CEO Yoshinori Yamashita shared a snapshot of our Healthcare business on IR Day. I will present the full picture today.
As you can see here, Ricoh’s Healthcare Business vision is to diagnose and swiftly detect and treat spinal cord, brain, and nervous system disorders to enhance health and longevity in aging societies.

Medical imaging is central to our business, core focuses being magnetoencephalographs, or MEG, and spinographs.

Our goal with MEG is to swiftly diagnose dementia and developmental disorders. We also seek to map the body’s entire nervous functions. We want these capabilities to be our strengths.

We will leverage proprietary diagnostics to drive progress in two areas.

The first is the biomedical business, shown in the top left of the slide. Here, we will cultivate drug discovery and diagnostics using bioprinting technology. Efforts will encompass such fields as highly precise genetic testing with DNA standard plates and drug discovery support with iPS differentiated cells and cell chips.

The other area is regenerative medicine, on the top right. We will strive to accelerate neuroregenerative medicine R&D with magnetospinography.

We thus seek to contribute to social progress with new technologies treating brain and nerve disorders.
Potential for Diagnosing and Treating Cranial Nerve Diseases

Significant unmet needs remain for central nervous system disorders

Ricoh seeks to save countless millions of people with brain and neurological disorders by leveraging medical imaging technology mapping neural activity and biomedical technology employing iPS cells

- The graph on the left plots treatment satisfaction and drug contributions for a range of disorders. In red are brain and mental disorders. In blue are central nervous system disorders.
- As the graph shows, brain and nervous system disorders have unmet medical needs for which effective diagnoses and treatment are urgently desired. We want to use our proprietary technology to save countless millions of people with brain and neurological disorders.
- I will now profile our core medical imaging and biomedical businesses.
Medical Imaging Business

- **Products and services**
  - Brain and central and peripheral nervous system imaging equipment

- **Features**
  - Functional diagnostics:
    - Unlike magnetic resonance imaging (MRI) and other systems that map shapes, measures human body's weak magnetic field (a billionth of Earth's)
    - Ultraprecision magnetic sensor: Harnesses SQUID (superconducting quantum interference device)

**MEG**

- For epilepsy and examinations prior to neurosurgery
- Detecting early signs of dementia and children's developmental disorders

**Magnetospinography** (not clinically approved)

- Supporting orthopedic surgical procedures for which MRI diagnostics have been difficult, notably for spinal collapses

This business focuses on MEG and magnetospinography, which map the nervous activity of the brain and central and peripheral nerves.

Unlike magnetic resonance imaging, which maps structures and shapes, MEG and magnetospinographs provide functional measurements of the body’s nerve activity. They measure weak magnetic fields from such activity.

We therefore use an ultraprecision magnetic sensor that harnesses a superconducting quantum interference device.
Page 5 highlights developments to date in our medical imaging business.

- We have conducted joint magnetospinography R&D since 2014 with Tokyo Medical and Dental University, and Kanazawa Institute of Technology. We started this work in view of the potential for mapping nervous activity in spinal cords.

- In April 2016, we fully entered the healthcare business in acquiring Yokogawa Electric’s MEG business. We obtained medical device approval in Japan and overseas, launching sales in the United States in December 2017 and in Japan in July 2018.
- Employed in clinical trials, notably to identify epilepsy and brain tumors
- R&D to swiftly diagnose developmental disorders and dementia

Using both MEG and MRI makes it possible to accurately identify sources of abnormalities and thereby determine surgical locations, such as for people with epilepsy.

- I will now overview MEG.
- MEG is used in preoperative epilepsy diagnostics. Using both MEG and MRI makes it possible to accurately identify sources of epilepsy abnormalities and determine surgical locations.
Our new MEG approaches have included launching a brain function dock initiative with Hokuto Hospital in Hokkaido. We announced this in a press release in January 2019.

In 2018, we started joint research with Kanazawa University to swiftly diagnose developmental disorders. This is part of Osaka University’s Center of Innovation national research project.
Spinograph

Detecting neural activity (in milliseconds, for one-tenth to one hundredth of brain magnetic field after electrically stimulating limbs)

The only system that can provide *minimally invasive* imaging of central and peripheral nerve activity, materializing safe and comfortable medical measurement services

- I will now turn to the spinograph.
- This is the world’s only system that can provide minimally invasive imaging of central and peripheral nerve activity.
- The graphic shows a magnetic sensor under the neck that electrically stimulates the limbs, with nerve signals being transmitted to the brain and mapped.
I. Magnetospinography
   1. Neck
   2. Waist

II. Magnetoneurography
   1. Hands
   2. Brachial plexus

- The image on the right shows a combination of several measurement results.
- Red shows stimulated nerves, and the path heading toward the brain is very clear. R&D has progressed since 2018, and we can now map neural activity for the whole body, notably the neck, waist, hands, elbows, and upper arms.
- We know that nerve conduction stops when a disorder is identified, this conduction stops, and our device pinpoints disorder locations.
Potential of Magnetospinography

- **Advanced** system developed to map neural activity of spinal cord and peripheral nerves
  - Enabling noninvasive assessments
  - Enabling functional rather than shape evaluations

- Conducting surveys in Japan and abroad through academic and other activities, **confirming spread of ailments that can be researched** and validating **great potential of practical applications** for system

<table>
<thead>
<tr>
<th>Key areas of research potential</th>
<th>Patient universe</th>
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<td>Spine and spinal cord diseases</td>
<td>Spinal diseases</td>
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<td>Brachial plexus disorder</td>
<td>Diabetic neuropathy</td>
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<td>Diabetic neuropathy</td>
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<td>Guillain-Barre syndrome</td>
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- Magnetospinography makes nervous activity extremely easy to understand. It is minimally invasive, causing no bodily harm, and enables functional rather than shape evaluations.
- As a diagnostic tool, our magnetospinograph offers considerable diagnostic potential for a range of disorders. These include spinal and spinal cord diseases, brachial plexus disorders, and diabetic neuropathy.
- Ours is the world’s only magnetospinograph, and it offers outstanding practical potential.
- In fiscal 2020, we will apply for medical device certification from the U.S. Food & Drug Administration and from Japan’s Pharmaceuticals and Medical Devices Agency), and look to commercialize our system as soon as possible.
I will now discuss our biomedical business.

We have two core technologies in this area. The first is our bioprinting technology. The second is the iPS cell technologies of Elixergen Scientific, in which we acquired a stake in July. Our goal in the biomedical business is harness these two technologies to pursue drug discovery and diagnostics for personalized medicine.
I will now explain our bioprinting technology. We developed a unique inkjet technology that can accurately dispense living cells, precisely controlling the number and positions of cells. As you see on the right, we will produce a range of patterns by combining human cells and hydrogels to reproduce the functionality of human organs.
The other technology is rapid iPS cell differentiation, which is Elixergen Scientific's Quick-Tissue technology, which uses nucleic acid-derived reagent cocktails of transcription factors on human iPS cells. This simple process makes it possible to rapidly transform stem cells into organ tissue cells. Differentiation conventionally takes one or two months. The Quick-Tissue technology leads to functionally mature neurons in just a week.
We aim to use these two technologies to drive drug discovery process innovation and personalized medicine.

The current drug discovery process uses limited cell lines to quite inefficiently screen candidate drugs from large numbers of compounds.

Technologies from Ricoh and Elixirgen Scientific can drive innovations and process improvements. We can consolidate many iPS cell lines on chips and select multiple drug candidates stratified by genome. We can develop optimal therapeutic medications according to gene sequences in our quest to materialize stratified medicine.
I will now go through our drug discovery business steps.

- In Phase 1, Elixergen Scientific is pushing forward with cell and reagent operations. It will expand this area and supply iPS differentiated cells or reagents. For neurons in particular, we look to expand by offering cells with mature functions.

- In Phase 2, we will develop the cell plate and chip business. We aim to contribute to the development of stratified drugs by selling chip plates that can evaluate the impact of genetic diversity on drug candidates.

- For Phase 3, we will develop an assay service business supporting drug discovery and assays that support our own tissue model.
Targeting Cranial Nerve Disorders

- Nerve tissue chip to evaluate efficacy and neurotoxicity with cranial nervous system diseases
- Efficacy and toxicity evaluation services using this chip

Nerve cell chip
- Evaluating diversity by using iPS cells derived from multiple people

Electrode chip for evaluating neural functions
- Measuring nerve cell firing electrophysiologically
- Evaluating spasms and other neurotoxicity
- Epilepsy and other efficacy evaluations

- We are looking into synergies between neurons and MEG and magnetospinographs, focusing on drug discovery that targets neurological disorders.
- We will evaluate diversity by using iPS cells derived from multiple people and assess drug efficacy and side effects.
- We also aim to work on an electrode chip with nerve cells deposited on electrodes, measuring nerve cell firing electrophysiologically, evaluating spasms and other neurotoxicity, and undertaking epilepsy and other efficacy evaluations.
Overview of Diagnostic Agent Business

- **Vision**
  - Supply diagnostic agents for personalized medicine, centered on companion diagnostic drugs

- **Products and services**
  - DNA standard plates to calibrate genetic testing equipment and control test precision
  - Looking to offer companion diagnostic agents to determine efficacy of stratified drugs for cranial nerve disorders

Finally, I would like to overview our diagnostic agent business.

Our vision is to supply diagnostic agents for personalized medicine, centered on companion diagnostic drugs. We will first commercialize DNA standard plates to calibrate genetic testing equipment and control test precision.

Down the track, we look to develop a business in which we offer companion diagnostic agents to determine the efficacy of stratified drugs for cranial nerve disorders.
Now, I will talk about DNA standard plates.

We are introducing desired DNA sequences into cells through genetic recombination. We are using our inkjet technology to count the number of cells and put them in plate wells. This result is plates with arbitrary numbers of DNA molecules in arbitrary sequences, as on the far right of this slide. This is a DNA standard plate. The number of DNA copies can be specified from 1 to 1,000.
Here is an example of actual DNA standard plate usage. We have obtained favorable linearity results for 1 to 1,000 DNA molecules. This shows that it is possible to perform reliable DNA testing from a single molecule.

At the same time, if linearity is disrupted when using a standard plate with various devices and reagents, one can conclude that device precision is poor. So, we look to use our technology to control precision or ensure detection accuracy for low numbers of molecules.
We plan to launch DNA standard plates

- Expand lineup of accuracy control and positive control plates
- Internationally standardize genetic testing

We have already completed DNA standard plate development, and are set for commercialization.

We plan to expand our lineup of accuracy control and positive control plates. We also look to internationally standardize genetic testing.

That ends my overview of our medical imaging and biomedical businesses. Thank you very much for listening.
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a. General economic conditions and business trend
b. Exchange rates and their fluctuations
c. Rapid technological innovation
d. Uncertainty as to Ricoh's ability to continue to design, develop, produce and market products and services that achieve market acceptance in hot competitive market

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