ADVANCEMENT OF DIGITALIZATION IN CANCER TREATMENT

— PHYSICIAN PRACTICE MANAGEMENT COMPANIES SPEARHEADING TECHNOLOGY INTRODUCTION AND DATA UTILIZATION —

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SUMMARY

- The development of digital technologies in the field of cancer treatment is rapidly growing, and active and effective utilization is expected for those technologies, which include AI liquid biopsy testing, AI diagnostic imaging supporting systems, clinical decision-making supporting software, and communication tools for patients.
- However, the processes of verifying and introducing new digital technologies can be difficult for individual medical institutions, except in the case of large hospitals. As such, the situation is giving momentum to the networking of oncologists by physician practice management (PPM) companies, which provide medical institutions with various support services, other than medical care.
- PPM companies provide advanced technical support and data management services in addition to outsourcing functions. Going forward, by distinguishing various digital technologies, PPM companies are expected to promote wider adoption of technologies that better satisfy the quality and cost optimization requirements of medical care.

1. AN OVERVIEW OF CANCER TREATMENT AND THE BACKGROUND FOR THE KEEN INTEREST IN DIGITAL TECHNOLOGIES

1.1 Overview of cancer

According to the World Health Organization's GLOBOCAN data (2020), more than 9.9 million people die from cancer each year worldwide,[1] and approximately 70% of those deaths[2] are in low- and middle-income countries. In addition, the number of new cancer patients diagnosed on an annual basis reached 19 million in 2020 and is projected to rise to 30 million in 2040.[1] In Japan, one in two people will suffer from cancer in their lifetime, and there were approximately 370,000 cancer deaths in 2019.[3]

Although it is difficult to calculate the economic impact of cancer, it has been reported that the annual cost of cancer treatments is approximately USD 160 billion (2017)[4] in the US, approximately EUR 199 billion in Europe (2018),[5] and about JPY 4.5 trillion in Japan (2018).[6]

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[1] WHO Global Cancer Observatory (GLOBOCAN) (https://gco.iarc.fr/)
[2] World Health Organization (https://www.who.int/news-room/fact-sheets/detail/cancer)
[3] National Cancer Center, Center for Cancer Control and Information Services (https://ganjoho.jp/reg_stat/statistics/stat/summary.html)
[4] The Cancer Atlas (https://canceratlas.cancer.org/taking-action/economic-burden/)
[5] Thomas Hofmarcher *et.al*, "The cost of cancer in Europe 2018," Eur J Cancer, 2020 Apr; 129:41-49 (https://pubmed.ncbi.nlm.nih.gov/32120274/)
[6] Ministry of Health, Labour, and Welfare, National Medical Care Expenditures: Results Summary for Fiscal Year 2018 (https://www.mhlw.go.jp/toukei/saikin/hw/k-iryohi/18/dl/kekka.pdf)
[7] IQVIA "Global Oncology Trends 2019" (https://www.iqvia.com/ja-jp/insights/the-iqvia-institute/reports/global-oncology-trends-2019)

The development of cancer therapies is also actively ongoing, with oncology-related treatments accounting for more than half of products under development by global pharmaceutical companies, such as Merck (US), Bristol Myers Squibb (US), and AstraZeneca (UK). Moreover, according to the drug market research firm IQVIA, global spending on pharmaceutical products used in cancer treatments reached USD 150 billion in 2018.[7] The US is promoting its national project called "The Cancer Moonshot" (with a budget of USD 1.8 billion appropriated for seven years beginning in 2016) to support research on cancer prevention, early detection, and treatment. As the project was launched during the Obama administration under the leadership of then Vice-President Joe Biden, further advancements are expected going forward.

1.2 Background behind the keen interest in digital technologies in oncology

Due to the aging of the population, the increase in the number of cancer patients, and advances in medical technology, cancer treatment expenses are rising, presenting the urgent need for cost optimization of medical expenses. In addition, with the spreading adoption of precision medicine for cancer care, in addition to the increase in the volume of individual patient data, including genomic information, treatments are becoming more segmented and thus placing greater burdens on not only oncologists, but also other healthcare professionals involved in cancer care.

These circumstances are providing momentum for the use of digital technologies to accelerate efforts in the early detection of cancer, improving treatment quality, increasing treatment process efficiency, promoting patient engagement, etc. This report presents the latest trends of companies providing services utilizing digital technologies (software using AI (such as machine learning and deep learning) or natural language processing technology, mobile apps, etc.) that are expected to find applications in oncology therapies, as well as physician practice management (PPM) companies that support the digitalization of medical workplaces.

2. PROSPECTS OF DIGITAL TECHNOLOGY APPLICATIONS IN CANCER THERAPIES: FROM PREVENTION TO PROGNOSIS

In the development of digital technologies for cancer treatments, healthcare-related companies are not the only ones competing fiercely, as companies from other industries and venture companies are also seeking to carve out a place for themselves. Introduced next in this report are the objectives of using digital technologies in each of the processes of cancer prevention, diagnosis, treatment, and prognosis management, as well as examples of companies' efforts in these areas (Figure 1).

Figure 1: Prospects of digital technology applications in cancer prevention, diagnosis, treatment, and prognosis management

	Prevention	Diagnosis	Treatment	Prognosis management
Objectives of digital technology use	Early diagnosis Prevent disease progression	Improve diagnostic efficiency Address shortage of healthcare workers	Improve quality of treatment Promote personalized medicine	Support patient communication Support disease management for home care patients
Examples of applications in cancer treatment	① Liquid biopsy utilizing deep learning ② Nutrition/exercise recommendations based on analysis of omics information and research paper data using machine learning and natural language processing	Image diagnosis support systems using machine learning and deep learning (X-ray, CT, PET, MRI, etc.)	Clinical decision-making supporting software for use by physicians	Two-way communication tool for home care patients (patient portal with links to electronic medical records, mobile apps)
Examples of companies	**① Liquid biopsy** GRAIL (US, owned by Illumina) Freenome (US) Thrive (US, owned by Exact Sciences) Preferred Medicine (Japan) **② Nutrition/exercise support** Molecular You (Canada)	**Lung cancer** Infervision (US) Enlitic (US) Optellum (UK) **Breast cancer** PathAI (US) Zebra Medical Vision (Israel)	IBM Watson for Oncology (US) Tempus (US)	**Patient portal** Navigating Cancer (US) **Mobile app** Bristol Myers Squibb (US)/Voluntis (France) Daiichi Sankyo (Japan)/CureApp (Japan)

Source: Compiled by MGSSI

2-1. Early diagnosis of cancer and prevention of disease progression (prevention)

Early detection of cancer and prevention of disease progression are important for reducing medical expenses, and the use of digital technology is expected to improve data analysis and prediction accuracy. The incorporation of deep learning and other technologies into liquid biopsy, which enables screening and diagnosis of various cancers using a small amount of blood, is expected to lead to improvements in diagnostic accuracy. In the US, venture companies such as GRAIL, Freenome, Thrive, and Preferred Medicine (a joint venture between Preferred Networks and Mitsui & Co., Ltd.) that utilize AI technology for data analysis are accelerating development in this field, and M&As by major companies are emerging.

The Canadian company Molecular You uses machine learning and natural language processing to analyze biomolecular information (also called omics information), such as on genomes, metabolites, and proteins, as well as research paper information, and provides, to patients receiving anticancer drug treatment, services for presenting personalized plans for nutrition and exercise, and information on genetic drug responsiveness. In general, it is difficult to prove the causal relationship between biomolecular information and nutrition/exercise, but for this service, the analysis results are reviewed multiple times by experts in order to improve the service quality. In cancer treatment, intervention by registered dietitians and physiotherapists is also important for preventing progression of the disease, and development of services like this is expected.

2.2 Cancer diagnostic imaging (diagnosis)

The greatest advancements provided by digitalization in the field of oncology have been achieved in the area of diagnostic imaging applications (X-ray, CT, PET, MRI, etc.). Many of the diagnostic imaging support systems that utilize machine learning and deep learning (in particular products for detecting breast cancer, lung cancer, and skin cancer) have been approved by regulatory authorities, and are seeing widening use by pathologists. As the shortage of pathologists is serious worldwide, the application of digital technologies is expected to lead to improvements in diagnostic efficiency.

According to market research firm IDTechEx, more than USD 1.1 billion has been invested in developers of AI diagnostic imaging systems, such as those developing instruments for lung cancer (InferVision (US), Enlitic (US), Optellum (UK), etc.) and breast cancer (PathAI (US), Zebra Medical Vision (Israel), etc.). In addition, global diagnostic imaging equipment manufacturers, such as GE Healthcare (US), Philips (Netherlands), Siemens Healthineers (Germany), FUJIFILM and Olympus in Japan are also promoting the installation of AI technology in their own equipment.

2.3 Clinical decision-making supporting software for cancer (treatment)

The development of clinical decision-making supporting software, which attracted attention with the appearance of IBM Watson, is still on an evolving stage. The final decision on the treatment policy for a cancer patient is made by the doctor, but improvements in the efficiency of the treatment process are expected with the presentation of recommended treatment methods that are best suited for the individual based on big data, such as genomic information and medical information. In this field, not only major IT companies but also cross-industry companies and ventures are pursuing development. Among them, it is worth noting that Tempus (US), which was established by the cofounder of Groupon (US), is developing software based on anonymized medical information equivalent to approximately one-third of all cancer patients in the US (30 petabytes of data).

2.4. Communication tool for home care cancer patients (prognosis management)

The increasing number of day-trip treatments using anticancer drugs is pointing to the need for tools to communicate with cancer patients receiving care at home. The patient portal operated by Navigating Cancer (US) supports not only general functions, such as the provision of cancer-related information, scheduling of medical appointments, and management of treatment history, but is also integrated with electronic medical records. When a patient enters the status of treatment side effects, for example, nurses and others who are members of their care team can respond appropriately. The platform thus realizes two-way communication. In

addition, it is equipped with a disease management and triage system for medical professionals, which contributes to reduction in the severity of illnesses and volume of emergency consultations. Pharmaceutical companies are also developing mobile apps that allow healthcare professionals and cancer patients receiving in-home care to share information. Notable alliances in this area include the collaboration between Bristol Myers Squibb (US) and medical app developer Voluntis (France), and between Daiichi Sankyo and CureApp in Japan.

3. PHYSICIAN PRACTICE MANAGEMENT COMPANIES PROMOTING DIGITALIZATION OF MEDICAL CARE

3.1 Relationship between medical institutions and physician practice management (PPM) companies

Examples of the use of various digital technologies in cancer care have been described above, but the processes of verifying and introducing new digital technologies can be difficult for individual medical institutions, except for large hospitals. This is because doctors need to attend to numerous tasks, such as management, recruitment, and patient marketing, in addition to providing medical treatment, and it is difficult for them to comprehensively grasp information such as that regarding digital technologies in addition to cutting-edge treatment methods that are evolving day by day.

As such, the situation has given impetus to the networking of oncologists by physician practice management (PPM) companies, which provide medical institutions with various support services, other than medical care. In addition to general business process outsourcing (BPO) functions, PPM companies provide advanced technical support and data management services unique to the medical field. The networking efforts target medical institutions specializing in cancer treatment (mainly private small-scale outpatient facilities, anti-cancer drug outpatient facilities, radiotherapy facilities, breast cancer facilities, etc.) and independent oncologists who are not affiliated with university hospitals or other medical institutions and operate their own private medical practices.

PPM is being developed not only for cancer care but also for other areas such as emergency outpatient and pediatric departments. PPM companies leverage the power of large-scale networks and engage in price negotiations with pharmaceutical companies and medical device manufacturers. Furthermore, they aggregate and analyze data obtained from a common IT platform, and utilize it to negotiate with insurers regarding medical expenses, etc. The same applies to the introduction of digital technology. For example, in the COVID-19 pandemic, a safe and secure telemedicine system is being quickly deployed to network affiliated facilities under the initiative of PPM providers.

As stated in section 2 of this report, digital technology is expected to play an increasingly vital role in all processes of cancer care, from prevention, diagnosis, and treatment, to prognosis management. Instead of busy doctors, PPM companies, which have a large number of system engineers and data scientists, are expected to play a leading role in improving the quality of treatment, and selecting and introducing cost-effective digital technologies. This will benefit patients as well in that the level of care they can receive at network-affiliated medical institutions will be no different from the most up-to-date medical care provided by large hospitals, which are leading the way in digitalization.

3.2 Cancer-specialized PPM companies and latest trends of digital technology introduction/data utilization

The growth of PPM companies specializing in cancer is especially notable in the US (Figure 2). McKesson, a US pharmaceutical wholesaler, acquired the PPM company The US Oncology Network for USD 2.1 billion in 2010, and currently has a network of more than 480 cancer treatment center and 1,380 physicians (contract terms differ depending on the state and cancer treatment center). The US Oncology Network's business model is to supply all equipment from advanced medical equipment to desks at low cost, while providing information on and technology of the latest treatment methods, management support, services for centralized purchasing of pharmaceuticals and medical materials, and support in various other areas, such as participation in clinical trials and negotiations with insurers. Affiliated medical institutions are under contract to pay the PPM company a certain percentage of their profits.

The IT system of The US Oncology Network aims to unify medical information and standardize data by introducing its iKnowMed electronic health record system to all facilities. In reality, not all medical information is centralized because there are cases where iKnowMed is used in combination with systems for certain clinical departments (such as for radiologists) that have been popular for many years. Therefore, the necessary data is extracted from each system and utilized. For the introduction of new technology from outside, McKesson takes the initiative in examining the feasibility. For example, in the case of adopting Navigating Cancer's software as explained in section 2-4 above, the software has been linked with iKnowMed. In addition, the company actively introduces and studies new technologies. Examples include its collaboration in conducting clinical trials with GRAIL in the liquid biopsy field (section 2-1) and the collaboration with Tempus in the clinical decision-making supporting software field (section 2-3). Data application that makes the most of the large volume of information is also one of the strengths of PPM companies. For instance, by analyzing the outcomes and costs of each medical service, the best practices for the outcomes and costs within the network can be visualized. Physicians can compare their treatment with the best practices for the same services and improve both quality and cost optimization.

The US company OneOncology, an emerging force in the field of PPM, has been growing rapidly since its establishment in 2018. OneOncology has partnered with Flatiron Health, a US provider of electronic medical record systems specializing in cancer, and AmerisourceBergen, a US pharmaceutical wholesaler. Compared to The US Oncology Network, it has a more flexible cooperative relationship with oncology providers that allows it to introduce digital technologies, such as those mentioned in section 2, to individual providers. At the same time, it centrally manages medical information obtained from IT infrastructure and applications in a centralized manner, and analyzes quality indicators (QIs) that indicate the quality of medical care, and management indicators (KPIs). In addition, by analyzing information all along the patient journey from prevention to prognosis, the company aims to utilize the data to improve the quality of medical care, such as by detecting diseases other than cancer based on the data.

PPM companies have been active not only in the US but also elsewhere. Australia's GenesisCare is a PPM company whose shareholders include investment company KKR and China Resources. It has been operating in Australia, the UK, and Spain, and further expanded its network, including the acquisition of the US PPM company 21st Century Oncology in May 2020. Since the structure of the medical insurance system differs from country to country, there are some aspects of the company's operations that differ from the US business model, but it similarly aggregates and utilizes the data obtained from IT infrastructure and applications. GenesisCare is also aggressively introducing cutting-edge digital technology, such as through its tie-up formed with US medical device maker GE Healthcare in November 2020.

Figure 2: Leading physician practice management (PPM) companies in the cancer field

Company	Established	Scale of network	Region of operations	Overview
The US Oncology Network (US)	2004	Over 480 cancer treatment center, 1,380 physicians (as of December 2020)	US	Acquired by US pharmaceutical wholesaler McKesson in 2010. To apply the IT and data utilization know-how gained from the acquired PPM company to other diseases, McKesson established Ontada in December 2020.
OneOncology (US)	2018	175 care sites, 500 oncology providers (as of February 3, 2021)	US	Formed a partnership with US pharmaceutical wholesaler AmerisourceBergen (July 2019). Also has partnerships with Flatiron Health, which provides an electronic medical records system specializing in cancer, and Foundation Medicine, which is a leader in cancer genomic testing for precision medicine (genetic testing).
American Oncology Network (US)	2018	88 physicians, 61 nurse practitioners (as of January 21, 2021)	US	Formed partnership with US pharmaceutical wholesaler AmerisourceBergen
GenesisCare (Australia)	2005	Over 440 centers (as of February 3, 2021)	Australia, UK, Spain, US	Acquired US PPM company 21st Century Oncology in May 2020. In November 2020, formed a partnership with GE Healthcare to promote wider use of diagnostic imaging, digital technologies, etc. Has expanded operations from the cancer field to cardiovascular diseases and sleep disorders.

Source: Compiled by MGSSI based on information on company websites and interviews

4. CONCLUSION

As the market for digital technology in cancer treatment expands, technology development competition is expected to intensify. Digital technology will be further introduced in the future for the purposes of improving the quality of treatment, promoting cost optimization of medical expenses, and reducing the burden on healthcare workers, but it is not easy for those on the medial frontline to obtain a thorough picture and verify all aspects of such technologies.

Companies that provide digital technology will be incorporated into treatment workflows and IT infrastructure that are provided through the networks of PPM companies, and it will be important for technology developers to pursue development with a focus on data utilization. To this end, the key will be to scrutinize usage cases, conduct validation tests, improve the user experience, and pursue outcomes that are commensurable with the cost of introduction. In addition, since medical professionals feel more secure about providing medical services in a familiar environment, communication from the field perspective is also required when introducing digital technology.

In the future, PPM companies that bundle networks will need to understand and categorize leading-edge digital technologies, and by doing so, will support the spread of technologies that satisfy both the quality and cost optimization requirements of cancer medical care. Furthermore, as the aggregation and analysis of medical information across national borders and regions progresses, it is expected that cancer medical care will become borderless and product development will make use of more data than ever before. In this trend, PPM companies have the potential to create new value and markets in the oncology sector.

At present, however, even PPM companies are facing challenges with respect to system integration and data standardization, and it is hard to say that patient data is now fully utilized seamlessly from disease prevention to prognosis. In addition, information security and the protection of personal information are also key issues in data utilization.