# Min Sen Health
## *Season* 1



สาระน่ารู้ด้านเทคโนโลยีสุขภาพ
กับ นพ.ธิติวัฒน์ ประชาธำรงพิวัฒน์



# AI in Health Technology

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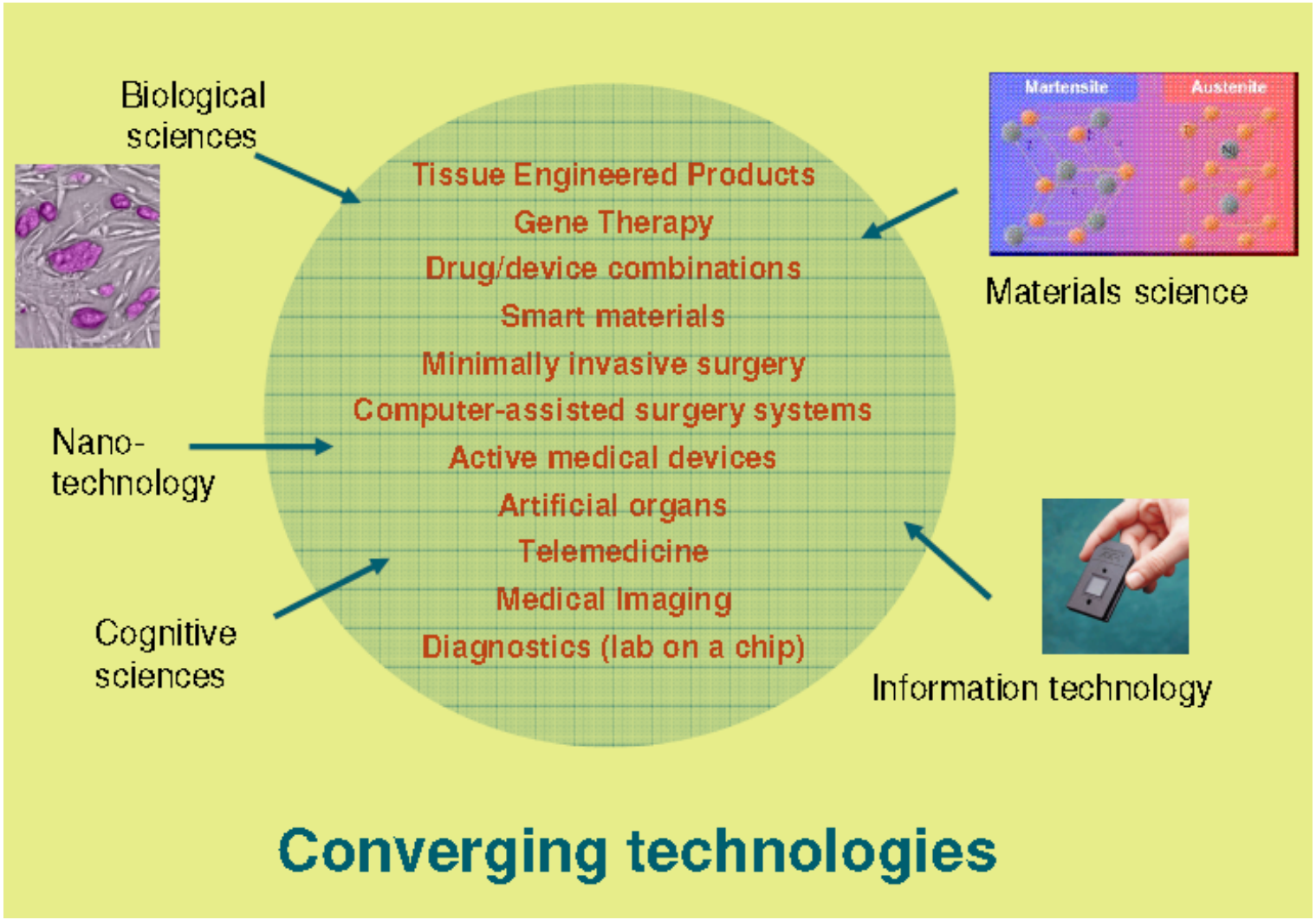
# Innovations in Medical and Biological Engineering

- 1950s and earlier
  - **Artificial Kidney**
  - X ray
  - Electrocardiogram
  - **Cardiac Pacemaker**
  - Cardiopulmonary bypass
  - **Antibiotic** Production technology
  - Defibrillator
- 1970s
  - **Computer assisted tomography**
  - Artificial hip and knee replacements
  - Balloon catheter
  - Endoscopy
  - Biological plant food engineering
- 1960s
  - Heart valve replacement
  - Intraocular lens
  - **Ultrasound**
  - Vascular grafts
  - Blood analysis and processing
- 1980s
  - **Magnetic resonance imaging**
  - **Laser surgery**
  - Vascular grafts
  - Recombinant therapeutics
- Present day
  - Genomic sequencing and microarrays
  - Positron Emission tomography
  - Image guided surgery

New generations of medical technology products are Combination of different technologies which lead to the crossing of borders between traditional categories of medical products such as medical devices, pharmaceutical products or human tissues



# What is Artificial Intelligence

- Definition--“Use of a computer to model intelligent behaviour with minimal human intervention”
- Machines & computer programs are capable of **problem solving and learning, like a human brain**.
- Natural Language Processing (“NLP”) and translation,
  - Pattern recognition,
  - Visual perception and
  - Decision making.
- Machine Learning (“ML”), one of the most exciting areas for Development of computational approaches to **automatically make sense of data**
- Advantage of Machine
  - Can retain information
  - **Becomes smarter over time**
  - Machine is **not susceptible to** Sleep deprivation, distractions, information overload and short-term memory loss

The application of **AI in medicine** has two main branches:

A) Virtual branch

B) Physical branch.

- Highly repetitive work
- Empower doctors
  - help them deliver faster and more accurate
- Augment the professionals, offering them expertise and assistance.
- Replace personnel and staffing in medical facilities, particularly in administrative functions,
- Managing wait times & automating scheduling
- “Deep-learning devices will not replace clinicians

# Artificial intelligence in medicine : The virtual branch

The virtual component is represented by Machine Learning, (also called Deep Learning)-mathematical algorithms that improve learning through experience.

Three types of machine learning algorithms:

1. Unsupervised (ability to find patterns)
2. Supervised (classification and prediction algorithms based on previous examples)
3. Reinforcement learning (use of sequences of rewards and punishments to form a strategy for operation in a specific problem space)

# AI in Healthcare and research

- **In Healthcare**:
  - IBM Watson is being piloted by Harrow Council with the aim of improving cost efficiency.
  - Alder Hey Children's Hospital in Liverpool is working with IBM Watson to create a cognitive hospital, app. facilitate interactions with patients.
- **In Medical Research**
  - Analyze and identify patterns if large can complex datasets faster and more precisely, search scientific literature for relevant studies, aid drug discovery.

# AI in Healthcare and research

- **In Pharmaceutical**
  - AI has already been used successfully in all of the 4 main stages in drug development.

    Stage I: Identify targets for intervention.

    Stage II: Discovering drug candidates.

    Stage III: Speeding up clinical trial.

    Stage IV: Finding Biomarkers for diagnosing disease.

# AI in Healthcare and research

- **In Clinical care**
  - Diagnosis: medical imaging (pneumonia, breast and skin cancers and eye diseases). Analyze EKG for coronary disease.
  - Maximize drug sensitivity and efficacy. Minimize number of drugs.
  - Continue prior therapy.
  - Give priority to covering likelier organisms.
  - Maximize number of suspected organisms covered.
  - Avoid contraindications for the patient.
  - Reduced side effects

# AI in Healthcare and research

- In Personalize treatment.  The algorithm can predict a patient's probable response to a particular treatment.
- In Improve Gene Editing.  Specifically the Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR-Cas9) system for gene editing, is a big leap forward in our ability to edit DNA cost effectively and precisely.

# AI in Healthcare and research

- This technique relies on short guide RNAs (sg RNA) to target and edit a specific location on the DNA.  But the guide RNA can fit multiple DNA location and that can lead to unintended side effect.  The careful selection of guide RNA with the lease dangerous side effects is a major bottle nect in the application of the CRISPR system.
- ML models have been proven to produce the best results when it comes to predicting the degree of both guide target interactions and off-target effects for a given sgRNA.

# AI in Healthcare and research

- **In Life-threatening & Terminal disease**:
  - Stanford Health Care developed a predictive analysis tool to reduce estimate errors.
  - John Hopkins early detection pancreatic cancer 4-12 months sooner.  Increase 5 year survival
  - Adelaide University: mammograms 5% of healthy women are required to come back for further screening.
  - NX Prenatal, a molecular diagnostic company, identify life-threatening in pregnancy by AI to scan the biomarkers in first trimester 87 % accuracy.

# AI in Healthcare and research

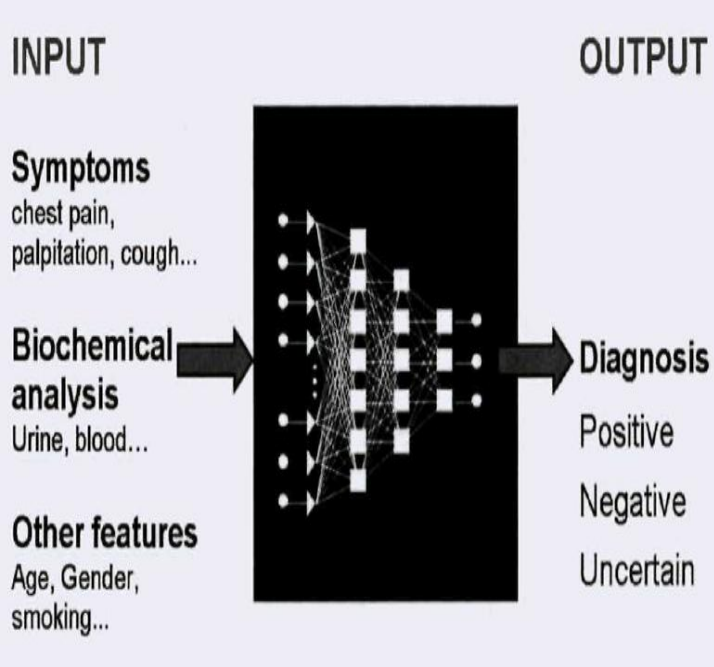
- **In Post-op, follow up & hospital stay**
  - Surgical Site Infection (SSI) average 2.3 % 5 years period from 30 hospitals based in America, Africa, Asia, Europe. 8,000 deaths/year in the USA.
  - University of Iowa Hospital reduced infection after surgery 74 % and generated $1.2 million in saving after implementing AI tech into their surgical procedure. Predicting infection before the surgeon even gets a chance to close the wound.

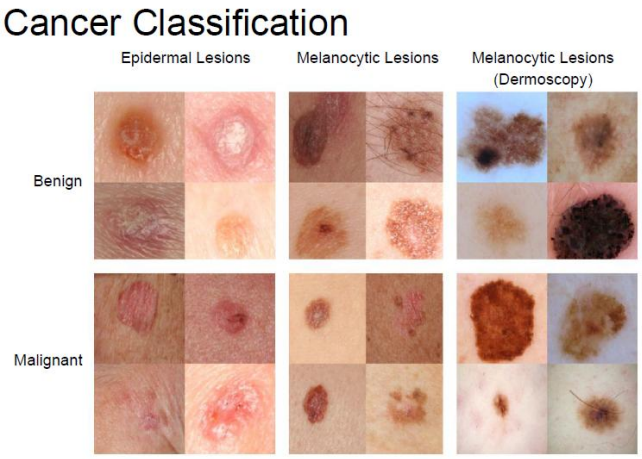
# AI in Healthcare and research

- **In Post-op, follow up & hospital stay**
  - GE launched Edison, AI apps aimed at centralizing information and putting it in the hands of hospital staff, enable clinicians to make quicker, well informed decisions.  It's make better care for the patients, smoother communication across the hospital and fewer errors.

# Benefits of Artificial intelligence

- AI can definitely assist physicians
  - Clinical decision making - better clinical decisions
  - Replace human judgement in certain functional areas of healthcare (eg, radiology).
  - up-to-date medical information from journals, textbooks and clinical practices
  - Experienced vs fresh Clinician
  - 24x7 availability of expert
- Early diagnosis
- Prediction of outcome of the disease as well as treatment
- Feedback on treatment
- Reinforce non pharmacological management
- Reduce diagnostic and therapeutic errors
- Increased patient safety and Huge cost savings associated with use of AI
- AI system extracts useful information from a large patient population
- Assist making real-time inferences for health risk alert and health outcome prediction
- Learning and self-correcting abilities to improve its accuracy based on feedback.

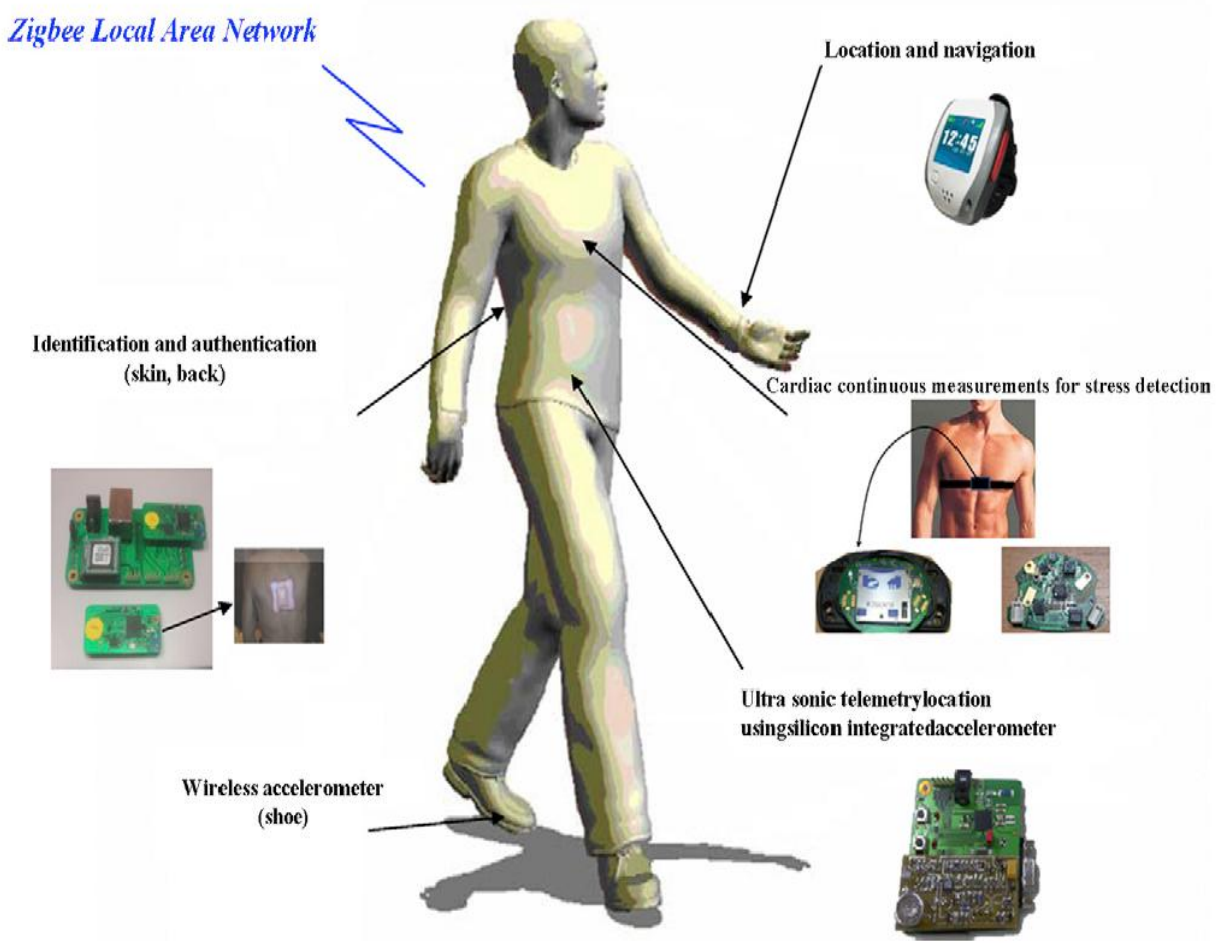


# Artificial intelligence in medicine : The physical branch

It includes:

- Physical objects,
- Medical devices
- Sophisticated robots for delivery of care (carebots)/ robots for surgery.



# AI in Healthcare and research

- **In Clinical care**

  Surgery

  – robotic tools in keyhole surgery.

  – Robotics care to monitor effectiveness.

  – robotics in remote care human actors.

  In Patients Department

  – Zigbee, Z-wave in patient rooms for their convenience

# AI in Healthcare and research

- **In Clinical care**

  Chatbot with these qualities

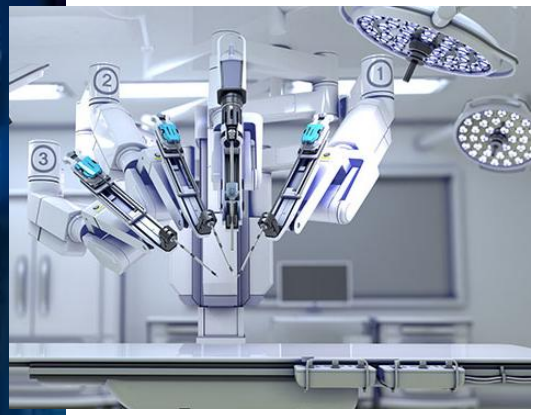
  - Omnicapable: converse multiple channels without losing data
  - Conversational: advance vocabulary with slang
  - Helpful: job efficiently and effectively
  - Insightful: improve your knowledge and well-being by giving advice, lessons, test or exercise

  **Psychology chatbot**

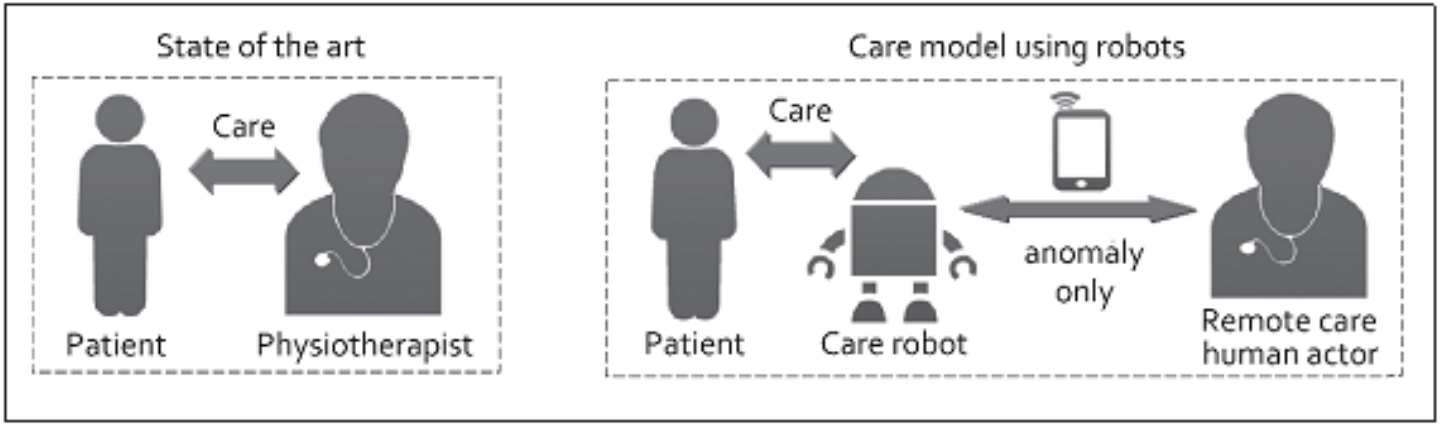
  - Woebot
  - Replika
  - Moodkit & Moodnotes
  - Pacifica
  - Wysa
  - Joy app.

# Use of robots to deliver treatment - Robotic surgery

Use of robots to deliver treatment..robotic surgery



# Use of robots to monitor effectiveness



# AI in Healthcare and research

- In Implants
  - Imperial College London: in treatment strategy for kidney failure patients, studied over 100,000 past cases, develop ideal treatment strategies for new patients.
  - Chinese University of Hong Kong & Robert H. Lurie Children's Hospital in Chicago, predict future speech learning in deaf children in cochlear implant. Study learning section of the brain to improve methods how to speak better.

# AI in Healthcare and research

- In Implants
  - University of Pennsylvania: 200 electrodes implanted on the 25 epileptic patient heads. Stimulation for engaging memory whilst AI analyzed the data from the impulse to learn how a brain retrieves that memory.  15 % performed higher than other subjects.

# AI in Healthcare and research

- In Prosthesis (for function and image)
  - Imperial College London + University of Gotting : self learning bionic hand. Improve and become even smoother.
  - 3 Universities in Arizona: knee prosthesis adjustment from hours to 10 min, 12 control parameters.
  - Duke University, North Carolina: fuse electrical signals produced by neurons in the brain with electronics. See how brain can move objects and non human limbs attached to arm to be used in performing different type of work or sports.

# AI in Healthcare and research

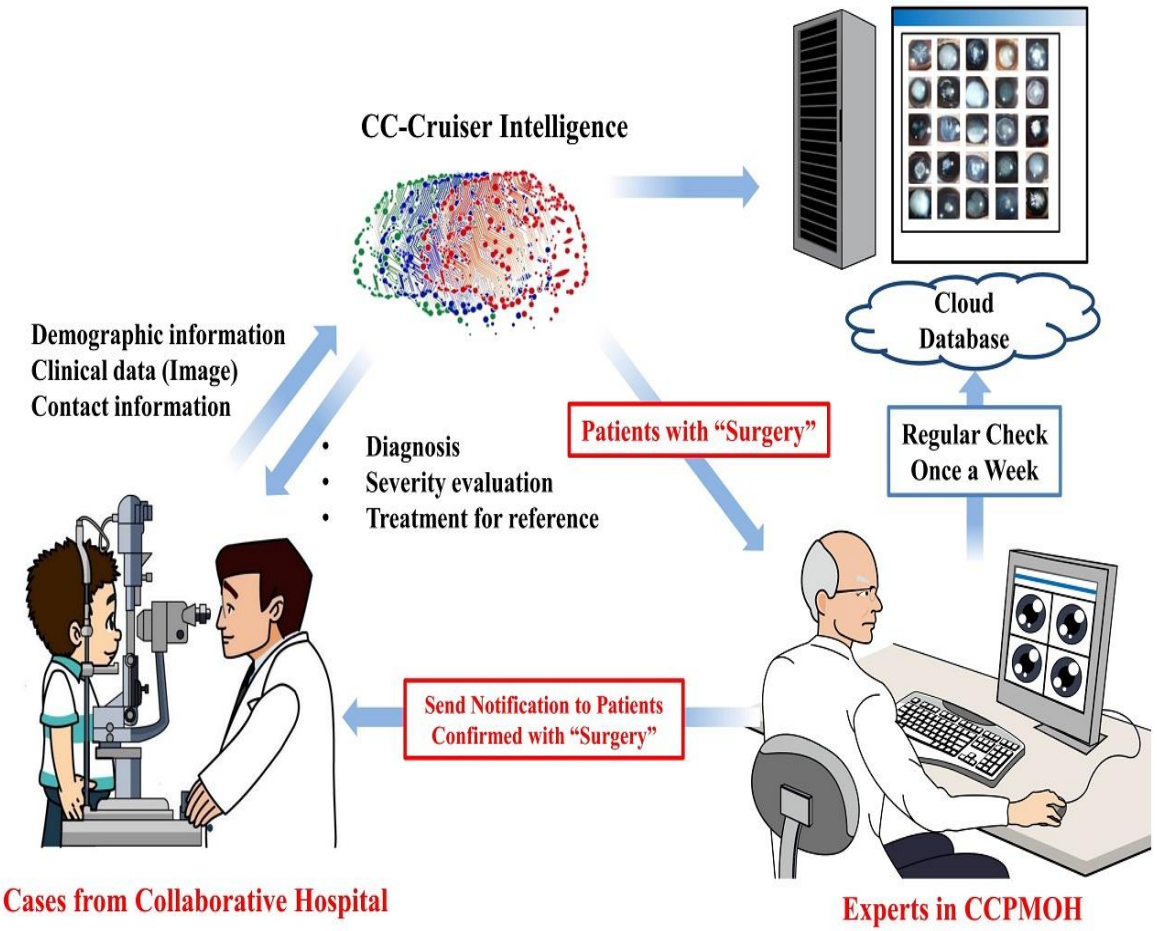
- In Optometry.
  - Moorfields Eye Hospital. 5.5 % error rate same as 2 of the world leading retina specialists. Identify up to 50 different eye diseases with almost accuracy by performing 3D scan of the retina.
  - Shiley Eye Institute at UC San Diego Health, developed a screening tool to diagnose eye diseases and pneumonia

# AI in Healthcare and research

- In Dentistry
  - Identify dental implant placement in National Center for Biotechnology, Seoul National University Bundang Hospital.

# Growth drivers of AI in Healthcare

- Increasing individual healthcare expenses
- Larger Geriatric population
- Imbalance between health workforce and patients
- Increasing Global Health care expenditure
- Continuous shortage of nursing and technician staff. The number of vacancies for nurses will be 1.2 million by 2020
- AI is and will help medical practitioners efficiently achieve their tasks with minimal human intervention, a critical factor in meeting increasing patient demand.



# Potential challenges

- Development costs
- Integration issues
  - Ethical issues
  - Reluctance among medical practitioners to adopt AI
  - Fear of replacing humans
- Data Privacy and security
  - Mobile health applications and devices that use AI
  - Lack of interoperability between AI solutions
- Data exchange
  - Need for continuous training by data from clinical studies
  - Incentives for sharing data on the system for further development and improvement of the system. Nevertheless,
  - All the parties in the healthcare system, the physicians, the pharmaceutical companies and the patients, have greater incentives to compile and exchange information
- State and federal regulations
- Rapid and iterative process of software updates commonly used to improve existing products and services

| Industry Challenges[11,12] |
| --- |
| High initial capital requirement |
| Potential for increased unemployment |
| Difficulty in deployment |
| Reluctance among medical practitioners to adopt AI |
| Ambiguous regulatory guidelines for medical software |
| Lack of curated healthcare data |
| Concerns regarding privacy and security |
| Lack of interoperability between AI solutions |
| State and Federal Regulations |

# Future Thailand Scenario

- **Collaboration** between medical and technical institutions
- Stop working in silos
- Remove **Firewall** of clinical load and hope of IPR
- Government **funding** – more intelligent and result oriented rather than you pat – i pat
  - Scientific mafia or scientist Mafia
- **Current status of medical records**
  - incommunicable silos of wasted information for the health system and for knowledge acquisition. Laboratories and clinics need to collaborate to accelerate the implementation of electronic health records
- Data need to be captured in real-time, and institutions should promote their transformation into intelligible processes
- New scientific and clinical findings should be shared through open-source, and aggregated data must be displayed for open-access by physicians and scientists and made automatically available as point-of-care information.
- Integration and interoperability including ethical, legal and logistical concerns are enormous
- Simplification, readability and clinical utility of data sets
  - Each result must be questioned for its clinical applicability.
  - Aim of increasing their clinical value and decreasing health costs
- ***Electronic medical or health records***
  - *are* essential tools for personalized medicine
  - Early detection and targeted prevention, again

# 4 Essential Elements for thriving AI

- Pervasive wireless connectivity: LPWAN, LTE Cat M, NB-IoT, LoRa, Bluetooth
- Open data  (more and better data)
- Security you can trust in: 4 core security objectives
- Flexible monetization scheme: subscription-based

# Cyber security

- New technologies bring benefits and challenges
- New technologies are changing the cyber landscape
- Industry must be prepared to take advantage of the opportunities presented by machine learning.
- AI and IoT, it is of vital importance that security by design and privacy by design be considered in the cyber world today.

# Cyber security

4 Core security objectives:

- Availability: real-time, reliable access to data to create information and shared with security
- Integrity: reliable and accurate data with accurate and free from manipulation
- Confidentiality: prevent unauthorized disclosure of sensitive information
- Accountability: Their interactions with sensitive systems should be logged and associated with a specific users.

Protect backend systems from intrusion and hacking.