

# Innovative **AI Hospital System**



# Artificial intelligence (AI) technologies promote patient-friendly, high-quality medical care!

A database consisting of a large amount of data (big data) from the medical care-based Internet of Things (IoT) will be established. Its objectives include ensuring high-quality medical care in the "super-aging" society, suppressing national medical spending, enhancing the international competitiveness of the medical care industry of Japan, and reducing the workloads of medical care professionals. Furthermore, AI technologies will be used to create new platforms that will assist in the diagnosis, training, and communication of inter-medical care professionals as well as in improving their interactions with patients and their family members.



**Program Director** 

Dr. NAKAMURA Yusuke

Director

**Cancer Precision Medicine Center.** Japanese Foundation for Cancer Research

#### Profile ·

NAKAMURA Yusuke, PhD, is currently the Director of the Cancer Precision Medicine Center, Japanese Foundation for Cancer Research, and Professor Emeritus at The University of Tokyo and Professor Emeritus at The University of Chicago. Since graduating from the Osaka University Faculty of Medicine in 1977, Dr. NAKAMURA has been one of the pioneers of genetic medicine, discovering a number of genetic disease markers useful for identifying pathogenetic mechanisms and treatment. His previous positions include the following: (i) Professor, Laboratory of Molecular Medicine, Institute of Medical Science, The University of Tokyo; (ii) Professor and Director, Human Genome Center, Institute of Medical Science, The University of Tokyo; (iii) Director, RIKEN Center for Genomic Medicine; (iv) Director, National Cancer Center Research Institute, Tokyo, Japan; (v) Special Advisor to the Cabinet Secretary General, Office of Medical Innovation, Cabinet Secretariat, the Government of Japan; (vi) Professor, Department of Medicine, Section of Hematology/Oncology, the University of Chicago; and (vii) Deputy Director, Center for Personalized Therapeutics, the University of Chicago. Dr. NAKAMURA has been the Director of the Cancer Precision Medicine Center since July 2018. He has published over 1,540 papers in peer-reviewed international journals, which have been cited over 195,000 times. He awarded in the Clarivate Analytics Citation Laureates 2020.

# **Research and Development Topics**

The R&D activities in the following Sub-themes will be the pillars of the future AI hospital system:

A : Construction of a highly secure medical database and development of mining and analytical technologies to find medically useful information; Creation of a glossary of medical terms, including dialects for natural language processing and their application to emergency situations; and Establishment of a data linkage platform that contributes to the development of therapeutic medicines and vaccines (only in 2020)

A medical database that contains clinical, imaging, pathological, and laboratory data will be created to improve medical practice. This database will support multiple languages, ensure data confidentiality, and possess defense capabilities against cyberattacks. In addition, a glossary and thesaurus for natural language processing and utilizing them, as well as a data linkage platform for research and development of COVID-19 will be created.

B: Development of an AI-assisted automated medical record documentation system, an AI-assisted bilateral communication system used in obtaining informed consent; Building an Healthcare AI Platform to implement AI hospital System; and Development of an AI Avatar as a consultation aid for COVID-19 AI and other technologies will be applied to create new platforms for the automated documentation of medical records, informed consent, and other medical care information.

These will help improve patient satisfaction and decrease the workloads of medical care providers. Also, AI-assisted medical platforms that assist diagnosis, as well as the selection of optimal treatments, will be developed to establish an autonomous operation system. Furthermore, an AI avatar to assist in the consultation of COVID-19 will be developed. C: Development of an AI-assisted support system for diagnosis, monitoring, and selection of treatments (including therapeutic agents) based on patient

biometric information, etc., focusing on Al-assisted ultra-sensitive testing of blood or other biological samples to reduce the patients' burdens and to enable the earliest detection of cancer and other severe diseases

AI-assisted ultra sensitive testing of blood or other biological samples (including quality assurance of specimen transport and test results) to reduce patients' loads and burdens, which is useful for detecting cancer and other diseases and for the earliest diagnosis of recurrence and relapse will be developed. An automatic insertion method for flexible endoscopes will be also developed. Furthermore, work on the monitoring system and the medical equipment that utilizes AI technology and big data will be undertaken.

#### D : Proof-of concept study of AI hospital functions in clinical practice settings

In addition to the currently available ioformation and communication technology tools for diagnosis and treatment, the AI-assisted methodologies, sensor instruments, and other technological innovations that are newly devoloped in Sub-themes A to C will be integrated for use in clinical settings. This will allow the AI to learn and improve diagnostic and decision-making algorithms so as to evolve into a highly efficient medical system.

#### E : Technical standardization of the AI hospital system, management of intellectual property rights, open and closed innovation strategies, and government-industry-academia collaboration

To implement the innovations generated in Sub-themes A to D, social challenges related to the use of electronic medical information (e.g., financial costs, intellectual property rights, and other issues) will be investigated to find appropriate solutions.

# Implementation Structure

Under the leadership of the Program Director (PD) Dr. NAKAMURA Yusuke, this program will be run with the help of the following: Sub-PD Dr. MIYANO Satoru (Specially Appointed Professor, Tokyo Medical and Dental University, Director of M&D Data Science Center), Sub-PD MANO Hiroshi (CEO, EverySense, Inc., Tokyo, Japan) and Sub-PD TSUJII Junichi (Director, Artificial Intelligence Research Center, National Institute of Advanced Industrial Science and Technology); the Ethical, Legal, and Social Issues (ELSI) Committee\*; the Intellectual property Committee; the Evaluation Committee; and the fund management organization. R&D efforts in the five subareas will be mutually supportive and reinforcing. In addition, training of human resources for AI in the medical field started.

\* The mission of the ELSI committee is to identify and address ethical, legal, and social issues related to this program



Cross-ministerial Strategic Innovation Promotion Program (SIP)

# Exit Strategies

# Y Practical applicability of the AI hospital service package

The proposed AI hospital service package should be applicable to a wide spectrum of medical service providers, ranging from regional core hospitals to family physicians.

## Y Practical application of Al-assisted medical equipment

In this program, AI-assisted medical devices will be developed and evaluated in clinical settings in collaboration with the private sector; this sector will then apply for authorization to market the new products.

## Al systems that enhance physician–patient communication and reduce the workload of health care providers

The AI systems that will be developed in this program will help medical care providers keep enough time to talk with their patients and provide them with the sufficient information they need.

#### Y Practical use of Al-assisted highly-sensitive hematological and other testing methods

Standard operating procedures and other technical requirements for the new AI-assisted laboratory tests will be established. These efforts will help overcome geographical access barriers to high-quality testing services.

# **Past Milestones and Anticipated Outcomes**

This program will develop a comprehensive package of advanced medical care services that are optimized by AI technologies and big data analytics. This program will help spread high-quality medicine that offers minimally invasive and personalized treatment options based on the genetic, physical, and lifestyle chatacteristics of individual patients. The advantages of this high-quality medicine include prolonging healthy lifespans, suppressing the increasing health care expenditures by identifying ineffective therapies and therapeutics, and strengthening the workforce. At the same time, the technologies to be developed in this Project will be useful in terms of reducing the workloads of medical care professionals, including doctors, nurses, and caregivers, and will lead to major changes for maintaining safe and secure medical care even as the super-aging society advances. Moreover, the new technologies that will support the AI hospital system will increase the international competitiveness of the medical, pharmaceutical, abd health care industries of Japan.

#### Goals of the overall project

- · Development of a high-security database system and extraction of useful medical information. Revitalization of the industries of pharmaceutical products, medical equipment, and medical information.
- "AI hospital system" will be introduced to at least 10 medical institutions. The operation of a safe, high-precision model hospital system that is stress-free for patients will be commenced.
   An AI-assisted imaging, pathological telemedicine system, and automated coloscopy will be implemented.
- AI-assisted highly sensitive laboratory test methods will be introduced in clinical settings. In the field of cancers, cure rate will be improved (improvement of 5-yeae survival rate by 10% or over), and medical cost will be cut by several hundreds of billions of yen per year.
- An AI-assisted speech-recognition/documentation system (used to record conversations in the consultation room and to document care records) and an AI-assisted informed consent assistance
  system will be operated to reduce the workloads of medical professionals.

#### **Past Milestones**

- Demonstrated by applying data secret sharing and secret calculating to various evaluations (including multicenter analysis of clinical and management indicators, treatment results, etc., survival curve analysis for each treatment, verification of distributed storage during disasters in hospital systems, etc.)
- Created a glossary of medical terms consisting of about 420,000 words such as disease names, symptoms, medicines, tests, and patient expressions. Introduced international coding based on the WHO's IDC to support standardization and multilingualism. In order to be used as a diagnostic assistance(disease candidate prediction) system, constructed a dictionary with associations between terms using information from the disease biobank (BioBank Japan ).
- To build the common basic technologies for the industry, established "Healthcare AI Platform Collaborative Innovation Partnership" approved by the Minister of Health, Labour and Welfare
  and the Minister of Economy, Trade and Industry in April 2021, accelerated the development of service provision platform and AI development platform toward social implementation. To
  promote proliferation of the AI hospital system, the Japan Medical Association established the Japan Medical Association Promotion Center for AI Hospital & Clinic.
- Introduced an automated wheelchair system for the transportation of elderly patients and those requiring nursing care in hospitals and have achieved a high level of satisfaction (more than 2,000 patients, patient satisfaction 81%).
- Digitalized pathological diagnostic images and constructed a system that displays patient summaries, AI prediction models, and simple nomograms using the AI-equipped integrated cancer database combined with electronic medical records.
- Standardized remote sample transport procedure for cancer diagnosis by blood-based liquid biopsy.
- By using AI, improved accuracies of voice input of nursing record and automated documentation of voice input of doctors' commands in emergency medical care (recognition rate about 95%).
- Confirmed usefulness of an AI robot as a guide during PET examinations, which reduces radiation exposure to medical workers (by 63%) and improves patient satisfaction (83%) with healing effect, etc.
- Demonstrated usefulness of tablet PC during preop or pre-exam explanations to patients; the doctors' workload was reduced by 98%, 3,000 hours of annual task shifts were achieved, and gained 100% patient understanding.
- Built a data linkage platform for COVID-19 (approximately 1,700 cases) and launched the database operation (May 2021).
- Started a consultation assistance system for COVID-19 using artificial intelligence avatars (it supports not only Japanese but also English and Chinese); the access count reached about 100,000 nationwide (as of June 2021).

#### Al supports that effectivly assist physician-patient interaction and communication applied by the big data information.

