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 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.

Dr. NAKAMURA Yusuke
Director
Cancer Precision Medicine Center, Japan Foundation for Cancer Research

Research and Development Topics

A : Construction of a highly secure medial database and development of 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

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, and AI-assisted diagnosis and treatment support system; Building an 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 AI-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 information and communication technology tools for diagnosis and treatment, the AI-assisted methodologies, sensor instruments, and other technological innovations that are newly developed 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 MIYANO 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.

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

Profile

NAKAMURA Yusuke, Ph.D., 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, REIKEN 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 1,525 papers in peer-reviewed international journals, which have been cited over 183,000 times.
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 characteristics 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. Simultaneously, the new technologies that will become available through this program will help reduce the workloads of physicians, nurses, and other medical personnel, thereby maintaining the availability of high-quality medical care services in the very high-aged society. Moreover, the new technologies that will support the AI hospital system will increase the international competitiveness of the medical, pharmaceutical, and 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-year 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

- Compiled a dictionary for medical use (approximately 420,000 terms including 54,000 drugs and treatments) and started a demonstration test to convert conversations and nursing records in medical settings to text (reducing the burden of inputting medical information records by approximately 30%).
- Introduced the system to store data in a secret sharing manner, and evaluate the secret calculation using the system.
- Introduced the voice input of doctors' commands in emergency medical care.
- Developed a grand design of an AI platform for medical applications, and established "AI Hospital Promotion Center” within the Japan Medical Association to promote and disseminate the AI Hospital.
- Completed the standardization of blood-based liquid biopsy for cancer diagnosis (standardization of sample transport from remote sites) and its evaluation.
- Reduced the radiation exposure of medical workers during PET examinations by approximately 50% by using AI robots.
- Digitalized pathological images and constructed a system that displays patient summaries, AI prediction models, and simplified nomograms using electronic medical records and an integrated AI-equipped cancer database with two screens.
- Introduced a consultation assistance system (prototype) for COVID-19 using AI avatars.