智慧醫療：台灣的機會和挑戰

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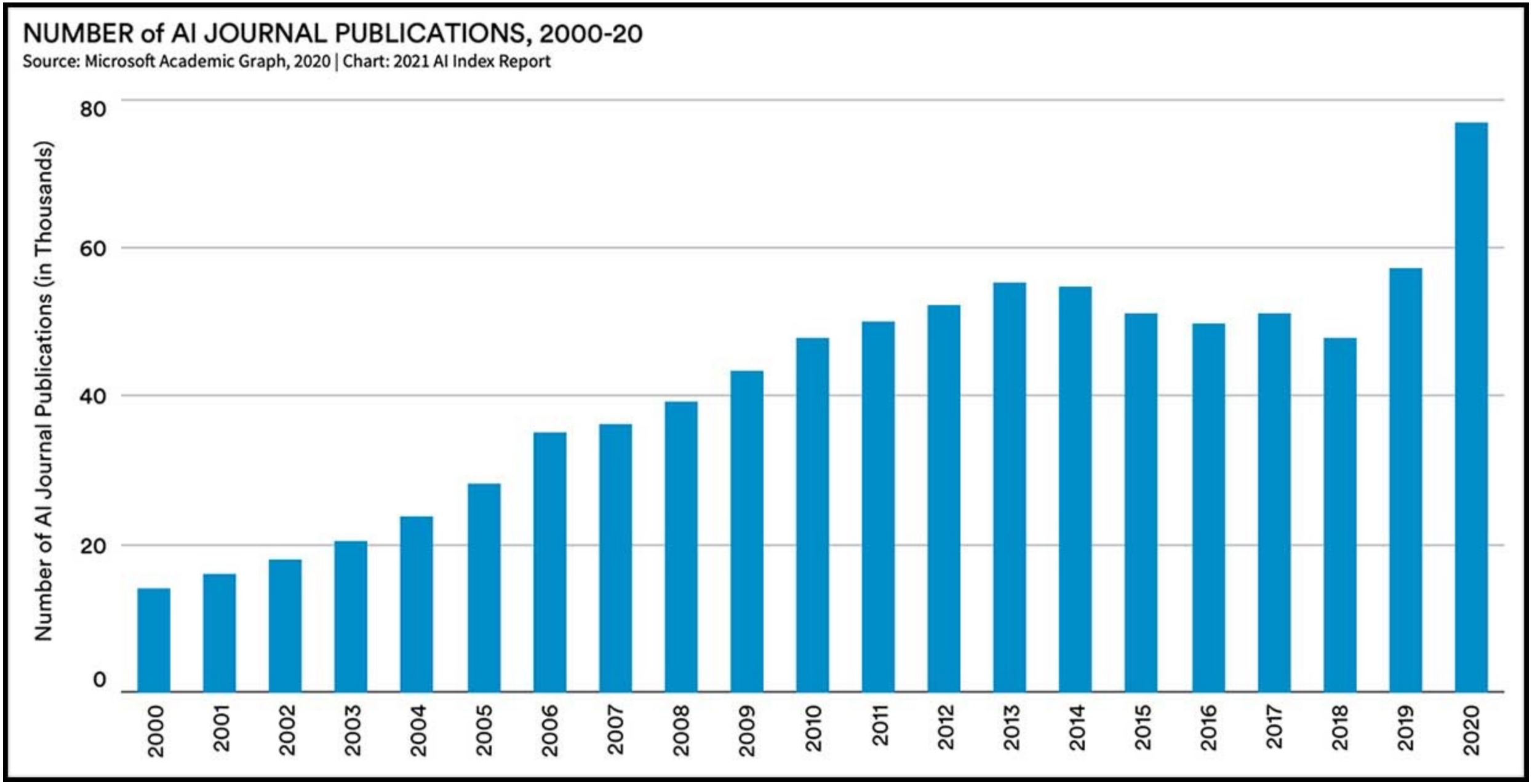
哈佛大學流行病學博士

Taiwan's
COVID
spike

CORONA
VIRUS


NUMBER of AI JOURNAL PUBLICATIONS, 2000-20
Source: Microsoft Academic Graph, 2020 | Chart: 2021 AI Index Report
Number of AI Journal Publications (in Thousands)
80
60
40
20
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
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2018
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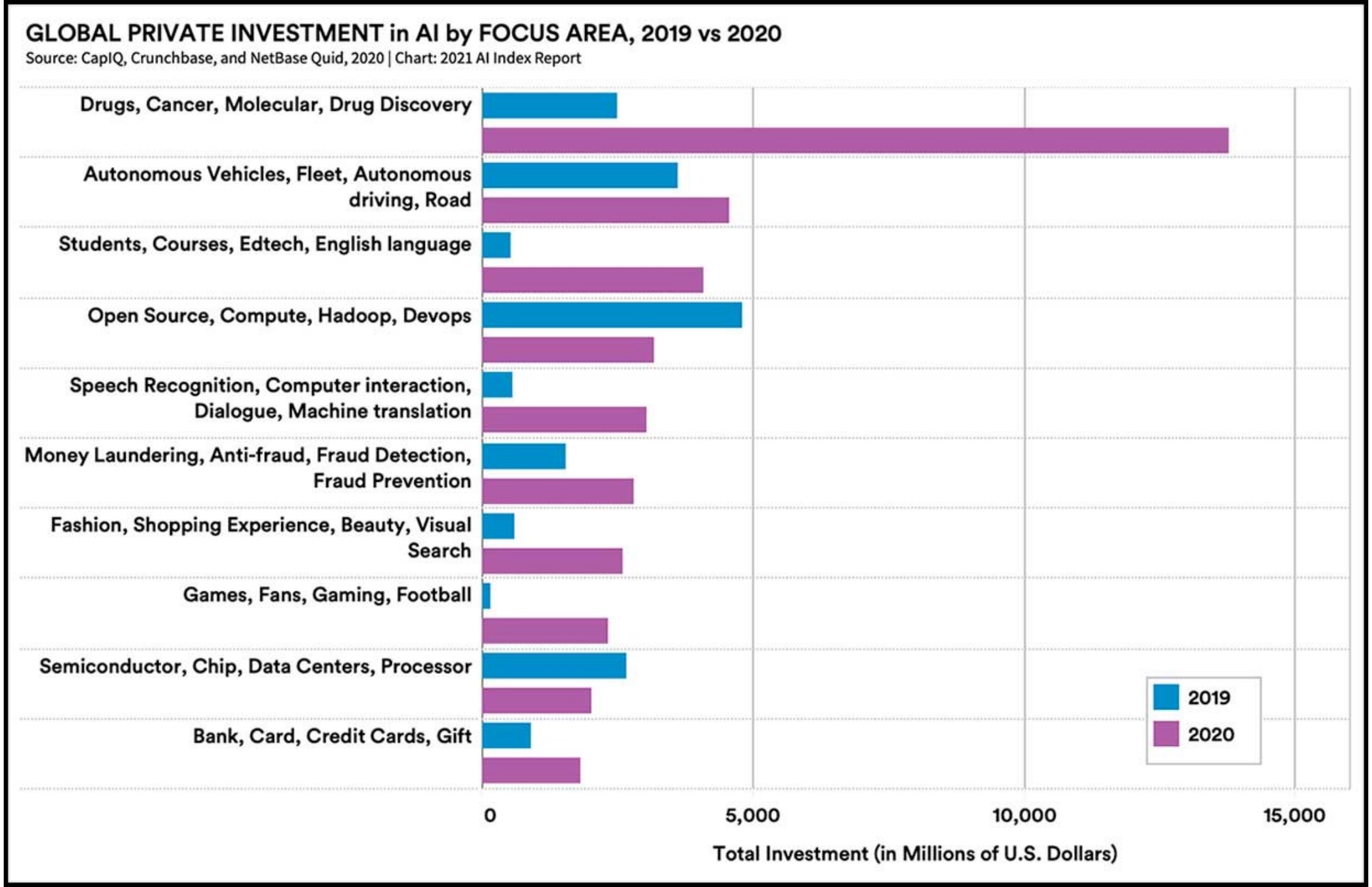
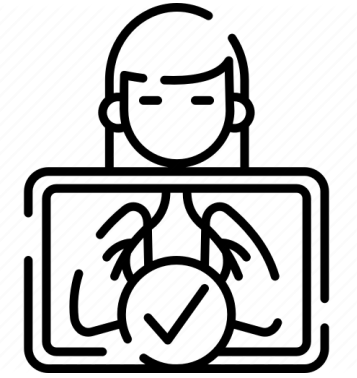
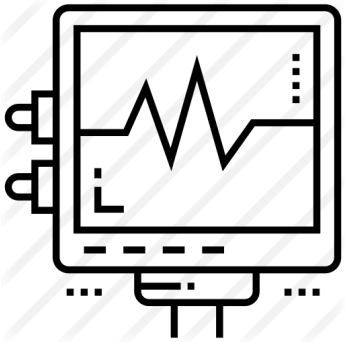
2020


GLOBAL PRIVATE INVESTMENT in AI by FOCUS AREA, 2019 vs 2020
Source: CapIQ, Crunchbase, and NetBase Quid, 2020 | Chart: 2021 AI Index Report
Drugs, Cancer, Molecular, Drug Discovery
Autonomous Vehicles, Fleet, Autonomous driving, Road
Students, Courses, Edtech, English language
Open Source, Compute, Hadoop, Devops
Speech Recognition, Computer interaction, Dialogue, Machine translation
Money Laundering, Anti-fraud, Fraud Detection, Fraud Prevention
Fashion, Shopping Experience, Beauty, Visual Search
Games, Fans, Gaming, Football
Semiconductor, Chip, Data Centers, Processor
Bank, Card, Credit Cards, Gift
2019
2020
0
5,000
10,000
15,000
Total Investment (in Millions of U.S. Dollars)

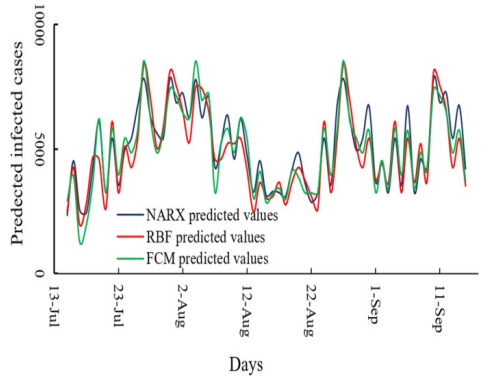


Automatic interpretation of radiological images



Monitoring disease risks

Develop new drugs

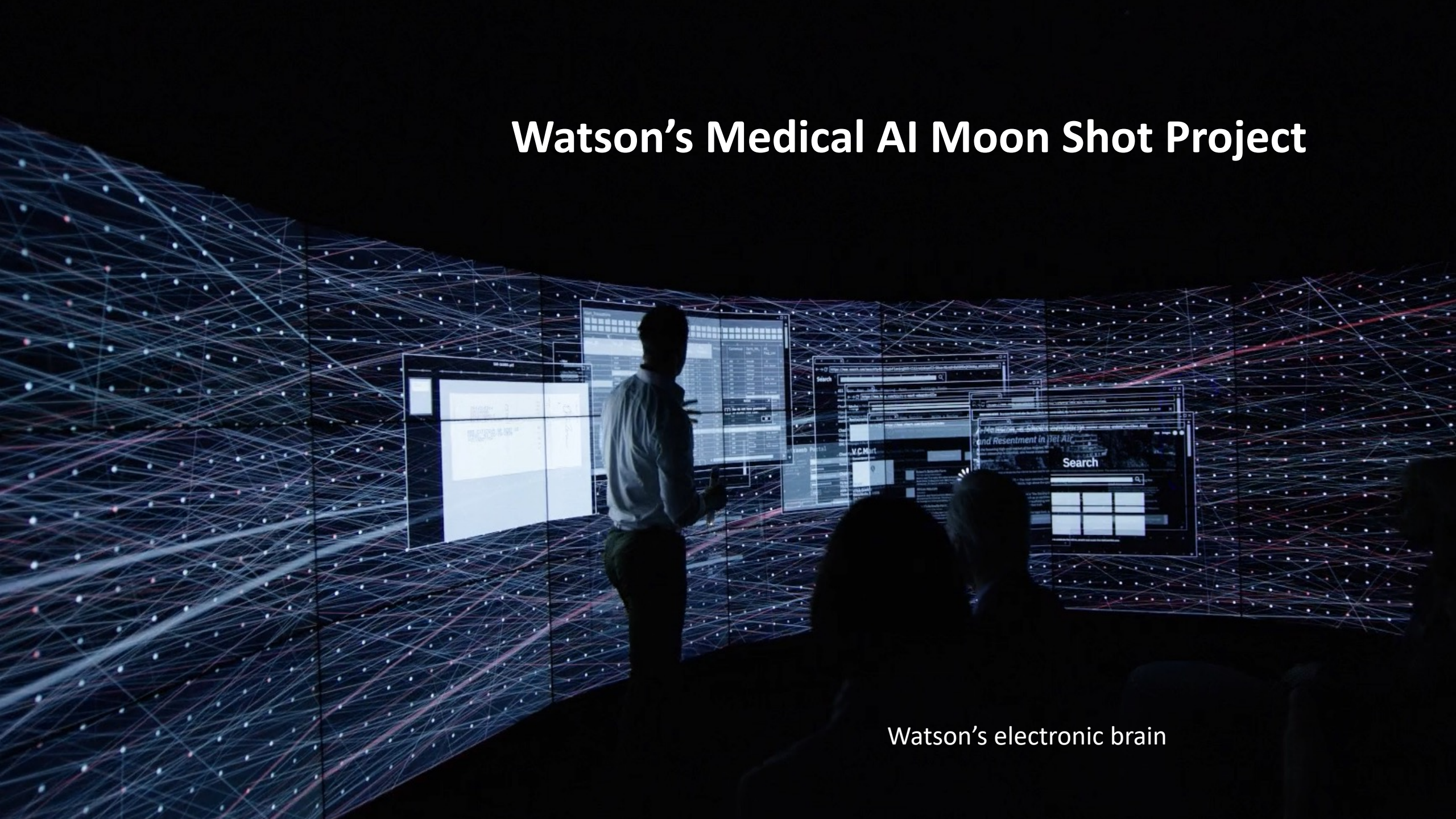


Predict COVID trend

IBM Watson

It seemed that Watson could understand the meaning of language, rather than just patterns of words

Watson’s Medical AI Moon Shot Project



Watson’s electronic brain

Dr. Watson

- Goal:
  - Reduce diagnosis errors
  - Optimize treatments
  - Alleviate doctor shortages

- How
  - Collection of symptoms and came up with a list of diagnoses and treatment
  - Each annotated with Watson’s confidence level and links to literature

- Confidence
  - Memory banks held knowledge of every rare disease and newest trials
  - Processors not susceptible to cognitive bias

Brief history of IBM Watson

IBM Research Project *(2006 –)*

R&D

Jeopardy! Grand Challenge *(Feb 2011)*

Demonstration

Watson for Healthcare *(Aug 2011 –)*

Commercialization

New Division

Watson for Financial Services *(Mar 2012 –)*

Expansion

Watson Industry Solutions *(2012 –)*

Cross-industry Applications

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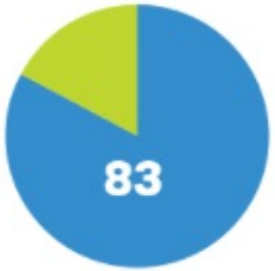
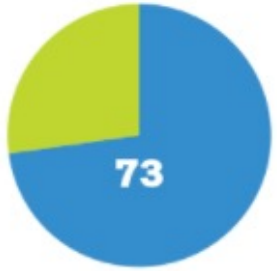
Bumrungrad International Hospital, Thailand: 83% concordance



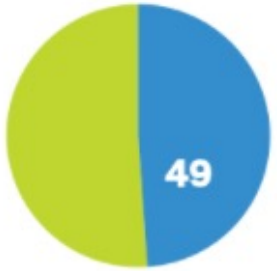
211 patients with breast, colorectal, gastric, and lung cancer

Manipal Comprehensive Cancer Center, India: 73% concordance



638 patients with breast cancer

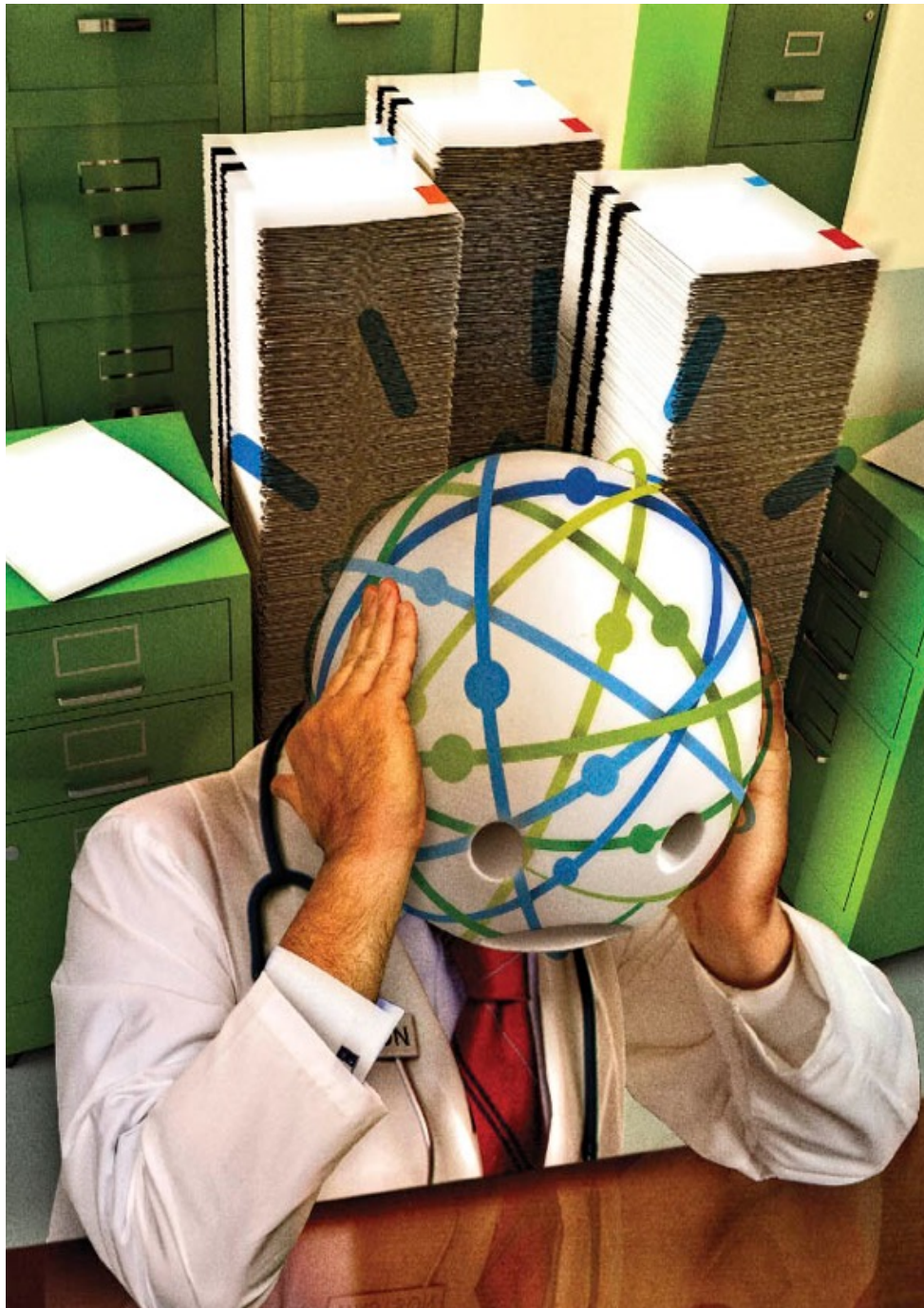
Gachon University Gil Medical Center, South Korea: 49% concordance



656 patients with colon cancer

"This product is a piece of sh–."

"Multiple examples of unsafe and incorrect treatment recommendations,"



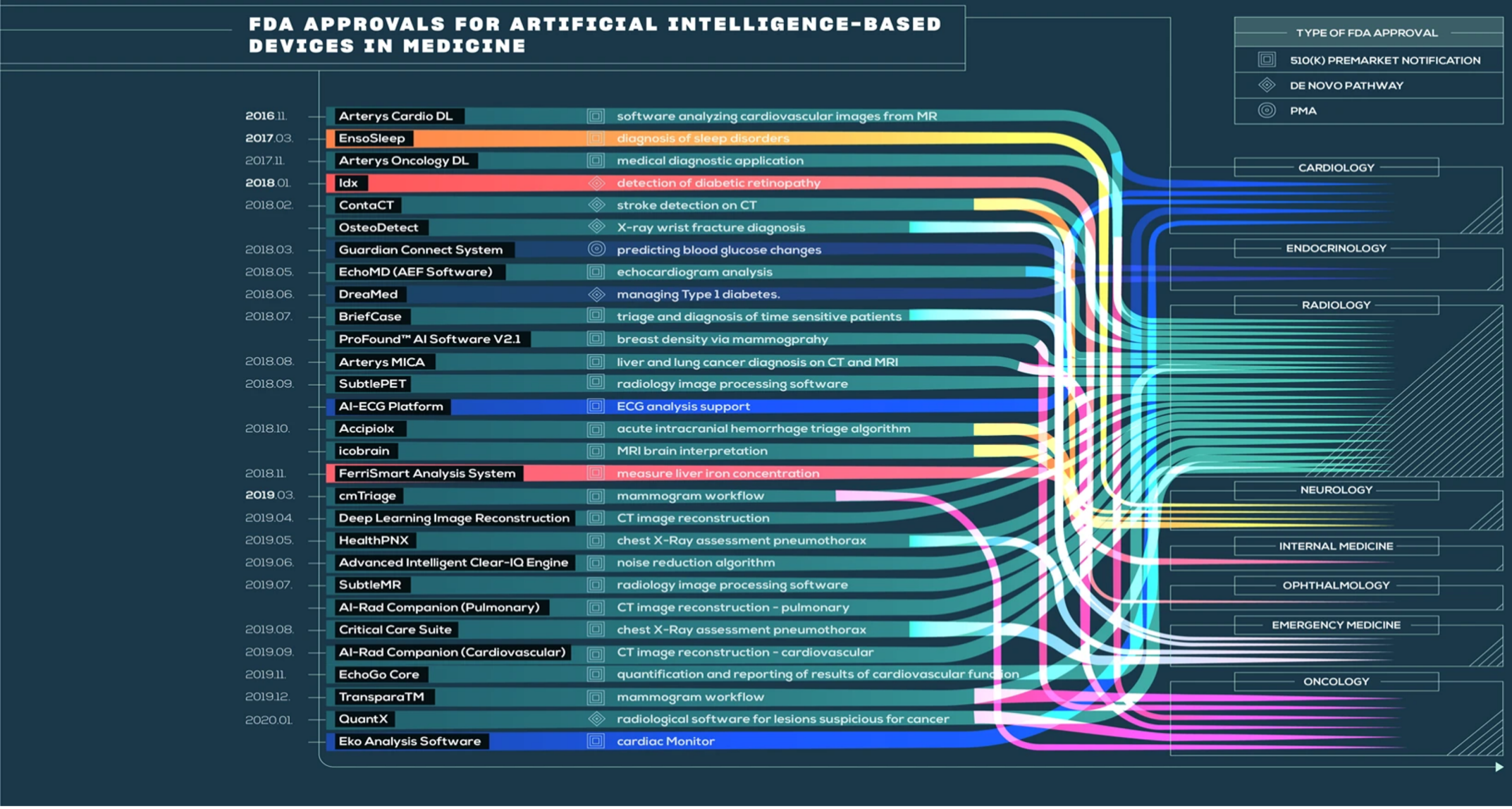
It’s all about “DATA”

- That narrative text accounts for about 80 percent of a typical patient’s record—and it’s a stew of jargon, shorthand, and subjective statements
- Even for MD Anderson, they only have hundreds of beds, could not cover the vast variety of human diseases
- Trained the software on a small number of hypothetical cancer patients, rather than real patient data leads to disaster

Dirty Medical Data

- Heterogeneity
  - Different drug preference for different hospital/physicians
  - Different treatment recommendation over different periods
  - Different insight for different levels of doctors
  - Different selection of testing orders

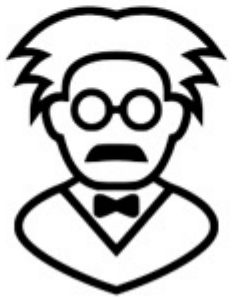
- Problems specific for Taiwan
  - Use a lot of atypical short-hand
  - Physician’s note, not English, not Chinese, but “Taiwanese Chinglish”
  - Under-recording for doctor’s note, overrepresenting of nurse charting notes



Of 29 FDA approved SamD, Image applications account for >70%

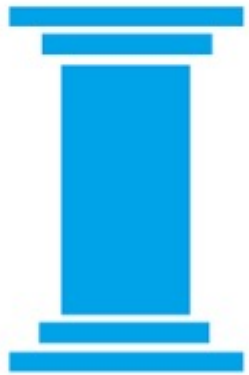
資料

人才



算力

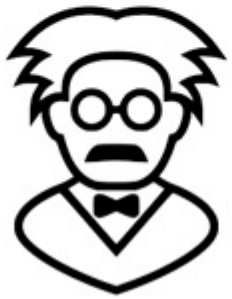
轉譯



台灣的機會和挑戰

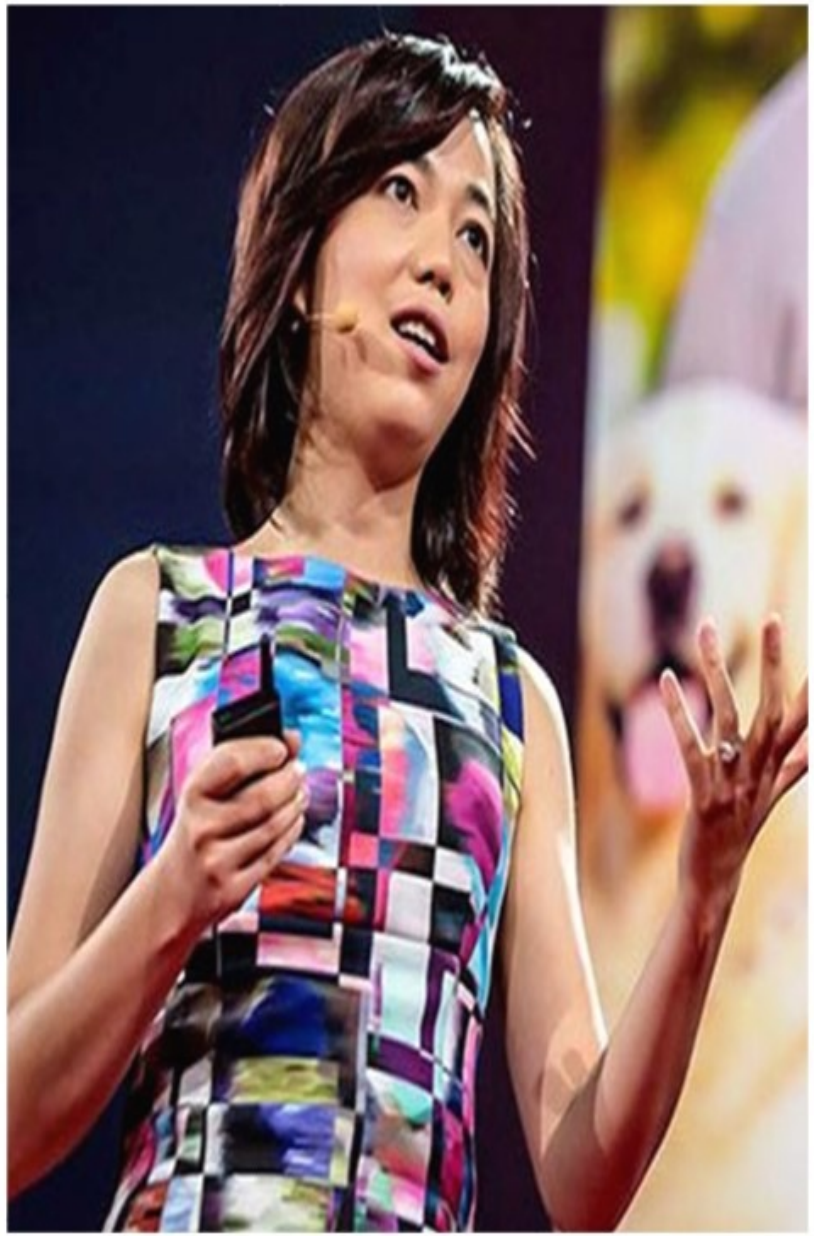
資料

人才

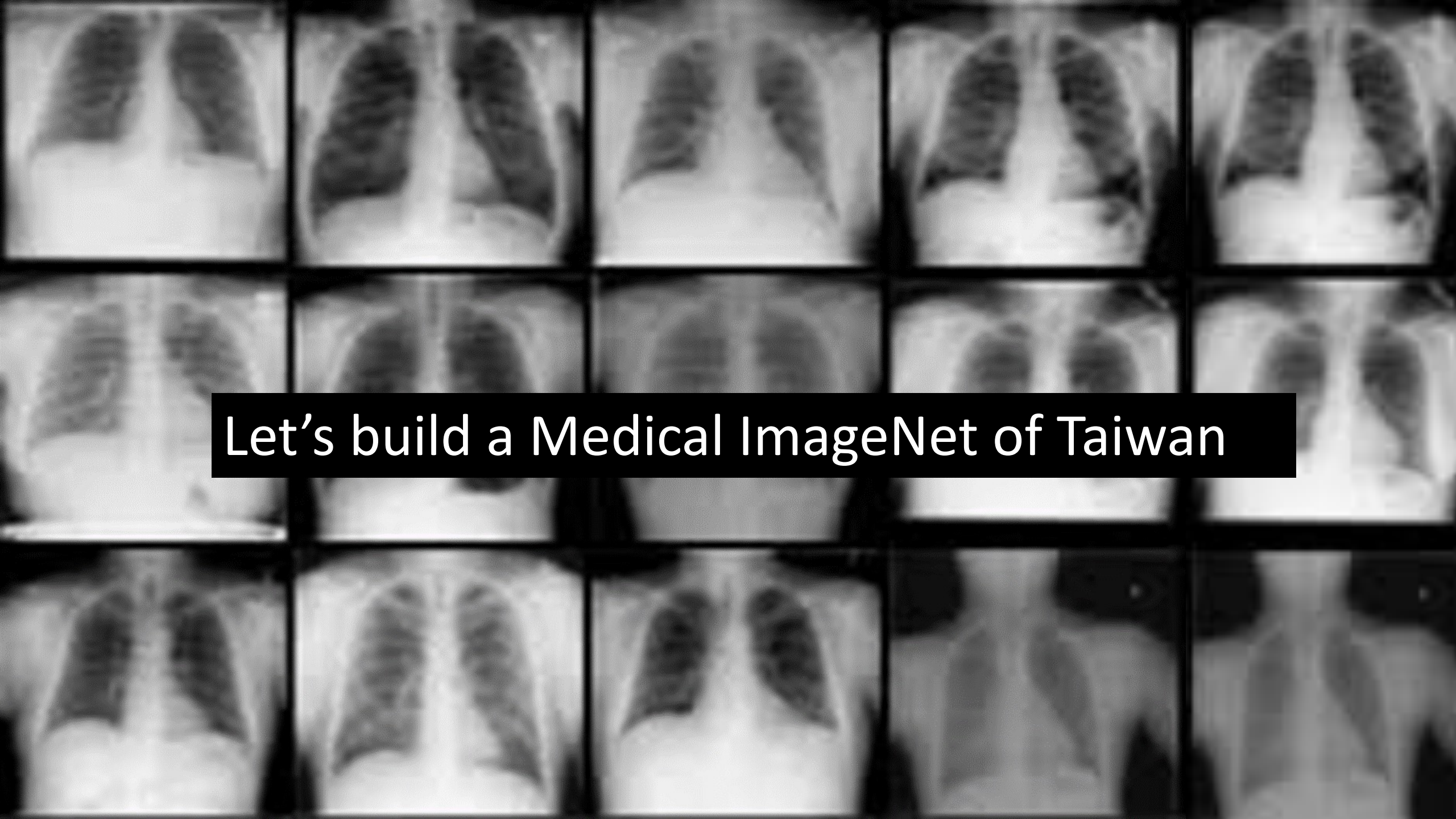


算力

轉譯



IMAGENET


Let’s build a Medical ImageNet of Taiwan

Photos

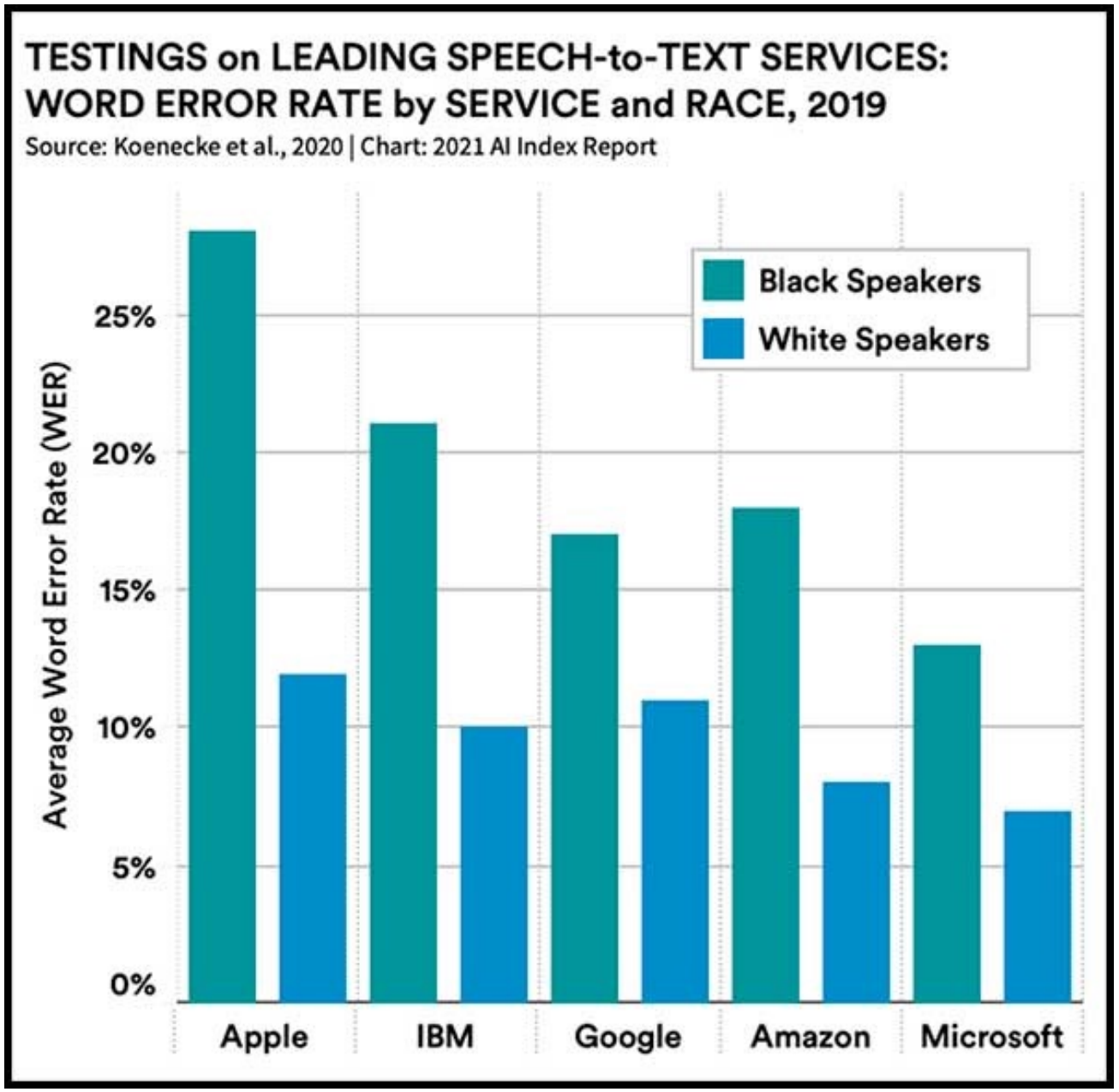
Videos

Ultrasound

X-Rays

CT Scan

MRI



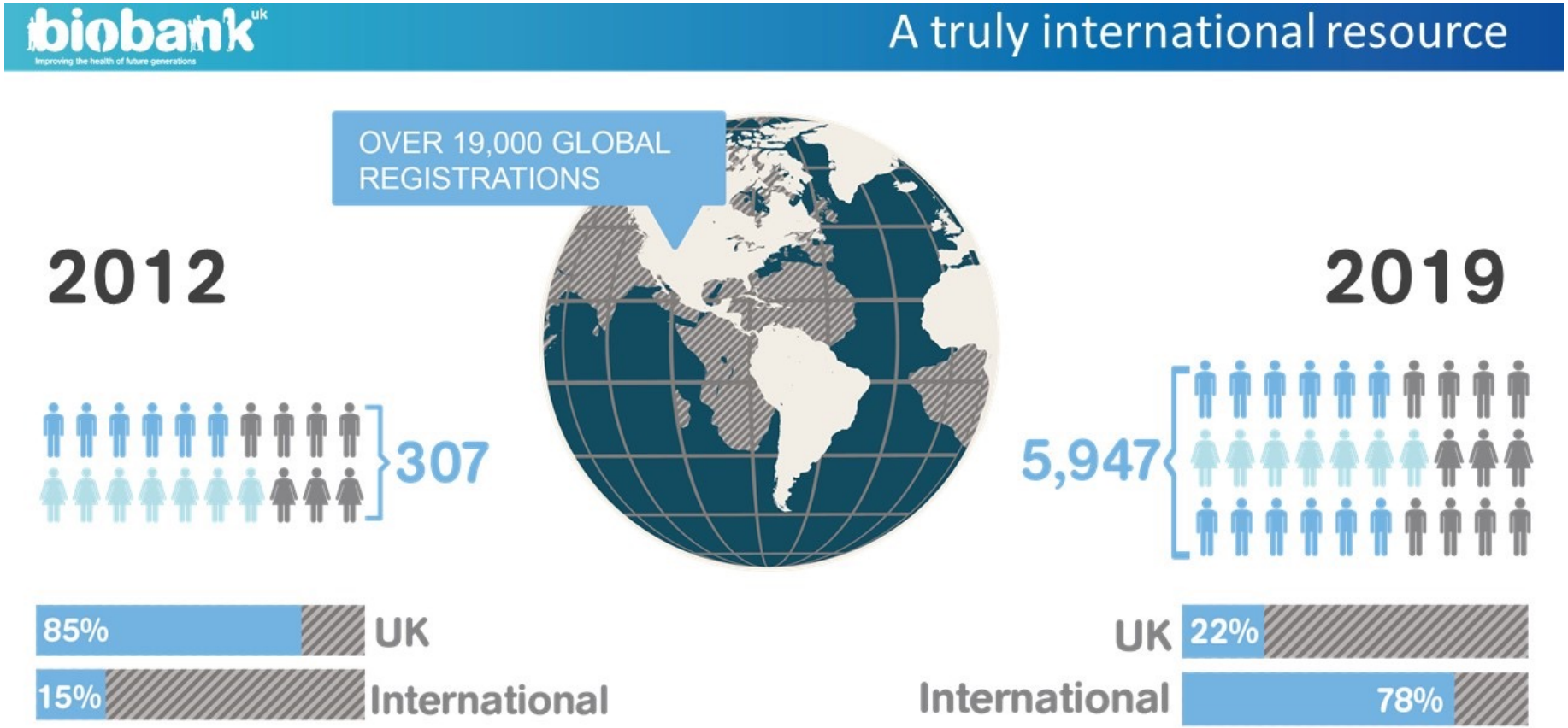
AI model is ethnic/region sensitive

AI model based on Western countries may not be able to apply to Asian countries

台灣三座金山

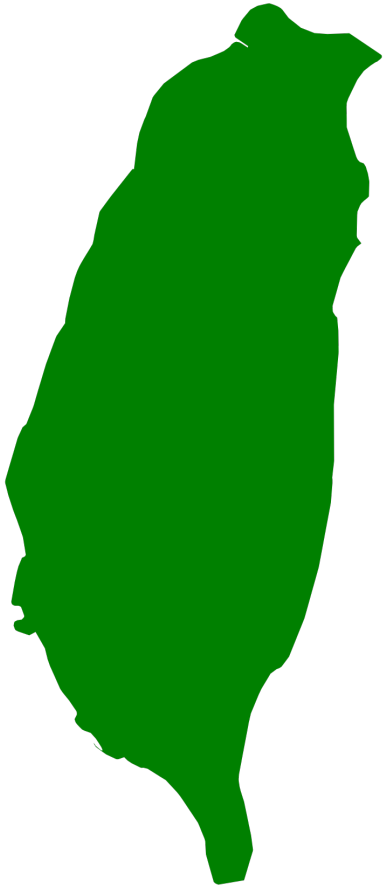
健保資料庫　電子病歷資料庫　人體生物資料庫

挑戰- Privacy Issue



資料

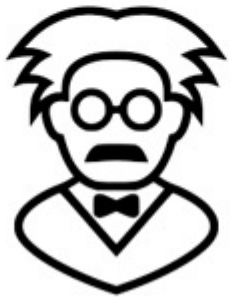
Opportunity



Challenge

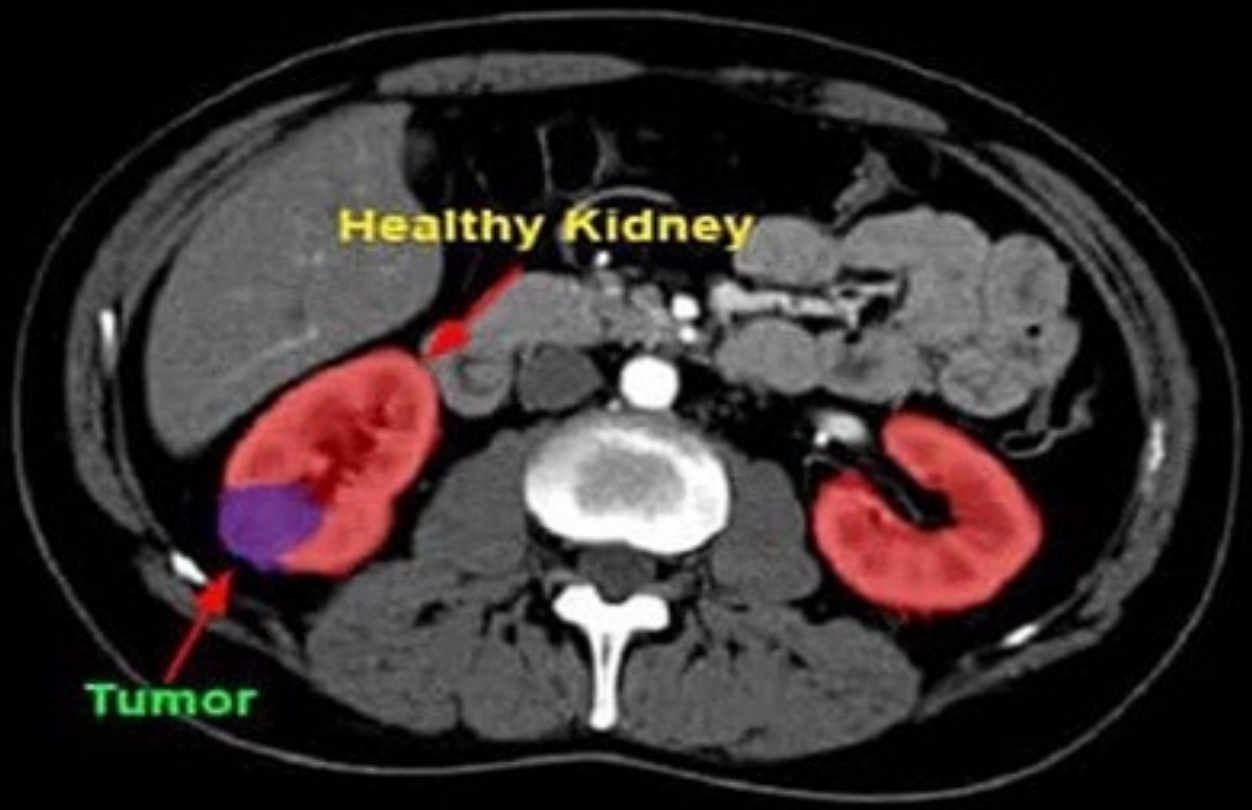
資料

人才



算力

轉譯



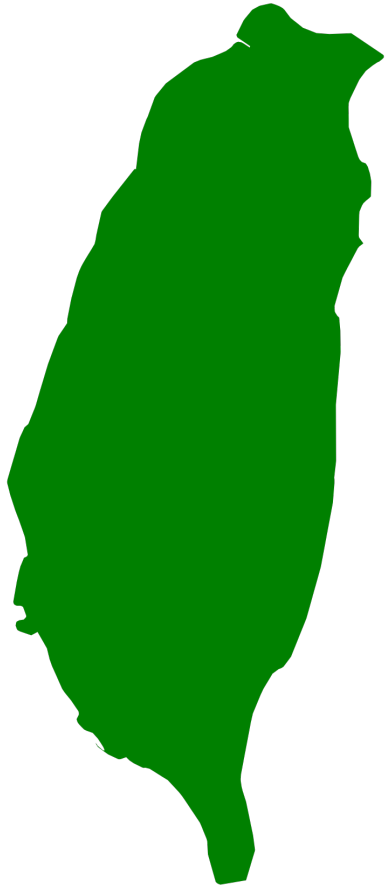
Medical image needs lots of efforts for annotation

Cross-disciplinary Training

人才

Opportunity

AnnotationIST

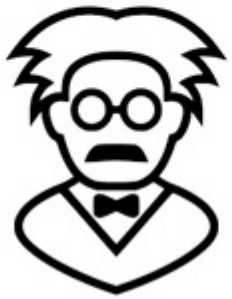


Challenge

Cross-disciplinary professionals

資料

人才



算力

轉譯

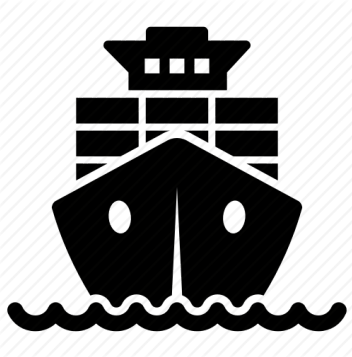
臺大醫院建置二套 NVIDIA DGX-A100
目前運算效能最快的AI超級電腦

醫學影像辨識、 基因體分析需要龐大的電腦儲存與算力

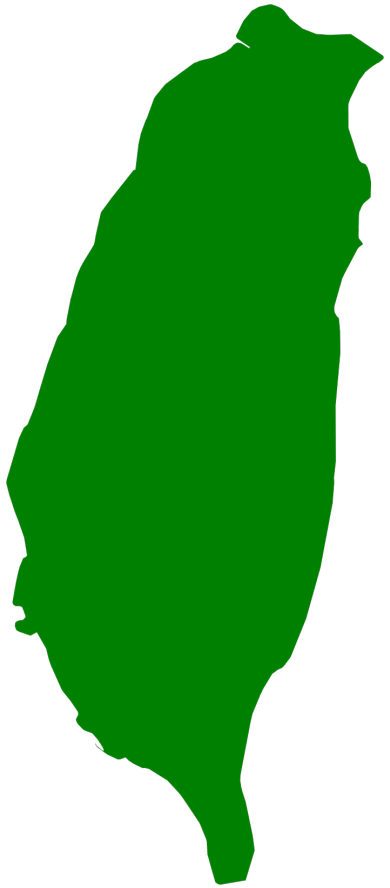
- 醫療影像: 提升2倍效能
- 自然語言: 提升5倍效能
- GPU 分成七個執行體，提升7倍效能
- 支援基因高速運算，提升2.25倍效能
- 人類全基因定序僅需20分鐘

算力

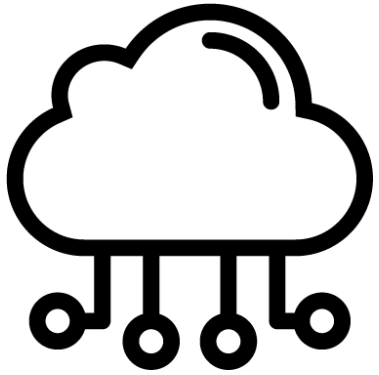
Opportunity



Strong IT industry



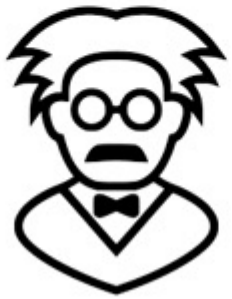
Challenge



Underuse of cloud computing

資料

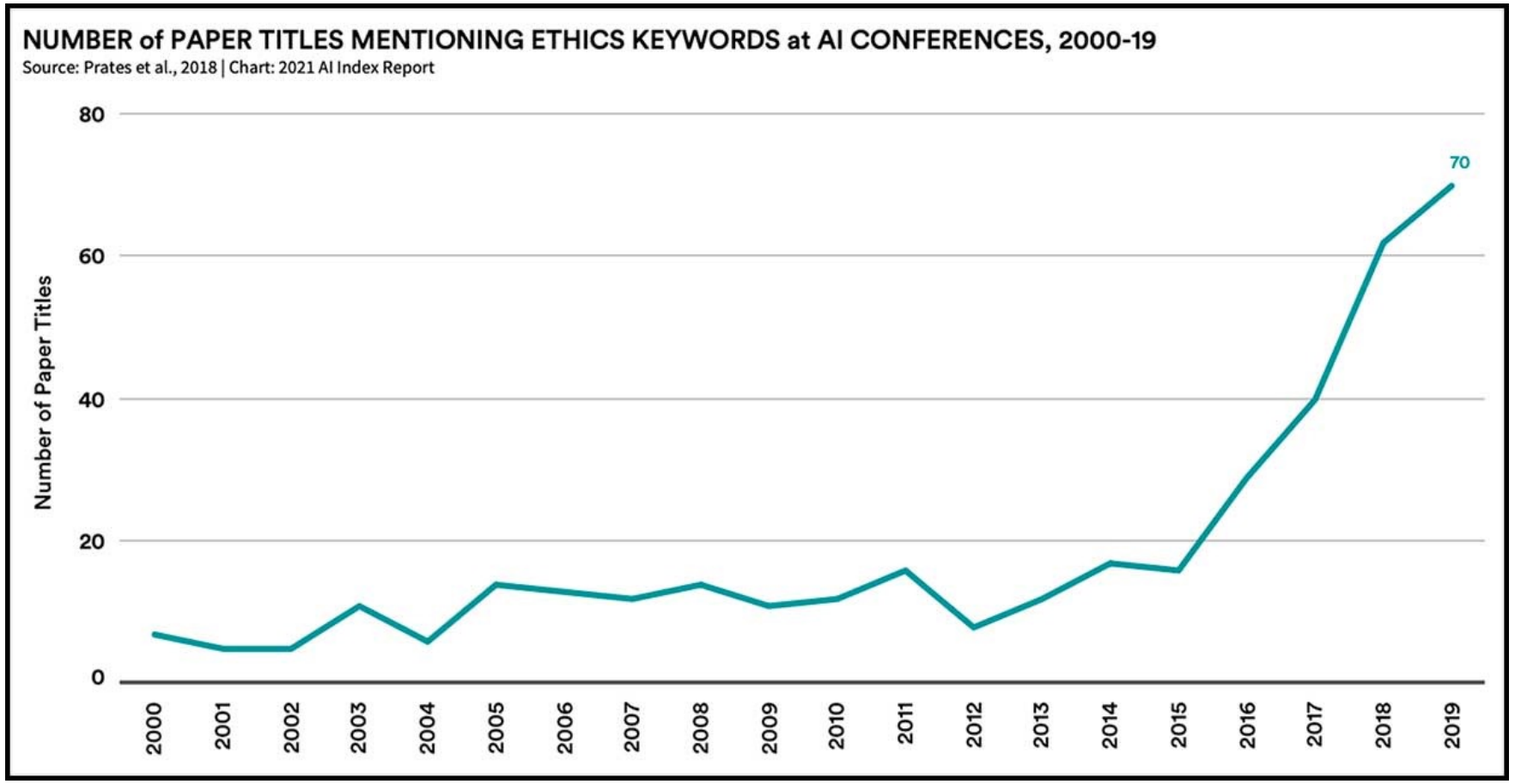
人才



算力

轉譯

AI paper hits record high



Newly funded AI startup record low

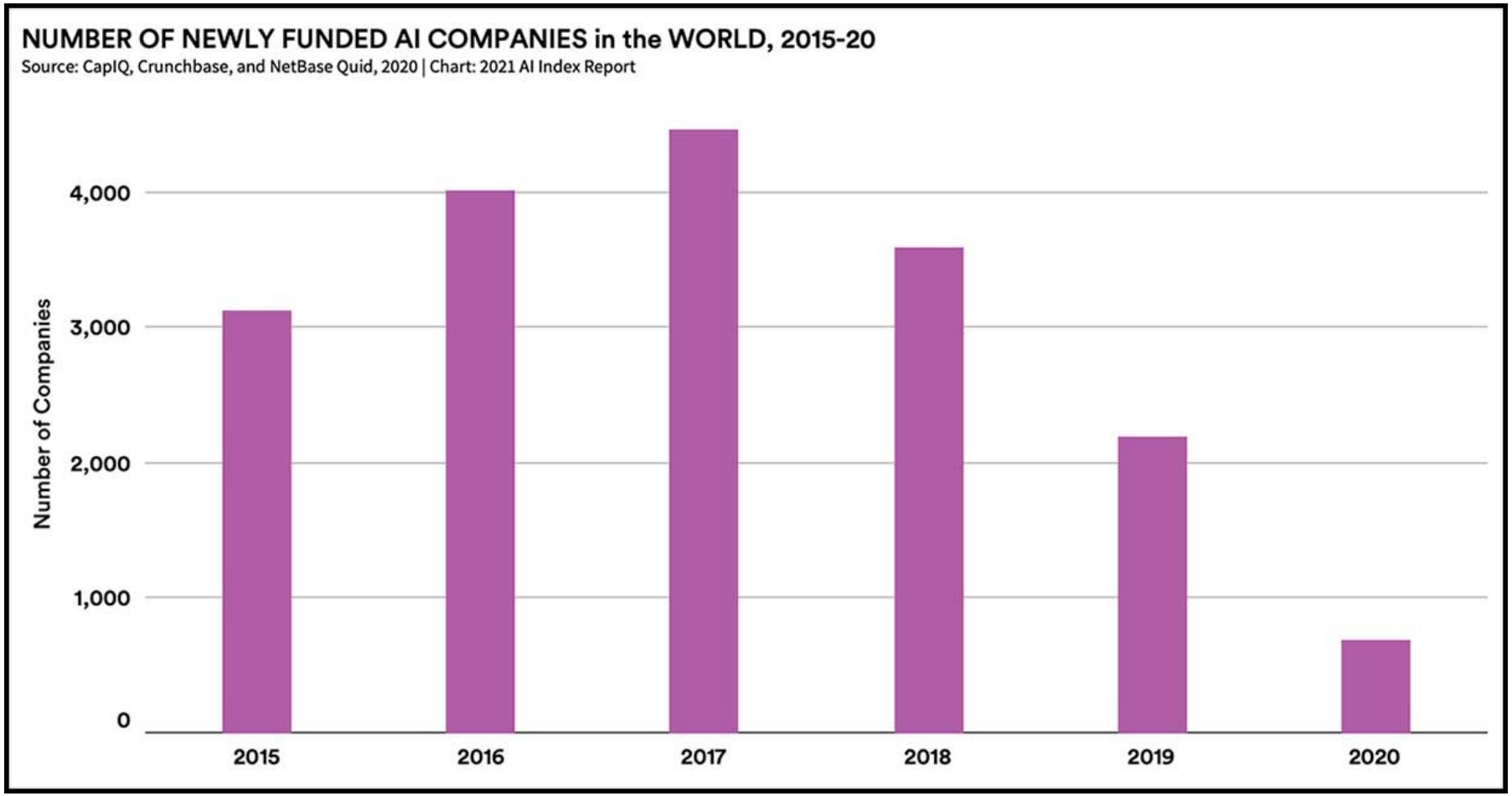


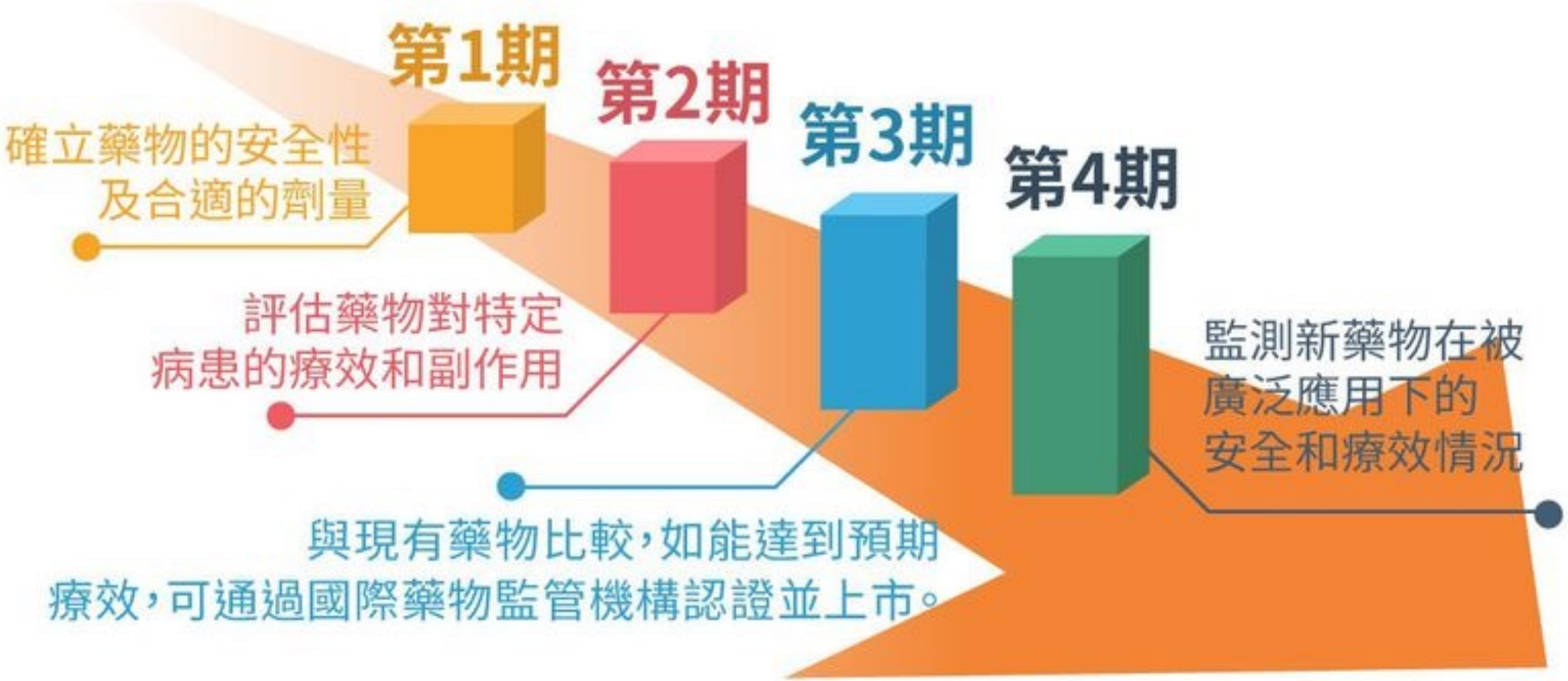
Table 1 Clinical machine learning readiness levels

TRL	NASA Definition	Clinical Definition	Explanation	Examples	Papers
1	Basic principles observed and reported	Clinical problem identification	Identification of potential medical machine learning solution to defined clinical problem. Appraisal of the literature is carried out. Medical research question is defined	Review of the literature giving clinical motivation for model Detailed clinical problem definition with identification of gap for novel machine learning solutions	0%
			al of potential medical machine to clini l and ou	Project proposal with Detailed description of proposed methods on prior to development	0%
			or mod **otential** **izing m** **ta**	**of novel machine learning techniques on** **t data contains predictive information** **earning model performance on prespecified** **nternal clinical data or online datasource**	**93%**
			odel is n origin lly data s are sp	tudy on retrospective data from other centers tudy on prospectively collected data, not levelopment of model and external validation	5%
			nce is te e EHR/ tings, bu v (i.e. n	rational studies E.g. comparing model ndard of care s for automated clinical data extraction ppropriate	1%
			ented in xposed t fety, and s are as valuated	2' safety / usability	0%
			del eval e 3' stud	al intervention trial implementing the model nically relevant outcomes to a control group tation intervention studies comparing clinically relevant outcomes	1%
9	Actual system proven through successful mission operations	Model integration	Model has proven to work in a research setting in its final form and in expected conditions. Model is integrated in the clinical workflow and evaluated in different centers (if appropriate) whether it meets specifications	Long term model evaluation after integration in a clinical workflow Studies reporting changes in clinical care and adaptation to model by clinical personnel Guidelines recommending machine learning tools in routine clinical practice Post-implementation surveillance studies	0%

Model prototyping & Model development

93%

AI 模型需要第三期臨床試驗



台大醫院成立智慧醫療中心

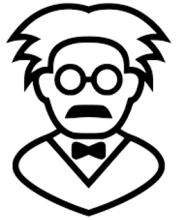
資料

華人最優質的
醫療大數據

算力

啟用2台
AI 超級電腦/
建置運算專區

人才



60個臺灣大學
人工智慧團隊/

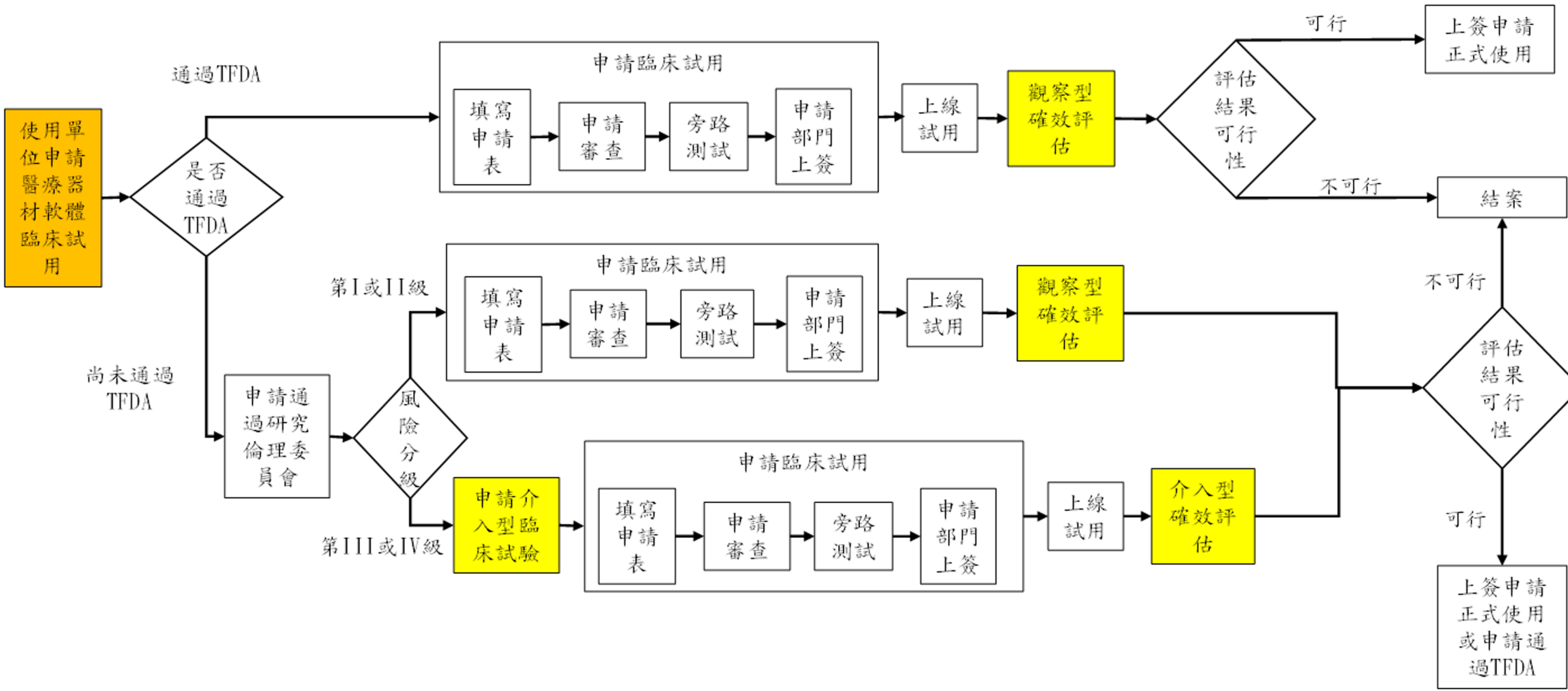
轉譯

臨床試驗場域/
推動醫療醫材
軟體試用

落地辦法

- 資訊安全
- 病患隱私資料不外洩
- 不影響Portal系統效能
- 確效機制與定期紀錄

台大醫院醫療器材軟體試用申請流程



適用之醫療照護情況	提供的資訊對於臨床照護決策之重要性		
	治療或診斷	驅動(drive)臨床管理	告知(inform)臨床管理資訊
危急情況	IV	III	II
嚴重情形	III	II	I
非嚴重情況	II	I	I

說明：

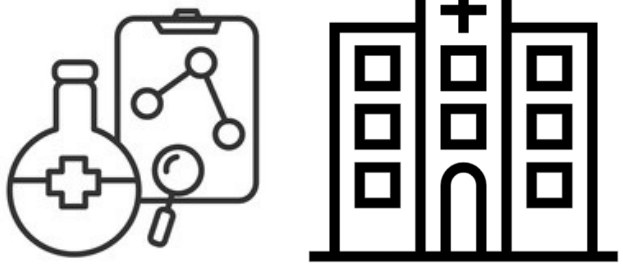
1.治療或診斷：醫材軟體輸出資訊直接作為醫師治療或診斷的依據

2.驅動(drive)臨床管理: 醫材軟體輸出的資訊啟動醫護人員對病人進行二度評估或介入

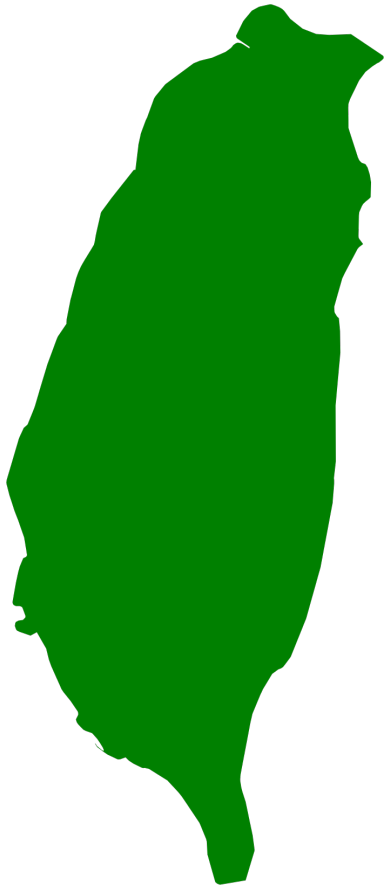
3.告知(inform)臨床管理資訊：醫材軟體輸出之資訊僅供參考，醫療診斷或決策由醫護人員執行

轉譯

Opportunity



High Quality Clinical Trial Center

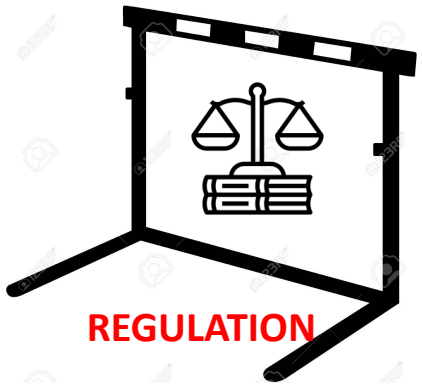


Challenge

PHASE III TRIAL

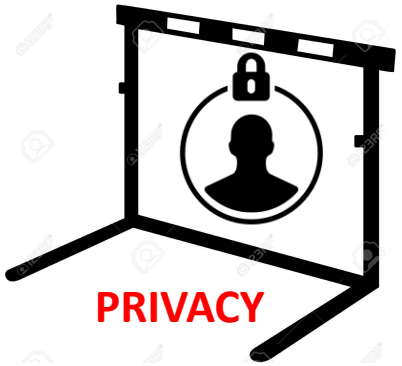
Education
Regulation

DATA ECONOMY



DATA SCIENCE

REGULATION



PRIVACY

DATA

Thank You

李建璋
台大智醫中心副主任