APPLICATIONS OF AI IN HEALTHCARE AND MEDICAL INDUSTRY

TEAM 2

TECHNOLOGY AND INNOVATION SEMINAR

YSEALI ACADEMY

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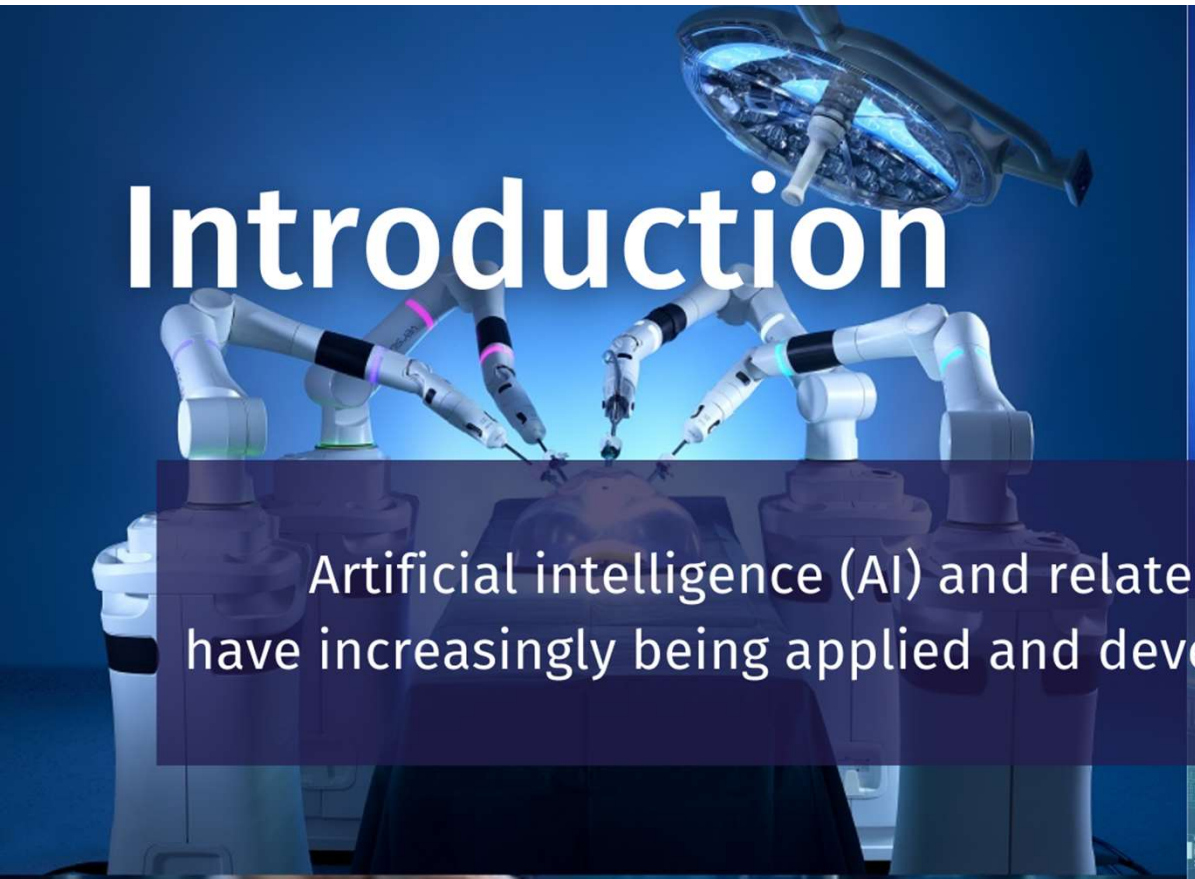
Introduction

Introduction

Artificial intelligence (AI) and related disruptive technologies have increasingly being applied and developed globally in many fields.



Introduction

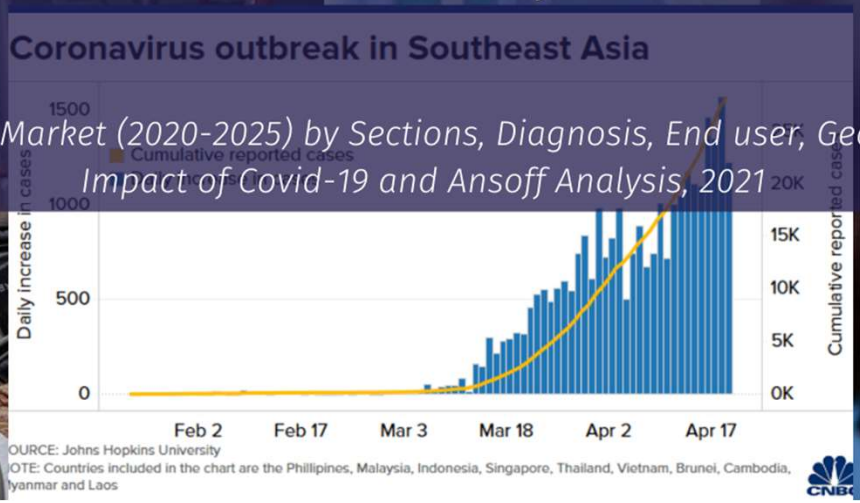
A growing need to use AI for healthcare since

- Possible reduction of expensive healthcare costs;
- Adoption and potential of AI in research areas and future applications;
- Reduced workload and increased quality of care;
- Growing demand for precision medicine;
- Shortage of health workforce to meet patient demand;
- Growing imbalance between healthcare teams and patients [1];
- The need for more efficient, customized healthcare services;
- The impact of the COVID-19 crisis

[1] The Next Generation of Medicine: Artificial Intelligence and Machine Learning, TMCapital, 2017

Introduction

According to a report in 2021, the Global AI in Healthcare Market size is expected to grow from USD 4.2 Bn in 2020 and reach USD 27.2 Bn by 2025 [2].



[2] The Global AI in Healthcare Market (2020-2025) by Sections, Diagnosis, End user, Geography, Competitive Analysis, Impact of Covid-19 and Ansoff Analysis, 2021

Objectives

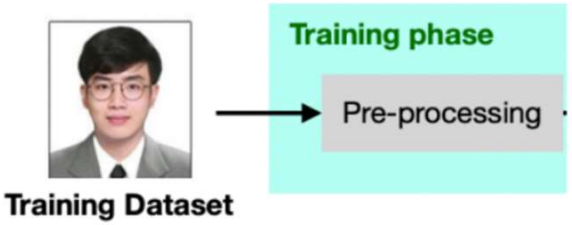
- Present current state of AI in healthcare and its applications
- Identify the rationale behind the usage of AI in healthcare
- Determine challenges and opportunities of AI in healthcare

Limitations

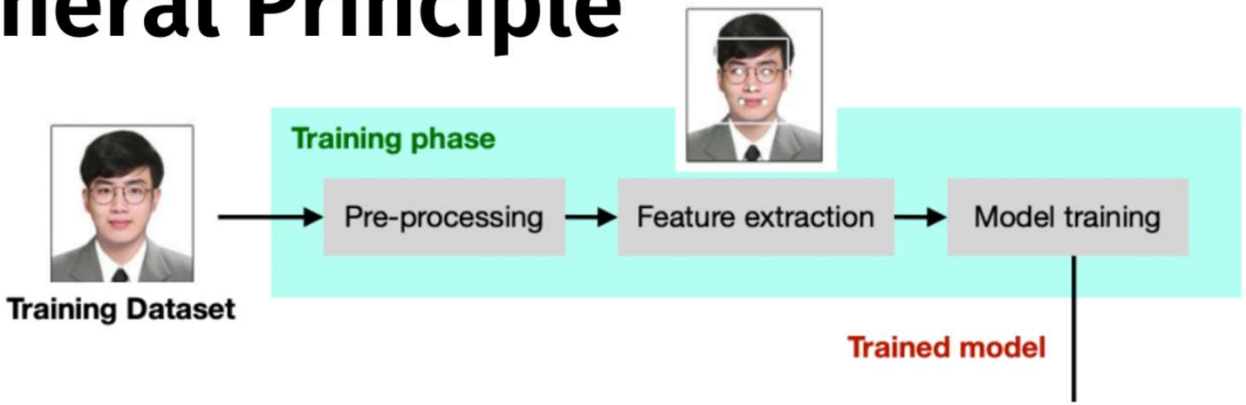
- Selected specific applications of AI in healthcare
- Brief literature review
- General descriptive research

Discussion

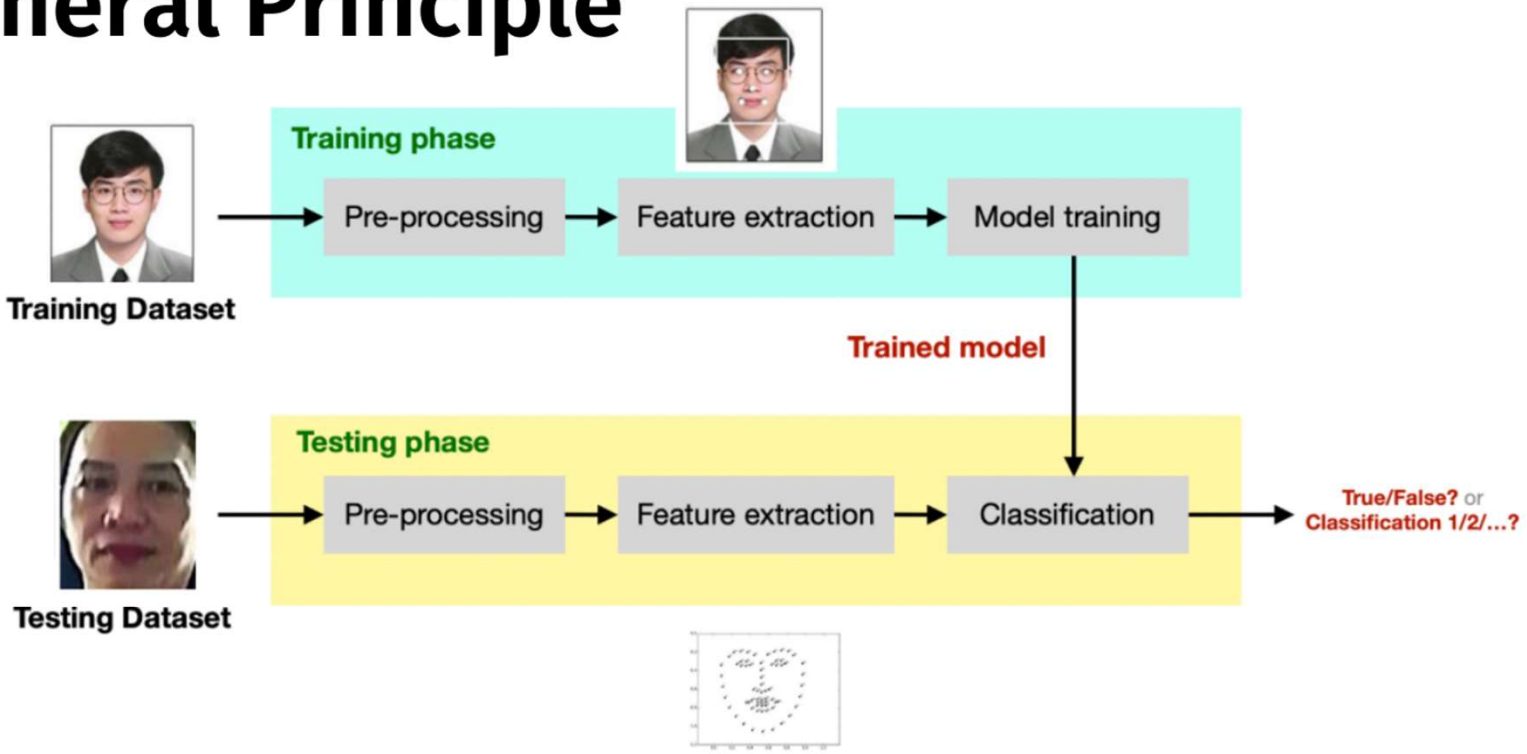
General Principle



General Principle

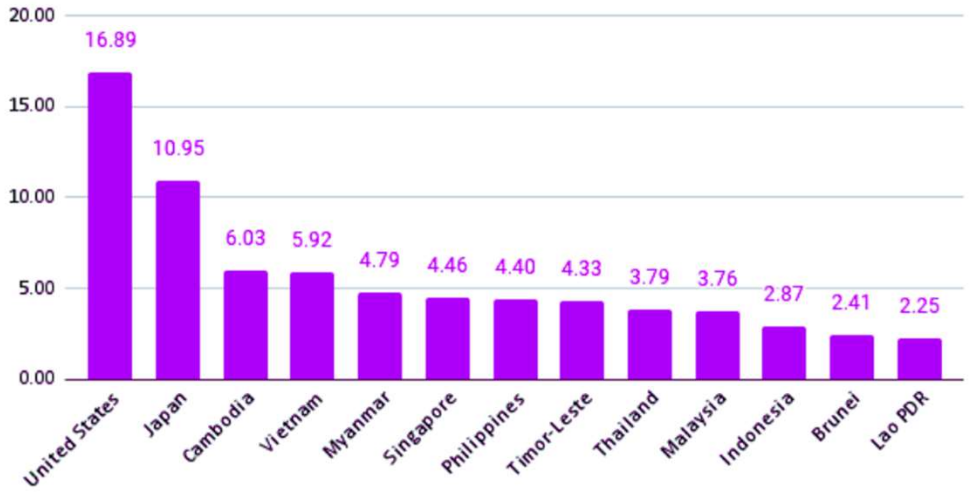


General Principle



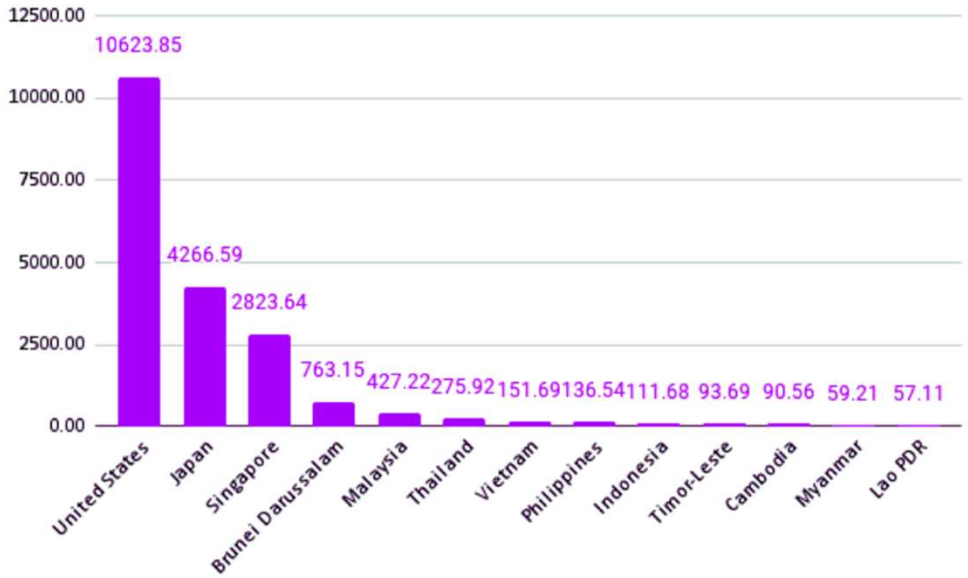
Current State of AI in Healthcare

Healthcare expenditure 2018 (% of GDP)



Source: World Bank (2021)

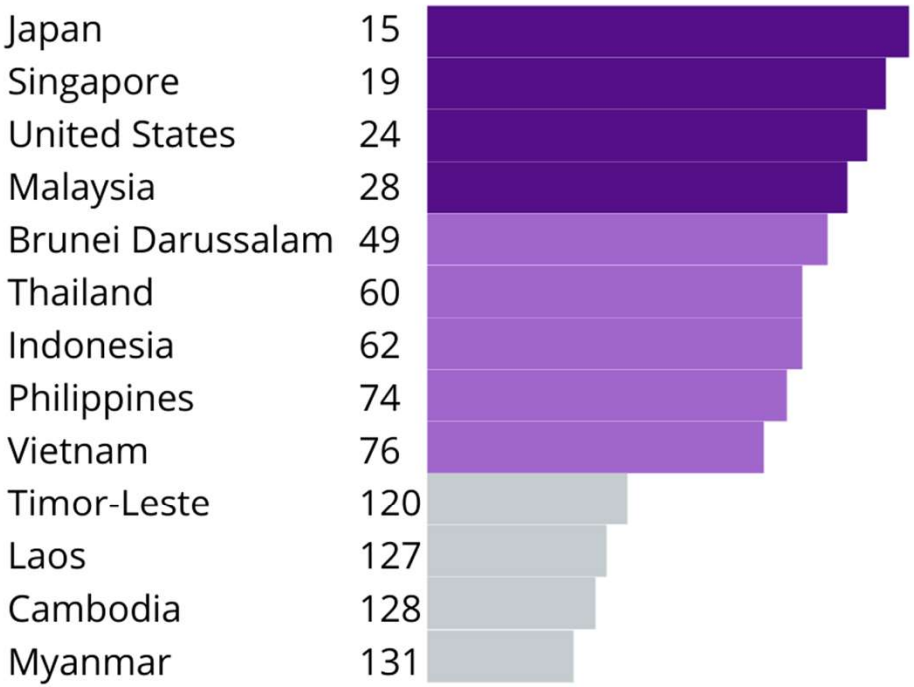
Healthcare expenditure per capita 2018



Source: World Bank (2021)

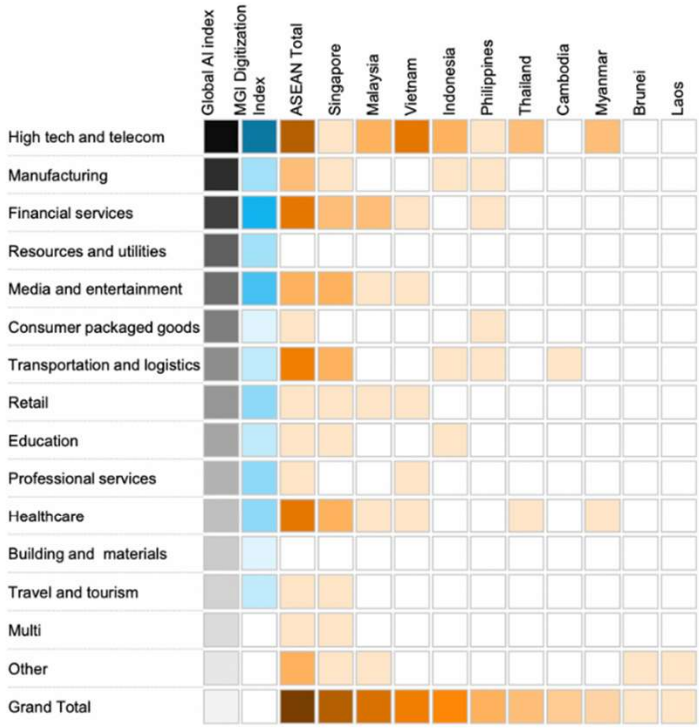
Current State of AI in Healthcare

AI readiness index (2020)



Source: Oxford Insights (2021)

AI adoption level of AI in Healthcare in ASEAN



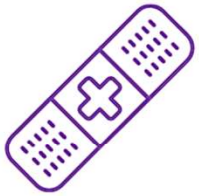
Source: McKinsey (2017)

Applications

Managing Medical Data

Medical Diagnosis

Decision Making



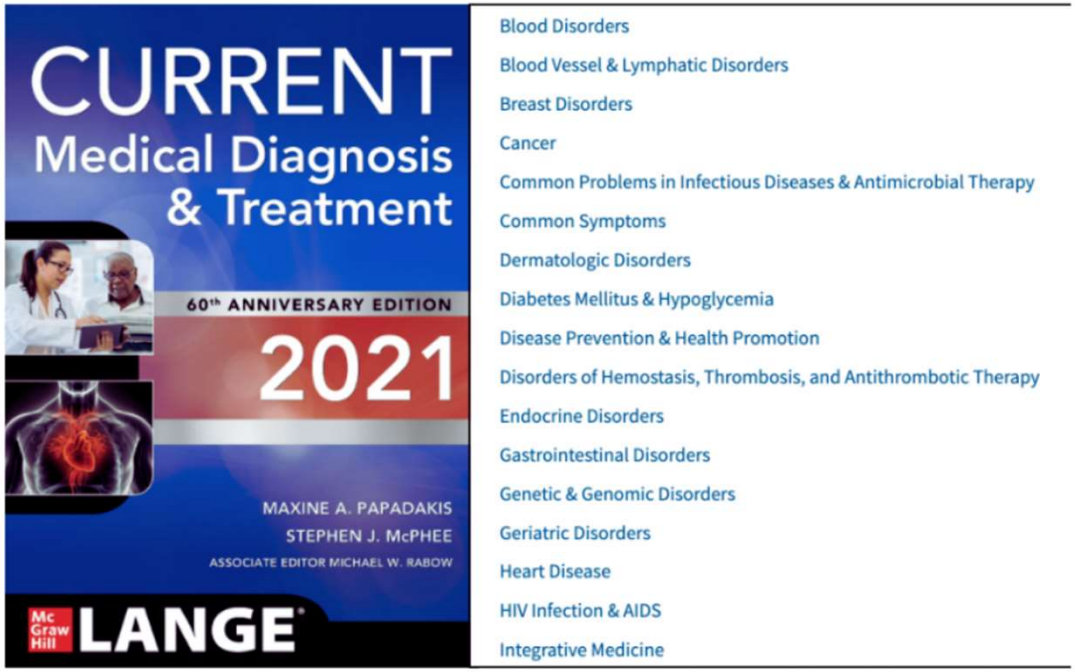
Medical Assistance

Managing Medical Data

- Changing Health Information Management System
  - Data storage/Data flow
  - Healthcare smart card
  - AI optimized patient record
- NLP to interpret clinical documentation
  - Generate medical reports
  - Precision
- Security
  - Identify cyber attack

Managing Medical Data

Medical Diagnosis



- Plenty kinds of disorders, diseases, infections, healthcare industry need to cover (McGraw Hill Medical)
- An on-time and accurate diagnosis help with early detection for prevention and early treatment for life and cost-saving.
- AI can help at all stages of healthcare: Diagnosis, Treatment, Caring/ Assistance
- AI input data: medical imaging modalities, different kinds of signals, etc.

Medical Diagnosis

SKIN CANCER

- The global incidence of skin cancer continues to increase (according to the Skin Cancer Foundation).
- In 2019, it is estimated that 192, 310 cases of melanoma will be diagnosed in the US.
- Early diagnosis of skin cancer is extremely important to improving outcomes with 99% overall survival
- Once the disease progresses beyond the skin, survival is poor.
- There is an increasing incidence of skin cancers but a lack of adequate clinical expertise and services.
- → Immediate need and extremely suitable for AI solutions to assist clinicians since a large number of datasets are available publicly

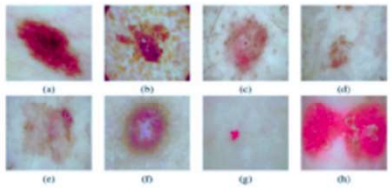


Fig. 1. Illustration of different types of dermoscopic skin lesions where (a) Nevus (b) Melanoma (c) Basal Cell Carcinoma (d) Actinic Keratosis (e) Benign Keratosis (f) Dermatofibroma (g) Vascular Lesion (h) Squamous Cell Carcinoma [22].

Manu Goyal et al., "Artificial intelligence-based image classification methods for diagnosis of skin cancer: Challenges and opportunities" , Elsevier, 2020

Medical Diagnosis

SKIN CANCER

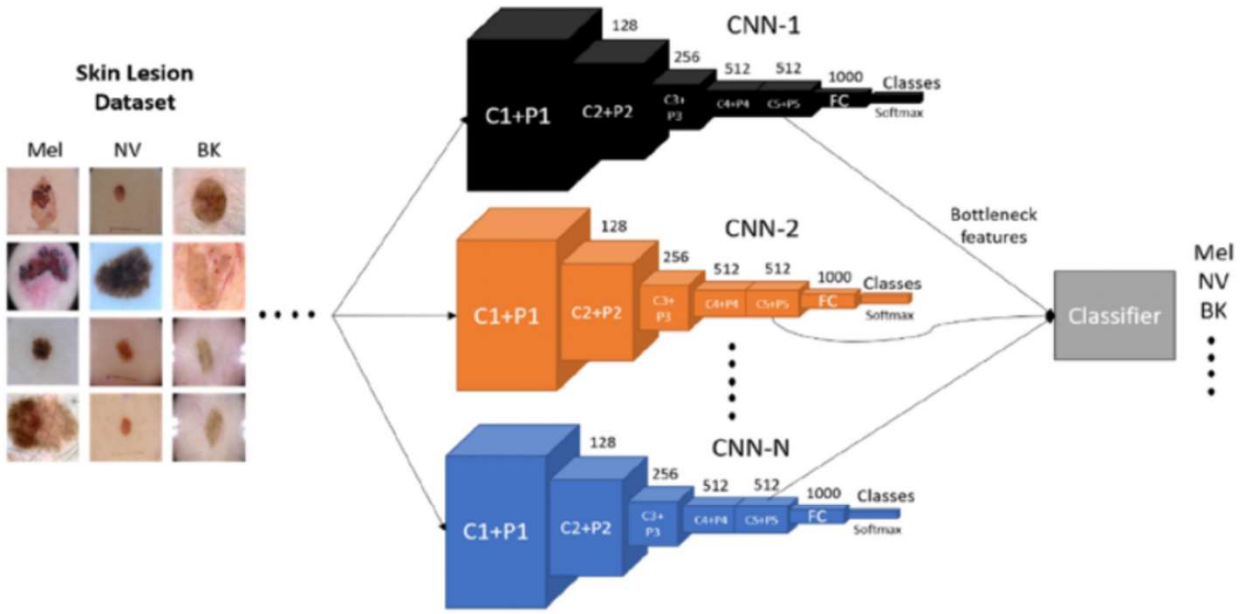
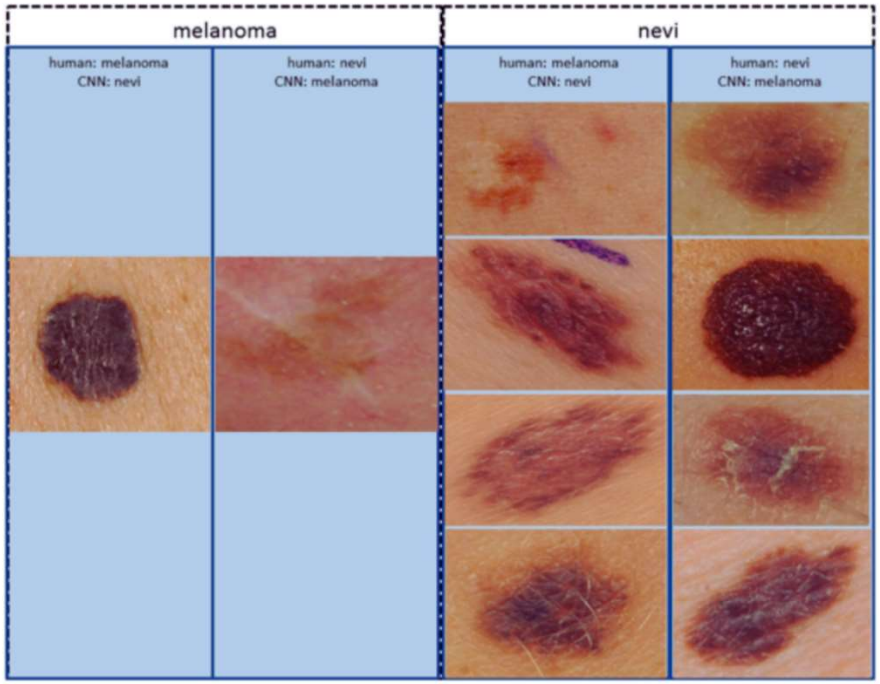


Fig. 4. Ensemble CNN approach for skin lesion classification.

Manu Goyal et al., "Artificial intelligence-based image classification methods for diagnosis of skin cancer: Challenges and opportunities" , Elsevier, 2020

Medical Diagnosis

- AI inputs: 3 main types of skin lesions: Clinical images, Dermoscopic images, and Histopathology images.
- The major works: Esteva et al. (from 2017): used a deep learning algorithm: a dataset of 129,450 clinical and dermoscopic images of 2032 different skin lesion diseases.
- AI was demonstrated to be on par with dermatologists in skin cancer classification performance.
- Other studies show the outperformance of AI than dermatologists, ex: accuracy of 76% vs 70.5% (Codella et al., 2017)



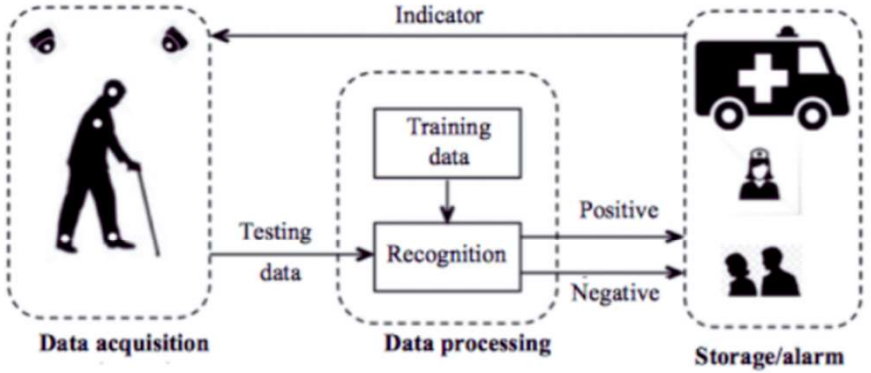
Brinker et al., 2019

Medical Diagnosis

PATHOLOGICAL GAIT DETECTION

Video-based Intelligent Analysis (**IVA**) for Healthcare Monitoring System (**HMS**)

- Detecting fall down and predicting fall risk caused by abnormal gaits.
- Detecting abnormal gaits, abnormal actions.

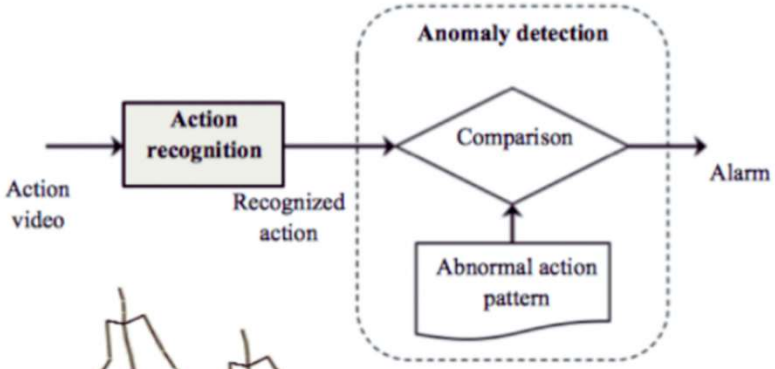


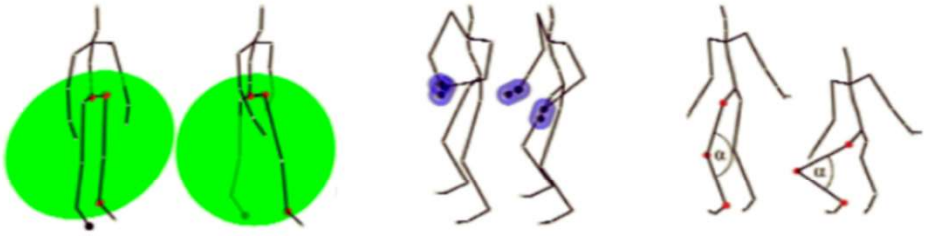
Hoang L.U. Thuc et al.

Medical Diagnosis

PATHOLOGICAL GAIT DETECTION

Feature description in abnormal action detection system

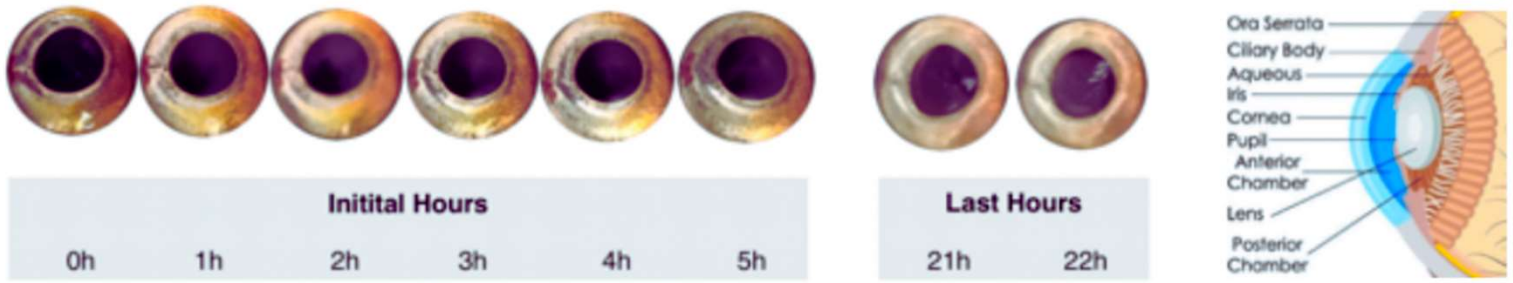




Medical Diagnosis

FOOD (FISH) QUALITY DETERMINATION

Problem - Fish freshness is the key factor to determine the quality of fishery products. How to detect freshness level to recommend a user?



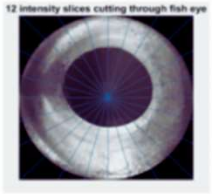
Fish eye images at time points: (0, 1, 2, 3, 4, 5 and 21, 22 hours) (a) and a fish anatomy (b).

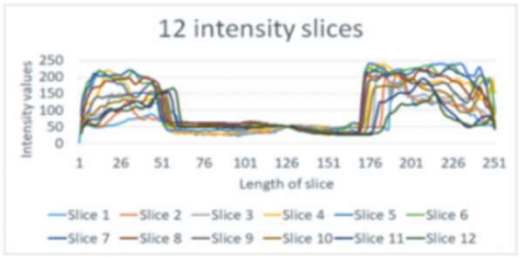
AnhThu Nguyen et. al

Medical Diagnosis

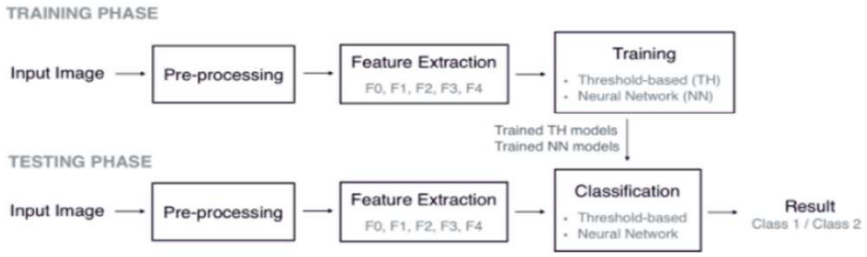
FOOD (FISH) QUALITY DETERMINATION

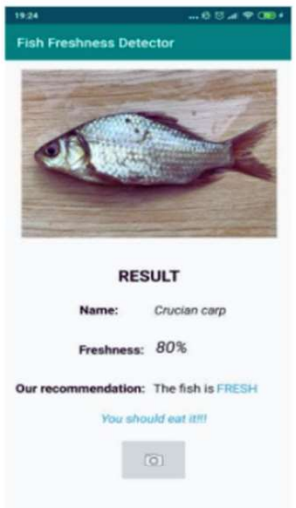
Feature extraction





Classification model





Medical Diagnosis

COVID INFECTION DETECTION

Fig. 3. Example CXR images from the COVIDx dataset. (1) CXR for normal case, (2) CXR for case of non-COVID-19 pneumonia, (3) CXR for case of COVID-19 infection.

Ba Hoang Nguyen et al, 2020

Medical Diagnosis

COVID INFECTION DETECTION

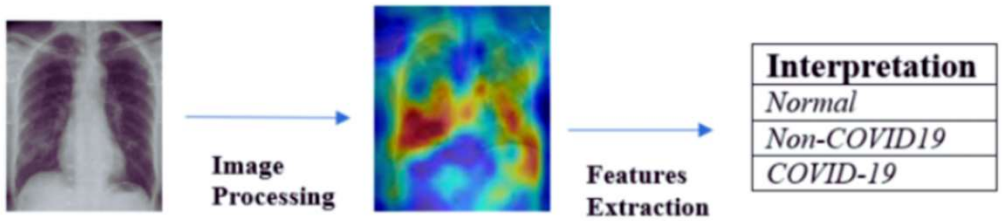


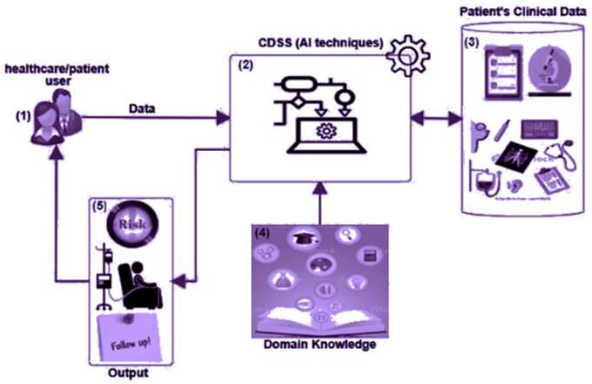
Fig. 1. The analytical workflow of COVID-19 Chest X-ray Image Detection systems.

The dataset: 13,975 chest X-ray images
- Training set: 13,675
- Test set: 300

Model	Acc
EfficientNet-CXR	93.65%
MobileNet	91.30%
ResNet	85.73%
VGG-16	80.21%

Ba Hoang Nguyen et al, 2020

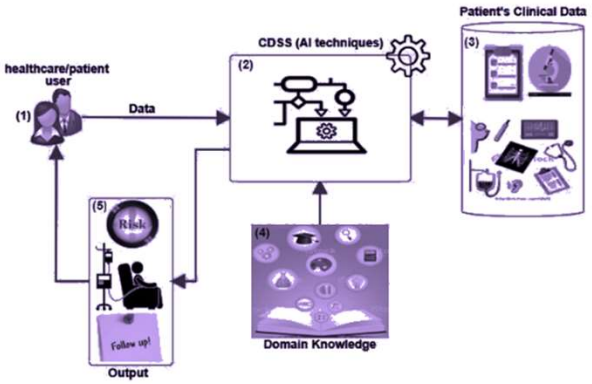
Decision Making



Claudia Mazo et al, 2020

Clinical Decision Support System analyzes data to help healthcare providers make decisions and improve patient care.

Decision Making



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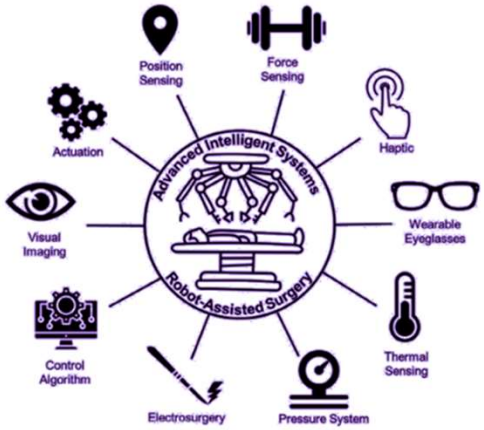
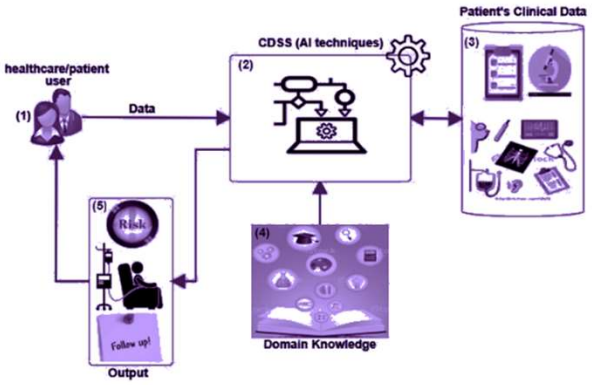


Thanh Nho Do et al, 2020

AI Robot Surgical System
Surgical robots that can minimize errors and any variations and help in increasing the efficiency of surgeons.

Decision Making



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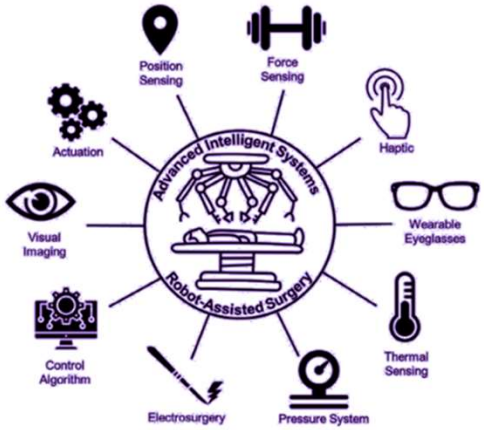

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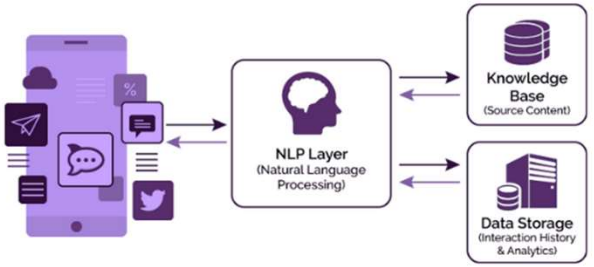


Source: Chatbotlife

Natural Language Processing
Artificial intelligence that helps computers understand, interpret and manipulate human language.

Decision Making

INTUITIVE SURGICAL®

USA, Da Vinci Surgical Systems

meerecompany 주|미래컴퍼니

KOR, Revo-I

prixa

IDN, NLP helps costumer decision

IDN, HAI-NLP helps doctor consultation

fdb First Databank

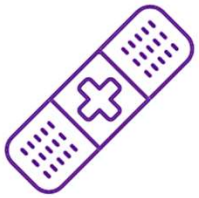
UK, CDSS provider for doctor

EndoMaster

SIN, MASTER Systems

Decision Making

- Legal Aspect
  - Ethical Considerations
  - Statutory, Regulatory and Common Law Requirements
  - Employment Considerations
  - Privacy and Security Risks
- Future Development
  - Global Standard Which Provide Supervision CDSS
  - Nanorobot



Medical Assistance

- Existence of healthcare assistant/virtual technology assistant/chatbots
- Healthcare Consumerism
- Personalization
- Convenience and Consistency

Medical Assistance

medwhat

2010, San Francisco California

"Virtual assistant that uses machine learning to respond instantly to medical and health questions."

can respond to verbal or typed questions after user sets up secure health profile

Suki

2017, Redwood, California

“Digital assistant uses that AI to help physicians manage medical documentation.”

designed to integrate with existing electronic health record system, voice-activated and responds by performing the requested commands given using natural language, system is cloud-based and accessible through mobile or desktop interface

botmd

2018, Singapore

“We believe that providing doctors with instant and reliable access to clinical information is essential to improve the quality of patient care. This is a significant need especially in large and underserved emerging markets.”

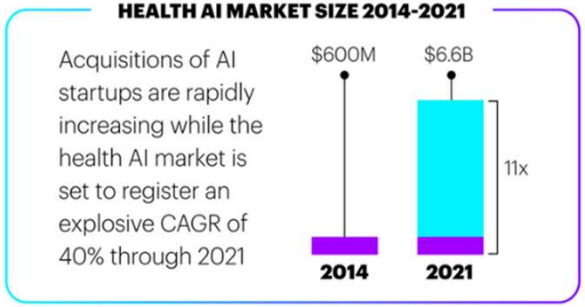
the AI of Bot MD can be trained on hospital and institution specific content to provide instant answers to clinical queries on treatment protocols, clinical guidelines, clinical calculators and others

Importance and Challenges

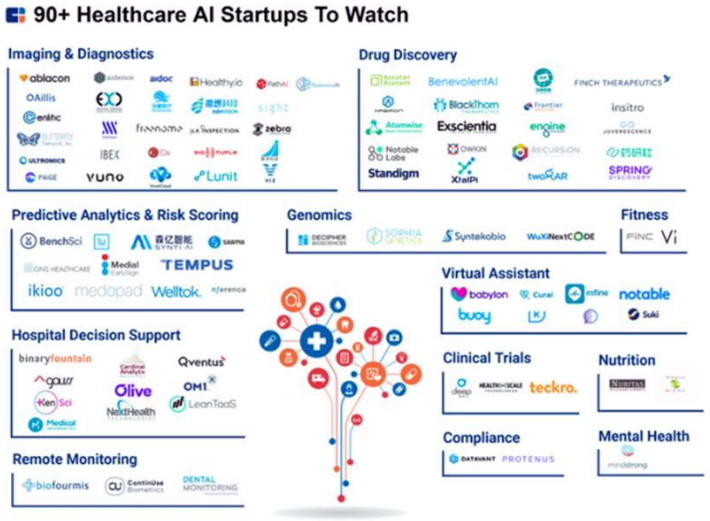
Importance of AI in Healthcare

- Economic Opprtunities
- Need for Reducing Costs and Boosting Resources
- Data Availability
- Demand of Personalized Healthcare

Economic Opportunities



Source: Accenture



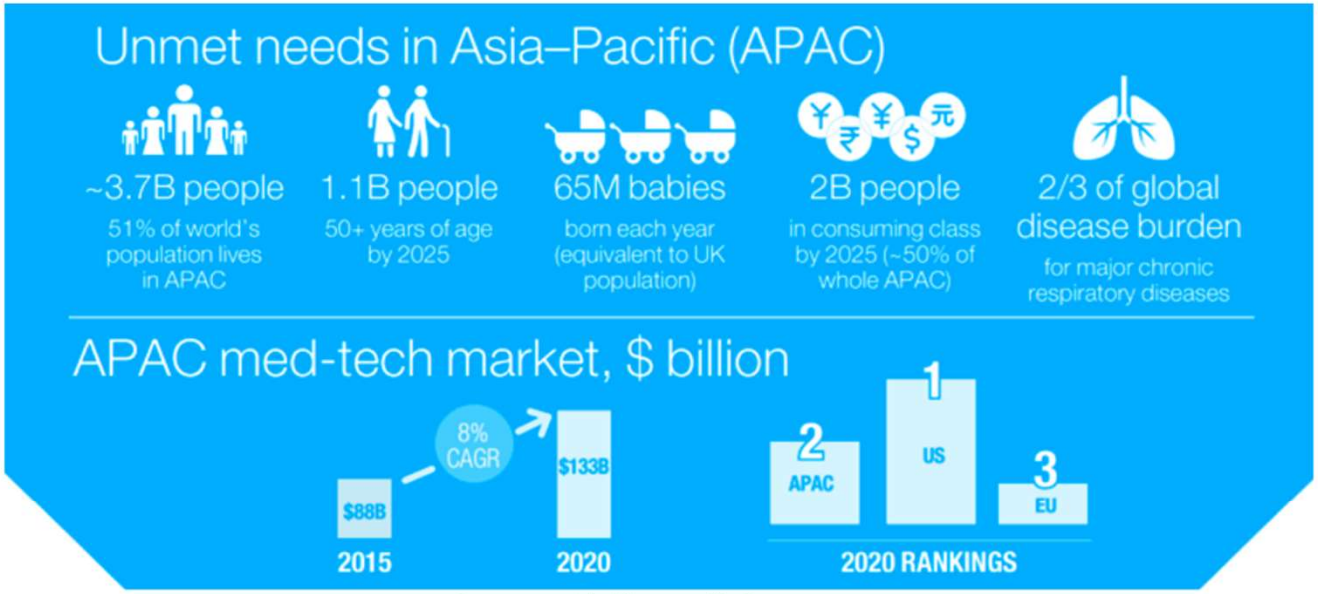
Source: CBInsight

Top 10 AI Applications

APPLICATION	VALUE*
Robot-Assisted Surgery**	$40B
Virtual Nursing Assistants	$20B
Administrative Workflow Assistance	$18B
Fraud Detection	$17B
Dosage Error Reduction	$16B
Connected Machines	$14B
Clinical Trial Participant Identifier	$13B
Preliminary Diagnosis	$5B
Automated Image Diagnosis	$3B
Cybersecurity	$2B
TOTAL =	~$150B

Source: Accenture

Economic Opportunities



Source: McKinsey & Company

Need for Reducing Costs and Boosting Resources

WHO Region	2013	2030
Africa	1.1	2.4
Americas	8.8	15.3
Eastern Mediterranean	3.1	6.2
Europe	14.2	18.2
South-East Asia	6.0	12.2
Western Pacific	15.1	25.9
World	48.3	80.2

Source: Worldbank Washington DC

Estimated health worker* demand (in millions**) in 165 countries, by Region

* : Health worker refers to physicians, nurses/midwives, and other health workers

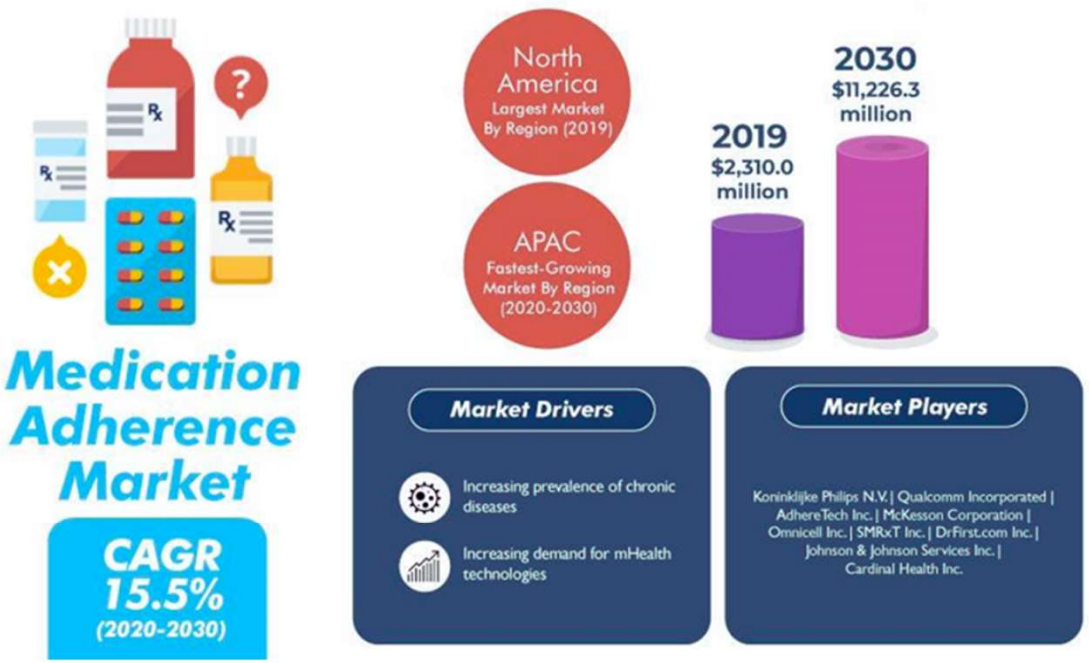
** : Since all values are rounded to the nearest 100 000, totals may not precisely add up.

Data Availability

Source: Stanford Medicine

Staying up to date with and accessing such data is beyond the scope of any individual human, but may be within the capabilities of AI to manage, analyse, and interpret.

Demand of Personalized Healthcare



Escalating demand of Personalized Healthcare will fuel Medication Adherence

Source: President Strategic Intelligence

Challenges of AI in Healthcare

S ecurity

P rivacy

A doption

E thical concern

I nfrastructure

K nowledge

- **Along with disruptive technologies (IoT, Big Data, Cloud Computing, Blockchain), AI is a must in the link with other technologies for digital transformation in the Fourth Industrial Revolution, especially in healthcare.**
- **The long-term benefits of AI in healthcare include saving costs, economic opportunities, and having the demand for AI personalization.**
- **SE Asia is still in the early stage of AI in healthcare, still concentrated on developed countries.**

- **AI is only instrument to help healthcare elements.**
- **AI is a great advancement in healthcare when employed judiciously, ethically and humanely.**
- **AI development is still on the early stage, still needs to be deeply studied and needs systematic database.**

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TEAM 2

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