年4月，日本理研發佈完成5例以異體iPSC所分化之視網膜移植至老年黃斑部病變患者，預後良好。

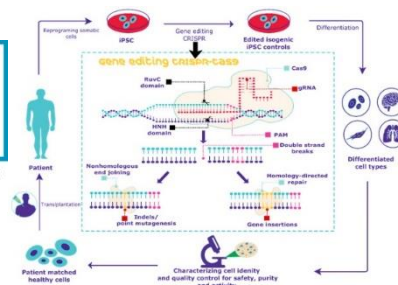
2019年9月，大阪大學西田幸二 (Koji Nishida) 教授利用異體iPSC分化之角膜上皮細胞層片治療角膜疾病



資料來源：<http://www.med.osaka-u.ac.jp/archives/7911>



資料來源：<http://www.riken-ibri.jp/>



資料來源：<https://www.sigmaaldrich.com/>

Japan moves to fast-track innovative stem cell therapy with first trials on human hearts

Nature News, 29 May 2018



Professor Yoshiki Sawa, center, has pioneered a new induced pluripotent stem cell therapy for treating damaged hearts (Credit: Osaka University)

日本京都大學附設醫院細胞治療研究中心

前川平 (Professor Taira Maekawa) 主任

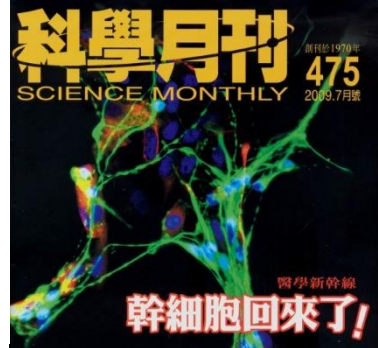
- 幹細胞治療糖尿病
- 每次療程至少300萬日幣
- 未必每次都有成效



認識幹細胞與大眾教育

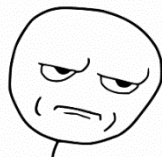
在這個日新月異的時代，對於富有潛力，但卻普遍缺乏推廣教育的幹細胞，社會大眾應該有更進一步的認知與理解。

錢宗良



- 臍帶血是否值得儲存? **YES!** 值得鼓勵。(公共財)
- 我兒子有先天性心臟病，臺灣是否有醫師可以利用「幹細胞」來治療? **No!** 目前技術尚未成熟。
- 目前熱門的嵌合抗原受體T細胞 (CAR-T)可以治療所有的腫瘤或癌症? **No!** 目前只有血癌比較有效。
- 目前「幹細胞」真能治療神經退化或老年癡呆嗎? **No!** 目前技術尚未成熟。
- 特殊配方「幹細胞」，吃了就有效? **No!**

ARE YOU KIDDING ME?



*Thank you for your
attention*

