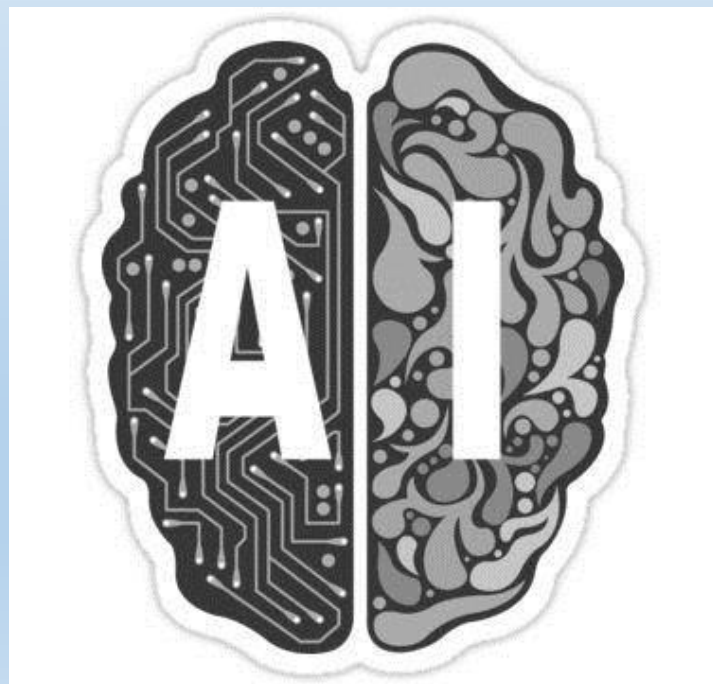


醫界的AI新思維



蔡輔仁 特聘教授

Fuu-Jen Tsai

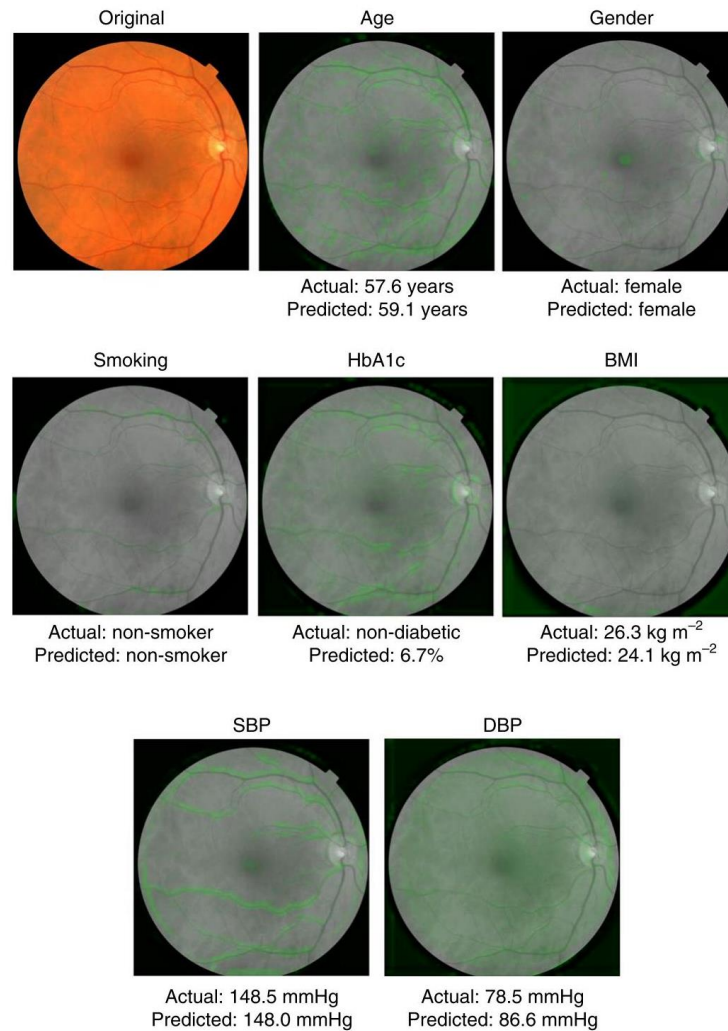
中國醫藥大學

Google 旗下人工智慧子公司 DeepMind 派出 AlphaGo

AlphaGO Win ! 4:1

人類贏AI的「最後一局」！





農曆七月?

Fig. 2 | Attention maps for a single retinal fundus image. The top left image is a sample retinal image in colour from the UK Biobank dataset. The remaining images show the same retinal image, but in black and white. The soft attention heat map (Methods) for each prediction is overlaid in green, indicating the areas of the heat map that the neural-network model is using to make the prediction for the image. For a quantitative analysis of what was highlighted, see Table 6. HbA1c values are not available for UK Biobank patients, so the self-reported diabetes status is shown instead.

2017-19 FDA Approved AI Product (all Class II)

醫療AI時代 33



• 20171116	K171816	DXH,DPS	Kardia Band	Apple watch ECG watchstrap	• 20180911	DEN180042	QDB	Irregular Rhythm Notification Feature	AFib
• 20180104	K171056	MWI	WAVE Clinical Platform	AI SCD alarm	• 20180928	K173872	DXH	FibriCheck	AFib
• 20180125	K173542	LLZ	Arterys Oncology DL	Broad Oncology Imaging Suite	• 20181026	K180647	QAS	MaxQ-AI / Accipio Ix	ICH Evaluation
• 20180126	K172935	POS	Embrace	Seizure Detection (20181220 / K181861)	• 20181017	K182034	LLZ	Arterys MICA	Medical Imaging Cloud AI
• 20180213	DEN170073	QAS	Viz LVO	Angiophraxis of Large Vessel	• 20181106	K181939	LLZ	Icometrix NV	BrainCT segmentation
• 20180308	P160007	MDS	Guardian Connect system	Blood Sugar Monitor	• 20181119	K180432	DQK,DPS	AI-ECG Platform	AI-ECT
• 20180309	K173972	LLZ	Quantib Brain	Brain Radiology for brain scan segmentation	• 20181121	K181704	QDQ	Transpara	Mammography
• 20180411	DEN180001	QDB	IDx-DR	Diabetic Retinopathy	• 20181130	K182336	KPS	SubtlePET	PET Imaging
• 20180429	K180161	LLZ	Viz CIP	Brain Stroke	• 20181106	K182336	QDQ	PowerLook	Digital Breast Tomosynthesis
• 20180522	K180055	IYN	NeuralBot	Ultrasound Cerebral Flow rate Prediction	• 20181210	K173681	PWE	Athena	COVID treatment
• 20180524	DEN180005	QBS	ClearDetect	AI Fracture Detection	• 20181117	K173544	LLZ	Quantib ND	Atrophy quantification and WMH detection
• 20180612	DEN170043	QCC	DreaMed Advisor Pro	Dose of Insulin Detection	• 20190219	K183241	PIW	BrainScope	TBI Head Injury Evaluation
• 20180613	K172983	JAK	HealthCCS	Radiology Triage	• 20190308	K183285	QFM	CmTriage	Malignant Lesion on Mammography
• 20180614	K173780	LLZ	EchoMD	Cardiac Ultrasound Measurement	• 20190506	K190362	QFM	HealthPNX	ChestXray Pneumothorax
• 20180718	K173327	JIL	DIP/U.S. Urine Analysis Test System	Urine Test	• 20190710	K182875	QAS	Deep01	ICH Detection
• 20180730	K080896	OIW	PATHWORK	Malignancy Prediction in Tissue Sample					
• 20180801	K180647	QAS	Aidoc BriefCase	AI-assisted radiology triage					
• 20180810	K180234	DPS	PhysiQ	Heart Rhythm Module					

Artificial Intelligence and Machine Learning in Software as a Medical Device



Where is Taiwan?

The 3 major factors for Medical AI

Medical Data

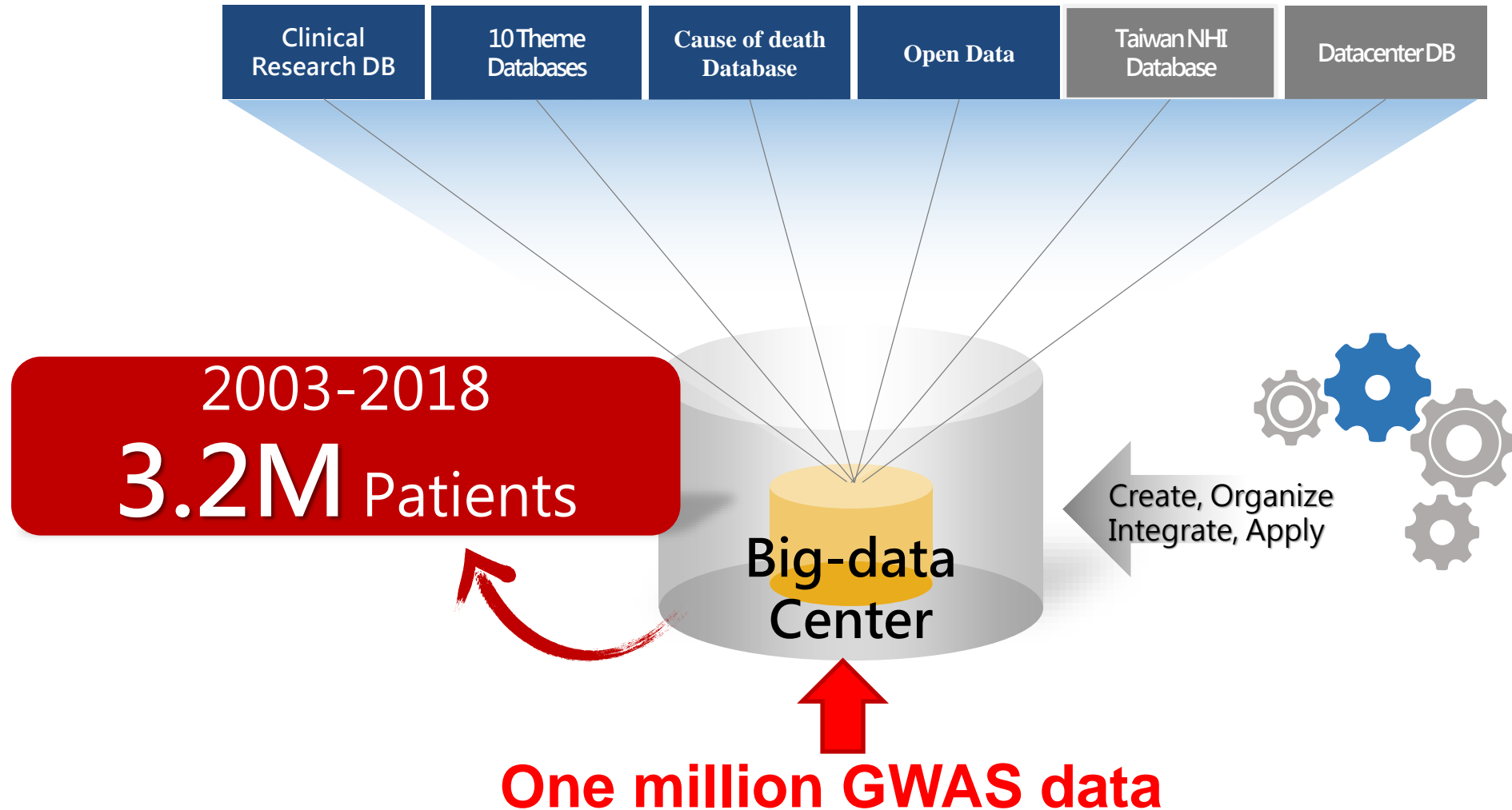
Medical Need

Medical Application

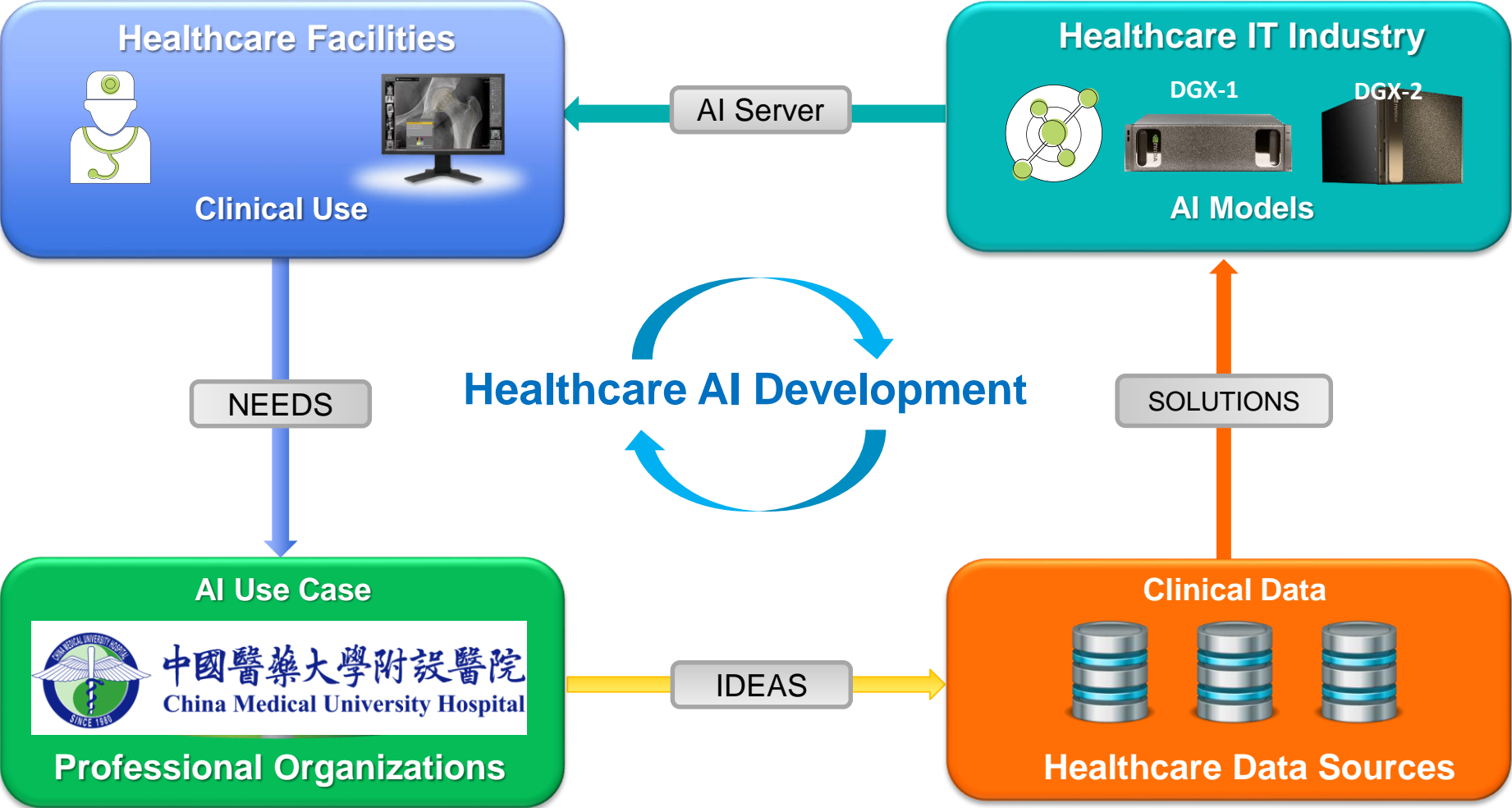
Big-data center in CMUH



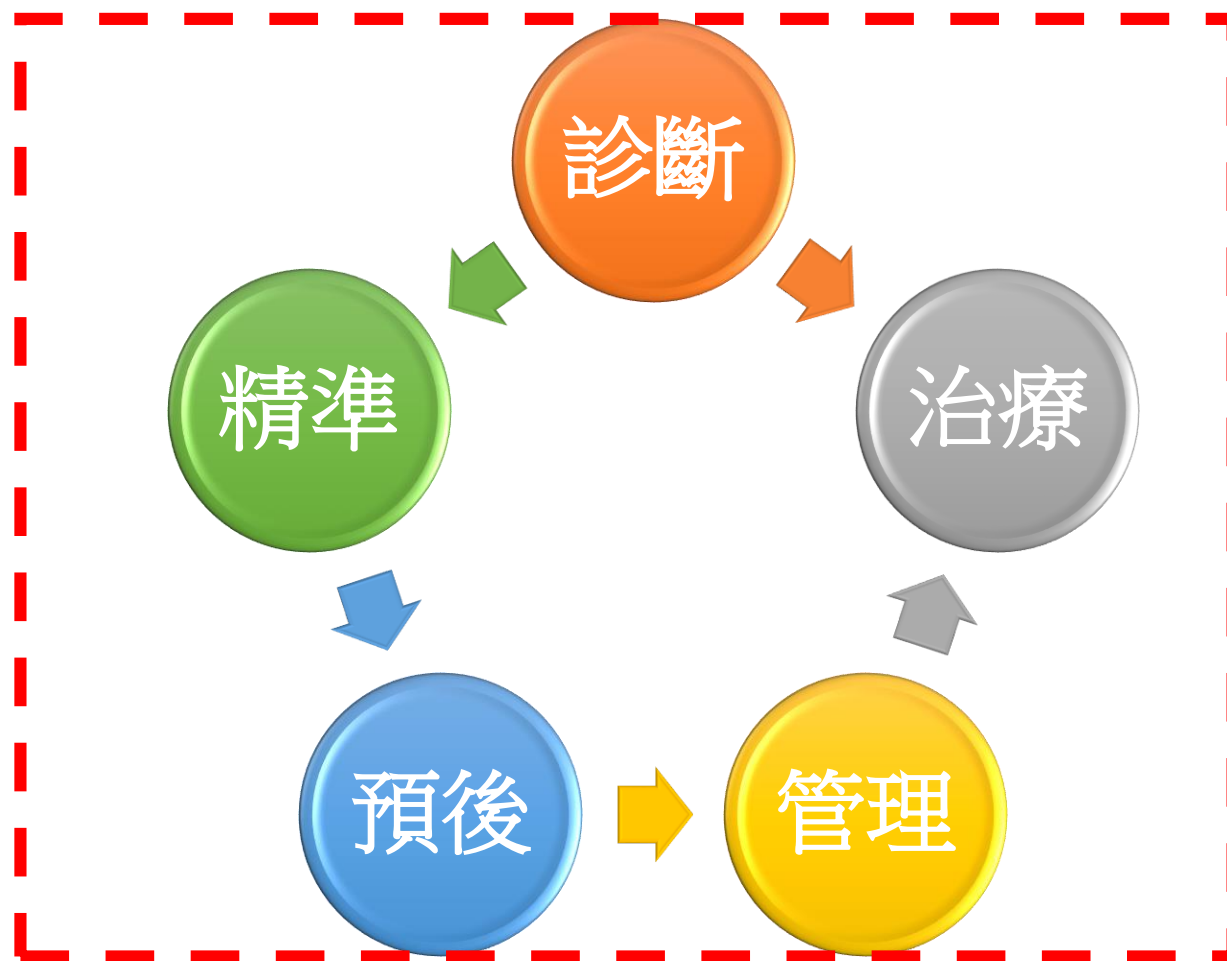
中國醫藥大學
China Medical University



Total Product Verification Environment

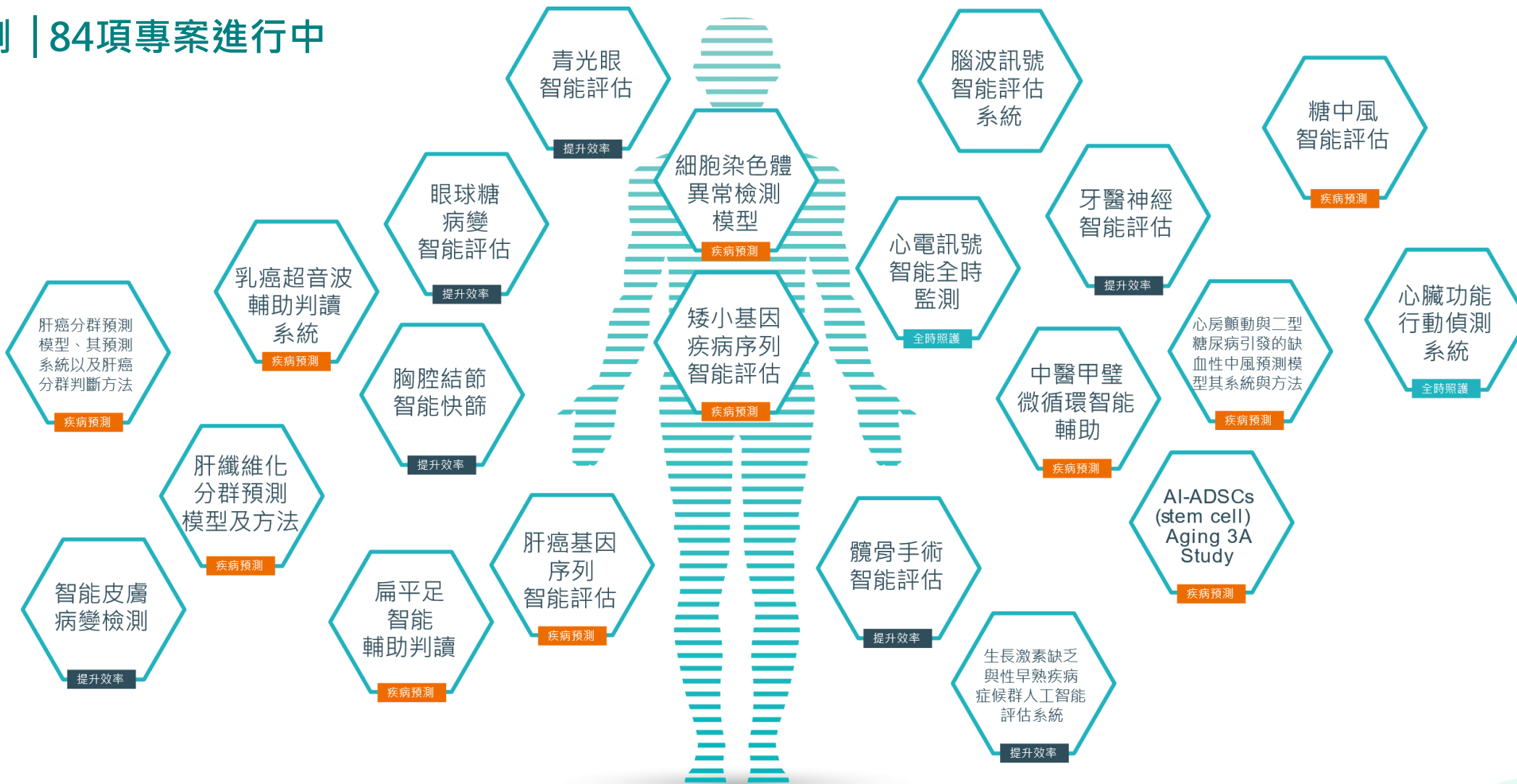


人工智慧於醫療之多面向



Our solution

短期規劃 | 84項專案進行中

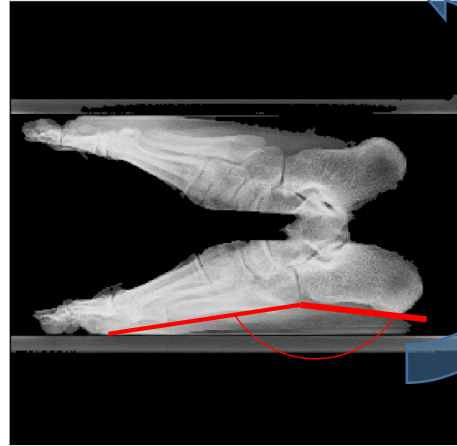


Flat Foot– Current Clinical Assessment

Abnormal: (154.8, 157.4)



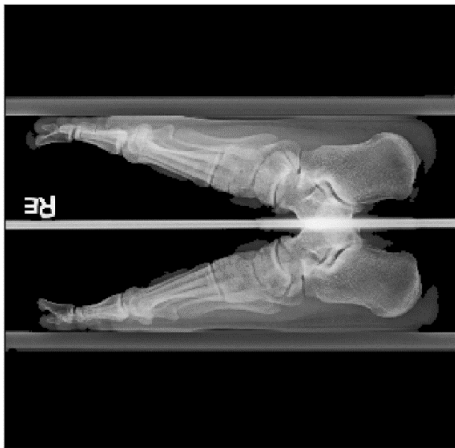
Abnormal: (165.9, 166.6)



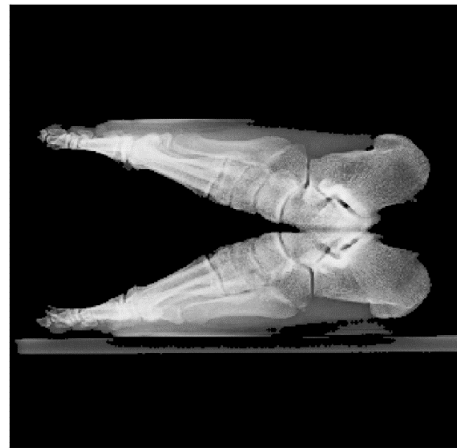
1. 足弓角度測量方法：醫師量測足之正側位站立照X光，第五跖骨兩端下緣連線與跟骨兩端下緣連線之交角為足弓角

2. 目前足弓角超過168度為免役體位

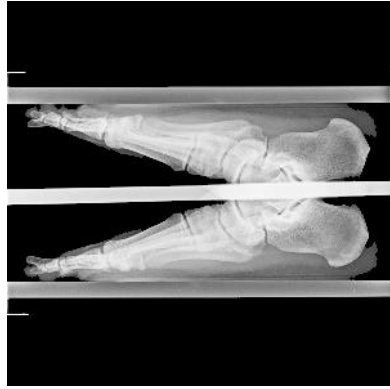
Abnormal: (162.8, 165.7)



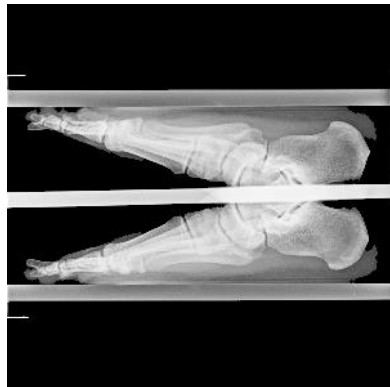
Abnormal: (158.6, 157.6)



Flat Foot Model - Overview

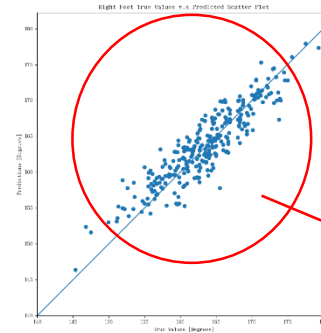
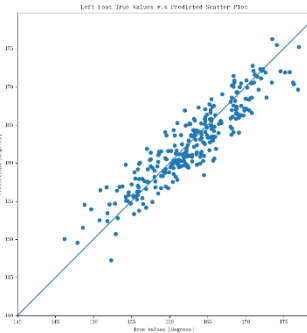
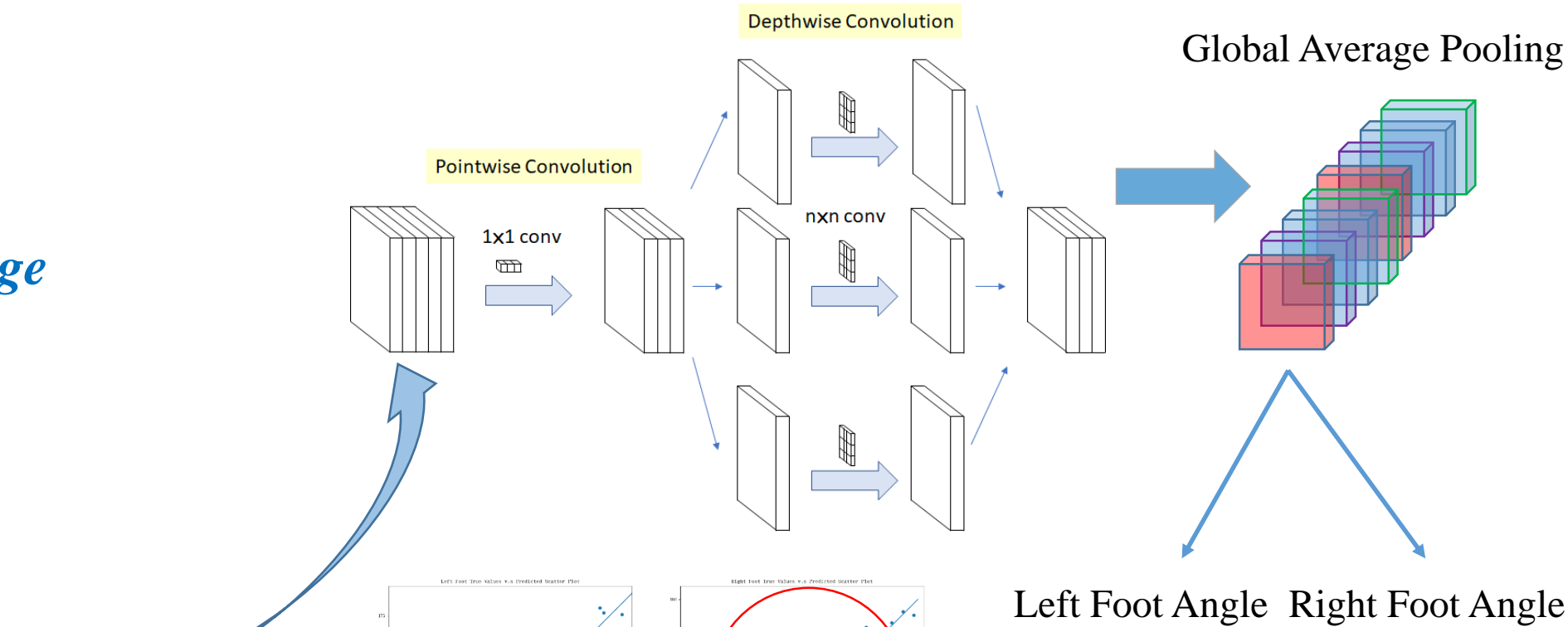


Step1: Input Raw Image



Step2: Resize Image

Step3: Model Training (Xception)



Step4: Output Prediction

Scatter Plot: True v.s. Predicted

結果：高精準度及預測力

評比項目：圈選腫瘤

評比結果：相似度可達

98%

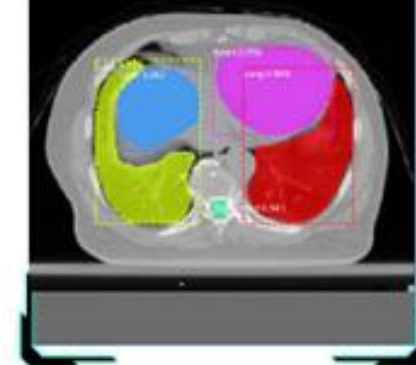
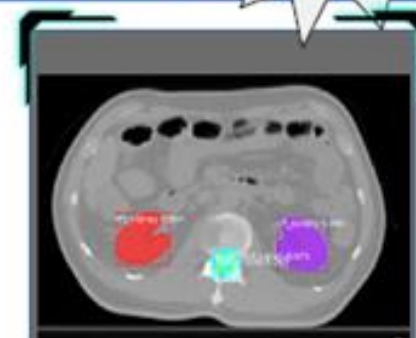
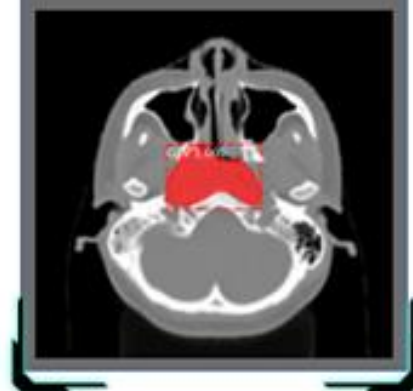
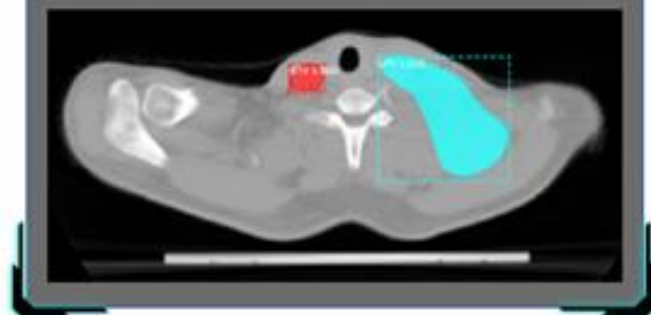
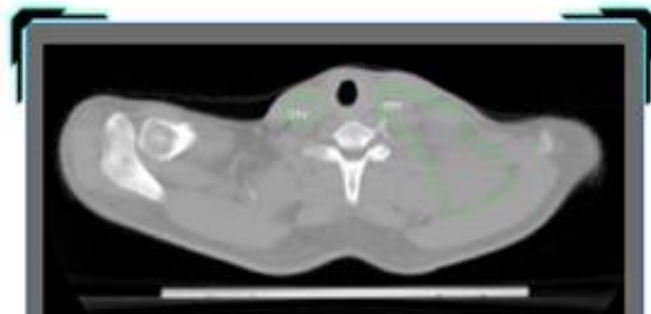


醫師勾畫

VS.



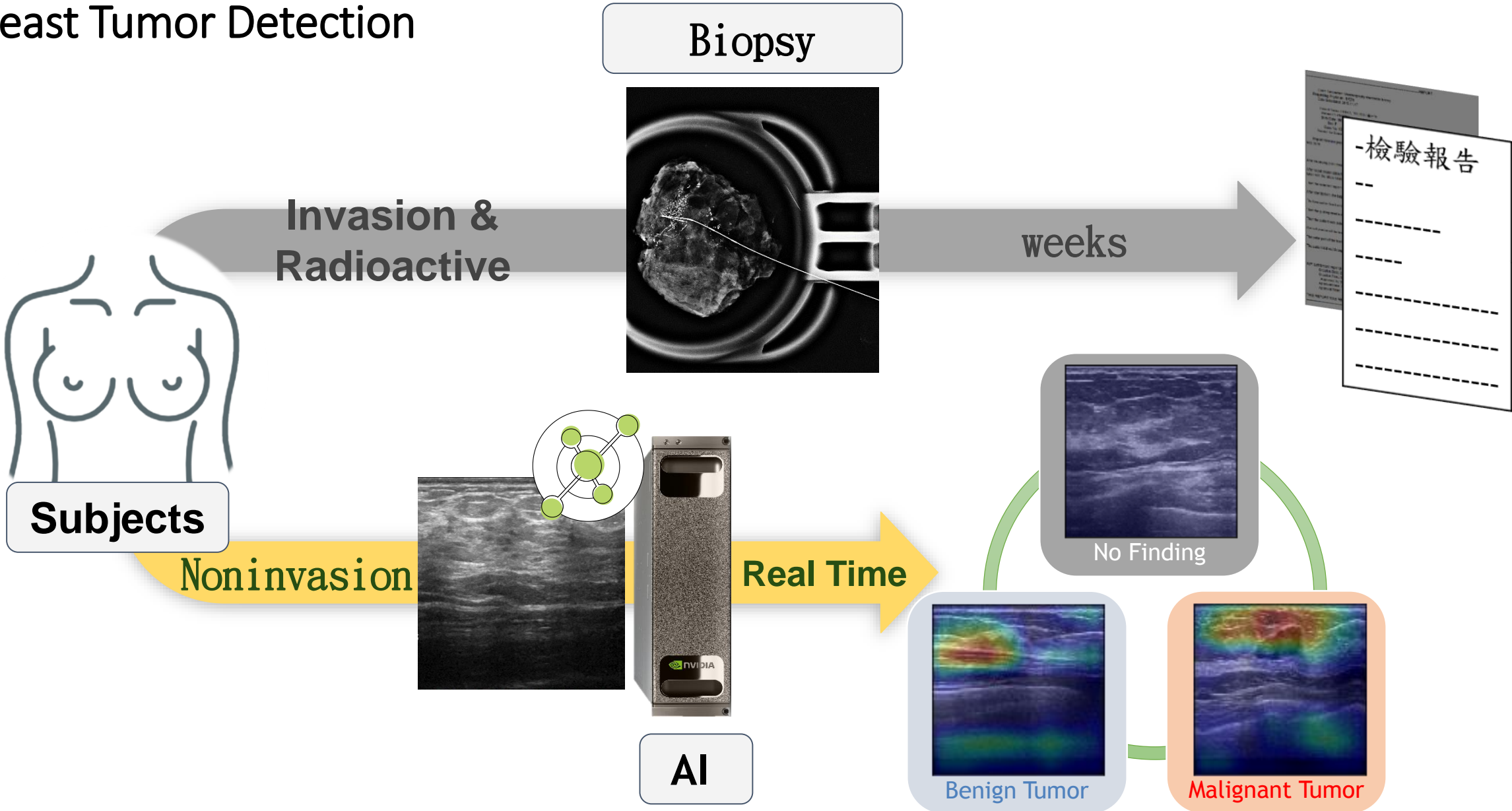
自動勾畫系統



AI影像勾畫系統

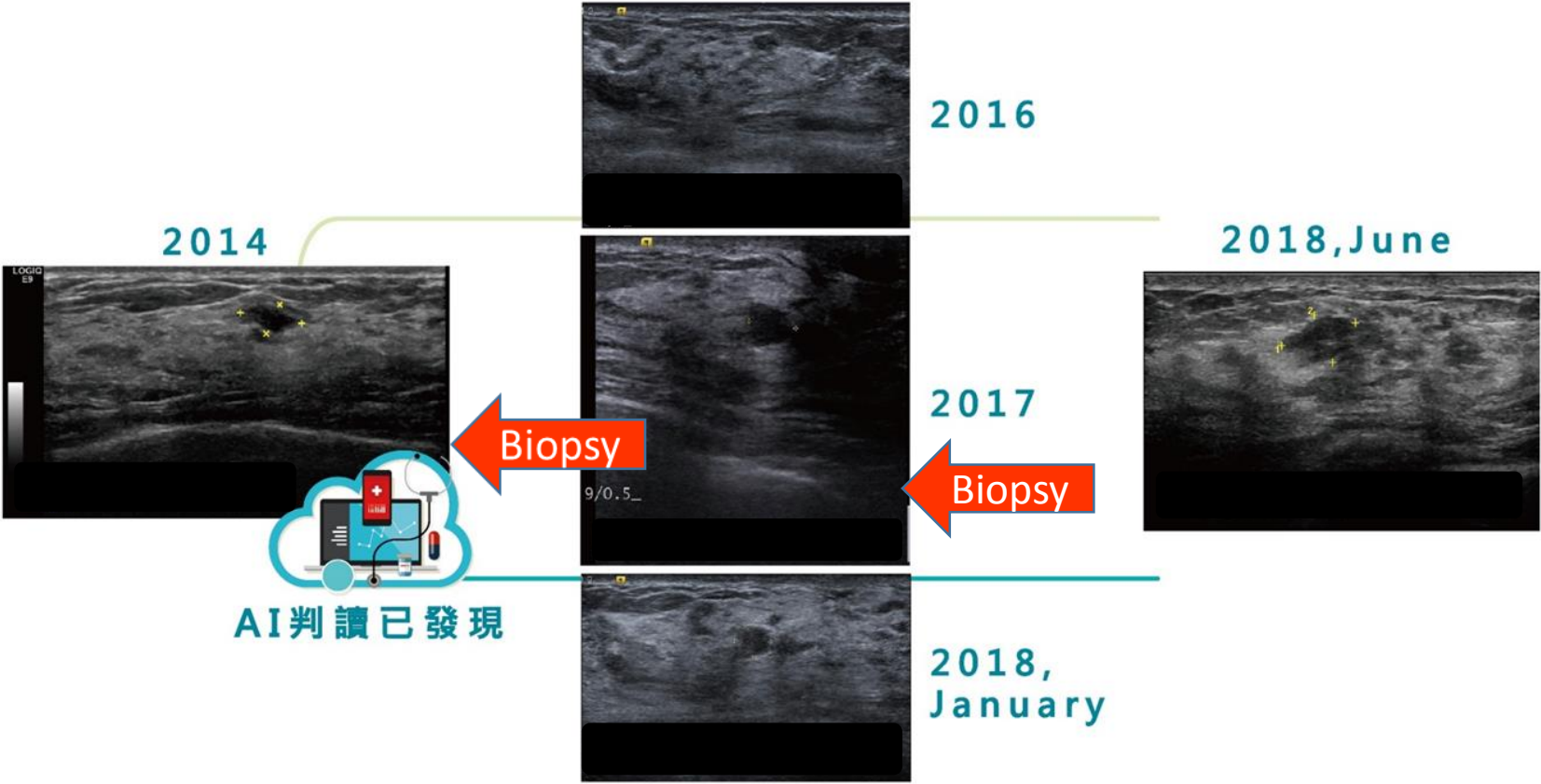


Breast Tumor Detection

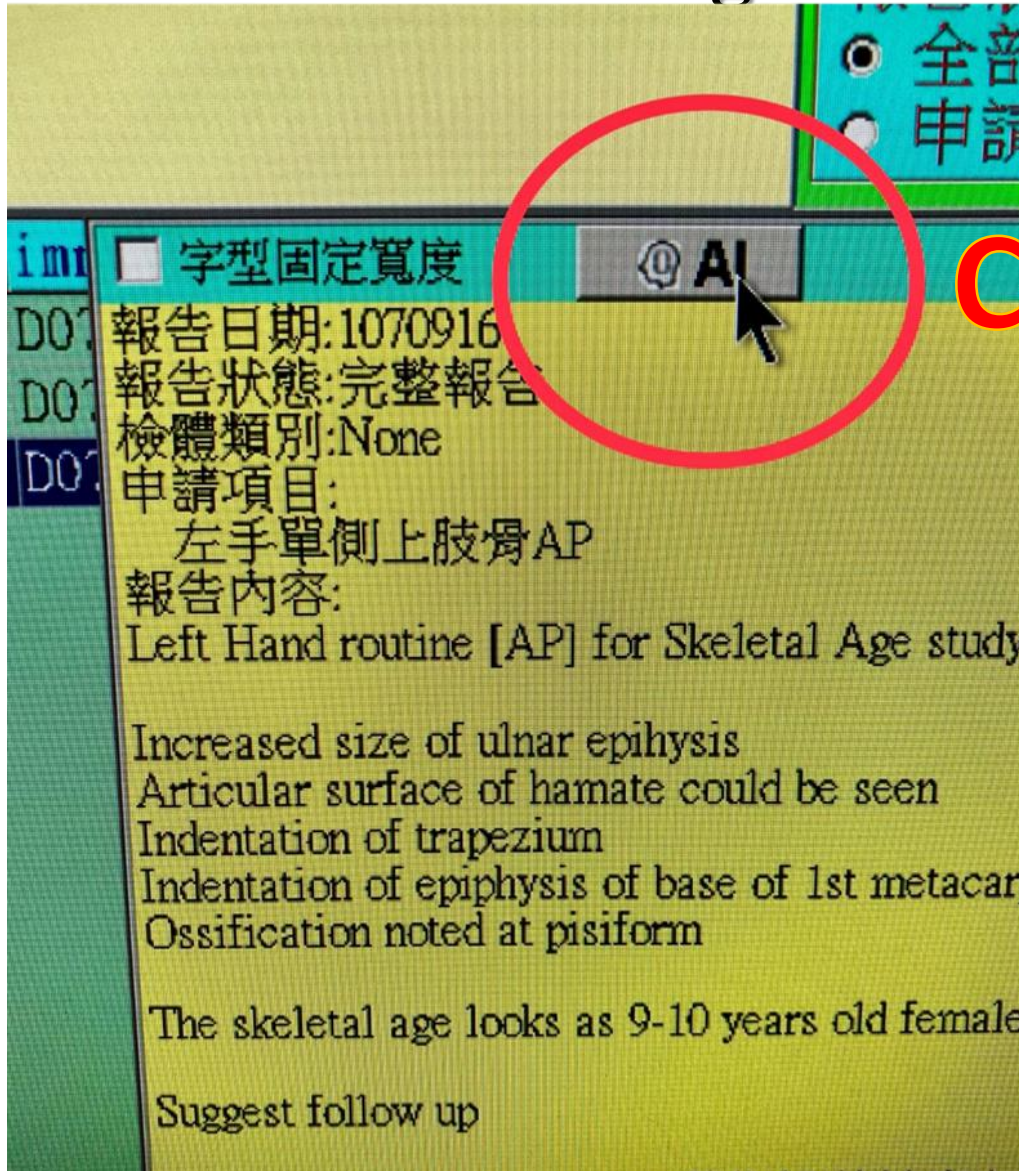


AI model can help physician make decisions more efficiently and precisely

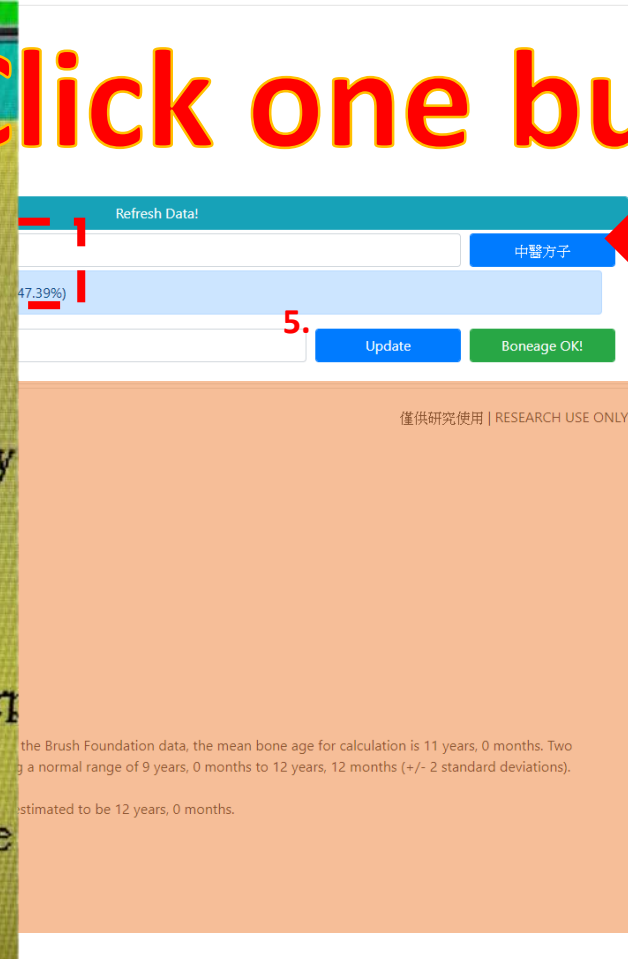
AI 提早發現潛在乳癌
增加治療黃金期以及準確率



Bone age assessment

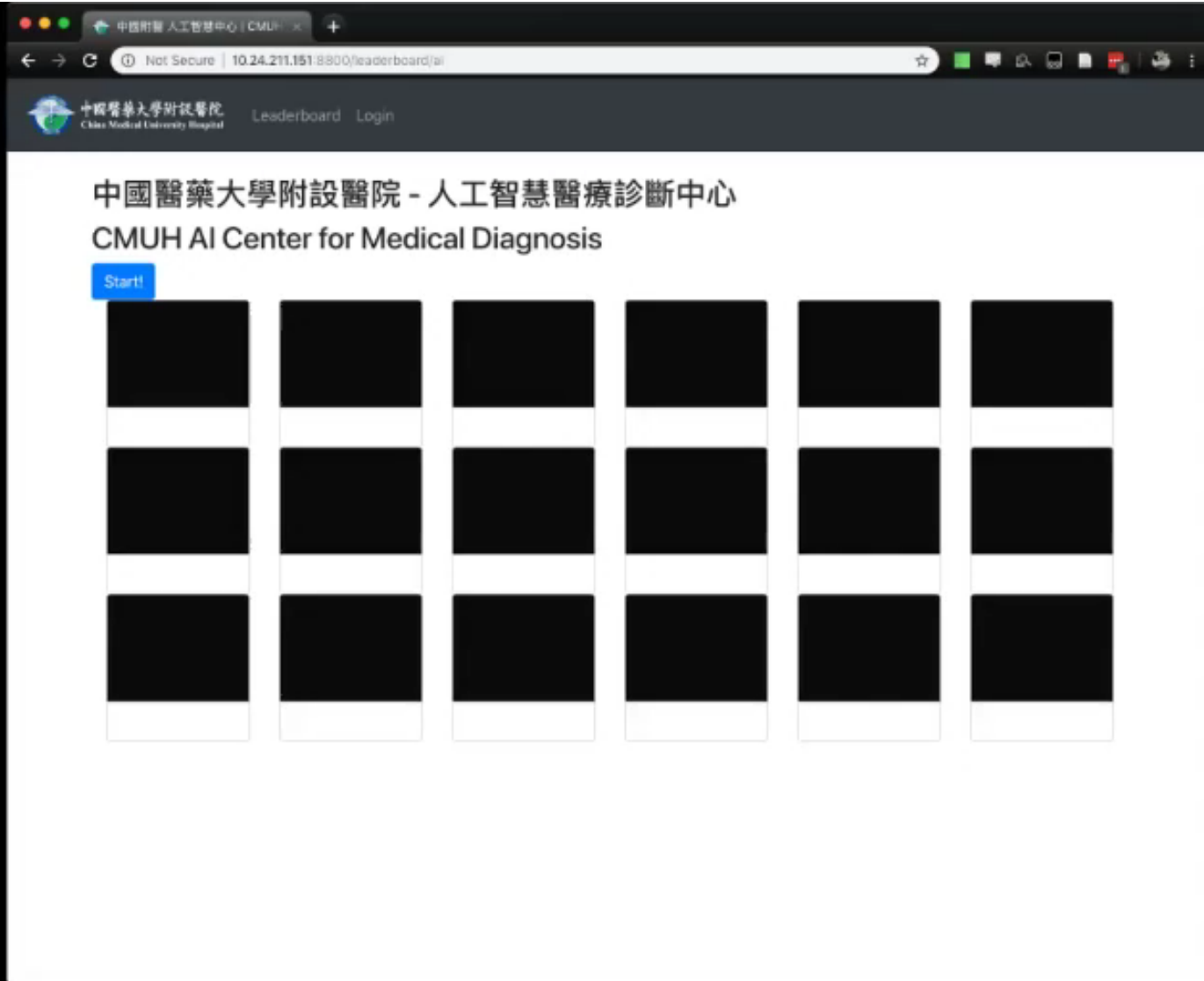


Click one button



the Brush Foundation data, the mean bone age for calculation is 11 years, 0 months. Two
g a normal range of 9 years, 0 months to 12 years, 12 months (+/- 2 standard deviations).

estimated to be 12 years, 0 months.



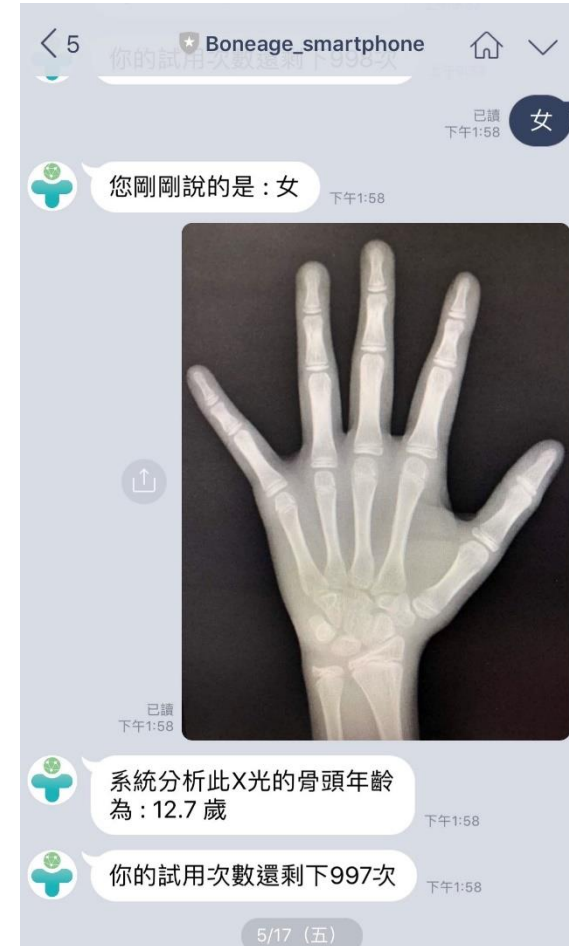
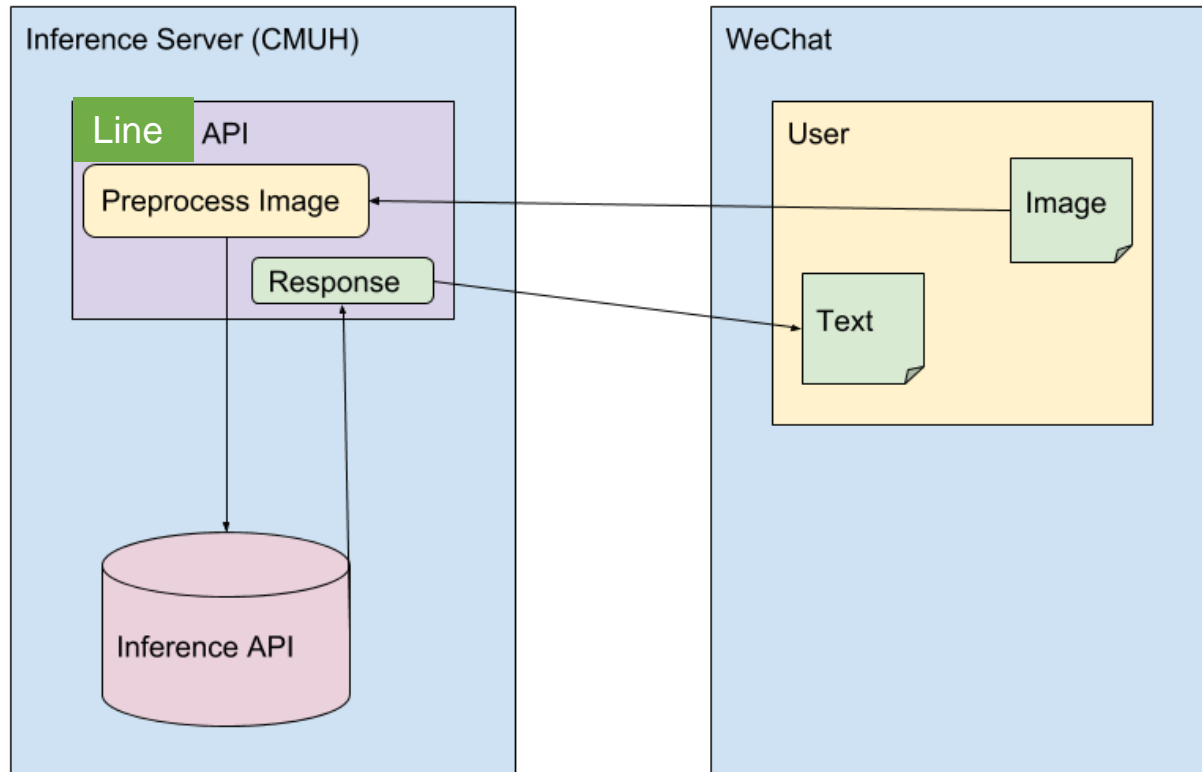
The screenshot shows a web browser window with the following elements:

- Browser Address Bar:** Shows the URL `10.24.211.151:8800/leaderboard/ai` and the text "Not Secure".
- Page Header:** Includes the logo of "中國醫藥大學附設醫院" (China Medical University Hospital) and the text "Leaderboard Login".
- Main Title:** "中國醫藥大學附設醫院 - 人工智慧醫療診斷中心" (China Medical University Hospital - AI Center for Medical Diagnosis) and "CMUH AI Center for Medical Diagnosis".
- Content:** A blue "Start!" button is positioned above a 3x6 grid of 18 black rectangular placeholders, which likely represent data points or images in a leaderboard.

clinical trial for Bone age AI

Pairwise CCC		
CCC: doctor vs. doctor	Doc1 vs. Doc2 pairwise CCC	0.9360
	Doc1 vs. Doc3 pairwise CCC	0.9345
	Doc1 vs. Doc4 pairwise CCC	0.9749
	Doc1 vs. Doc5 pairwise CCC	0.9648
	Doc2 vs. Doc3 pairwise CCC	0.9848
	Doc2 vs. Doc4 pairwise CCC	0.9410
	Doc2 vs. Doc5 pairwise CCC	0.9462
	Doc3 vs. Doc4 pairwise CCC	0.9461
	Doc3 vs. Doc5 pairwise CCC	0.9512
	Doc4 vs. Doc5 pairwise CCC	0.9712
CCC: doctor vs. AI	Doc1 vs. AI	0.9822
	Doc2 vs. AI	0.9279
	Doc3 vs. AI	0.9368
	Doc4 vs. AI	0.9822
	Doc5 vs. AI	0.9721
Overall CCC		0.9574

Available for Line and WeChat





2.5 hours

Colony	No	Slide	Chroms No	D prep	Fluor	Cardiast	Identification	Key-typing	Photo Image	Karyotype	Note
1	1	β1	47	6	4	42,2,7,12	47,XX,i-1	①		47,XX,i-1	
2	2	β1	46	6	5	46,XX,12	46,XX,12	②	✓	46,XX,12	
3	3	β1	46	6	5	46,XX,12	46,XX,12	③	✓	46,XX,12	
4	4	β1	46	6	5	46,XX,12	46,XX,12	④	✓	46,XX,12	
5	5	β1	46	6	5	46,XX,12	46,XX,12	⑤	✓	46,XX,12	
6	6	β1	46	6	5	46,XX,12	46,XX,12	⑥	✓	46,XX,12	
7	7	β1	46	6	5	46,XX,12	46,XX,12	⑦	✓	46,XX,12	
8	8	β1	46	6	5	46,XX,12	46,XX,12	⑧	✓	46,XX,12	
9	9	β1	46	6	5	46,XX,12	46,XX,12	⑨	✓	46,XX,12	
10	10	β1	46	6	5	46,XX,12	46,XX,12	⑩	✓	46,XX,12	
11	11	β1	46	6	5	46,XX,12	46,XX,12	⑪	✓	46,XX,12	
12	12	β1	46	6	5	46,XX,12	46,XX,12	⑫	✓	46,XX,12	
13	13	β1	46	6	5	46,XX,12	46,XX,12	⑬	✓	46,XX,12	
14	14	β1	46	6	5	46,XX,12	46,XX,12	⑭	✓	46,XX,12	
15	15	β1	46	6	5	46,XX,12	46,XX,12	⑮	✓	46,XX,12	
16	16	β1	46	6	5	46,XX,12	46,XX,12	⑯	✓	46,XX,12	
17	17	β1	46	6	5	46,XX,12	46,XX,12	⑰	✓	46,XX,12	
18	18	β1	46	6	5	46,XX,12	46,XX,12	⑱	✓	46,XX,12	
19	19	β1	46	6	5	46,XX,12	46,XX,12	⑲	✓	46,XX,12	
20	20	β1	46	6	5	46,XX,12	46,XX,12	⑳	✓	46,XX,12	
21	21	β1	46	6	5	46,XX,12	46,XX,12	㉑	✓	46,XX,12	
22	22	β1	46	6	5	46,XX,12	46,XX,12	㉒	✓	46,XX,12	

0.1 second

Date Collected: 08/17/18 Date Received: 08/17/18
 Date of culture: 08/17/18 Date of report: 08/27/18
 Staining Methods: G-banding(500 bands)
 Specimen Quality: Good Acceptable Poor Unacceptable

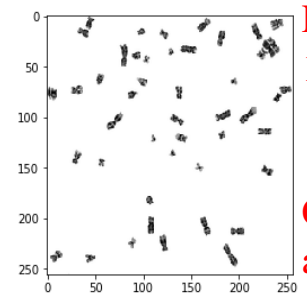
Results:
 Chromosome counts: <45 45 46 47 >47 Total
 No. of colonies: 19
 No. of cells: 21 21
 Karyotype: 47,XX,inv(9)(p12q13),+21

Interpretation:
 Chromosome analysis of 21 cells cultured from the amniotic fluid sample revealed an abnormal female karyotype 47,XX,inv(9)(p12q13),+21, compatible with clinical findings of Down syndrome.
 According to general guidelines, whenever the result is abnormal, a post-amniocentesis genetic counseling session should be made available to the patient and her husband.
 If the patient chooses to terminate the pregnancy, please notify us the time and location of the therapeutic abortion so that arrangement can be made to transport specimens to our laboratory for confirmation study.

Technologist: [Signature] Director: [Signature] M.D., Ph.D.

```
In [35]: g = gen(val_df, 1)
a, b = next(g)
plt.imshow(((np.squeeze(b)*127.5)+127.5).astype(np.uint8), cmap='gray')
```

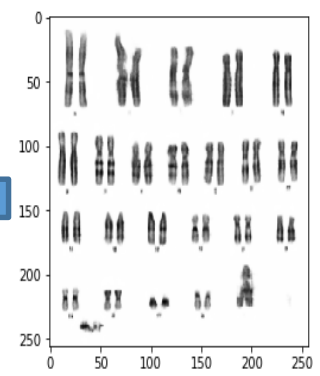
Out[35]: <matplotlib.image.AxesImage at 0x7f03fc0881d0>



- Features :
1. Detection number of chromosome
 2. Identify each Chromosome and arrange order

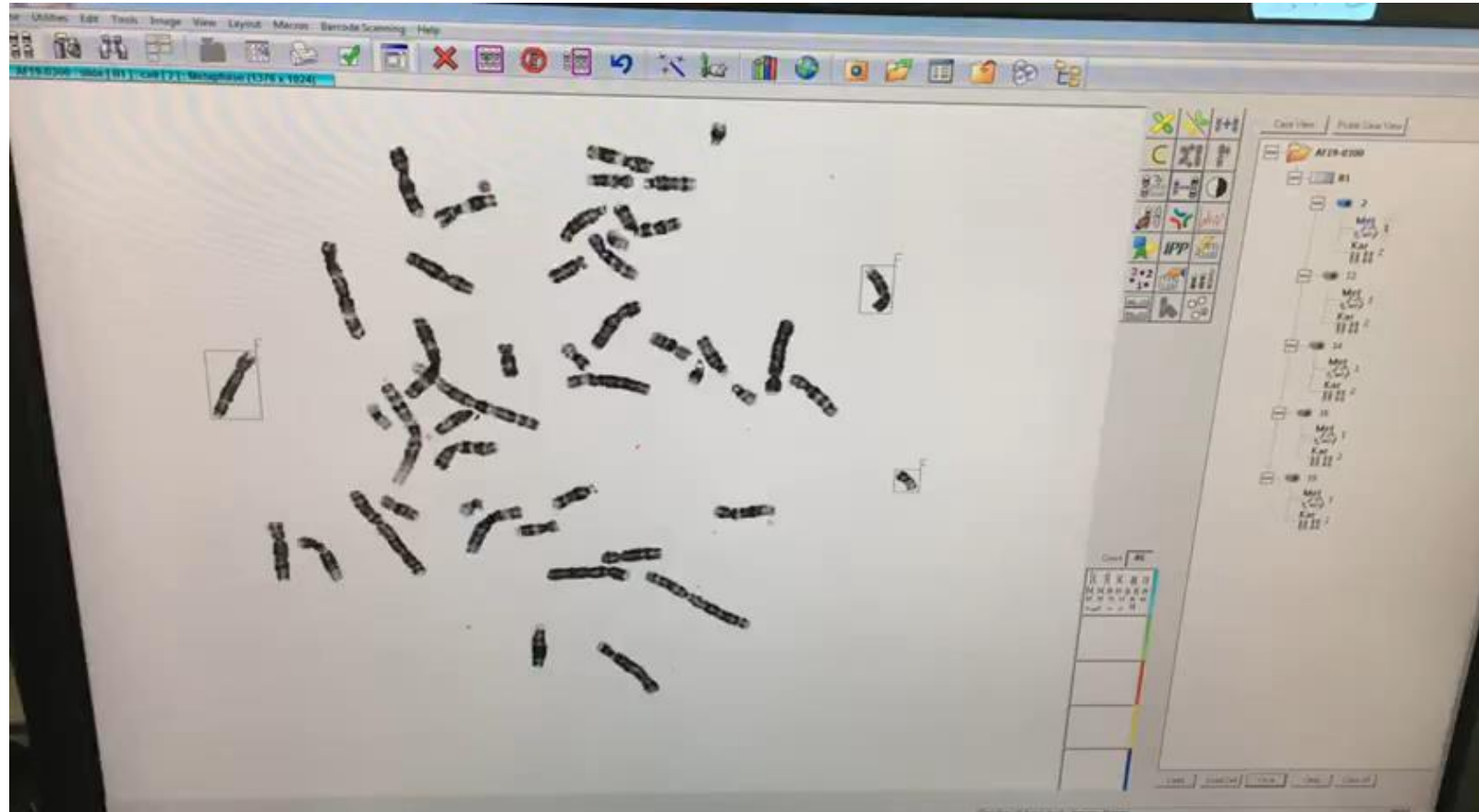
```
In [37]: a_p = generator.predict(b)
plt.imshow(((np.squeeze(a_p)*127.5)+127.5).astype(np.uint8), cmap='gray')
```

Out[37]: <matplotlib.image.AxesImage at 0x7f03e3f72160>

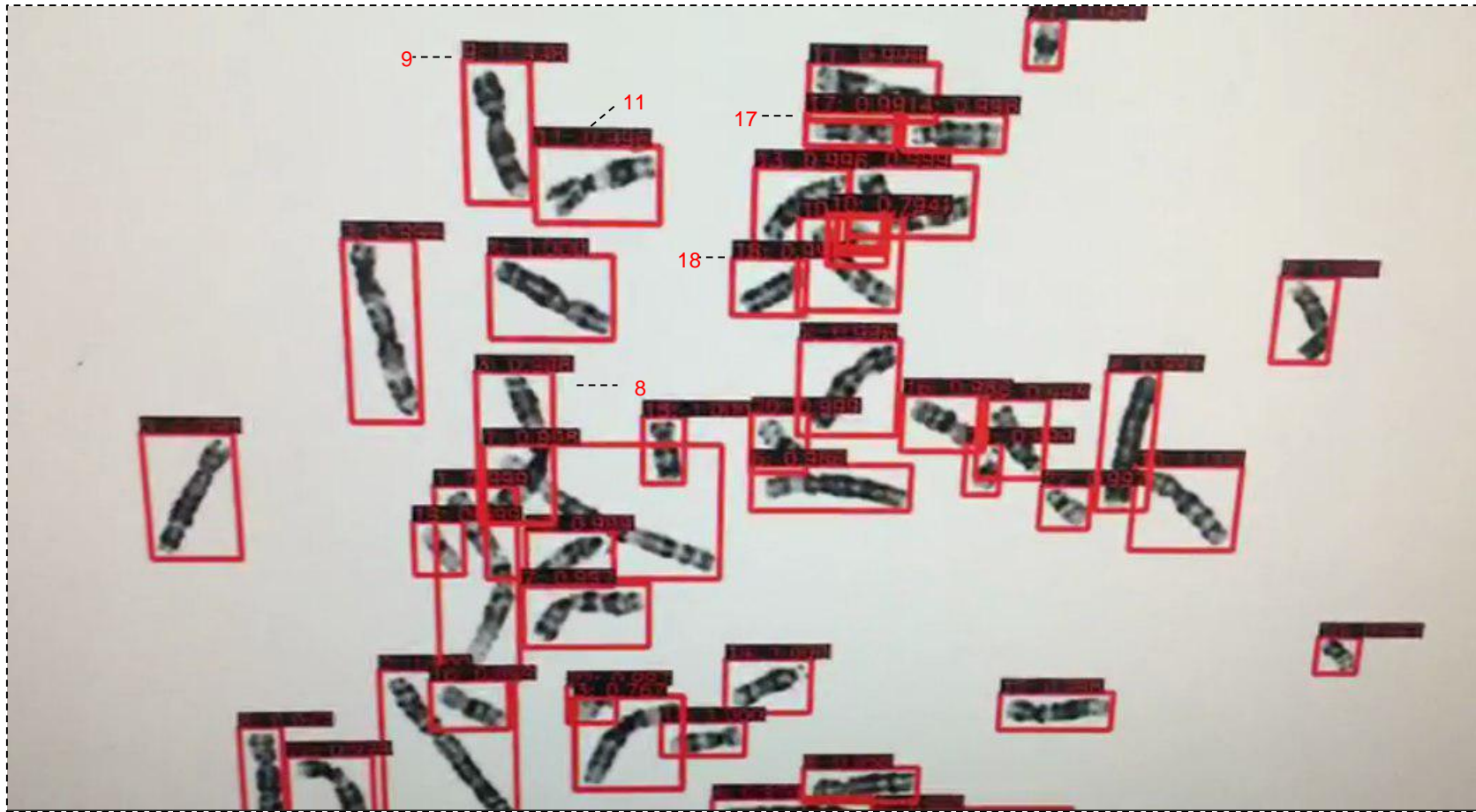


GAN

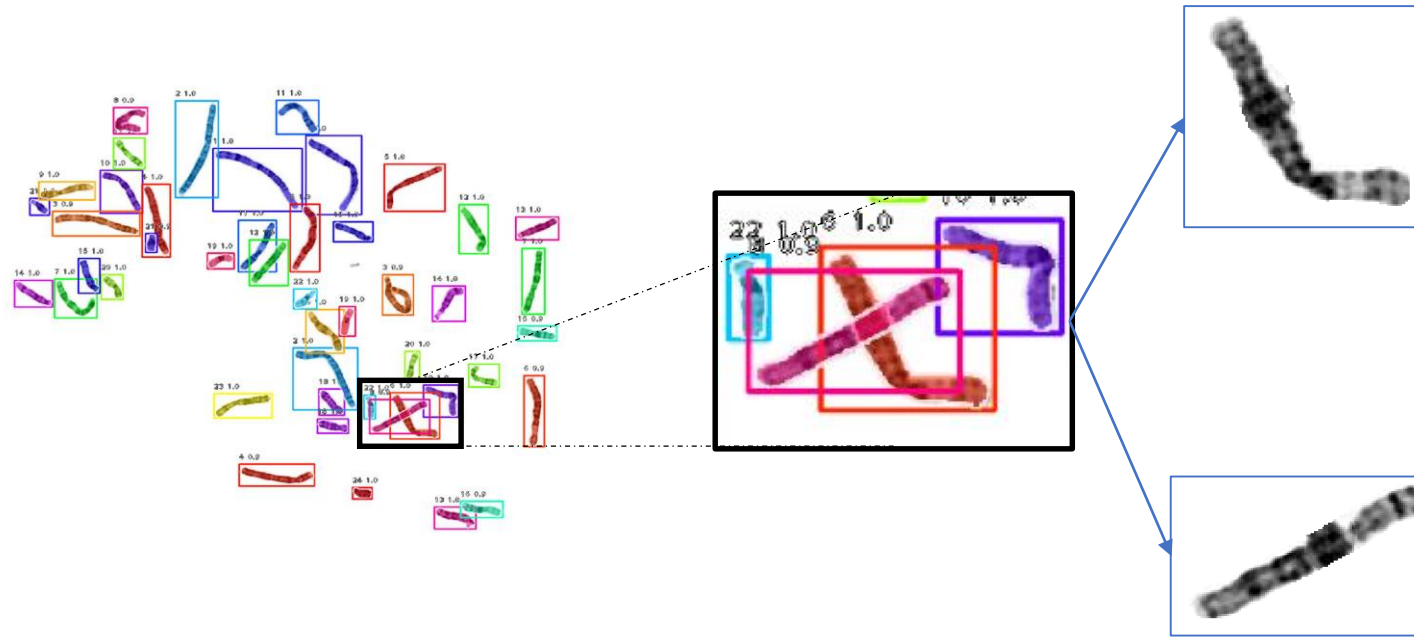
Chromosome recognition - video



Chromosome recognition

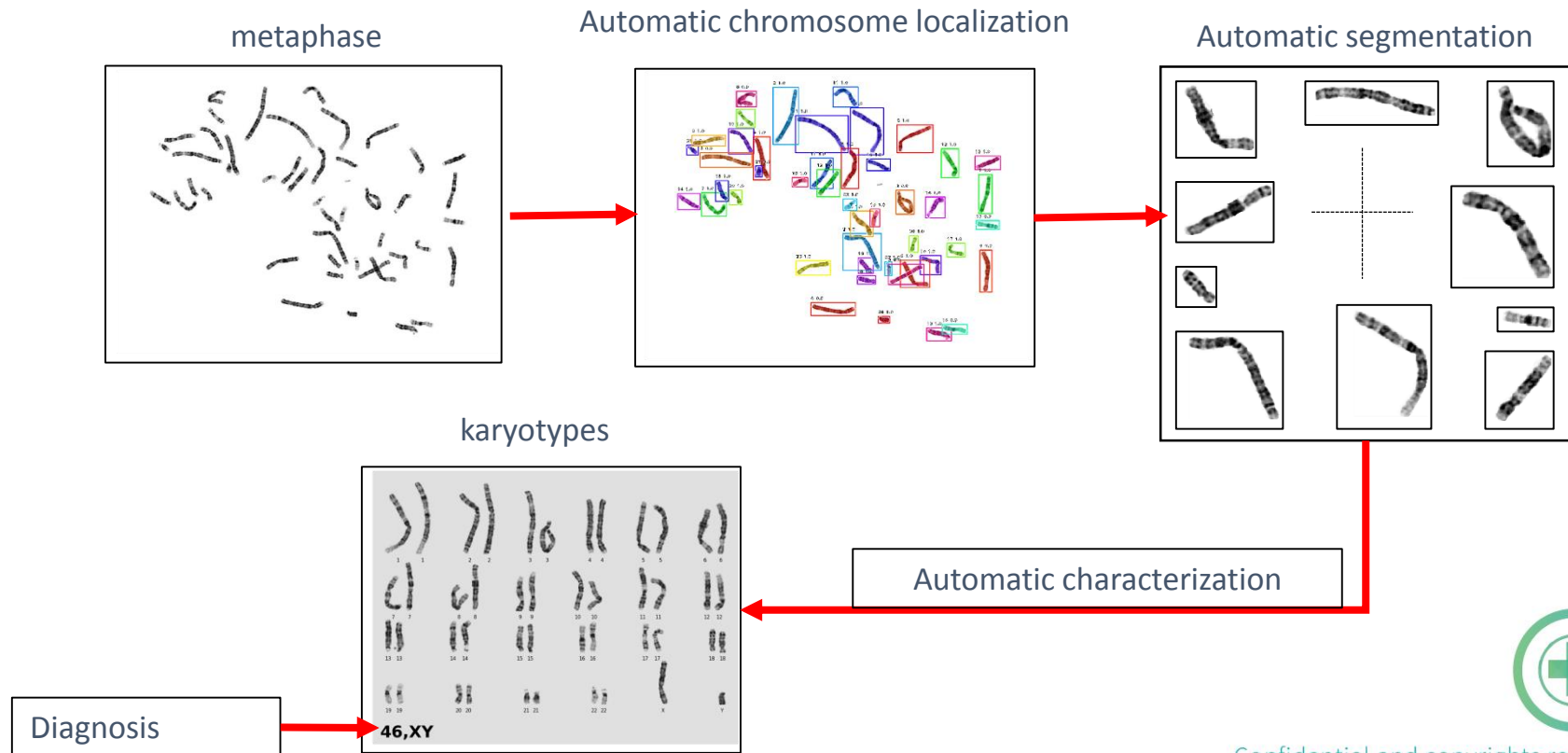


a CNN based model performing altogether, Localization, Classification and Segmentation



Confidential and copyrights reserved

Chromosome analysis AI model flow chart



Confidential and copyrights reserved

ECG labeling competition

ECG (Data Labeling)

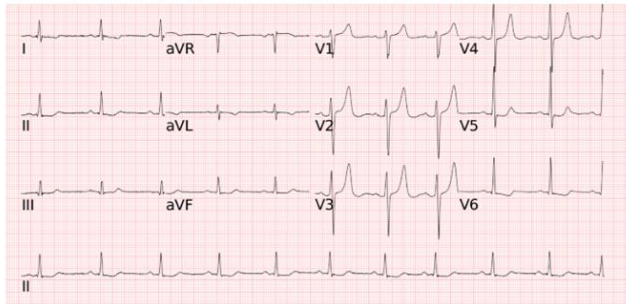
* Not Updated
Employee ID:

已標記: 0條

Patient Info

- Patient Birth: 19671119
- Patient Gender: MALE

ECG



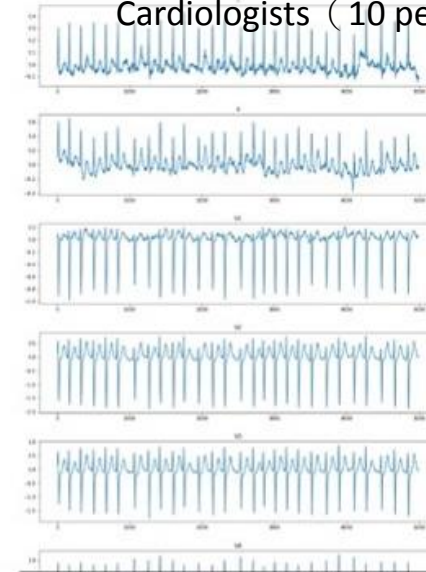
Label

- Atrial Fibrillation
- Atrial Flutter
- Ventricular Bigeminy
- Complete AV Block
- Normal Sinus Rhythm
- Second Degree AV Block Type 1
- Atrial Premature Beat
- Ectopic Atrial Rhythm
- First Degree AV Block
- Paroxysmal Supraventricular Tachycardia
- Ventricular Premature Beat
- Sinus Tachycardia
- Other

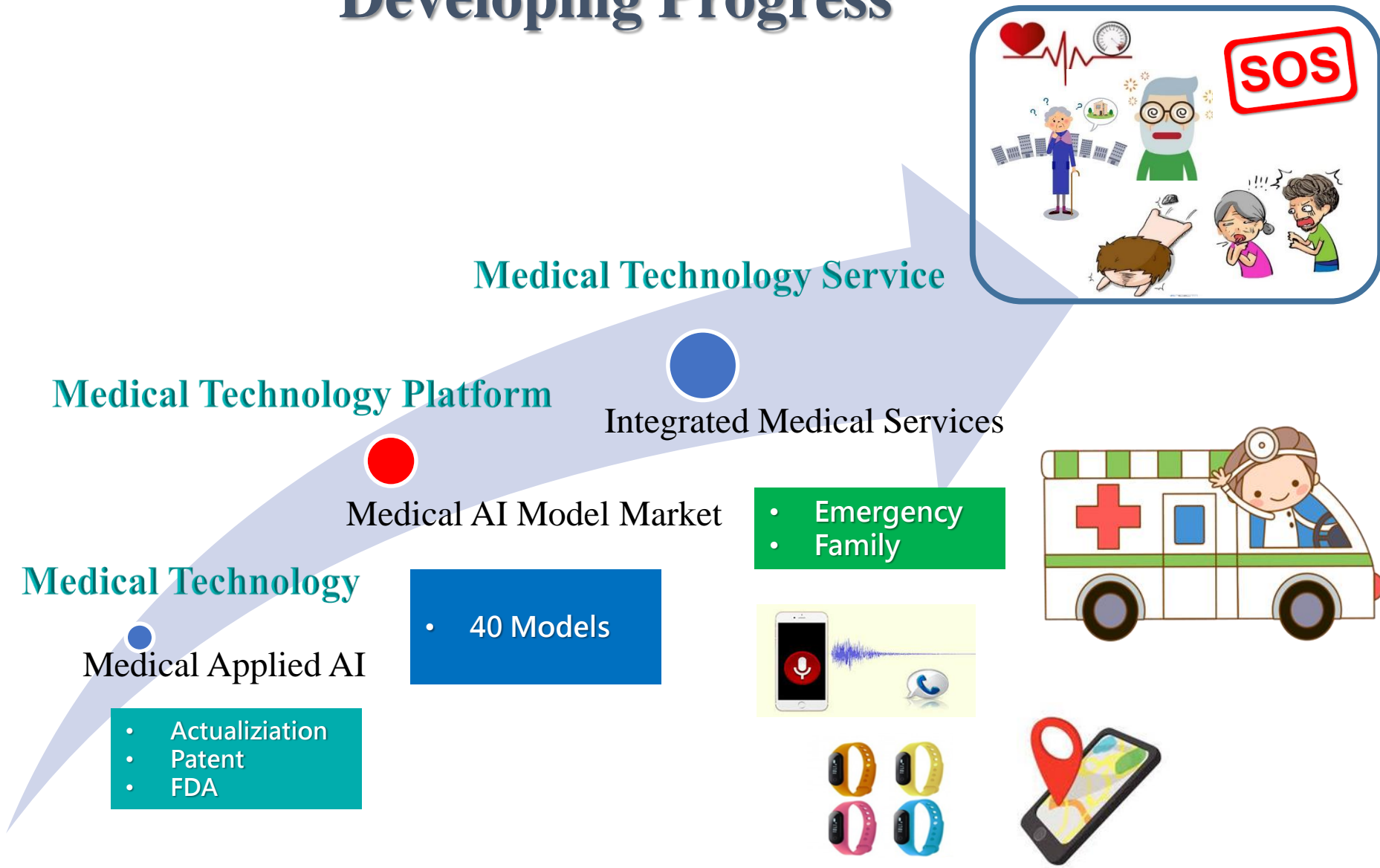
No.	Full Name	Abbreviation
1	Atrial Fibrillation	AFIB
2	Atrial Fultter	AFL
3	Atrial Premature Beat	APB
4	Ventricular Bigeminy	BIGEMINY
5	Complete AV Block	CHB
6	Ectopic Atrial Rhythm	EAR
7	First Degree AV Block	FRAV
8	Normal Sinus Rhythm	NSR
9	Paroxysmal Supraventricular Tachycardia	PSVT
10	Second Degree AV Block	SAV
11	Sinus Tachycardia	ST
12	Ventricular Premature Beat	VPB

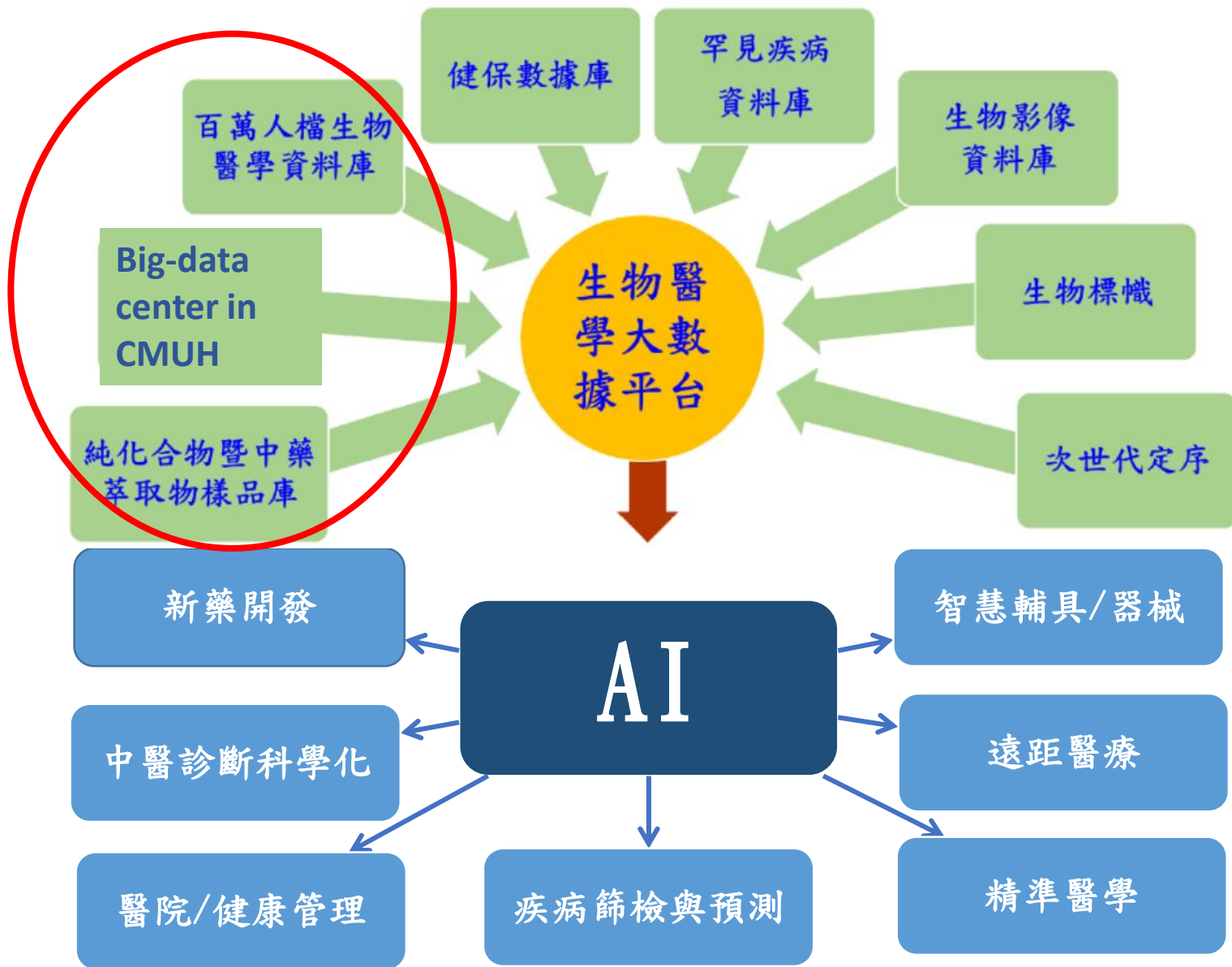
Group	Accuracy	Label Time
Resident, Chief resident	55%±15% (28%-78%)	51:04
Emergency physician	73%±9% (57%-83%)	37:19
Cardiologists	83%±9% (61%-93%)	31:33
MUSE(GE)	73%	N/A
AI Win!	90%	00:03 (26 ms/sample)

Amount of data: 120 Label 12 kinds of ECG images
Resident、Chief resident (10 people)
Emergency physician (8 people)
Cardiologists (10 people)



Developing Progress





AI視角下的

時空

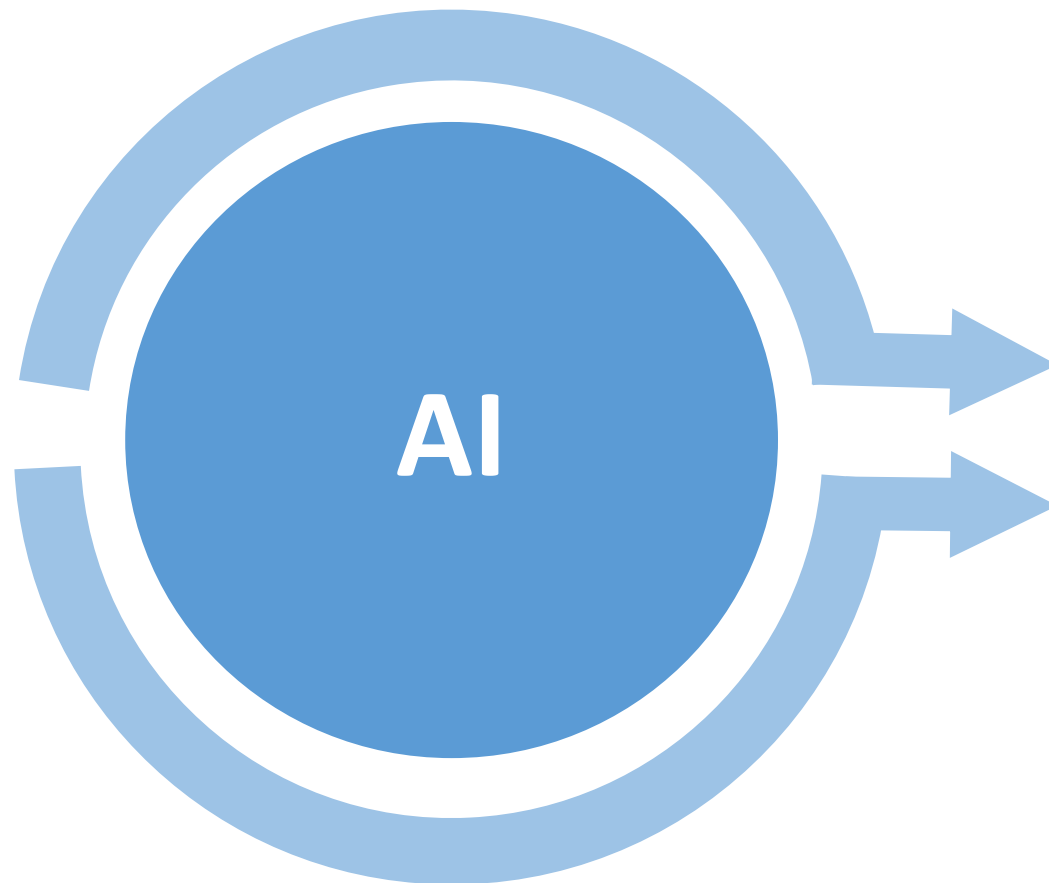
瑣碎繁雜

罕見困難

AI

縮短時間

累積經驗



小狗或馬芬？ 圖像辨識的進步

機器在分辨看起來類似的圖像類型方面，已很大進展。



Disguise faces of diseases



人工智慧不會取代醫師，
但會帶來新的思考，
出現新的流程，
衍生新的分配，
長期下來就是醫療復興運動。

2018 FJ Tsai



醫療 AI 門診系統

- 已開發落地AI 13 項目：
 1. 骨齡判讀 Bone Age - 1
 2. 乳房超音波良惡性偵測 Breast Ultrasound - 1
 3. 眼底影像視網膜病變判讀 Diabetic Retinopathy - 1
 4. 胸腔X光正/異常分類 - 1
 5. 心電圖波形判讀 - 7
 6. 染色體異常偵測 - 2
- 進行中AI計畫 38 項目：
 1. 胸腔X光異常部位偵測 - 6
 2. 胸腔X光心臟疾病偵測 - 5
 3. 牙科疾病及部位偵測 - 6
 4. 脊椎骨折判讀及治療建議模型 - 3
 5. 腦部CT ASPECT Score判讀 - 1
 6. 股骨粗隆間骨折判讀 - 1
 7. KUB X光影像判讀 - 8
 8. 二次中風預測模型 - 1
 9. 扁平足輔助診斷模型 - 1
 10. 兒童腦波癲癇判讀 - 1
 11. 中草藥辨識模型 - 5



中國醫藥大學附設醫院
China Medical University Hospital

健康·關懷·創新·卓越

4月 門診時間表

2019 APRIL OPD SCHEDULE

- 1 掛號就診須知、就醫注意事項
- 2 AI人工智慧門診、整合照護門診、病歷影本及持具X光申請流程
- 3 國際醫療/轉運門診、週末特別門診
- 4 內科部 胸腔內科、胸腔腫瘤、內分泌新陳代謝科、風濕免疫科
腎臟內科、消化內科
- 5 一般內科、感染科、心臟血管系、血液腫瘤科、神經內科
- 6 外科部 胸腔外科、一般外科、乳房腫瘤、乳房重建、消化系腫瘤、肝臟移植門診
大腸直腸外科、大腸腫瘤、心臟外科、美容中心自費門診、整形外科、減重外科
- 7 神經外科、國際代謝形體醫學中心、泌尿科、泌尿腫瘤、骨科
- 8 婦產科部 女性整合門診、一般婦產科、不孕症門診、婦科腫瘤、婦女就醫須知
- 9 眼科、耳鼻喉科、高壓氧門診、營養諮詢自費門診
腫瘤營養諮詢自費門診、放射腫瘤科
- 10 家庭醫學科、體重控制特別門診、疼痛科、皮膚科、復健科
- 11 精神科門診、醫學影像部、中醫部、中西醫結合科
- 12 中醫部 中醫內科、中醫婦科
- 13 中醫部 中醫兒科、小兒氣喘特別門診、中醫傷科、埋線門診、針灸科、睡眠中心門診
- 14 牙醫部 兒童牙科、兒童身心障礙門診、根管治療科、齒顎矯正科、牙周病科
家庭牙醫學科、口腔顎面外科、義齒修復科、人工植牙
- 15 兒童醫院 兒童血液腫瘤科、兒童營養腸胃及肝膽內科、新生兒科、
兒童遺傳及內分泌科、中醫兒科、兒童神經內科、兒童發展遲緩診特別門診、
兒童過敏免疫風濕科、兒童腎臟科、兒童感染科、兒童心臟科、健兒門診、胸腔內科暨一般兒科
- 16 兒童其他專科
- 17 健康視窗 18 新進主治醫師介紹 19 特色醫療專區
- 20 特色醫療專區 21 就醫服務諮詢、收費標準 22 健康講座

4月 APR						
日	一	二	三	四	五	六
	1	2	3	4	5	6
	廿六	廿七	廿八	兒童節 清明節	初二	
7	8	9	10	11	12	13
初三	初四	初五	初六	初七	初八	初九
14	15	16	17	18	19	20
初十	十一	十二	十三	十四	十五	十六
21	22	23	24	25	26	27
十七	十八	十九	二十	廿一	廿二	廿三
28	29	30				
廿四	廿五	廿六				

4/4兒童節(星期四)
上午正常門診、下午、晚上部份醫師開診

4/5清明節(星期五)
上午正常門診、下午、晚上部份醫師開診

5月 MAY						
日	一	二	三	四	五	六
	1	2	3	4	5	6
	廿九	初一	初二	初三	初四	初五
7	8	9	10	11	12	13
初六	初七	初八	初九	初十	十一	十二
14	15	16	17	18	19	20
十三	十四	十五	十六	十七	十八	十九
21	22	23	24	25	26	27
廿一	廿二	廿三	廿四	廿五	廿六	廿七

5/1勞動節(星期三)
上午正常門診、下午、晚上部份醫師開診

小兒科

啟動AI醫院 中國附醫邁向新紀元

人工智慧骨齡輔助判讀系統

★不耗時只須在電腦上按個鍵

★可預測兒童未來成人後身高

★評估內分泌及代謝相關疾病

專業醫師經驗 + 結合AI大數據

◎雙重確認 ◎診斷準確 ◎簡易流程

◎融入門診 ◎增加效率





兒童醫院小兒遺傳科 蔡輔仁部主任

兒童醫院小兒遺傳科 王仲興主任

兒童遺傳諮詢專線 (04)22052121 轉2128·2132·2135

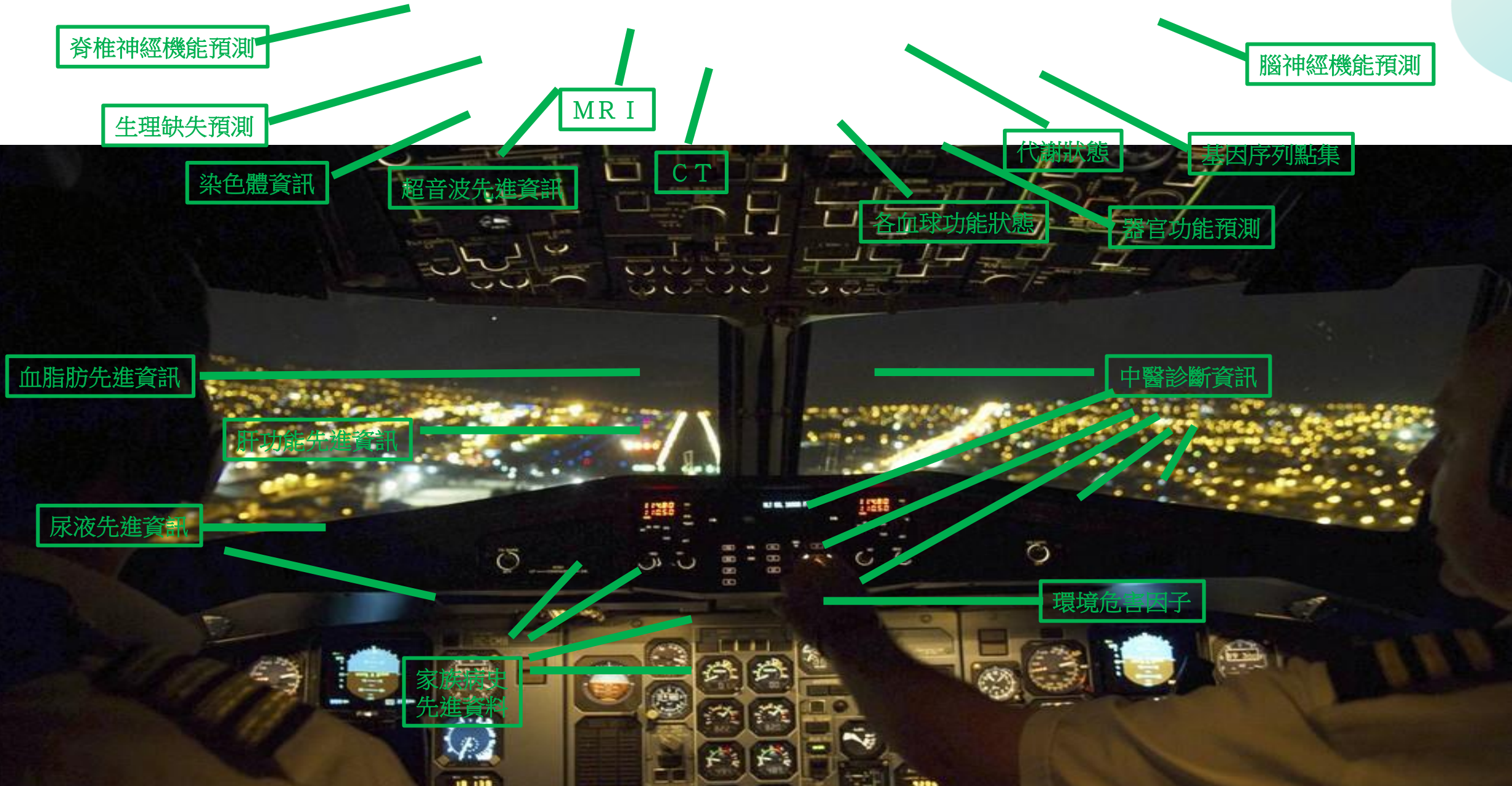
中國醫藥大學附設醫院

●臺北分院 電話: 02-27919696 院址: 臺北市內湖路二段360號(原內湖醫院)
 ●中國醫藥大學新竹附設醫院 電話: 03-6590558 院址: 新竹縣竹北市興隆路一段199號
 ●豐原分院 電話: 04-25223522 院址: 臺中市豐原區中正路199號
 ●台中東區分院 電話: 04-22121588 院址: 臺中市東區

The computer monitor in future OPD



All decisions will supported by AI network

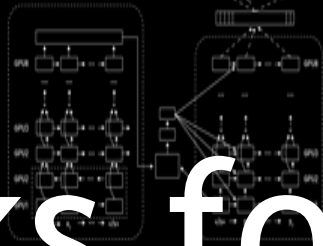


AI - 神經網路架構

Convolutional Networks



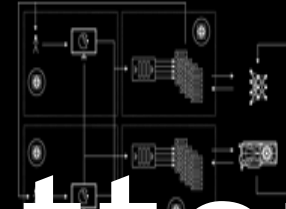
Recurrent Networks



Generative Adversarial Networks



Reinforcement Learning



New Species



Thanks for your attention



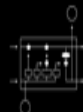
Encoder/Decoder



ReLu



BatchNorm



LSTM



GRU



Beam Search



3D-GAN



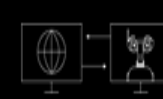
MedGAN



Conditional GAN



DQN



Simulation



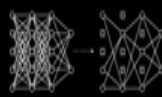
Mixture of Experts



Neural Collaborative Filtering



Concat



Dropout



Pooling



WaveNet



CTC



Attention



Coupled GAN



Speech Enhancement GAN



DDPG



Block Sparse LSTM

The Value of AI to the Practice of Physicians

- We will employ AI to augment what we do **as physicians**.
- AI will provide us **more time** to spend with the patient.
- AI will assist in **preventing diagnostic errors**.
- AI will suggest laboratory and other studies that will **improve our diagnostic accuracy**.
- AI will contribute to substantially to the **interpretation** of diagnostic studies.
- AI vast compendium of the medical literature will suggest treatment regimens **supported by the best evidence**.