Editorial

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New possibilities for medical support systems utilizing artificial intelligence (AI) and data platforms

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SUMMARY In Japan, there is a growing initiative to construct centralized databases and platforms that can aggregate and manage a vast range of medical, health, and caregiving data for research and analysis. Recent advancements in artificial intelligence (AI), particularly in general-purpose models like the Segment Anything model and Chat GPT, promise significant progress towards utilizing such data-rich platforms effectively for healthcare. Traditionally, AI has displayed superior performance by learning specific images or languages, but now it is advancing towards creating models capable of learning universal traits from images and languages by training on extensive datasets. The challenge lies in the fact that these general-purpose models are trained on data that does not sufficiently incorporate medical information, making their direct application to healthcare difficult. However, the introduction of data platforms can potentially solve this problem. This would lead to the development of universally applicable models to process medical images and AI assistants that can support both doctors and patients. These medical AI assistants can function as a "sub-doctor" with extensive knowledge, assisting in comprehensive analysis of symptoms, early detection of rare diseases, and more. They can also serve as an intermediary between the doctor and the patient, helping to simplify consultations and enhance patient understanding of medical conditions and treatments. By bridging this gap, the AI assistant can help to reduce doctors' workload, improve the quality of healthcare, and facilitate early detection and prevention in the elderly population.

Keywords artificial intelligence, healthcare, data platform, medical assistant

In recent years, Japan has been promoting "Data-based Health Management Initiatives" in preparation for a super-aged society (*1*). Japan has a national health insurance system, and in order to maintain that system and provide quality medical services to the elderly in an aging society with a declining birthrate, it is promoting the construction and operation of a database platform that can centrally manage not only medical data, which has been separately managed by various medical facilities, but also beneficial information for public health such as nursing care and health information. On this platform, citizens can access their own medical information, health check-ups, and prescription drug information. In addition, with the patient's consent, each medical facility can access the patient's past medical information, electronic medical records, and images from magnetic resonance imaging (MRI) or X-ray examinations, allowing medical facilities to better cooperate with each other. This centralized electronic health record database is similar to Australia's "My Health Record" and the United Kingdom's "NHS Digital" (*2,3*). Japan's data platform focuses on the management of personal healthcare records (PHRs) beyond medical care. The platform will also enable integration with external services for PHRs. Another major point is that the collected data can be used for analysis and research after anonymizing personal information. This is expected to lead to prevention, measures to combat lifestyle-related diseases, and the development of new treatments.

Generic image segmentation models specific to each medical imaging device

Deep learning technology, a form of artificial intelligence (AI), has made significant advances in recent years and is expected to be used in various fields. Deep learning models using convolutional neural

networks (CNNs) specifically for image processing have emerged in the field of image recognition in particular, and high-performance models such as VGGNet (*4*) and ResNet (*5*) have been proposed. These models extract visual patterns of objects from images and predict the type of object. In addition, object detection and segmentation models that mask the area of an object in an image, such as Mask R-CNN (*6*), YOLO (*7*), and U-Net (*8*), have been proposed. These models are used not only to detect typical objects like animals, faces, and human bodies, but they are also used in research to detect tumors and nodules on images from computed tomography (CT) scans (*9*), MRI scans (*10*), X-rays (*11*), and ultrasonography (*12*). These studies anticipate that AI models can help prevent doctors from missing diagnoses, improving the accuracy of diagnoses. AI can serve as an excellent assistant for physicians in diagnostic medical imaging. However, creating such image diagnostic support models requires a vast amount of applicable images from imaging studies, and a model needs to be created individually for a given disease. This requires significant cost and data collection, which is a challenge for AI technology.

Amid these issues, Meta has released a model for segmentation called the Segment Anything model (SAM) (*13*). SAM is a model that can generically detect objects by learning about various objects contained in about 11 million vast images. Therefore, it can detect objects from various images without additional learning. The conventional approach has been to collect specific images and focus on detecting specific objects, but the creation of a general-purpose model using a large amount of data represents a new approach. Attempts are being made to apply this SAM to medical image data (*14,15*). However, SAM was trained based on images obtained in general situations, so its use as it is has been difficult. Nonetheless, SAM could be a promising model for use in medicine. SAM could be used as a foundation and further trained with diagnostic medical images obtained from specific examination devices to create a general-purpose detection model specifically for images obtained with specific devices. Images obtained from CT scans, MRI scans, X-rays, and ultrasonography each have unique features that differ significantly from images taken with normal cameras, so a general model could be created as the foundation for detecting various diseases without specializing in a specific disease. However, a significant issue in creating a general-purpose medical model is the collection of vast amounts of data. Centralized medical databases can be effectively utilized to solve this problem. Images obtained from regular health check-ups and screening tests for the public, including those with diseases, can be collected and managed, and these can be used to create a general-purpose model to detect objects and diseases in medical images. If such a general-purpose model were integrated into a data platform for effective use, then AI would be able to automatically examine diagnostic images from each patient. As a result, the data platform could become not just a place to manage data but also a valuable support service for diagnosis of disease, thereby providing support to doctors.

Medical health assistants for doctors and patients

Recent developments in AI are not limited to the field of image recognition but are also in the field of natural language processing. Models that use a structure called Attention, such as Transformers (*16*), have become the foundation for BART (*17*) and GPT (*18*), leading to the creation of large general-purpose language models. Chat GPT (*19*) in particular, which appeared in 2022, has attracted a lot of attention, and its use in various fields is being researched. These language models acquire their capabilities by collecting articles published on the Internet and learning from a large amount of data. While Chat GPT can carry out natural conversations, it does not always output correct information. Combining such a large-scale language model capable of natural conversation with a medical data platform would enable the creation of an assistant that supports both doctors and patients. On a centralized data platform, information such as patients' symptoms, diagnostic information, and results are managed and accessible. Training on this large amount of medical data would allow the creation of an assistant model that supports doctors in their medical practice. The medical AI assistant can assist both patients and doctors and function as a bridge between patients and doctors.

For doctors, the medical AI assistant can function as a "sub-doctor" with a wide range of knowledge. In medical practice, the medical AI assistant can comprehensively indicate additional examinations that should be performed and symptoms that should be checked based on patients' symptoms, thereby preventing doctors from overlooking them. Moreover, the medical AI assistant has learned a wide range of information, so it can provide information even on rare diseases and diseases in fields where the doctor is not a specialist, allowing the identification of early signs of disease in general clinical settings and suggesting more detailed examinations.

Patients can benefit in various ways by accessing the medical AI assistant from the data platform. For example, they could tell the medical AI assistant about their own physical ailment and find out what the early signs of disease are, what measures they need to take, and whether they need to go to a medical facility. In addition, recording and sharing personal health records such as daily food intake, lifestyle habits, and heart rate with the data platform and the medical AI assistant will reduce the effort of recording data and also enable the medical AI assistant to provide early notification if any abnormalities are found and to suggest lifestyle modifications. This helps in preventing disease and

detecting it early.

Moreover, the medical AI assistant not only supports doctors and patients but also serves as a bridge between the two. For example, the medical AI assistant may be able to substitute for the doctor during a patient interview. Patients can consult the medical AI assistant about their symptoms in advance, and having the medical AI assistant ask them pertinent information would simplify interaction between the doctor and the patient and save time. Conversely, patients can ask the medical AI assistant about a disease diagnosed by a doctor, examinations, and surgery to better understand their condition. This could help to reduce the burden on doctors in a super-aged society with a decreasing working population while providing higher quality care and contributing to early detection and prevention.

In summary, Japan is making progress in building databases and platforms that can collect and manage medical, care, and health data for use in research and data analysis. Such a platform, capable of centrally managing a vast amount of data, can be expected to serve as a venue for developing and effectively utilizing general-purpose models such as SAM and Chat GPT for medical purposes. Thus far, AI has performed well by learning specific images and languages, but models that learn universal features of images and languages are becoming feasible through the use of a vast amount of data for extensive learning. However, these general-purpose models are learning from training data that does not contain sufficient medical data, so their direct use in medicine would be difficult. With the advent of data platforms, however, the hope is that these issues can be resolved and that the creation of a universal model to process medical images and an AI assistant that supports both doctors and patients will become possible.

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