

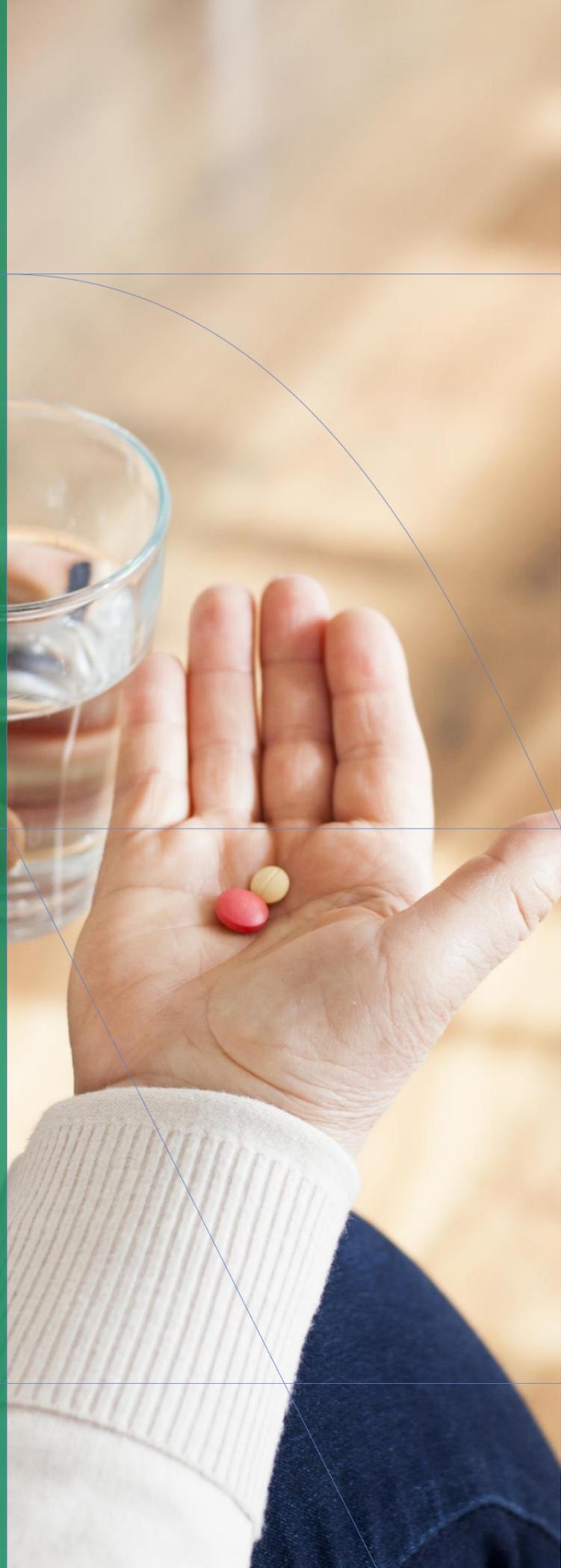
# The Future of Pharmaceutical Industries Envisioned by NTT DATA

Achieving MX (Medical Experience) innovation by utilizing data



# Mission

Enable Patient-centered Medical Experience (MX) through digital transformation



## Achieve Patient-centered Health Care Brought about by Digital Transformation in the Pharmaceutical Business

Business transformation based on digital technology is now progressing on a global scale in all industries. As shown by Amazon.com in the retail business, the customer journey will be reconstructed into a more personal and seamless process by the progress made in business DX (Digital Transformation is equivalent to structural transformation).

This digital wave is sweeping the medical and healthcare industry, and not only medical institutions, but also government and private companies are working together to achieve patient-centered healthcare. Recently, the accumulation of personal data such as vital and lifelog data including genome data which is considered to be the ultimate in personal information is progressing throughout academia, medical institutions, and private company sectors. The creation of an integrated patient-centered healthcare service that spans the areas of prevention, treatment, and prognosis is now becoming possible in the not-too-distant future by accelerating the distribution and analysis of these data across all stakeholders in the healthcare ecosystem.

Considering the kaleidoscopic structural transformation of the medical industry and the evolution in digital technologies, NTT DATA believes that "a change in medical experience in a patient-centered healthcare by medical DX" is an essential goal and important role for players involved in future medical and healthcare industries, and we advocate

this concept as the **innovation of medical experience in patient-centered healthcare ("Medical Experience = MX")**.

The collaboration among academia, medical institutions and medical administration, and private sector companies including pharmaceutical companies is considered essential since more than anyone else, pharmaceutical companies are increasingly attracting considerable attention from various stakeholders as powerful private companies that will drive life science. Pharmaceutical companies are increasingly expected to hereafter play a role in innovative new drug development driving personalized medicine and creating a comprehensive healthcare service that is inseparable from the patient journey from prevention through prognosis.

On the other hand, the environment enveloping pharmaceutical companies is becoming more severe, due to increasing difficulties in drug development. NTT DATA understands that digital technology is once again attracting attention as a key factor in resolving these issues.

NTT DATA helps organizations to transform their MX (medical experience) by supporting the digitization of the entire business realm of pharmaceutical companies, accelerating drug development speed and expanding the domain of service creation in the healthcare field at the same time.

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# Chapter 1

Digital Transformation in Pharmaceutical Business.

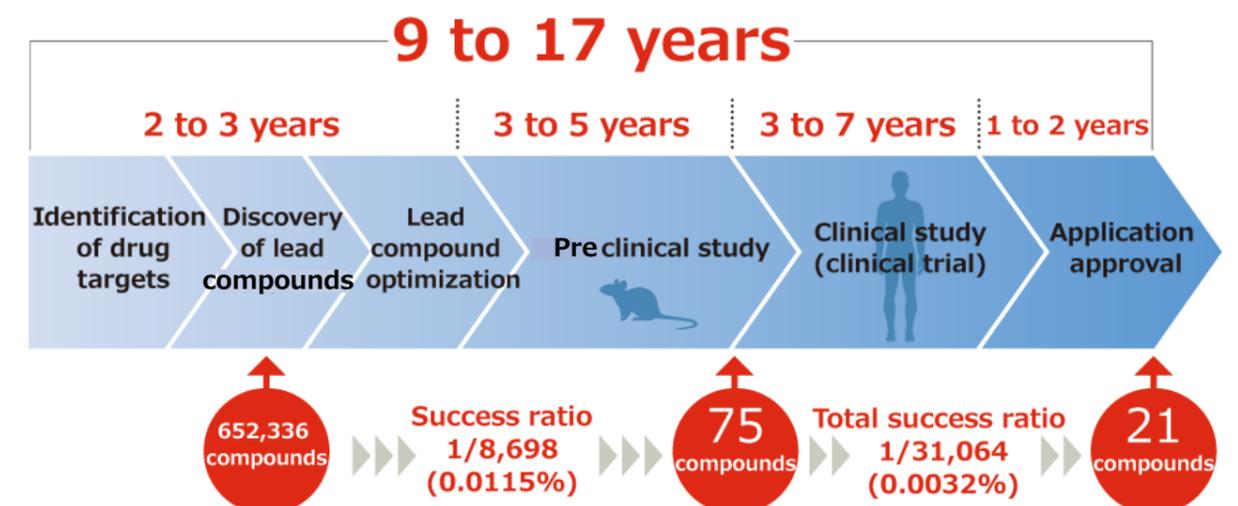
## Digital Transformation Is a Lifeline For Pharmaceutical Companies In an Increasingly Severe Business Environment

### Changes in profit structure in pharmaceutical companies

The business environment facing pharmaceutical companies is becoming more severe year by year. This turbulent environment also makes it difficult to generate corporate profitability due in part to a drop in the success ratio for new drug development. The intractable and rare diseases for which there is no effective medical treatment still remain as “unmet medical needs” whose development for medical treatment is increasingly difficult due to the lower new drug success ratio.

According to a report\*<sup>1</sup> by the Japan Pharmaceutical Manufacturers Association, the probability that a newly discovered drug compound will be launched as a new drug is only about one in 30,000 (0.003%), even after many years of research and development.

\*1 Japan Pharmaceutical Manufacturers Association “Submitted material in the 1st Drug Development Conference” <https://www.kantei.go.jp/jp/singi/kenkouiryuu/iyakuhin/dai1/siryuu2-5.pdf>



Source: Japan Pharmaceutical Manufacturers Association “Submitted material in the 1st Drug Development Conference” <https://www.kantei.go.jp/jp/singi/kenkouiryuu/iyakuhin/dai1/siryuu2-5.pdf>

# Digital Transformation Accelerates Innovation in New Drug Discovery

## Digital transformation in pharmaceutical companies is accelerating globally

Though the business environment enveloping pharmaceutical companies is becoming increasingly severe, technological progress is still remarkable. In particular, the use of "Digitalization" is expected to lead to an evolution in the drug development process and the expansion of channels for providing value to patients. We present two symbolic cases relating to the utilization of digital tech in drug development.

- Vaccine development at ultrahigh speed in Moderna

The development of CORONA virus (COVID-19) vaccine by Moderna is a remarkably successful case of utilizing digital tech. This company gathered attention for developing a digital

infrastructure on the cloud aimed at high-speed drug discovery research by mRNA or messenger RNA and for completing the process from discovery of a drug target through market distribution at an unprecedented speed. This company is a digital native pharmaceutical company and actively utilizes digital tech for developing vaccines.

Note that AI utilized in the development of novel coronavirus vaccine was optimized for the development process and is said to have passed the testing in only 42 days by learning twenty thousand specific mRNA sequences.\*1 The mRNA development method is spreading beyond the novel coronavirus vaccine, and the mRNA market is expected to expand to 23 billion dollars by 2035.

\*1 Michiaki Tanaka, "Why was Moderna able to create a vaccine in just three days?", Shueisha International Inc.

## Pursuit of efficiency and accuracy in drug discovery by drastic digital transformation

- ✓ Improvement of efficiency and accuracy in advanced intellectual work by drastic digital transformation
- ✓ High-speed growth cycle becomes possible by utilizing the obtained data
- ✓ transformation of the entire business process other than drug discovery research



	Drug discovery targeting	mRNA design and synthesis	Reagent production	Non-clinical study
<b>Sense of challenge in mRNA drug discovery</b>	Heavy research work Work was dependent on the researcher	Trial-and-error work in discovering optimized mRNA sequence	Highly difficult cell cultivation work and formulation	Complicated information management
<b>Drug discovery in Moderna</b>	Original protein library Automatic transformation to mRNA sequence	Design of mRNA with AI Multi task	Automated reagent production linked with equipment	Unification of experimental progress and information management

Source: NTT DATA prepared referencing Michiaki Tanaka, "Why was Moderna able to create a vaccine in just three days?", Shueisha International Inc.

- Investment in AI startups for drug discovery research

Digital utilization in the drug discovery research field is now the premise for collaborative creation with a wide range of players, including start-up companies. From this perspective, investment in start-up companies that can be expected to be future partners is increasing.

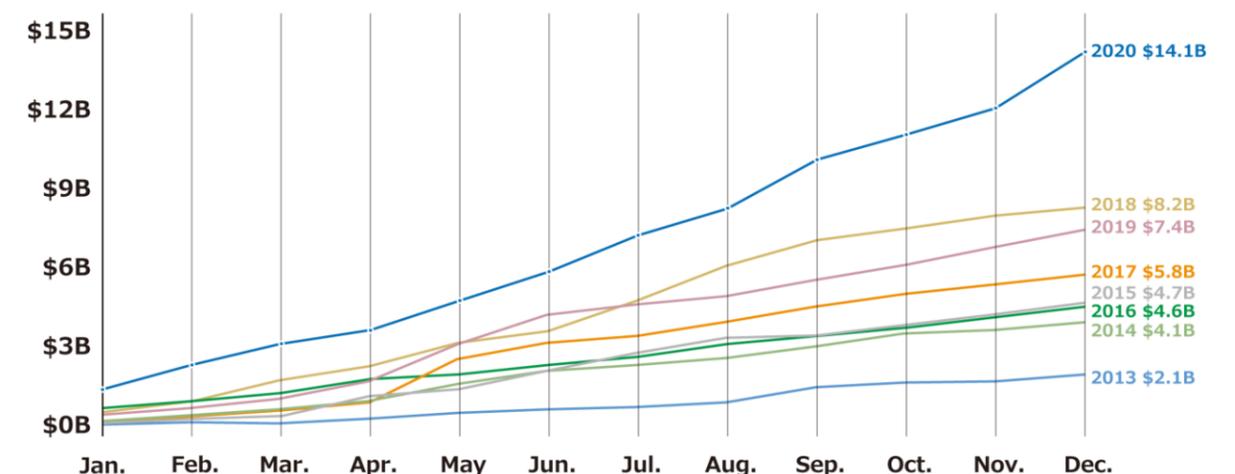
For example, Alphabet Inc. known as the parent company of Google LLC intends to increase its competitiveness in the drug discovery field by acquiring AI-related startups as subsidiaries. DeepMind Technologies, known as the developer of "AlphaGo" which defeated a professional Go player for the first time, have many achievements in the drug development field. For example, they developed "AlphaFold-2" in 2022

which is an AI that analyzes 3-dimensional protein structures based on their gene sequences information. Not only AlphaFold-2, DeepMind also developed AlphaFold DB which contains data related protein structures. By utilizing those, drug discovery research would reach to the new era.

Furthermore, Isomorphic Laboratories, a startup company established in 2021 by DeepMind Technologies, is conducting an analysis of interactions among several proteins, using findings obtained by "AlphaFold". The business aim of this company is not to create new drugs on its own, but rather to function as business type of distributor that distributes useful tools for drug discoveries to pharmaceutical or biomedical companies.

## Investments in healthcare related startup companies in the USA

DIGITAL HEALTH VENTURE FUNDING 2013-2020



<https://rockhealth.com/insights/2020-market-insights-report-chasing-a-new-equilibrium/>

# New Technology for Achieving Patient-centered Health Care

## ● Current Status of Investments in Digitalization in Pharmaceutical Companies

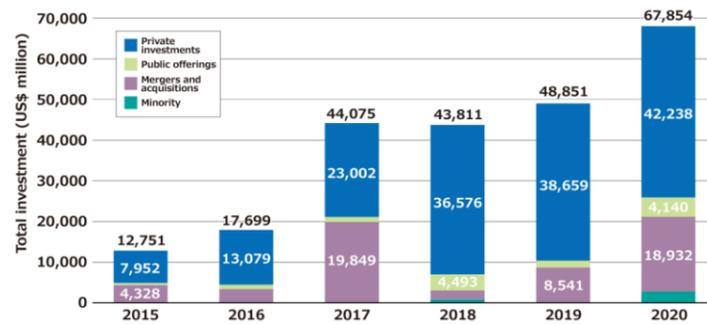
Now, to what extent have pharmaceutical companies invested in digital technologies? Let's take AI as an example and look at the amount of investment in digital technology in each industry.

According to a report by Stanford University\*<sup>1</sup>, global worldwide investment in AI in 2020 increased by about 40% compared with the previous year, reaching \$67.9 billion. In particular, the medical and pharmaceutical field investments have grown overwhelmingly with a peak up to 13.8 billion dollars.

Examples of co-creation among pharmaceutical companies and digital companies include Novartis Pharma. developing an analysis platform through partnership with Amazon Web Services, establishing AI innovation laboratories by collaboration with Microsoft Corp., and developing AI applications through cooperation with Tencent Holdings, Ltd. of China. By doing so Novartis Pharma is succeeding in bringing about innovation by utilizing AI or analytics technology. Moreover, Pfizer Inc. is aiming to develop a drug discovery platform for low-molecular compounds through a partnership with Iktos of France in 2021 that engages in AI drug discovery. Thus, Global mega pharma is actively proceeding ahead with digital investments, and is engaging in co-creation with digital companies through advanced R&D. This investment trend is considered likely to accelerate year by year from here onwards.

## Global investment on AI

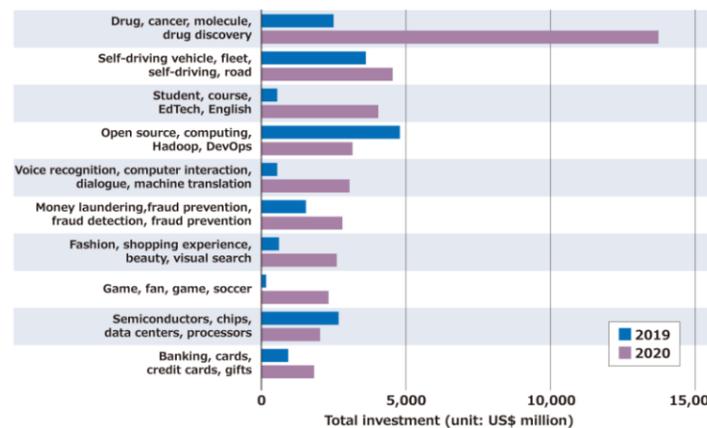
Global corporate investment in AI classified by investing activity



[https://aiindex.stanford.edu/wp-content/uploads/2021/03/2021-AI-Index-Report-\\_Chapter-3.pdf](https://aiindex.stanford.edu/wp-content/uploads/2021/03/2021-AI-Index-Report-_Chapter-3.pdf)

Source: Human-Centered Artificial Intelligence "2021 AI Index Report"

Global private sector investment in AI classified by priority areas 2019-2020



[https://aiindex.stanford.edu/wp-content/uploads/2021/03/2021-AI-Index-Report-\\_Chapter-3.pdf](https://aiindex.stanford.edu/wp-content/uploads/2021/03/2021-AI-Index-Report-_Chapter-3.pdf)

Source: Human-Centered Artificial Intelligence "2021 AI Index Report"

## Patient-centered healthcare brought about by digitalization

Advances in technology are transforming the patient experience. Recently, health-management and treatment methods utilizing digitalization are expanding and include for example, applications promoting health-management and self-diagnosis, as well as applications for drug dosage management have also appeared. The active use of these technologies helps to streamline healthcare, as well as contribute to improving the health of consumers and the industry's development.

One example of this is "Society 5.0" \*<sup>1</sup> advocated by the Japanese Cabinet Office, that utilizes AI analysis of real-time personal physiological measurement data or information from medical practice, healthcare, infection, and the environment to solve the following issues:

## ● Promotion of health

Promote wellness and early disease detection through measures such as real-time automated health checks

## ● Optimized treatment

Optimized treatment can be obtained almost anywhere by sharing physiological and medical data

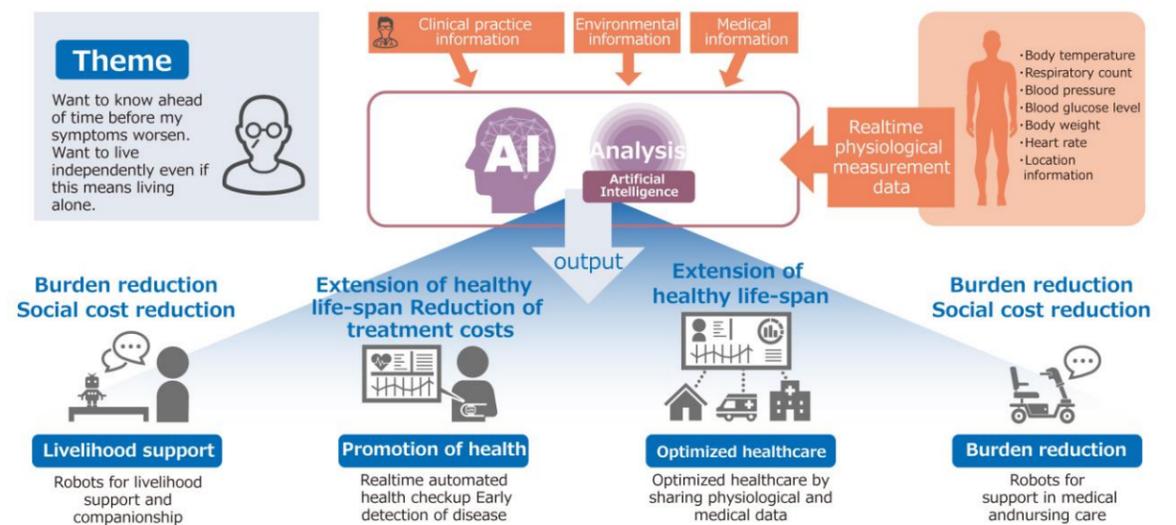
## ● Burden reduction

The burden on medical and nursing care sites can be reduced via robot support

## ● Life support

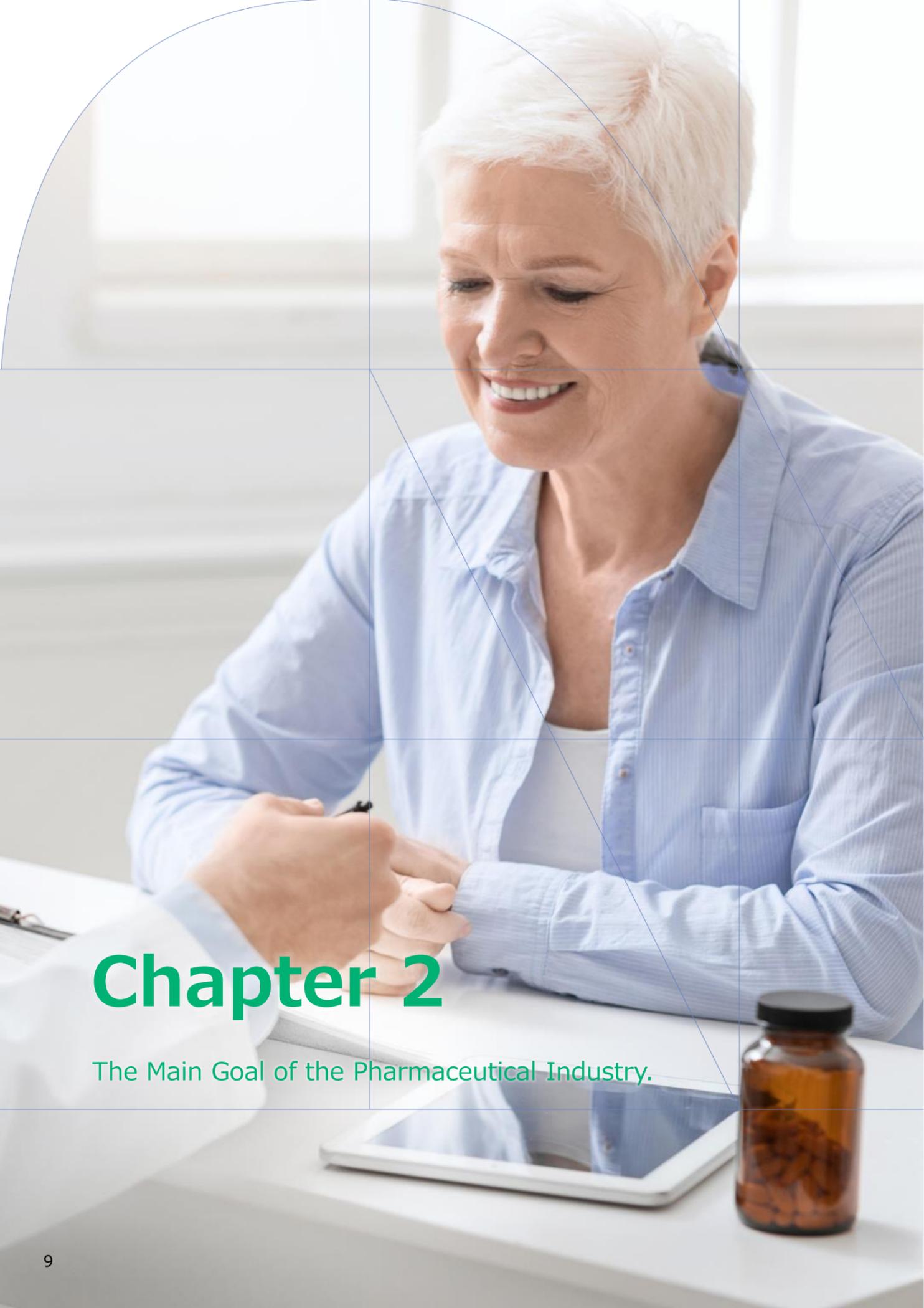
A comfortable life is possible even for people living alone, by providing robots for daily living support and as a conversation partner.

Achieving such a society will greatly change the patient experience and is anticipated to make it possible for the individual to be able to healthily extend their life-span, or to live comfortably at home in spite of a pre-existing diseases. The reduction achieved in social costs including medical and long-term care costs for society as a whole will lead to solutions to the labor shortage in medical treatment and care.



Source: "Society 5.0, New value in the fields of healthcare and caregiving" [https://www8.cao.go.jp/cstp/society5\\_0/medical.html](https://www8.cao.go.jp/cstp/society5_0/medical.html)

\*1 Source: Human-Centered Artificial Intelligence "2021 AI Index Report" [https://aiindex.stanford.edu/wp-content/uploads/2021/03/2021-AI-Index-Report-\\_Chapter-3.pdf](https://aiindex.stanford.edu/wp-content/uploads/2021/03/2021-AI-Index-Report-_Chapter-3.pdf)



## Chapter 2

The Main Goal of the Pharmaceutical Industry.

# Digital Tech is transforming the Patient Experience

### Efforts by pharmaceutical companies aimed at innovating the medical experience MX

The concept of "Patient Centricity is important for delineating a future image of the pharmaceutical industry and hence the sphere of all medical activities. According to a paper entitled "Guidebook for implementing the activities based on Patient Centricity by pharmaceutical companies and drug development reflecting patient opinions" published by the Japan Pharmaceutical Manufacturers Association, patient centricity is defined as the "Utilization of patient opinions obtained directly from patients or through their family and patient groups in corporate activities."

Furthermore, this activity in drug development by companies is defined as "Company activities reflecting 'the desire to know' the voices of patients in addition to the utilization of their opinions in the process of developing a concept planning, conducting clinical trial and their application for approval".

The creation of this kind of feedback cycle, in which information is delivered appropriately to the patients and the voices of individual patients are picked up and used in product development, is exactly what the digital technology field excels at. This is because the digital megatrend itself implies the idea of promoting the transformation of UX (User Experience) under human-centered thinking.

Stemming from these aspects, the evolution in

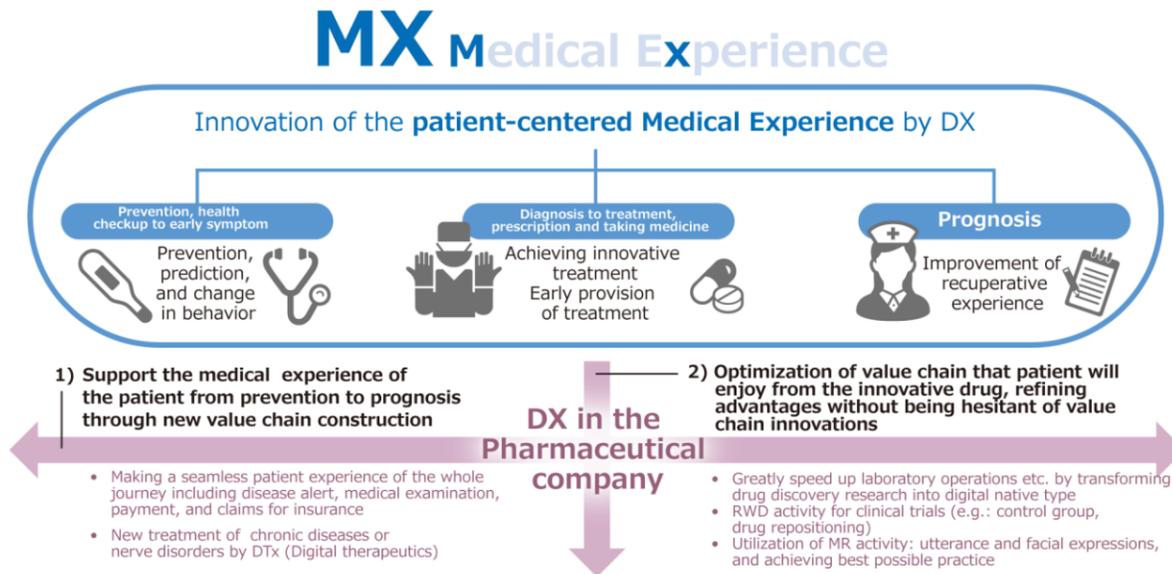
digitalization will become a key driver toward the realization of patient-centered healthcare (i.e. "a seamlessly connected medical experience from the perspective of a personalized medical experience and consumers, that is close to each single patient")." We believe that maximizing the use of this digital technology and **transforming the patient-centered medical experience (MX = Medical Experience) through medical DX** will play a vital role for players involved in the medical and pharmaceutical companies in the future.

What kind of approach should pharmaceutical companies consider taking toward fulfilling the huge digital agenda of this "MX" transformation? Broadly speaking, there are two directions that need to be taken: 1) maximizing the value that patients can get from innovative drug discovery by refining and improving the accuracy of the overall process from drug discovery to market launch; and 2) supporting cross-sectional patient experiences from prevention to prognosis.

# Efforts for “Value Maximization that Patients Will Enjoy from Innovative Value Chain”

## Direction taken for medical DX and by pharmaceutical companies

The goal of DX is the innovation of patient-centered medical experience in every scene  
 Pharmaceutical company aims for: 1) cross-sectional support of the patient from prevention to prognosis, and 2) MX by innovative drug discovery through refinement of the process from drug discovery to launch



In regard to various types of data that could not be used or supplemented in the past such as RWD (Real World Data) or activity data in the laboratory, the information from experimental equipment, and the activity logs of MR (Medical Representative) will lead to the creation of innovative new drugs.

Example above encompasses the entire patient journey, including and not limited to the provision of medicines, and provide total support for patients' healthy lives from prevention to

prognosis. By providing a new product or service that encompasses the entire patient journey including measures that are not just limited to medicine.

In order to realize such digital MX transformation, it is essential to promote a "data-driven" pharmaceutical business that collects, analyzes, and utilizes all kinds of medical data, such as patient health conditions, diagnosis records, and prescription histories.

## The point of transformation in the pharmaceutical value chain

Pharmaceutical companies are expected to create innovative new drugs continuously as leaders in “patient-centered healthcare.” To make this happen it is essential that the drug discovery capabilities are augmented by making full use of AI and data analysis so that the costs are reduced through optimization of the pharmaceutical value chain. In both cases, the role of digital tech or digitalization is increasing.

Taking drug discovery research to a more sophisticated level through collecting and analyzing data at various points in a pharmaceutical value chain, together with increasing efficiency and improving accuracy of clinical trials and marketing, will enable development of innovative drugs at high speed and low cost and their delivery to the patient at an earlier stage.

The transformations described below have been gathering special attention in recent years.



### ● Drug discovery innovation by digital transformation

Digitalization is indispensable for drug discovery innovations such as extracting chemical compounds with AI or laboratory automation. In particular, "data-driven drug discovery research" will have a major impact to drug discovery innovation.

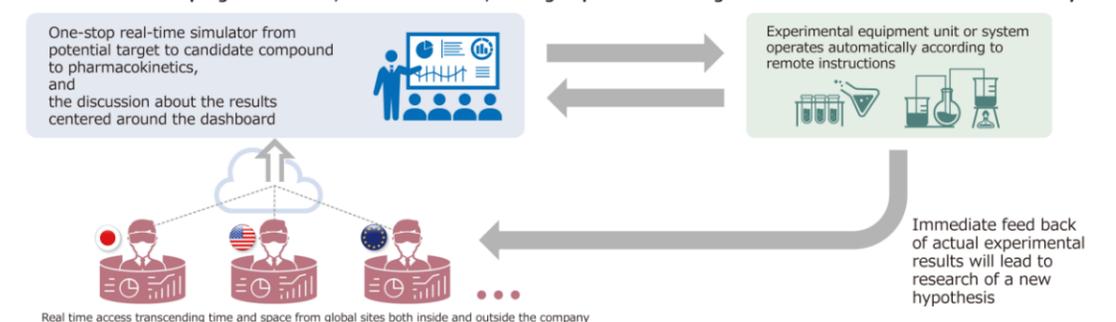
Current drug discovery research relies to a great extent on analog or manual experimental operations and each researcher needs to spend much time on tiresome step-by-step work. However, many of these tasks in drug discovery research will likely be digitized and further

developed through AI or equipment controllers, IoT, sensing technology, and other tech in the future.

For example, as the automation of laboratory equipment progresses, all kinds of data generated from work and activities in laboratories are accumulated as big data. By leveraging these features, researchers will be able to drive the hypothesis verification cycle at high speed. In the medium to long term, "digital native research activities" will become commonplace, and a new form of research activity will become the standard, starting from the point where exploratory research at unprecedented speed and precision will become universally available

### Future digital concept image of drug discovery research activity (an example)

A collaboration transcending time and space achieved by remote or xR technology, the simulation of the entire drug discovery research process by internal and external big data along with AI, and the servitization of experiment by IoT and automatization will progress forward, and furthermore, the high-speed DMTA integration of these items will become a reality.



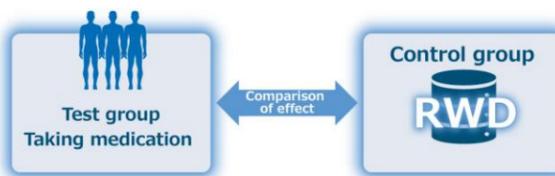
# Creation of MX Including Prevention and Prognosis

- Optimization of clinical trials through digital transformation

Since the cost for clinical trials takes up 30 to 40% of the drug development cost, if a cost reduction is possible, its impact will render a greater end effect. Applying digital transformation to clinical trials will also lead to a transformation into a corporate culture that can strengthen research activities and create high-value-added pharmaceuticals.

As one example, efforts to utilize RWD (Real World Data) in the approval application are starting to make progress. Utilizing RWD as a control in RCT (Randomized Controlled Trials), will accelerate the clinical trials, reduce the burden on the medical institution and pharmaceutical companies, and eliminate potential ethical issues which will all help produce great benefits not only for patients participating in clinical trials but also patients waiting for the product launch.

### Utilizing RWD as a control



Source: NTT DATA prepared referencing Japan Pharmaceutical Manufacturers Association, "Real World Data for application for approval - a proposal for promotion of utilization"  
[https://www.jpma.or.jp/information/evaluation/results/allotment/lofurc000005k34-att/bd\\_rwd\\_sg2.pdf](https://www.jpma.or.jp/information/evaluation/results/allotment/lofurc000005k34-att/bd_rwd_sg2.pdf)

- Digital transformation in MR activity

The means for providing information are changing due to the COVID-19 pandemic as well as from person-to-person visit restrictions that also stem from it. Digital channels such as information provision by e-mail and online interviews are now being used as alternatives to traditional face-to-face interviews. The digitization of MR operations has the advantage of increasing the efficiency of sales activities, as well as being able to provide information to doctors more quickly and accurately. As of 2022, MR visit restrictions are still in place, so digital channels will likely be used more in the future.

In the past, communication with doctors has been considered to be dependent on individual skills in the MR business. However, in recent years, improvements in voice/image recognition technology and the development of natural language processing have made it possible to digitize information on detailed activities that approach the subtleties of people, in such a way that data-driven business is making huge progress.

For example, visualizing of optimal MR performance will become possible by analyzing the digitized utterance content in interviews with high-performing MR, and combining the content with the daily report or profile data of each doctor. The data obtained here will be applicable to educating new employees, etc. Furthermore, a supervisor can be assigned according to their area of interest or the doctor's communication style, and deeper communication with the doctor will become possible by accumulating information on the expertise and performance of the MR. Digital transformation of MR activities is therefore likely to have an effort on improving the organized business capabilities of pharmaceutical companies. Additionally, these efforts will enable doctors to receive sufficient information on the best channel, and make more appropriate decisions on administering drug dosages. Ultimately leading to more opportunities for patients to be appropriately dosed with innovative new medicines.

### Personalized and Seamless Patient Experience

Each pharmaceutical company is accelerating its efforts to develop support programs covering from prevention to prognosis as a business field contributing to improvement of the patient's MX. When pharmaceutical companies approach these businesses, they are likely to encounter cases of collaboration or competition with players from different industries in non-medical fields, and considering their expertise in the disease domain, fields in which pharmaceutical companies can be active, will expand more than ever before. For example, they will be expected to contribute to achieving patient-centered healthcare through developing treatment applications such as DTx and creation of new healthcare programs such as health-management and diagnostic applications utilizing PHR (Personal Health Records).

From here onwards, not only pharmaceutical companies and medical institutions but also the whole spectrum of health industries including food companies, fitness companies, and developers of healthcare applications including prevention and prognosis or healthcare maintenance are going to shift over to a new world that supports the patient throughout their

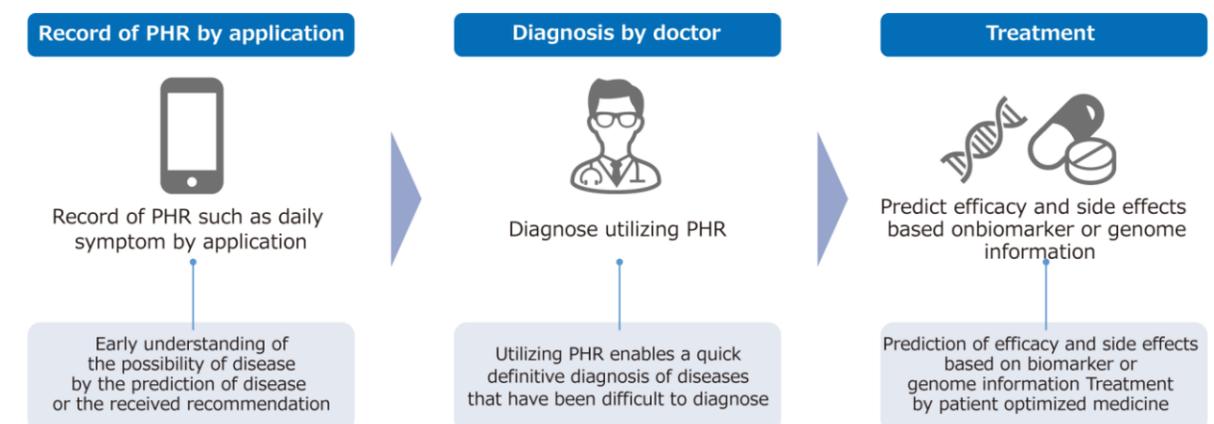
entire life through digital transformation. Among these, the presence of pharmaceutical companies will have a great impact.

- Personalization of Patient Experience

Personalization of patient experience utilizing digitalization will also move to a higher level. Giving a highly accurate diagnosis enables the patient to receive the best possible treatment, by utilizing their activity information including the diet and exercise history of the patient and their vital data such as medical questionnaire data and pulse rate, etc.

Furthermore, based on the biomarker or genome information, the treatment can then be decided upon after predicting efficacy and side effects. For example, an understanding of the genomic risks faced by ordinary persons through utilizing genome analysis technology will avoid having to apply the trial-and-error process in the treatment. In addition, it will be possible to provide programs such as disease prevention and health habit improvement according to genetic risk and encourage lifestyle revision and regular health checkups.

### Personalization of Patient Experience



- Making the patient experience seamless

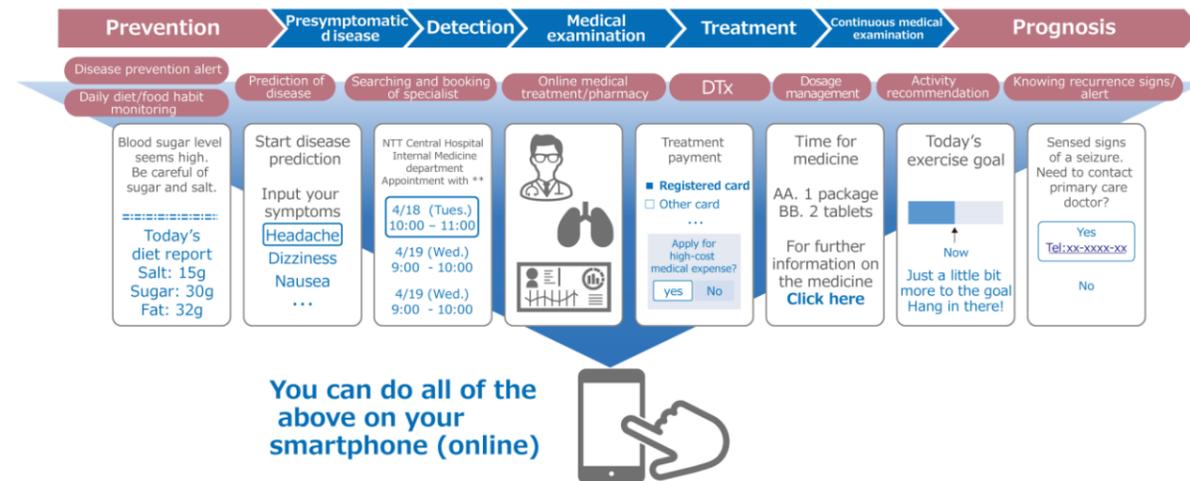
Each of the medical scene - prevention, awareness of symptoms, finding a hospital, seeing a doctor, paying a doctor, receiving a prescription, picking up a medicine, taking a medicine - that until now had been experienced individually, is being integrated online, and the barriers between daily life and medical care are consequently disappearing. Patients can in this way reduce the time and effort needed for maintaining their health by making use of all healthcare processes including from prevention

through prognosis.

For example, when the risk of a specified disease such as diabetes can be predicted during a medical check-up, a forecast of the patient's disease can then be made from daily life logs. Furthermore, when the state of the disease worsens, patients will be helped to recover while receiving digital management and treatment of their prognostics and health by a medical specialist to achieve a state where the patient can enjoy the entire process as an on-line service.

#### Making the patient experience seamless

- Health care that had been a individual experience is integrated online and gradually eliminates the boundary between everyday life and health care.
- Patients can reduce the time or effort needed for maintaining their health by utilizing all of the health care processes including from prevention to prognosis.



# Chapter 3

NTT DATA's Solutions for MX transformation.

NTT DATA actually offers a wide variety of solutions, starting with providing these RWD distribution platforms and analysis capabilities.

Here are typical examples.

- **Data infrastructure for pharma**
- **Health management solution, Health Data Bank**
- **Integrated clinical trial platform, PhambieLinQ**
- **Digitalized laboratory for drug discovery**

## “Data Infrastructure for Pharma” Specialized for Pharmaceutical Companies

### What are the essential requirements for a Data Analysis Infrastructure for Pharma?

In view of the special nature of the pharmaceutical industry, the three factors of high-performance, high-security data governance, and data sharing potential are essential points for a data analysis infrastructure.

The unique features of the pharmaceutical industry, also make the following three points important for a data analysis infrastructure.

1. High-performance platform capable of handling huge volumes of experimental data such as RWD and image data including laboratory data at high speeds
2. High security platform that maintains data governance in compliance with CSV (Computerized System Validation) as a required measure among pharmaceutical industries and protects personal information
3. Platform that can easily share data while maintaining security for linking with external organizations such as academia, medical institutions, and partner companies.

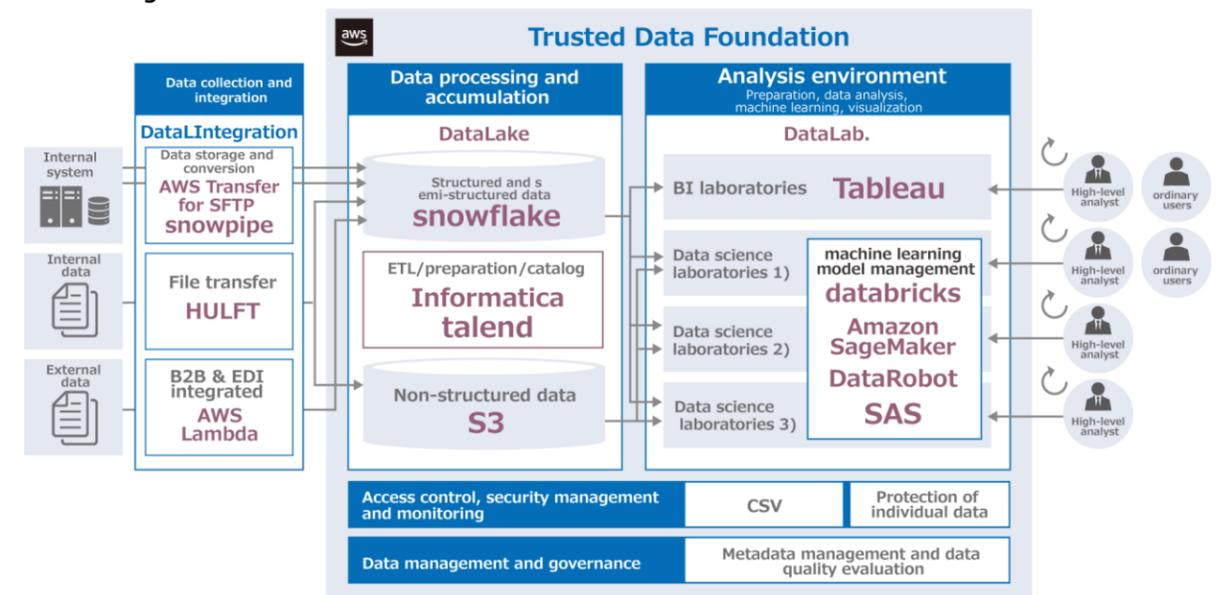
### “Data Infrastructure for Pharma” from NTT DATA

To resolve multiple issues, NTT DATA is developing “Data Infrastructure for Pharma” as a solution for helping pharmaceutical companies achieve high-performance, high-security, and easy external connections. This infrastructure is created by optimizing a plurality of advanced solutions utilized globally and constituting a solid asset.

Using “Data Infrastructure for Pharma” will bring the following benefits.

- **Provides an easy-to-build infrastructure at a low cost, within a short period, and at high quality compared to building one from scratch**
- **Users can start operating it in gradual steps while selecting technology to match their applications and budget**
- **The feasibility and performance can be verified under a trial environment before actually building up the structure**

### Entire Image of “Data Infrastructure for Pharma”



# Health Data Bank Supports Health-management on the Cloud

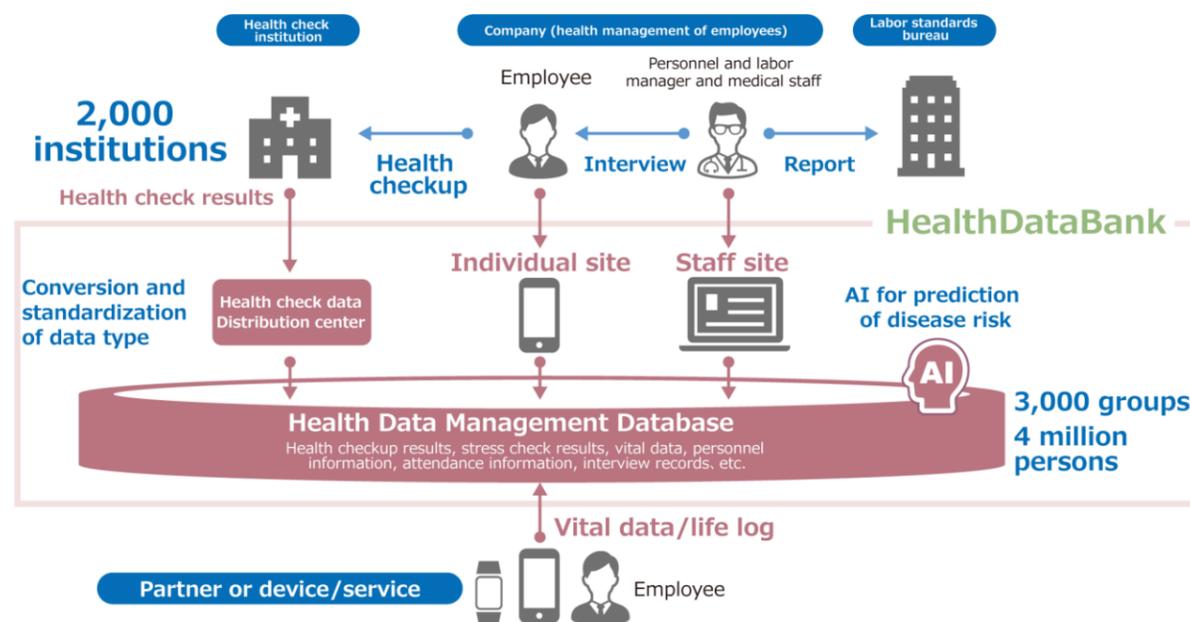
## Health-management on the cloud via the Health Data Bank

Health Data Bank is a solution provided by NTT DATA for health-management on the cloud. It was launched in 2002 as a cloud-based service that supports employee health management at companies. The Health Data Bank has a system called the "Center for distributing medical check data" which runs a series of operations to register information in the database, after receiving health examination data of employees directly from medical examination institutions on

behalf of companies, and converting and unifying it into a date format different for each medical examination center, etc.

Recently, we have also been working on collecting various vital data or life logs in cooperation with various companies that provide IoT devices or smartphone apps. Now that we are celebrating our 20th anniversary, we are entrusted with the health data from roughly three thousand organizations and 4 million people, and have the top share as a cloud-based service in this area.

### Overall Picture of Health Data Bank



### "Health Data Bank" Next Generation

With IoT devices and smartphone apps enabling consumers to measure their vital data and lifelogs on a daily basis, the use of health data is expanding. The vital data measured daily by ordinary persons is focused on as "Real time data that indicates the nature of and preferences relating to personal health" and various use cases are emerging, such as the utilization by companies in promotion and product development according to the customer's health

condition, or utilized by primary care doctors to confirm the condition of patients outside the hospital.

In view of these trends in the health market, NTT DATA has provided the Health Data Bank for several years as a "A storage mechanism for safely and securely collecting and managing health data required for services provided by companies" to those companies that provide services utilizing health data in a diverse range industries such as insurance, production, retail sales and medicine etc.

## Consumer-oriented health management realized by the My Health Data Bank concept

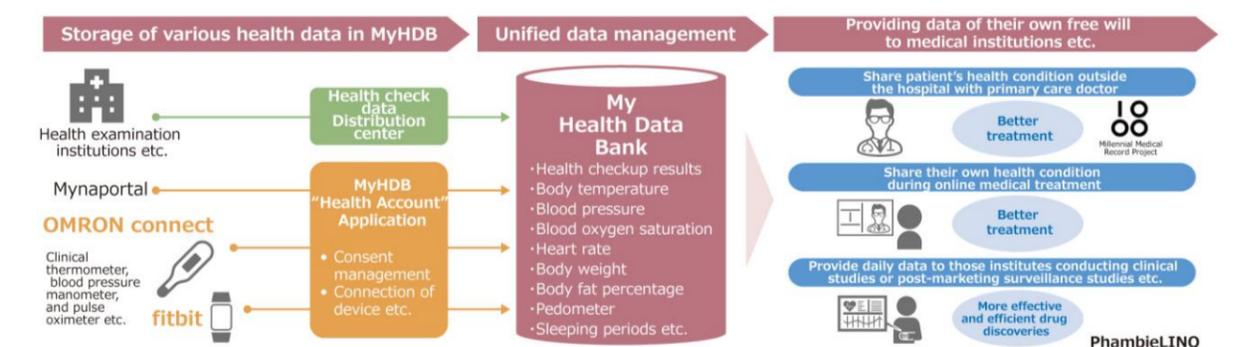
Health data has always been managed from a "provider-oriented viewpoint", Vital data for example, is managed by companies providing IoT devices while medical check-up results are managed by their companies or schools, and local government, etc. Therefore, ordinary persons cannot freely use their own data. On the other hand, the government is promoting an "Each person takes responsibility for their own health" approach under the slogan of "Achieving a society of health and longevity." In addition, due to the spread of COVID-19, consumers are facing a life-threatening crisis and are facing the need to "protect their own health."

Along with all these societal trends, "Ordinary persons can learn to manage their health data on

their own and 'understand their own health status,' by making use of their health data, so a system for 'improving and promoting one's health on one's own'" will become necessary.

In view of such trends, NTT DATA is considering a "People-oriented health data management and operation service" also called My Health Data Bank Plan. This service would allow the average person to achieve good health based on their own motivation by integrating and managing their own health data at various sites such as medical check-up results obtained by way of Mynportal (portal site used for public administrative process in Japan) or results measured by Fitbit into the "Health Account" belonging to My Health Data Bank. Their health data would then be supplied to service provider or primary care doctors. These patients could then obtain optimized products and services, and better medical treatment and care, etc.

"Consumer-oriented service for health data management and operation" is under evaluation for planning. Ordinary persons achieve well-being by integrating health data into a "Health Account" and self-managing and operating it.



**Practical example of “Utilization of people-oriented health data” in Kashiwa-no-ha Smart City**

In “Kashiwa-no-ha Smart City” operated by Mitsui Fudosan Co., Ltd., any person can take advantage of various healthcare services through a portal site for residents called “Smart Life Pass,” or “Kashiwa-no-ha data platform” that also offers identity management and ID linkage

and management features. NTT DATA provides Health Data Bank by connecting to Kashiwa-no-ha Data Platform, and consumers can use it by way of Smart Life Path. Kashiwa-no-ha Health Data Bank collects and manages personal health data with the user’s consent, and plays a crucial role in linking health data to other services while developing new products and services in medical and nursing care.

As an actual example of how Kashiwa-no-ha Smart City functions we will show how “Vital data management service” supports cancer patients in cooperation with the National Cancer Center Hospital East and Mitsui Garden Hotel.

Data Bank with healthcare professionals of Hospital East or hotel staff in order to receive “Better treatment” or “More comfortable hotel service.” If the patients equip their home with this OMRON medical device, then the service will be available continuously even at home.

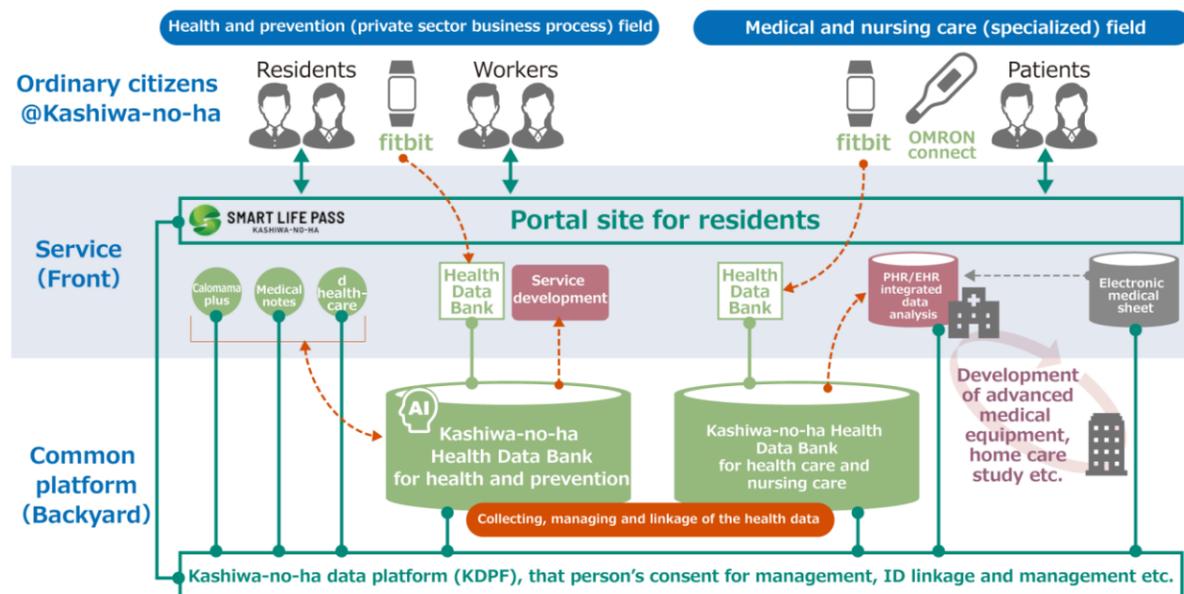
On the Kashiwa-no-ha park side of the Mitsui Garden Hotel next to National Cancer Center Hospital East, a variety of services are provided for those cancer patients receiving regular treatment at Hospital East and their accompanying families. One of these is the “Vital data managing service,” that allows cancer patients staying at the hotel to measure vital data using the OMRON thermometer, blood-pressure gauge, and pulse oximeter or their walking steps or sleeping time through Fitbit into the Health Data Bank and then utilizing this service by way of Smart Life Pass.

Healthcare professionals have always known that the patient’s condition outside the hospital is based on the content described by patients at the medical examination, however, we expect that by browsing the daily transition of patient’s vital data etc., it will be possible to better understand the patient’s condition and lead to better treatments. The service is currently at the service effectiveness validation stage for patients staying at hotels, but NTT DATA is considering future lateral expansion to community medicine and home healthcare as well.

Besides this, with their consent, patients can share their accumulated data from the Health

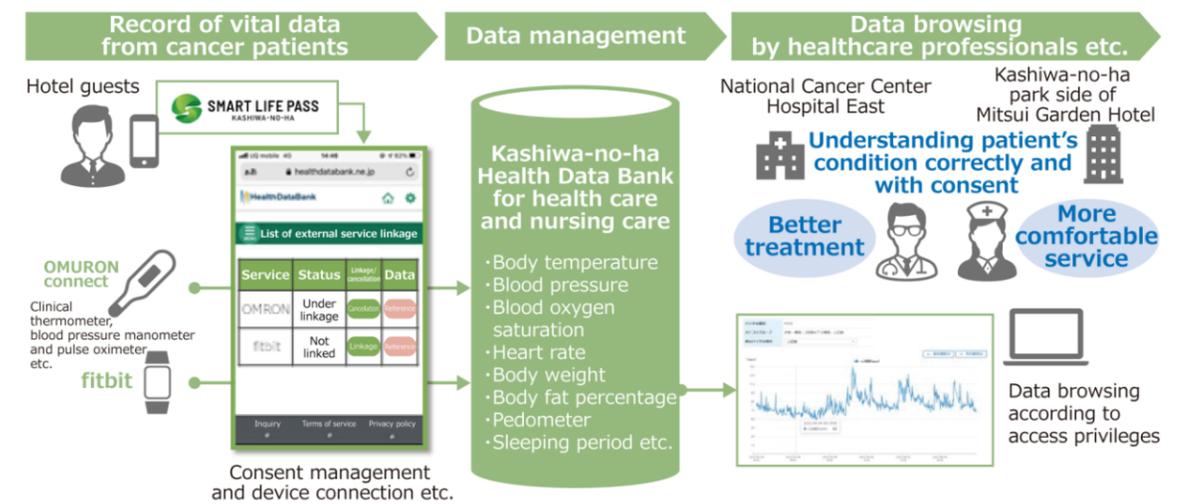
**Concept image of My Health Data Bank (Health data version of banking model)**

Health data obtained from ordinary citizens with their consent, is integrated into Health Data Bank and then linked with health care, nursing care, and development of services etc.



**[Usage Example from Kashiwa-no-ha]; Vital data management service at the “hotel linked to the hospital”**

A service supporting cancer patients provided in cooperation with National Cancer Center Hospital East and Mitsui Garden Hotel



# Data Linkage by PhambieLINQ

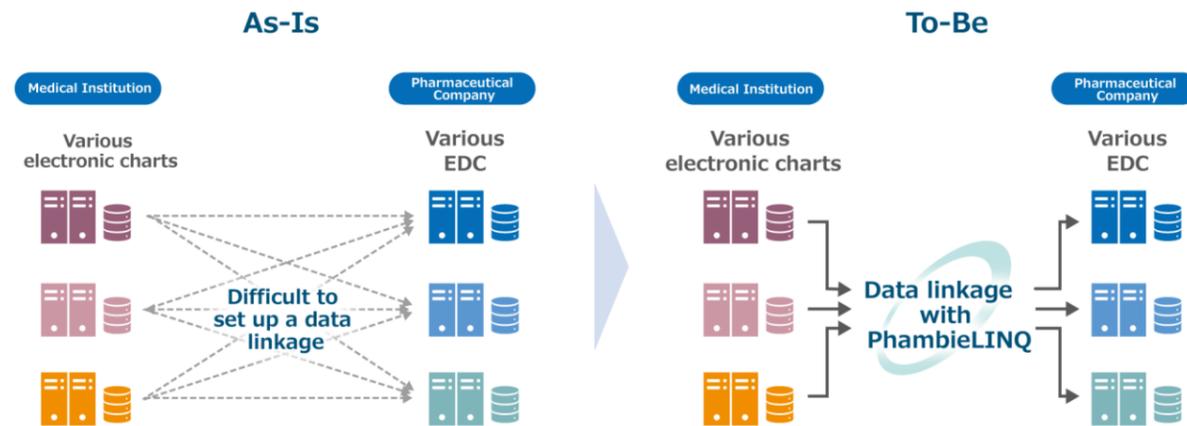
## A Total Solution Platform for Clinical Trials

### Issues in linking data to EDC from electronic medical records

Linking eSource data (or namely electronically recorded data) with Electronic Data Capture (called EDC) that collects electronic clinical examination information is drawing attention as a means for optimizing or making qualitative improvements in clinical trials and its importance is now common knowledge across the industry. At this time it still has not reached a full-scale spread within the industry.

One possible reason for this is that electronic medical record products for medical institutions or EDC products for study sponsors come in many variations and their specifications are not standardized. In many cases, the data exported from the electronic medical record cannot be imported into the EDC as it is, and as a result, in order to transfer the data between the electronic medical record and the EDC, it is necessary to perform time-consuming adjustments and procedures, which delay the data linkage process.

### Issues in linking data to EDC from the electronic medical record



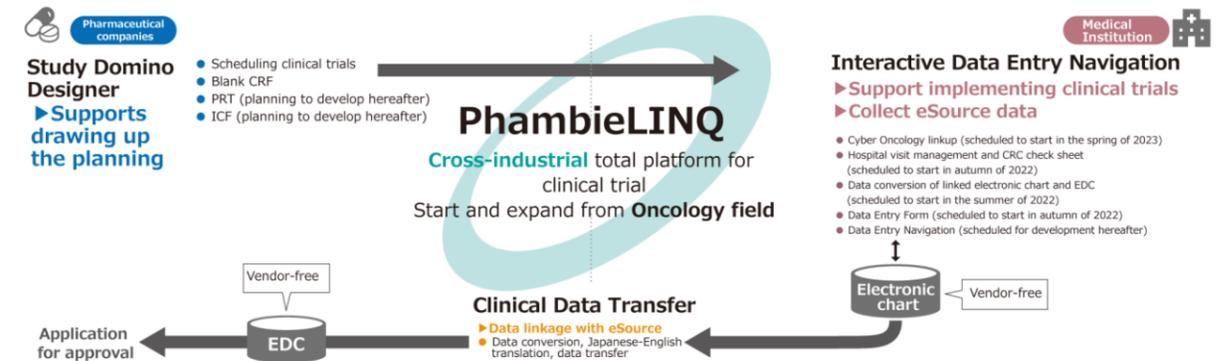
### Data linkage achieved by PhambieLINQ

NTT DATA developed a total solution platform for Clinical Trials called "PhambieLINQ" to overcome these issues. In addition, NTT DATA is aiming to standardize the data output from various electronic medical records, and link them with EDC.

PhambieLINQ, as a cross-industry comprehensive clinical trial platform, enables the collection and linkage of eSource data with the following three functions.

1. Support for planning in pharmaceutical companies
2. Support for collecting clinical data in medical institutions
3. Linking clinical data from medical institutions to the test client

### Overall Image of PhambieLINQ



### Main features of PhambieLINQ

PhambieLINQ offers the following three features.

- Linkage with electronic medical records  
It saves labor in SDV or namely Source Document Verification with direct browsing by linking the required information for case reports to test clients from stored in the electronic medical record. original materials
- Multivendor support  
Designed as a platform utilizable in every type of test, it supports a variety of diverse electronic medical record and EDC systems.
- Designed and developed from a medical institution perspective  
NTT DATA achieved a user-friendly system for medical institutions from the user's point of view, participating as experienced CRC or Clinical Research Coordinators. A special task force will also be made available support the installation and user training during initial startup and operation.

### Provides functions and support from the viewpoint of a medical institution

Making use of PhambieLINQ for hospital visit day management or visit check sheets allows staff to prepare hospital visit management and check sheets for each examinee. So this not only cuts down on deviations caused by human error but also handles tasks such as adding items specific to each medical institution or changing visit days thereby improving operational efficiency. NTT DATA is also starting to consider the future electronic linkage of protocol information from trial sponsors to medical institutions on the PhambieLINQ platform, and is planning to enable automatic generation of standard check lists. Also, during PhambieLINQ introduction and initial use, a task force specializing in startup assistance will fully and continuously support the installation and setup of PhambieLINQ even after startup of operation.

# The NTT DATA Vision for Digital Drug Discovery Research

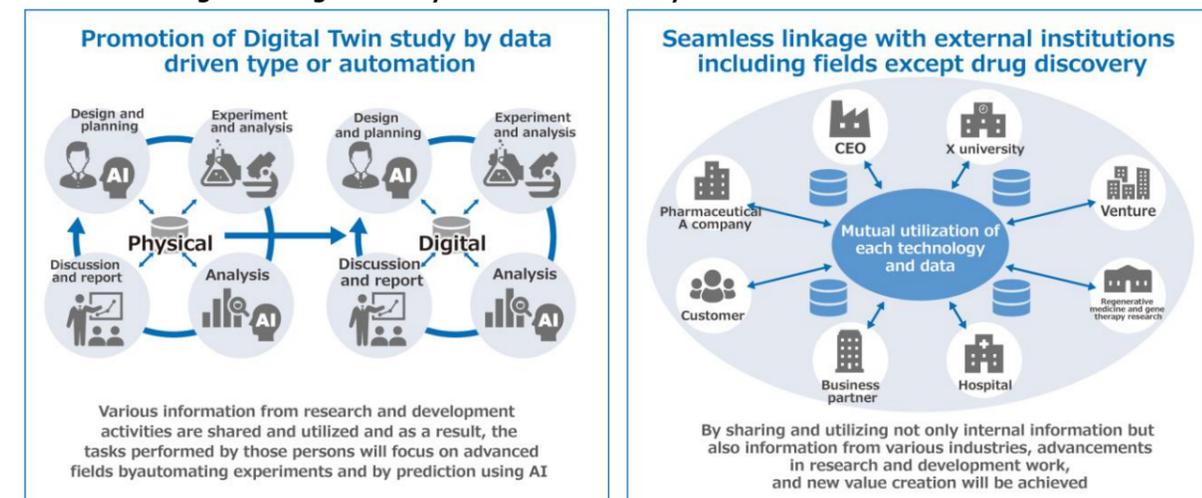
## Digital evolution brings a change in direction for research activities

Competition for enhanced drug discovery capability among pharmaceutical companies is getting fiercer year by year. Amid the emergence of diverse modalities as well as their own practical realization such as nucleic acid medicine, mRNA (messenger RNA), ADC (Antibody Drug Conjugate), cellular medicine, genome editing, gene therapy, digital therapeutics and development of small molecules having a plurality of action points such as Proteolysis Targeting Chimera (PROTAC), , ultrahigh accuracy in protein structure prediction by AI such as AlphaFold\*1, high-accuracy in prediction technology by cheminformatics

(information chemistry), and bioinformatics (computational systems biology) utilizing huge amounts of data are making rapid technical advances. These create a huge demand for making a fast counter-response with capabilities spanning a wide range of technologies. On the other hand, by making the most of digital technologies in the drug discovery research field, we can anticipate exploratory research activities that occur at unprecedented speed and accuracy as well as a speed-up in cross-external border collaboration.

\*1 A program for protein structure prediction using AI developed by DeepMind, the subsidiary company of Alphabet.

## The future image for drug discovery research as seen by NTT DATA

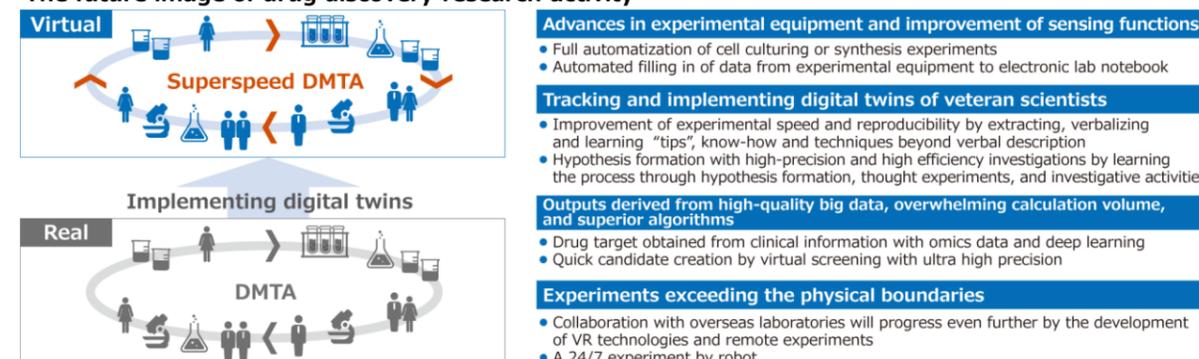


## Future vision for drug discovery research activity

The future vision that lies beyond the evolution of such drug discovery research capabilities is a fully integrated digital native laboratory not limited to the introduction of discrete AI tools or data utilization platforms. By expanding digitalization to IoT and full automation of test equipment, the sensing of environmental factors such as objects and air temperatures, and tracking of researcher's investigations,

explorations and thinking activities will achieve ultrahigh speed DMTA/PDCA cycles, the generation of qualitative and quantitative output beyond physical constraints, together with intellectual deliverables produced by AI, which has a way of thinking different from that of humans, will become commonplace. NTT DATA believes that in such a new world, researchers will play an active role in highly specialized intelligent activities on a level not seen up to now.

### The future image of drug discovery research activity

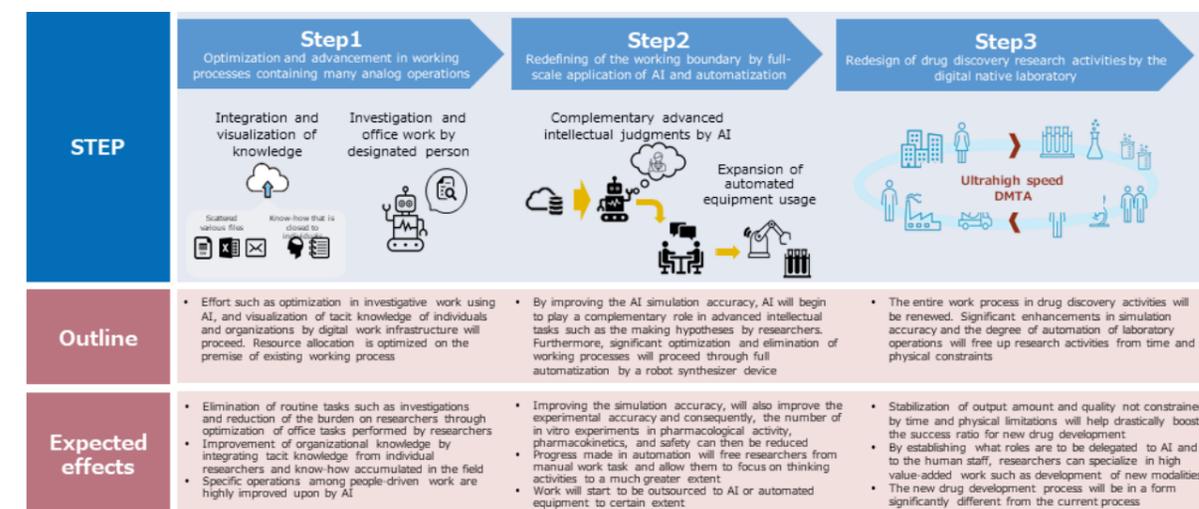


## The road to achieving a digital native laboratory

Although these changes might be realized in a single leap, a staircase approach that gradually changes the way researchers work to get innovative results while keeping an eye on future goals might also be a valid option. The first steps towards establishing the long-awaited digital native laboratory, are making use of a data

platform, IoT and AI to resolve or eliminate currently recognized issues; prepare the groundwork for post-digital drug discovery research activity, and then take measures to create new research successes.

NTT DATA is currently preparing its specific and concrete vision by taking a step-by-step approach and holding regular discussions about it with field-expert.





# Contributing to the realization of MX through Digital Transformation of Pharmaceutical Companies

In the pharmaceutical industry a major management issue is how to achieve value chain innovation with 'data-driven' as the central keyword and how to create value in new areas making use of the people and tools that have supported conventional drug discoveries. Innovation takes a long time in pharmaceutical industries because of the lengthy process of basic research, clinical development, and sales. On the other hand, the pharmaceutical industries must also retain enough power to remain competitive against new players such as tech giants and startup companies. Furthermore, it is important to consider how to develop cross-industry collaboration or ecosystems in this market because industries such as food, real estate, banking, and insurance are now starting to take part in this market.

NTT DATA has constantly supported the realization of a society of health and longevity where people can live safely in good health and as well as a sustainable society with less environmental impact, through the provision of services and solutions that enable information-sharing or joint utilization that transcends the boundaries of companies and industries. Based on these experiences and achievements, NTT DATA would like to continue to promote patient-centered healthcare in the future, and improve the MX through the digital transformation of pharmaceutical companies.

## NTT DATA CORPORATION

### Pharmaceutical and life science industry, Foresight Design Team

#### Manufacturing IT Innovation Sector Manufacturing Division 4



Senior Manager  
Shiko Sekine



Deputy Manager  
Yosuke Nishida

#### Consulting & Marketing Sector, Enterprise segment Consulting & Marketing division, Enterprise segment



Manager  
Tatsuya Motomura



Assistant Manager  
Keisuke Takenaga



Assistant Manager  
Kaho Goto