Healthcare Innovation in Japan

August 21st, 2019

Masaya Watanabe

VP and Executive Officer, Hitachi, Ltd.
Vice Chairman, JFMDA

Masaya Watanabe

Vice President and Executive Officer,
CISO & GM, Smart Transformation
Hitachi, Ltd.

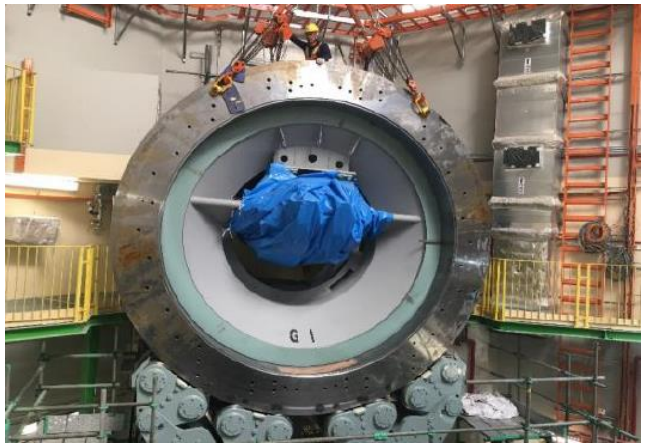
Vice Chairman,
The Japan Federation of Medical Devices Associations　(JFMDA)

June 2017	Chairman, The Japan Federation of Medical Devices Associations
April 2015	Vice President and Executive Officer President and CEO, Healthcare Company
April 2014	President and CEO, Hitachi America
April 2012	Vice President and Executive Officer CSO, IT Group
April 1982	Entered Hitachi, Ltd

National Cancer Centre Singapore (NCCS)

New NCCS Building

- 24 stories above ground and 4 stories below ground
- Scheduled to open in 2021.
- Proton Therapy System installation started from this July in the below ground level



Installation of Gantry Parts

Contents

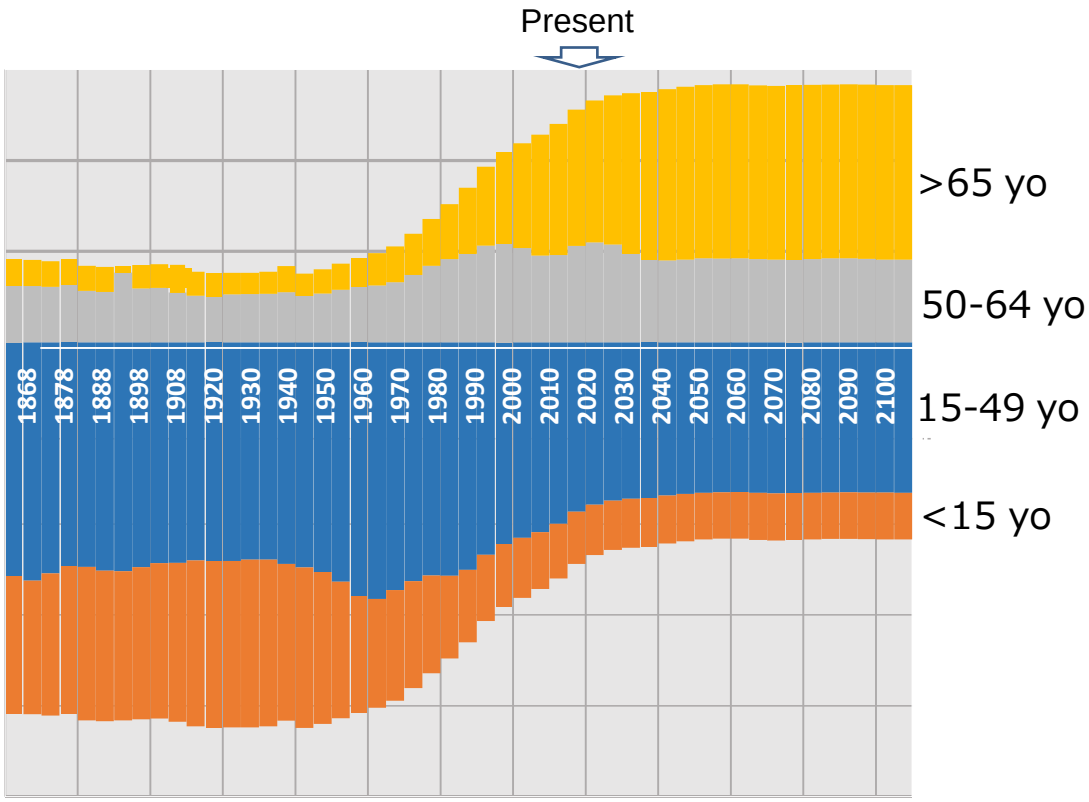
- **Introduction to Healthcare and Med-tech in Japan**
- **Digital/e-Health in Japan**
- **Foundation for New Digital Innovation**
- **Singapore-Japan Collaboration**

Introduction to
Healthcare and Med-tech in Japan

Aging Society, Japan and Global

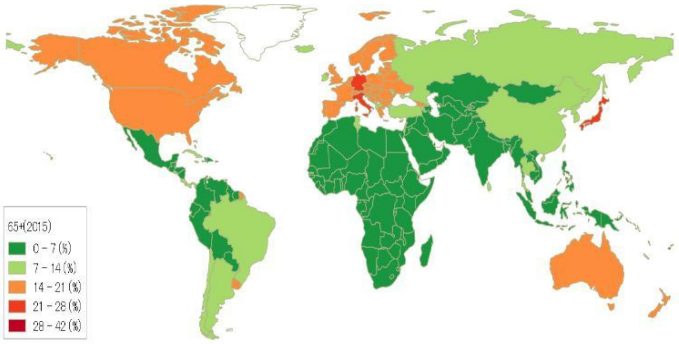
Japan: World top Aging Society & Decrease of Population
Population over 65yo 26.0% (2015) → 38.1% (2060)

Demographic Shift in Japan

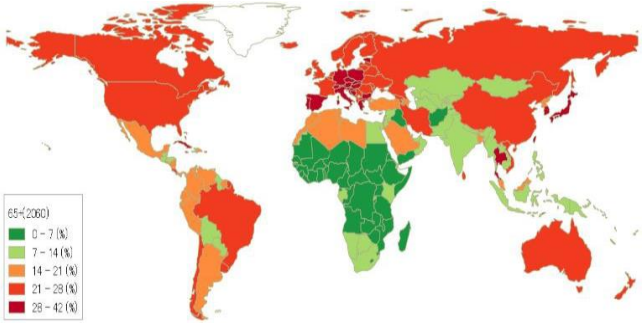


Population(%) over 65yo

in 2015



in 2060

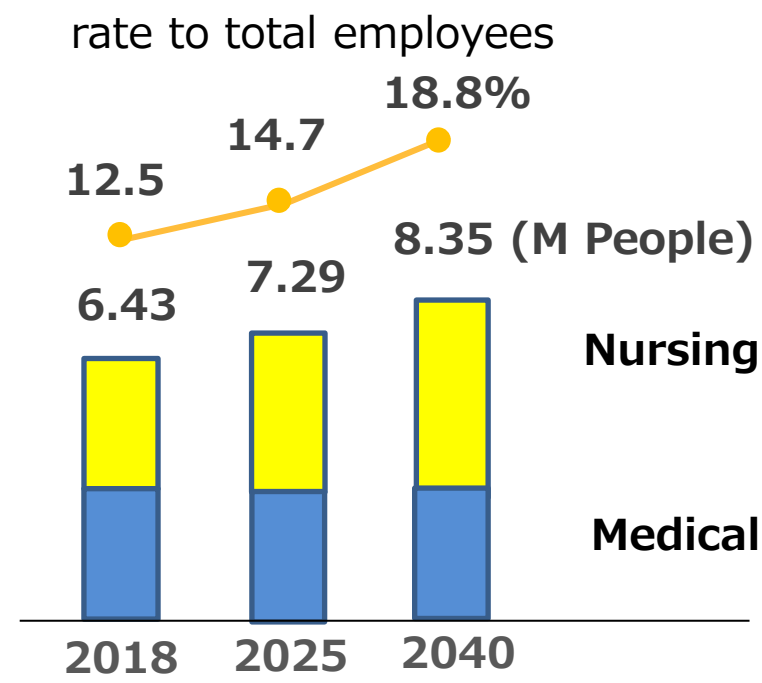


Source: Ministry of Health, Labor and Welfare 8th Healthcare medical AI development acceleration consortium (Jun. 6, 2019), "Current status of image-related database and common platform building research at AMED"

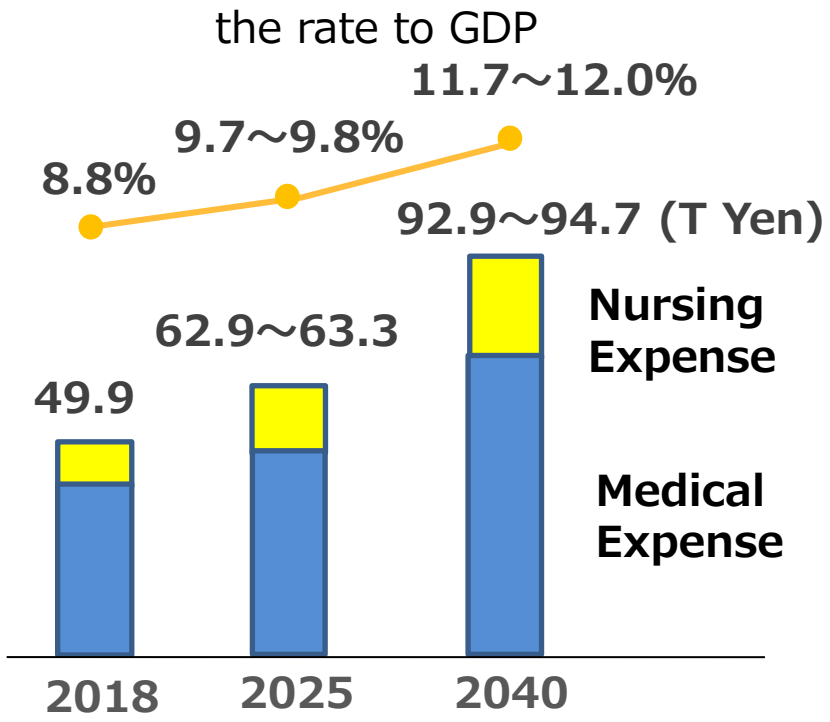
Critical Issues anticipated in 2040

- Lack of labor in medical and nursing service
- Increases of medical and nursing cost
- Shortage of medical and nursing service in big cities

Number of employees in Medical and Nursing



Medical and Nursing Expenses



Source: Ministry of Health, Labor and Welfare Committee

Sustainable Social Growth

Solve Social Problems and Develop Values that supports the Sustainable Growth

Sustainable Development Goals (SDGs)

Society 5.0
Society where people can live vividly and comfortably

Japanese Med-tech Market and JFMDA

Med-Tech. Market

- 3.0T Yen (8% of WW)
- CAGR approx. 4%
- Export:0.6T Yen
  vs Import:1.6T Yen
- 300K types of Devices

JFMDA (Japan Federation of Medical Device Association)

- Founded in 1984
- 21 Association Members
- Total 4,280 Companies
- 120,000 Employees

JFMDA Association Members

- **JMIA**: Japan Medical Industry Association
- **JEITA**: Japan Electronics and Information Technology Industries Association
- **JMOIA**: Japan Medical-Optical Equipment Industrial Association
- **JAMDI**: Japan Association of Medical Devices Industries
- **MTJAPAN**: Medical Technology Association of Japan
- **JAHID**: Japan Association of Health Industry Distributors
- **JASS**: Japanese Association of Surgical Sutures
- **JHPIA**: Japan Hygiene Products Industry Association
- **JIRA**: Japan Medical Imaging and Radiological Systems Industries Association
- **JOIA**: Japan Ophthalmic Instruments Association
- **JCLA**: Japan Contact Lens Association
- Japan Condoms Industrial Association
- **JHHC**: Japan Home Health Care Association
- **JDTA**: Japan Dental Trade Association
- **JAIMA**: Japan Analytical Instruments Manufacturers' Association
- **JHIMA**: Japan Hearing Instruments Manufacturers Association
- **JHIDA**: Japan Hearing Instruments Dispensers Association
- **HAPI**: The Japan Home-Health Apparatus Industrial Association
- Japan Industries Association of Physical Therapy Device
- **JACRI**: Japan Association of Clinical Reagents Industries
- **@MD-Net:** Association of Japan Medical devices Network

AMDD: American Medical Devices and Diagnostics Manufacturers' Association

EBC: European Business Council in Japan

JFMDA Vision 2018

Transform to Lead “Society 5.0”

- Innovation including Digitalization
- from Single Device to System to to resolve Social Agenda
- Collaboration with Stakeholders

For the Patients

- Safety, Supply, Traceability(UDI)

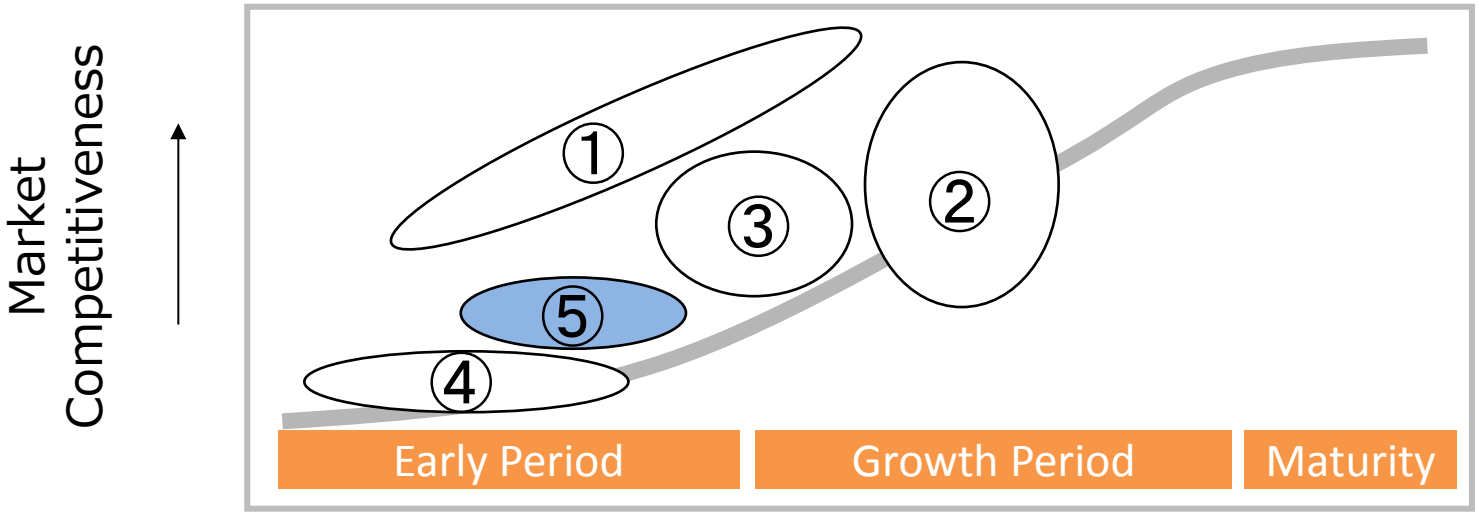
Industry Growth

- Globalization
- Attract Young Talent

Next R&D Investment of Med-tech

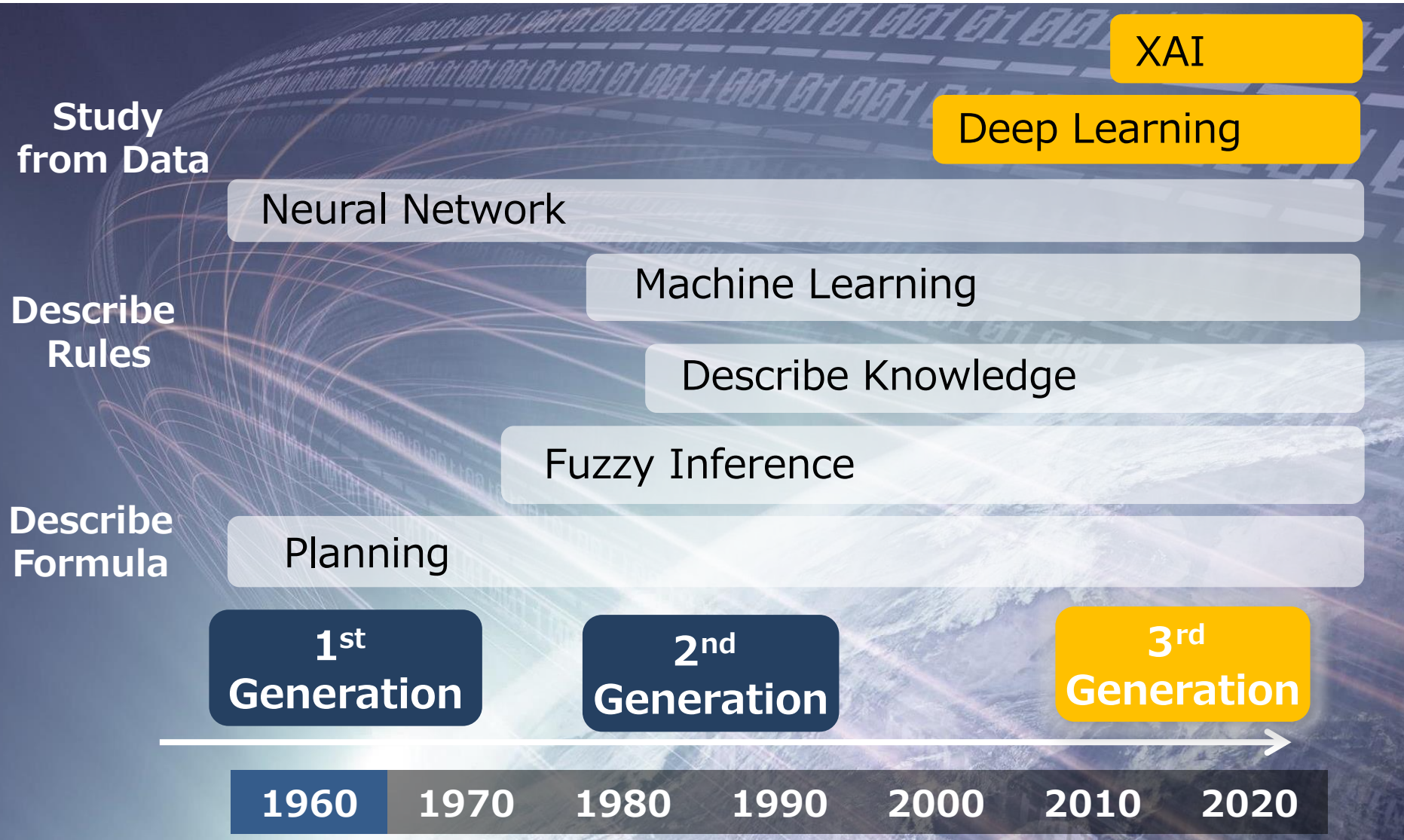
AMED Working Group concluded Five Focuses:

① Early and Simple Exam. and Diagnosis
② Diagnosis and Treatment that maximize Outcome (eg. Cancer)
③ Prevention (eg. High Blood Pressure, Diabetes)
④ Human Function Enhancement to Aged People
⑤ Digital Health and Platform



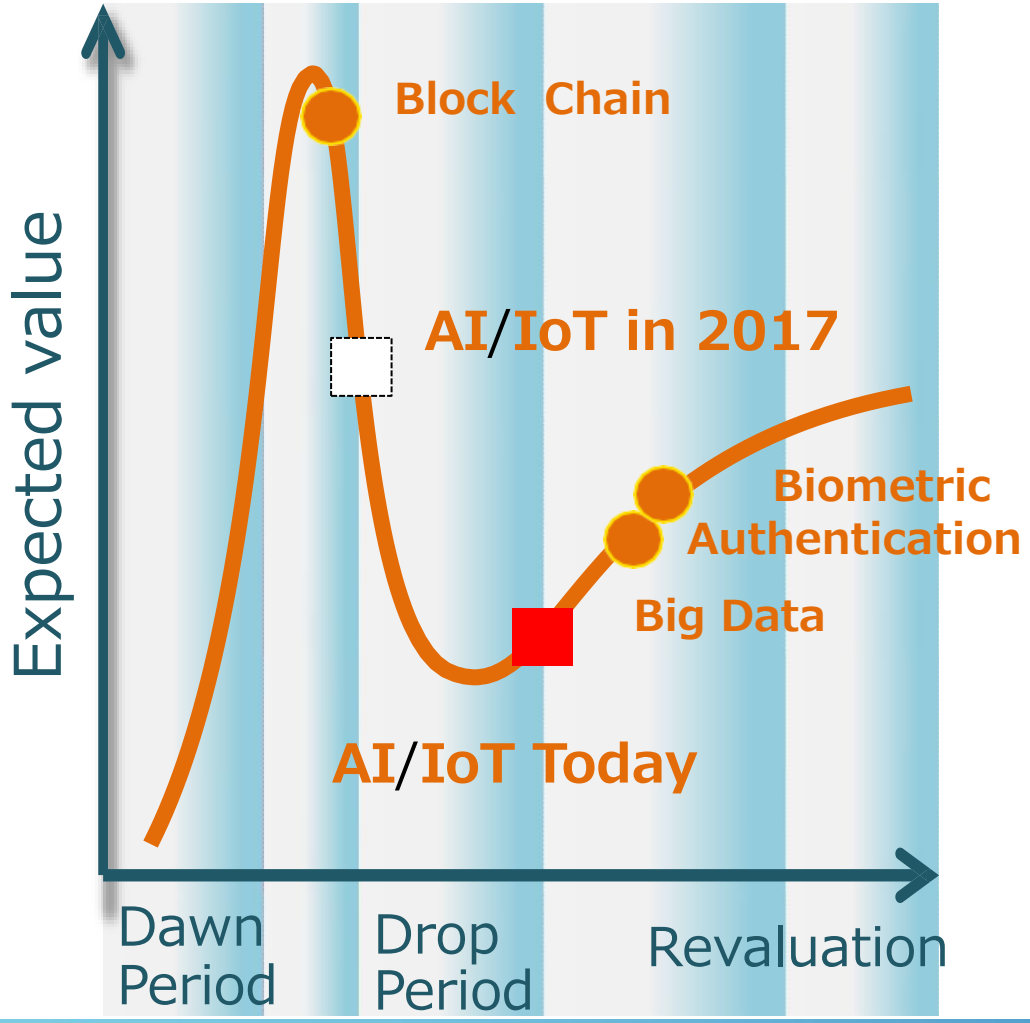
Digital/e-Health in Japan

AI Technology History



AI for Society in Japan

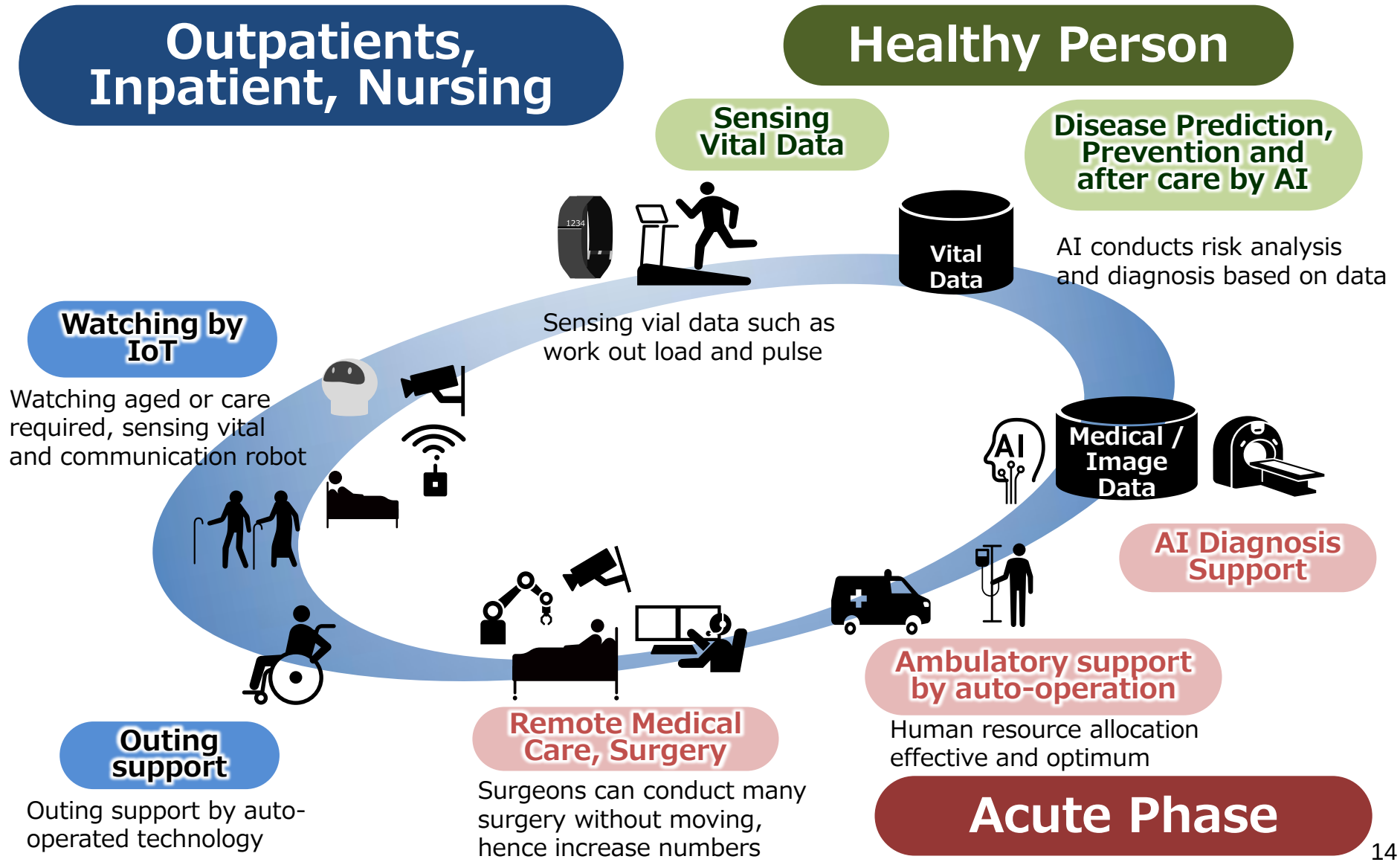
Disruptive Tech. Adoption



AI Social Implementation

- Health, Medical, Nursing
  - Data Base Establishment
  - Medical AI Hub
  - Recurrent Training to Medical Staff
- Smart Agriculture
- National Enforcement
  - Infrastructure
  - Disaster Prevention
- Transportation and Logistics
- Local Development
  - Smart City from Japan

Connect Care Cycle by Digital Technology



Surgery 4.0

Surgery 4.0

Future
Surgery 4.0

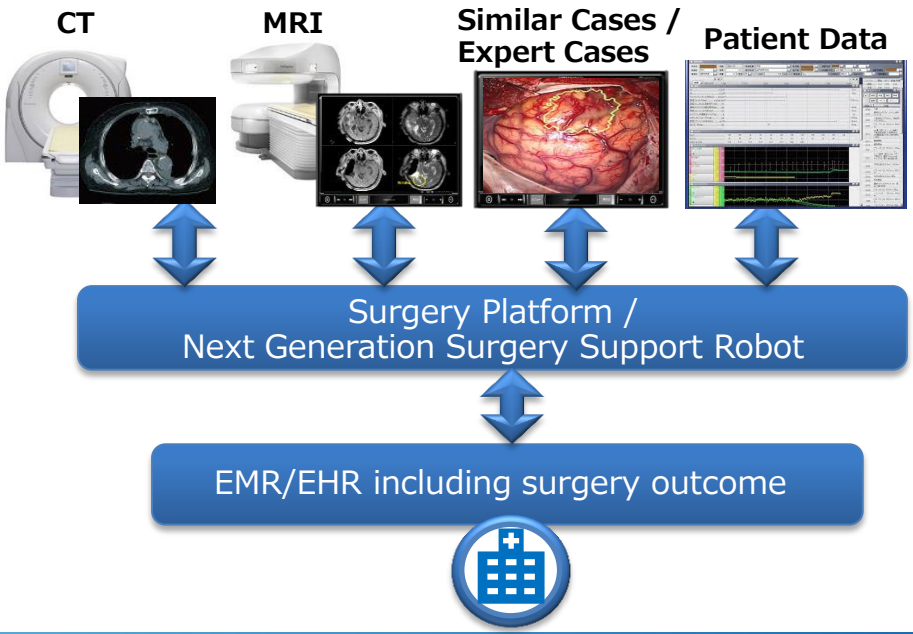
Today
Surgery 3.0
Robotic Surgery

1990s
Surgery 2.0
Endoscopic Surgery

1800s
Surgery 1.0
Surgery by inhalation anesthesia

Expectation to Surgery 4.0

- **Support immediate and accurate decision by summarizing patients information such as diagnostic data**
- **Define "Optimal Surgery" by linking surgery data and clinical outcome. Accelerate Standardization**
- **Support Surgeon training by AI**



SCOT for Smart Surgery

Intra-Operative MRI

- First in 2000 at Tokyo Women's Medical University
- 2,000 surgeries
- Brain tumor 5 year survival rate improved by 80%
- Introduced in 16 Hospitals

SCOT

Smart Cyber Operating Theater

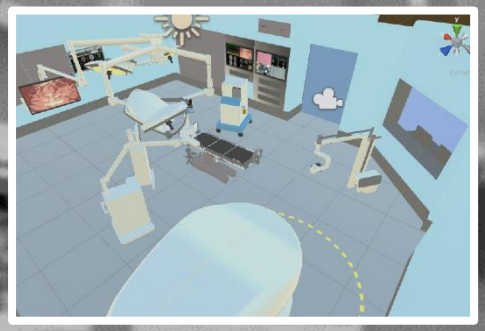
ORiN®

Medical Device

- Standardize surgery devices
- Improved safety
- 46 medical devices connected

SCOT for Surgery 4.0

VR/AR



AI-SCOT

Conference before surgery
- Search and display similar cases

Navigation during surgery
- Prediction after surgery

AI-SCOT Data Warehouse

Cleansing

AI

SCOT
Smart Cyber Operating Theater

ORiN®
Medical Device

ORiN is a registered trademark of the Japan Robot Association

Surgical Skills Assessment with Digital

NCGM National Center for Global Health and Medicine

HITACHI Inspire the Next

2018年11月5日
国立研究開発法人 国立国際医療研究センター
株式会社日立製作所

国立国際医療研究センターと日立が次世代医療の実現に向けた連携協定を締結
IoT やロボットを活用し、手術室の高度化や医療従事者の働き方改革をめざす

Surgery Work Flow Analysis with Digital Tech.

- Staff and device status transition sensing and visualization
- Ascertain Surgeon's Skill Level Objectively
- Clarify the Tasks during Surgery

Digital Solutions

- **Surgery Scoring System**
- **Surgery Support Robot**
- **Surgery Assistant System**

HyperSCOT

Tokyo Women's Medical University

C-SATS

accurate and objective surgical skills assessment system, designed to help health care professionals continuously improve (source: http://www.csats.com/)

AI Hospital

AI Hospital Project in SIP

PD
Yusuke Nakamura
Director
Cancer Precision
Medicine Center

- ✓ SIP(Strategic Innovation Promotion) Program funded by Japanese Gov.
- ✓ Realize advanced “patient-centered medical care” through hospital digitalization and AI usage
- ✓ Realize both quality of medical care and staff satisfaction through audio visual data at medical fields
- ✓ 10 model hospitals by 2022

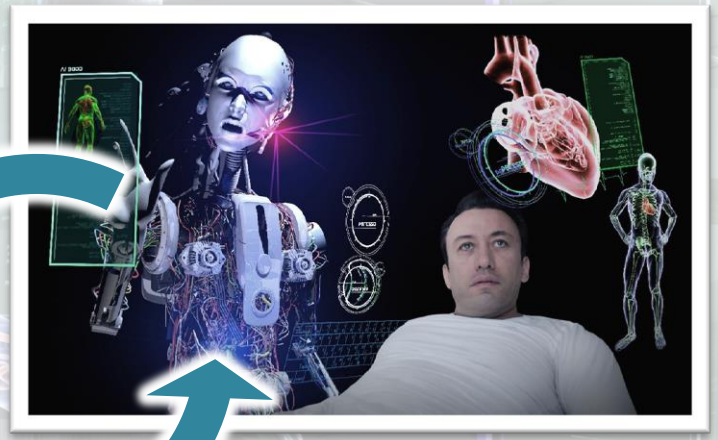
AI Hospital Implementation

- Diagnostic Conversation Doc.
- Summary Document for patient
- Bidirectional patient explanation

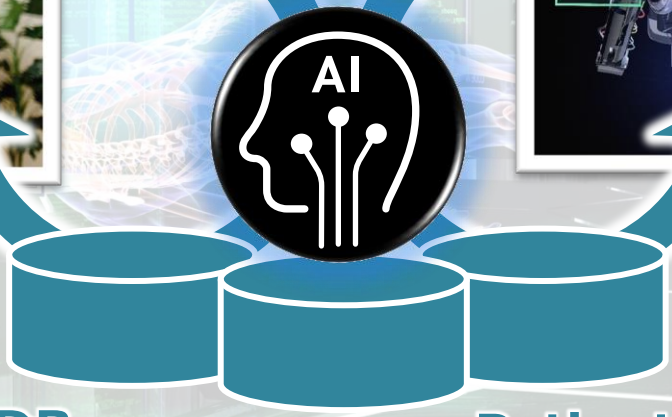
- Endoscopy with sensors and AI
- Comprehensive analysis system including vital and genome data
- Super precise analysis by AI

Improved Communication with Patient

Advanced Diagnosis and Treatment



Audio Visual

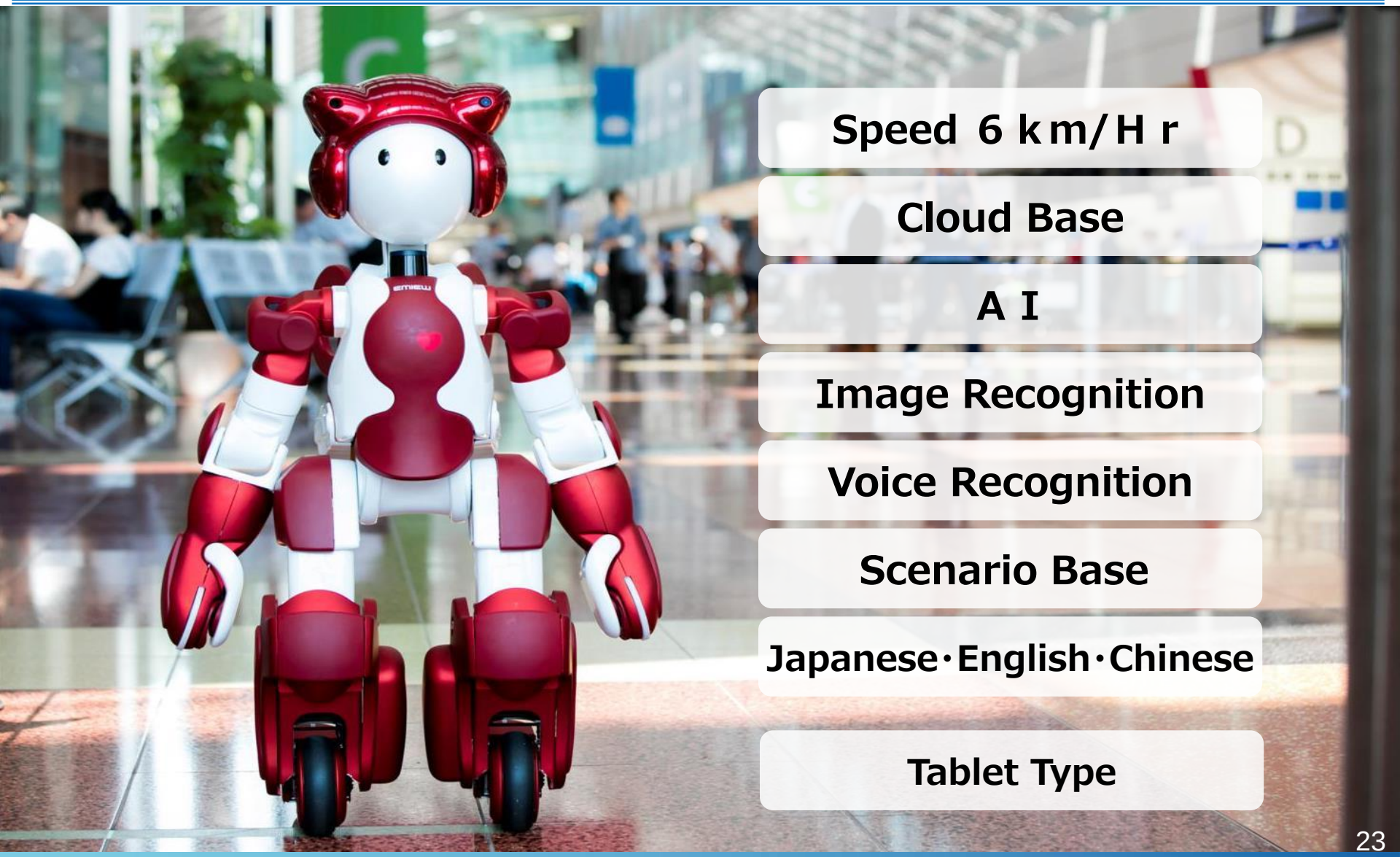


Knowledge DB

Patient Info. DB

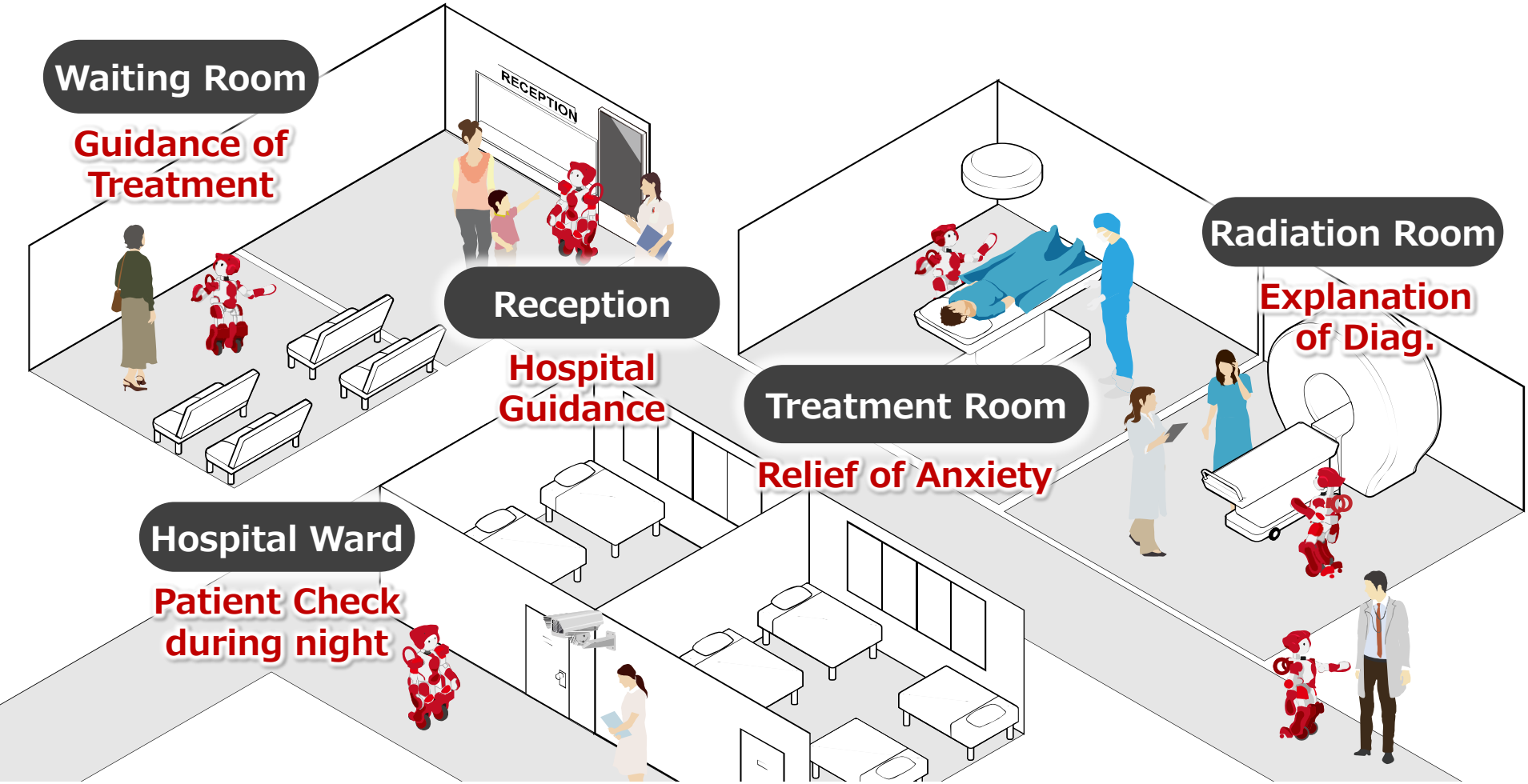
- High Security DB
- Medical effective information extraction and analysis

Humanoid Robot EMIEW3



- Speed 6 km/Hr
- Cloud Base
- AI
- Image Recognition
- Voice Recognition
- Scenario Base
- Japanese・English・Chinese
- Tablet Type

PET Examination with Humanoid Robot



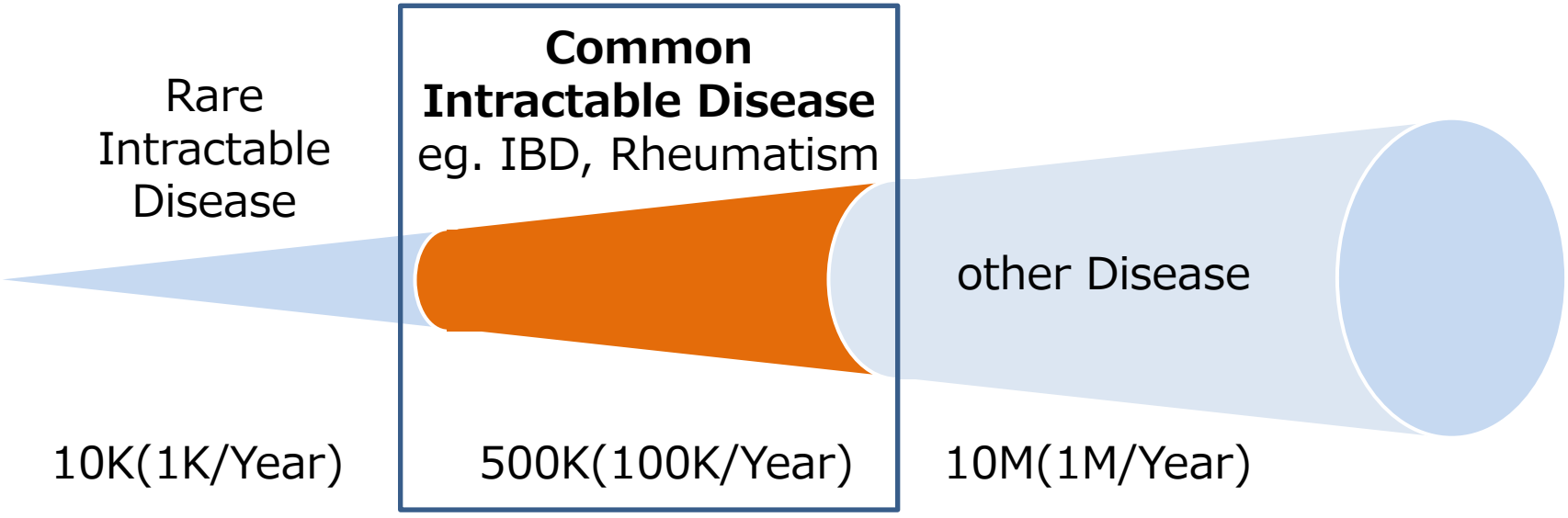
Diagnostics and Treatment × AI

Collaboration
Tokyo Medial and Dental University and Hitachi

“Common Intractable Disease”

Improve Medical Care to “Common Intractable Disease” with AI and ICT

- Collaboration between High Level Medical Institute and Local Hospitals
  - Share clinical Specialists Knowledge
  - Share Patient information in timely manner
- Improved QOL for Patient
- Improve Medical Economics by Optimized Cost



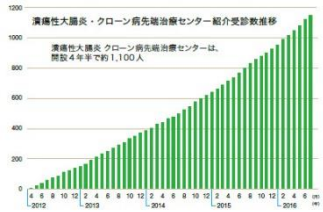
Source: Tokyo Medical and Dental University document

IBD Patient Care: Today

IBD: Inflammatory Bowel Disease

- Highly Specialized Medical Institute and Local Hospitals/Clinics have cooperation mechanism but not effectively implemented and it causes problems to each sides.
- Best care to patients may not provided that causes lack of satisfaction

Specialized Medical Institution



Tokyo Medical and Dental University
Intractable Disease Treatment

Lack of Resources
・Patients over concentration
・Remission and mild patients over stay

Without Referral

Patient Referral

Counter Referral

Local Hospitals/Clinics

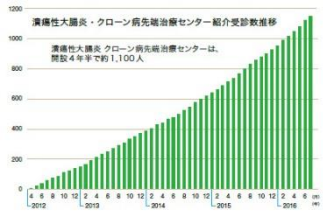
Uneasy to accept intractable patients

IBD Patient Care: Future with AI and ICT

Realize Specialist/Local/Patients linked medical care by digital tech

- Specialists patient watch using smart devices
- AI diagnosis based on structuralized specialists clinical knowledge and clinical information
- Clinical Research started in July 2019 at Tokyo Medical and Dental University

Specialized Medical Institution



Tokyo Medical and Dental University
Intractable Disease Treatment

Patient Referral

Counter Referral
Supervise

Local Hospitals/Clinics

Focus on severe and exasperation period patients

Comfortable Self Management

Information share and patient monitoring by devices

Secure feel by support from highly specialized medical institutes

Diagnostic Imaging with AI

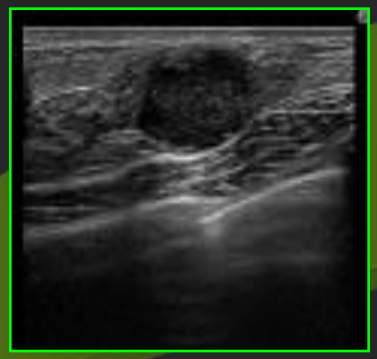
Image Diagnosis × AI

Dementia CAD

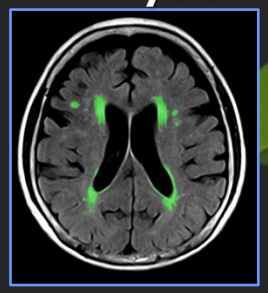
Brain Shrink Evaluation

Ion Deposition Evaluation

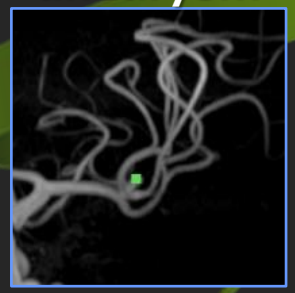
US Breast Cancer CAD



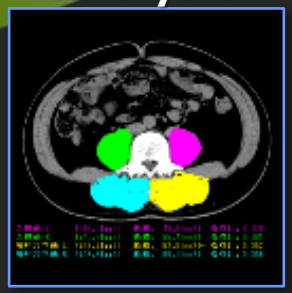
White Matter Analysis



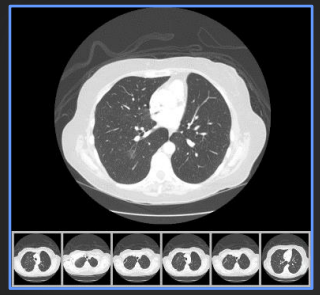
Cerebral aneurysm



Muscle Analysis

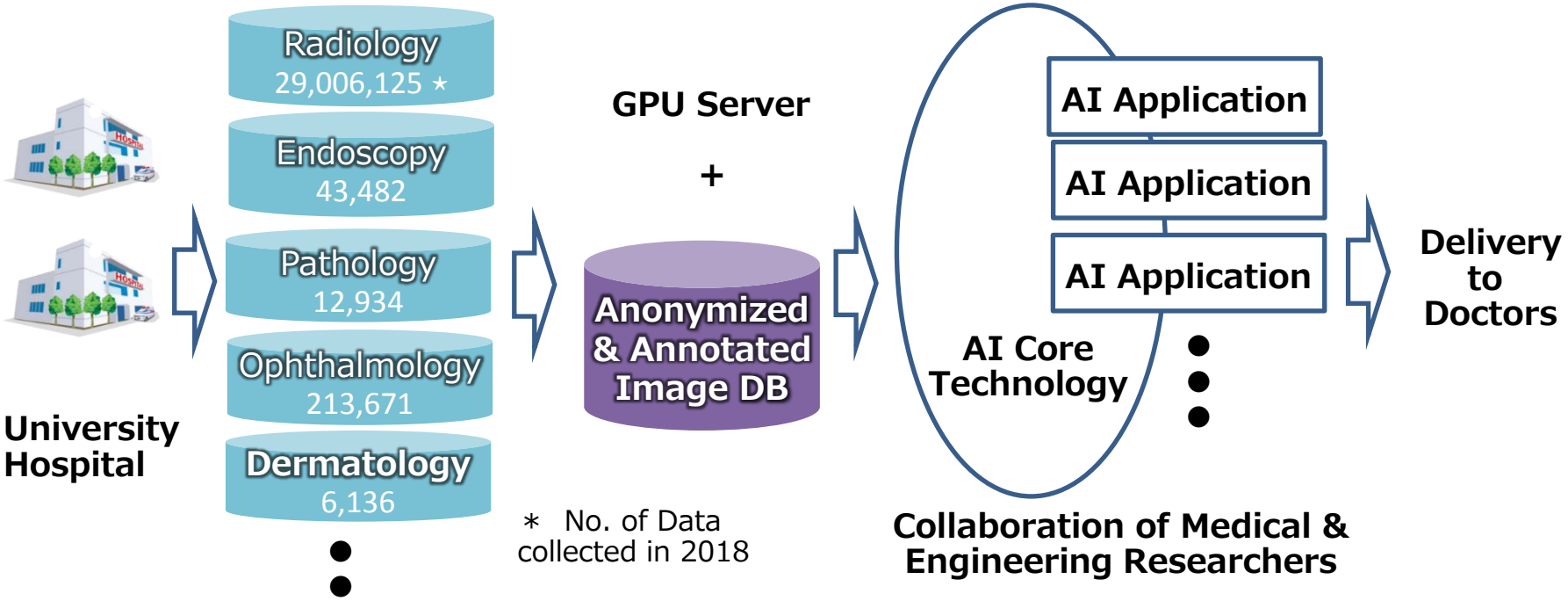


Lung Cancer CAD



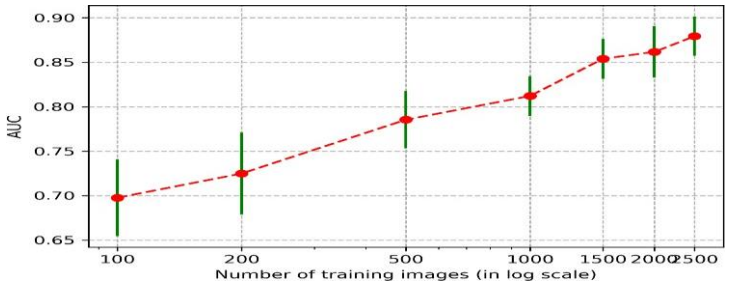
AMED Sponsored Research Project(1)

AMED: Japan Agency of Medical Research and Development



Research by Japanese Ophthalmological Society

Glaucoma positive/negative



Source: Ministry of Health, Labor and Welfare 8th Healthcare medical AI development acceleration consortium (Jun. 6, 2019), "Current status of image-related database and common platform building research at AMED"

AMED Sponsored Research Project(2)

Challenges to the Next Step:
To Utilize DB collected by Academic Society in Boarder Community including Industry

1. to Create Teacher's Data
(1) Meta data Generation, Annotation
(2) Anonymization

2. to Provide Data to the Third Parties
(1) Personal Information, Ethic Examination
(2) Data Security
(3) Data Standardization
(4) Intellectual Property Rights

Source: Ministry of Health, Labor and Welfare 8th Healthcare medical AI development acceleration consortium (Jun. 6, 2019), "Current status of image-related database and common platform building research at AMED"

MRI Quantitative Parameter Mapping

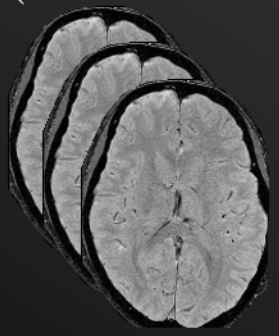
Works in Progress

--- Simultaneous measurement of multiple quantitative maps ---

Acknowledge Risk and optimization → Easy Imaging → Rapid Imaging → High Quality Image → **Image Quantification** → Support Interpretation Detect/Analyze/Report

3D-GrE

$I_{acq}(FA, TR, \theta, TE)$



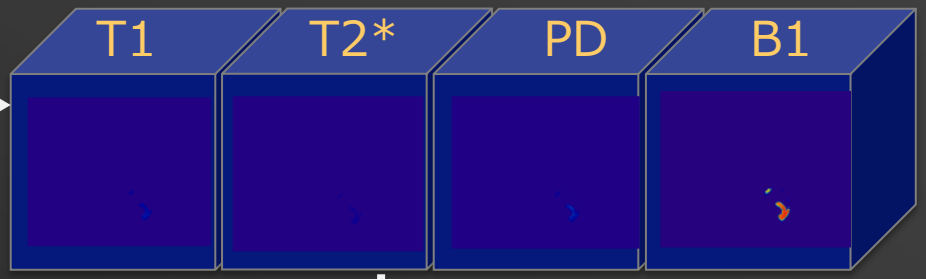
Taniguchi Y, et al. ISMRM 2010; 3113.

Parameter fitting

$I_t = f(T_1, T_2^*, \rho, FA, TR, \theta, TE)$

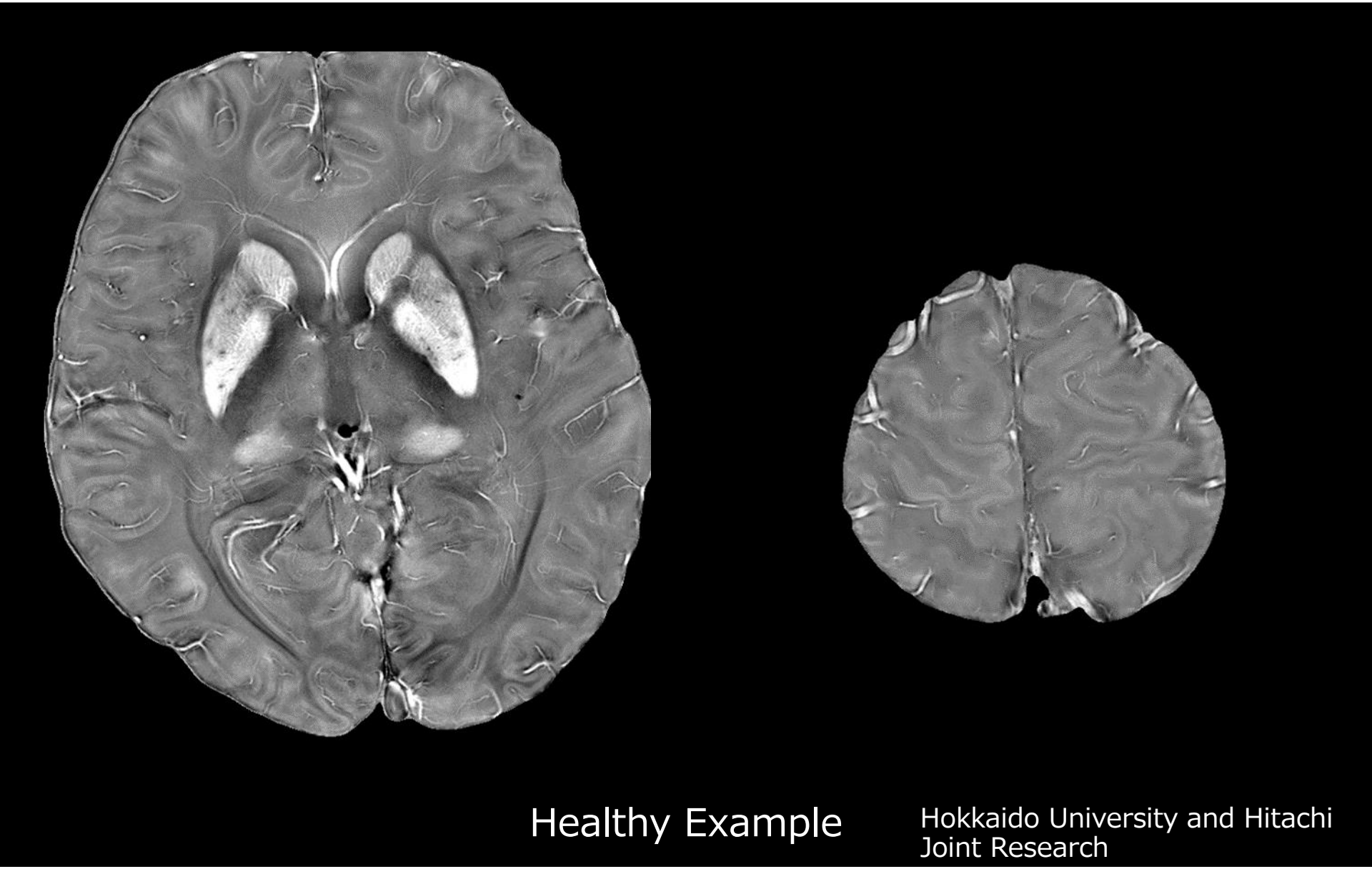
Signal intensity function by Bloch simulator

Quantitative parameter maps



Derived maps & weighted images

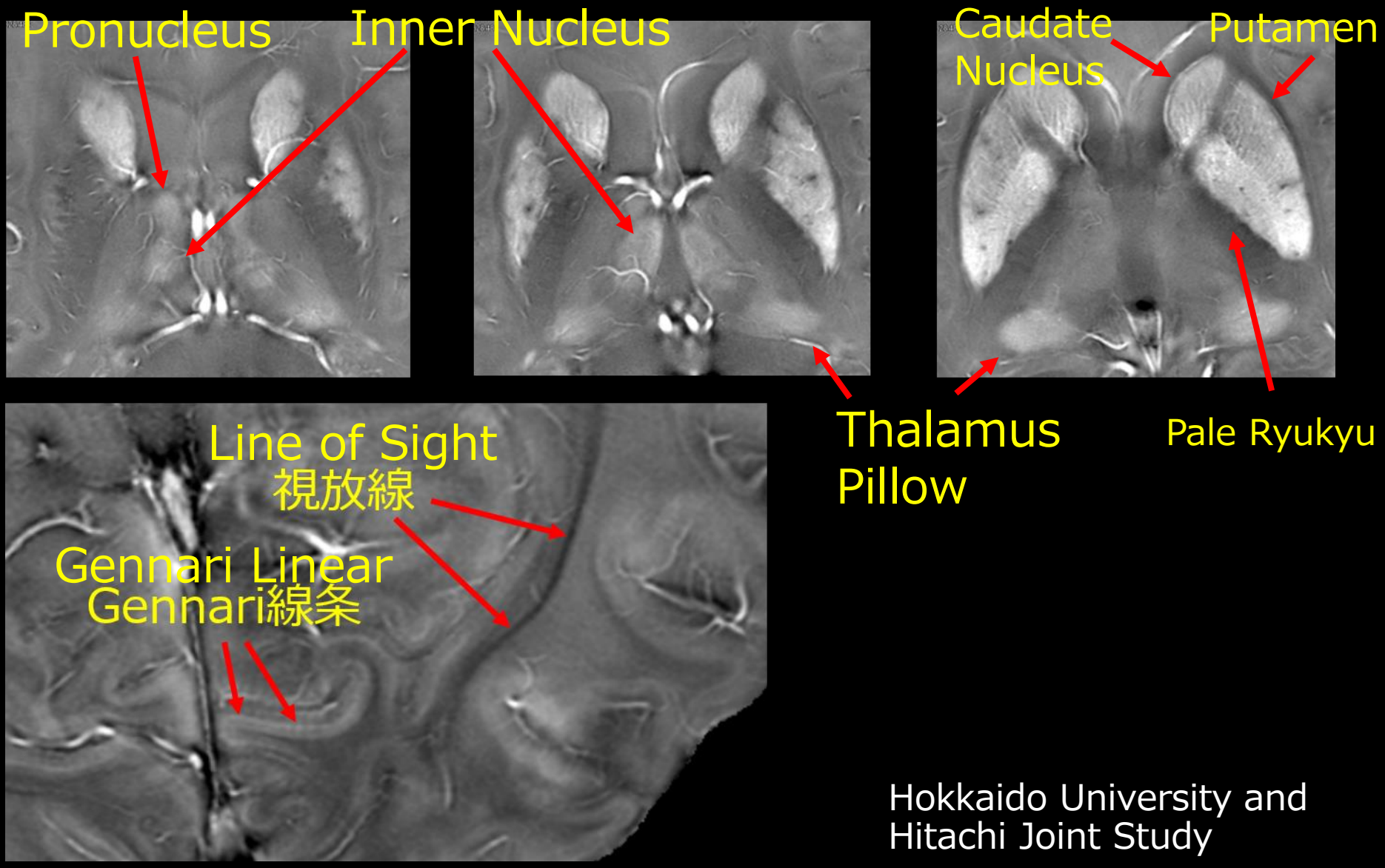
QSM High Resolution Imaging(1)



Healthy Example

Hokkaido University and Hitachi
Joint Research

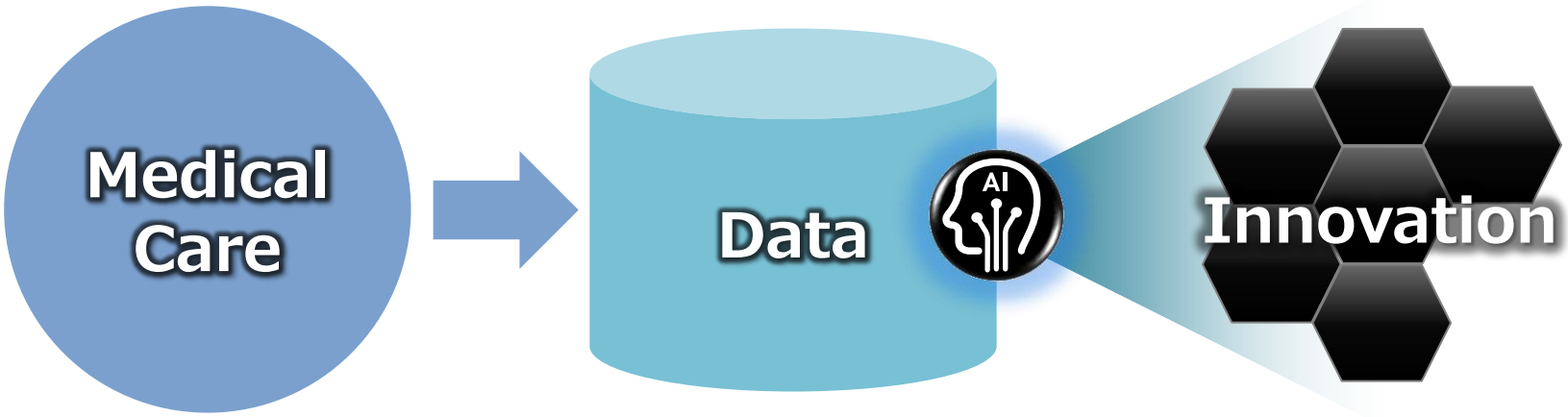
QSM High Resolution Imaging(2)



Hokkaido University and
Hitachi Joint Study

Foundation for Digital Innovation

New Innovation driven by “Data”



Data extracted from medical fields drives Innovation

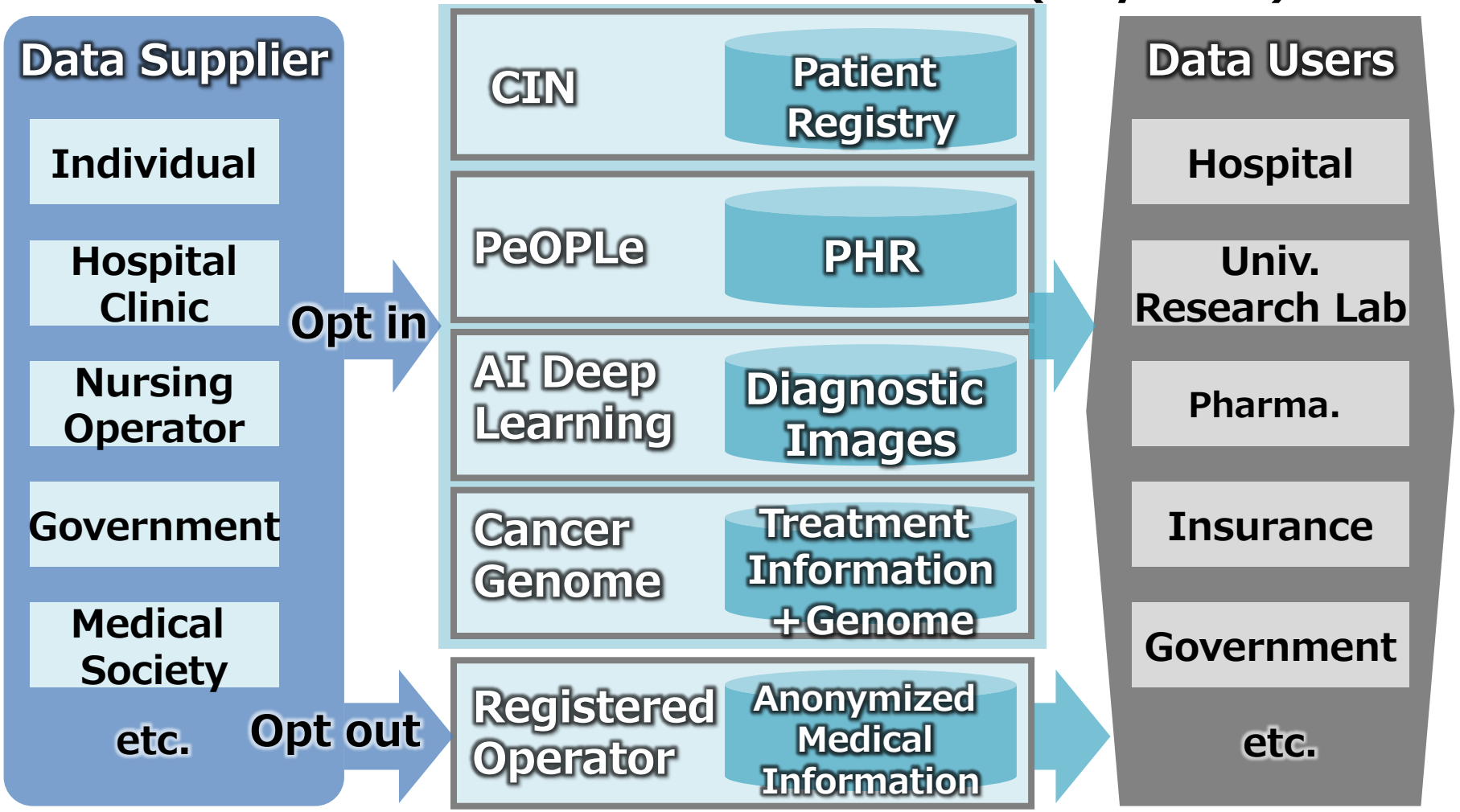
What are required as foundation of Digital Innovation ?

- National Data Platform
- Personal Data Protection
- AI Ethics
- Cybersecurity
- New Talent

etc.

National Data Platform in Japan

- Investment to National Healthcare Data Platform
- ”Next Generation Medical Platform Law“ (May 2018)



CIN: Clinical Innovation Network, PeOPLe: Person centered Open Platform for wellbeing

AI Ethics in Global

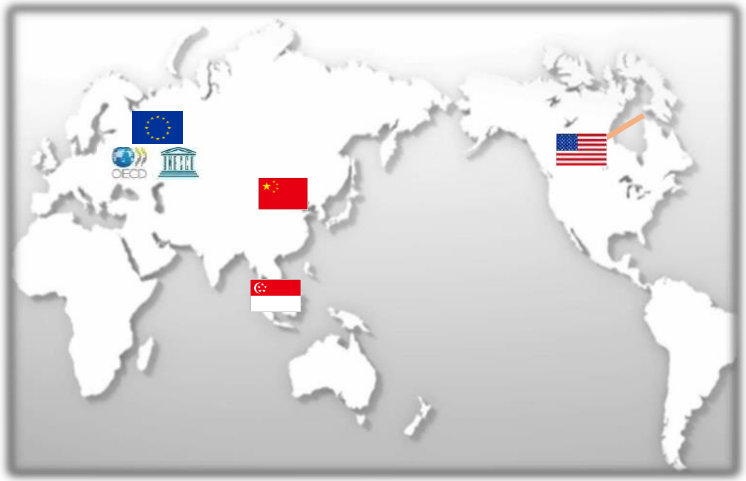
Social principle and AI ethics needed for the implementation of AI to the society

EC

・Ethics guideline for trustworthy AI (Apr. 2019)

Singapore

・AI governance and Ethics initiative (Jun. 2018)



USA

・Presidential decree signed "American AI Initiative" (Feb. 2019)

China

・Establish AI ethics committee (Jul. 2019)

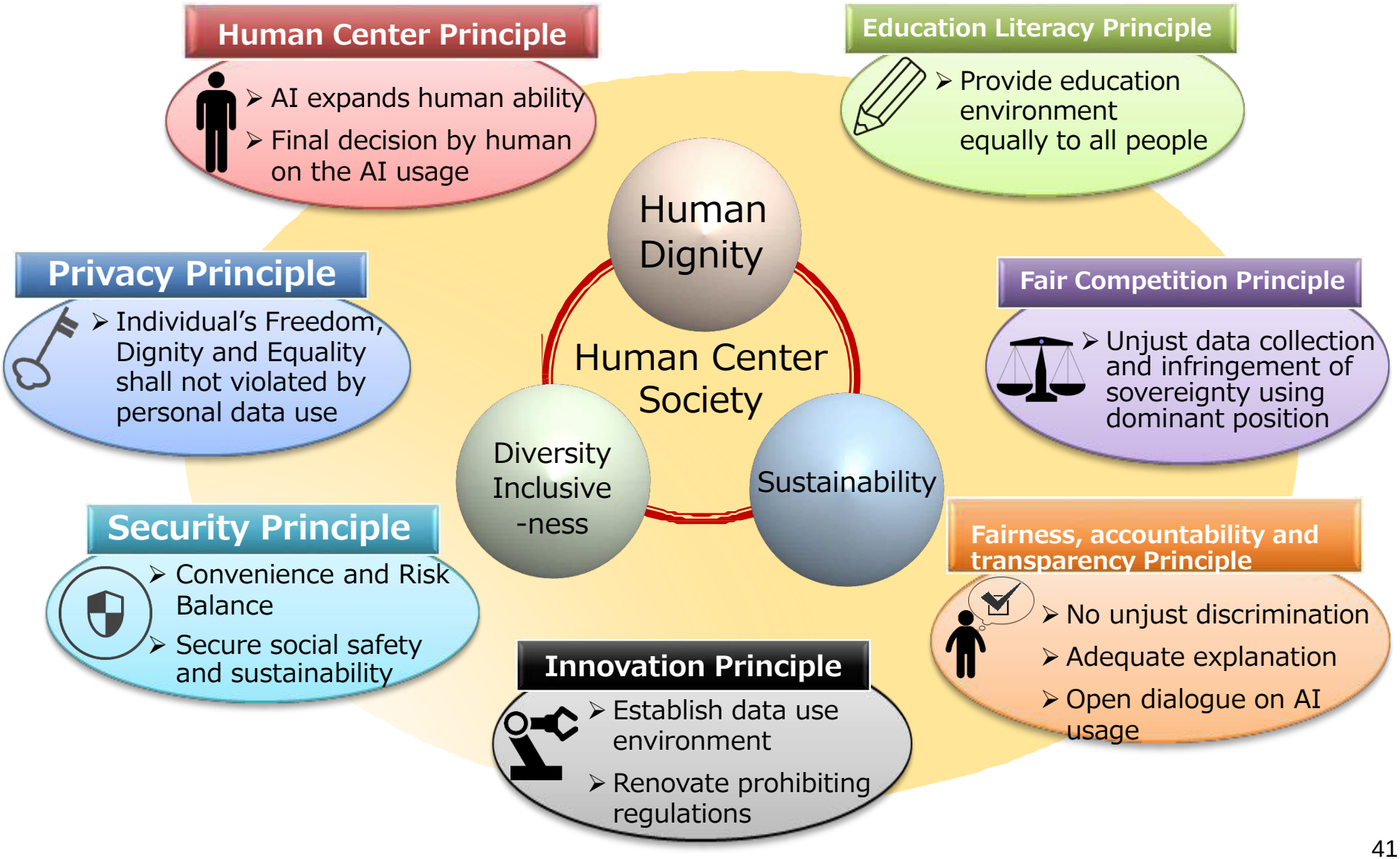
OECD

・AIGO(Expert Group on AI) Final meeting (Feb. 2019)

UNESCO

・Forum on artificial intelligence in Africa (Dec. 2018)
・Principle for AI (Mar. 2019)

Social Principle “Human-centric AI”



Healthcare Cyber Security

Increasing Risks

- Digitization and Networking in Medical Field
- Increase to be vulnerable to Cyber attack in medical data
- Information leak by cyber Attacks
- Information leak by the increased chance of carrying medical information outside of the facility by mobile devices
- Malicious use of IoT equipment that has vulnerability

Japan Actions

- Guideline to Secure Medical Device Cyber Security (Apr 2015)
- Slow implementation in Japanese Healthcare

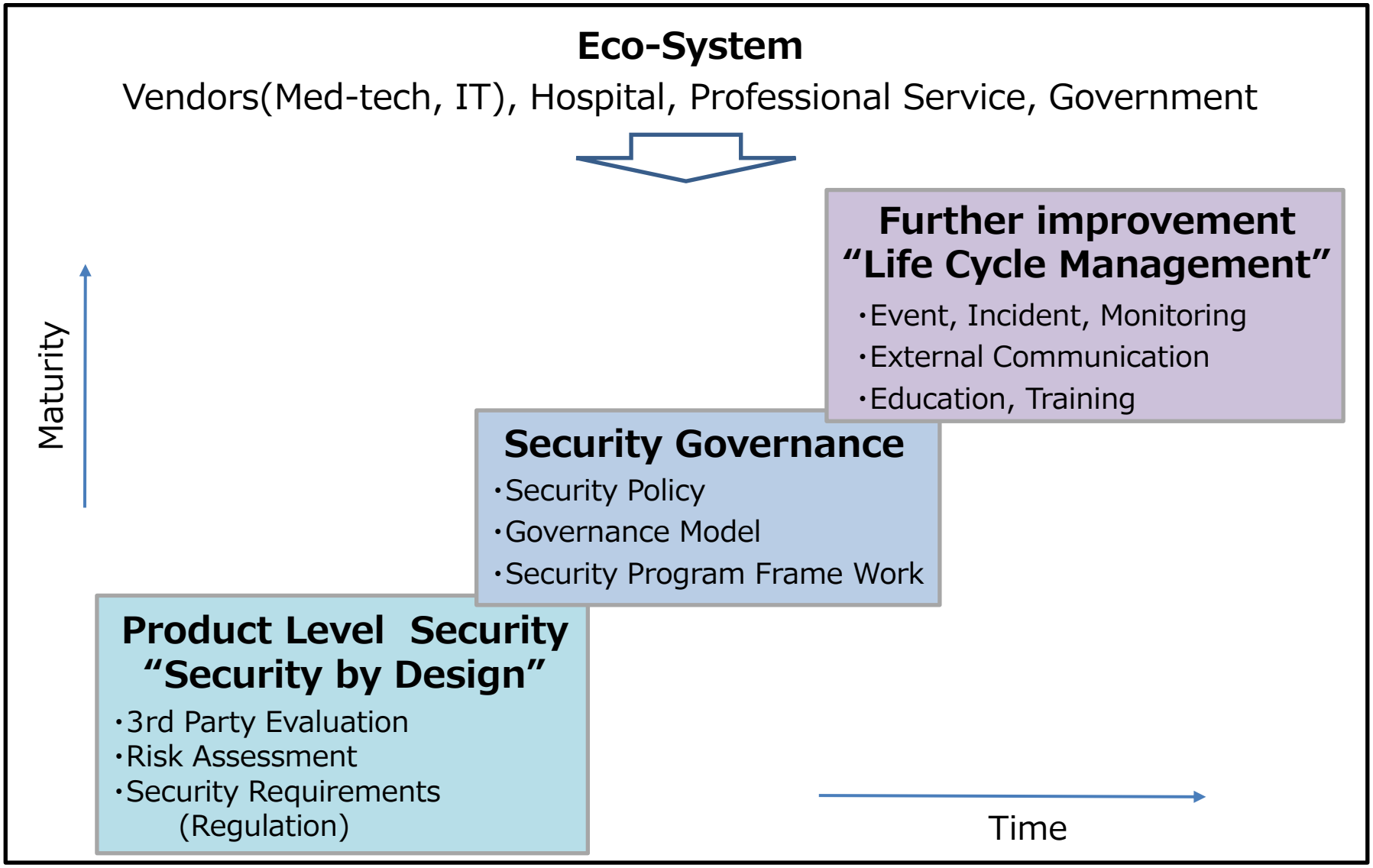
Telecom-ISAC JAPAN
Telecom Information Sharing And Analysis Center Japan

Financials ISAC Japan
Information Sharing and Analysis Center

ICT-ISAC JAPAN
ICT Information Sharing And Analysis Center Japan

JE-ISAC
Japan Electricity Information Sharing and Analysis Center

Cyber Security in Healthcare



Professional Education

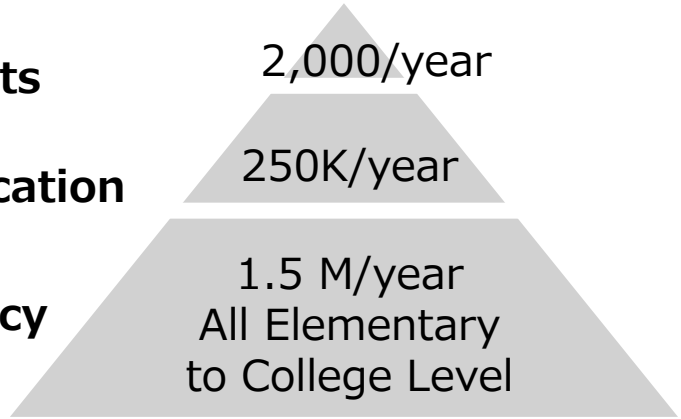
Medical Engineering Cooperation

TWIns(TWMU-Waseda)

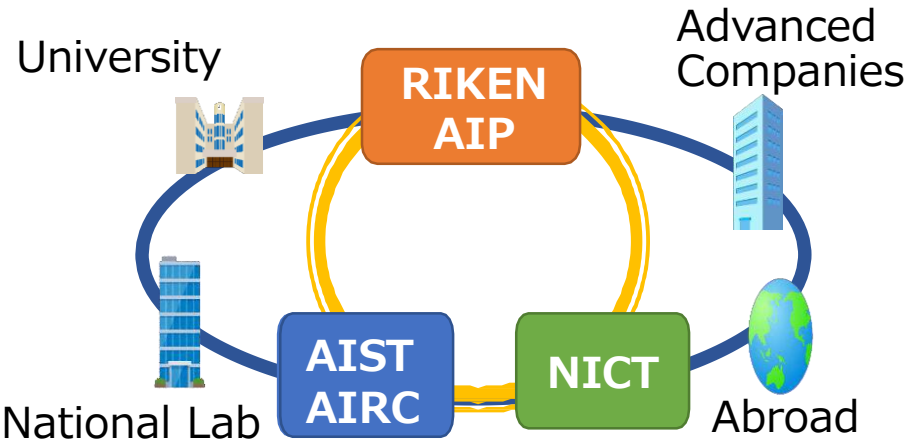
Japan Biodesign

Government actions on education and R&D in "AI Strategy"

AI Staff training target (2025)



AI R&D Network Idea



Singapore-Japan Collaboration

- Efforts to Solve Common Social Agenda
- Co-create Innovation
- Harmonization in Medical Regulations

Long Term Commitment

Hitachi Young Leaders Initiative 2019

July 9-12,2019
Singapore


JFMDA
The Japan Federation of
Medical Devices Associations