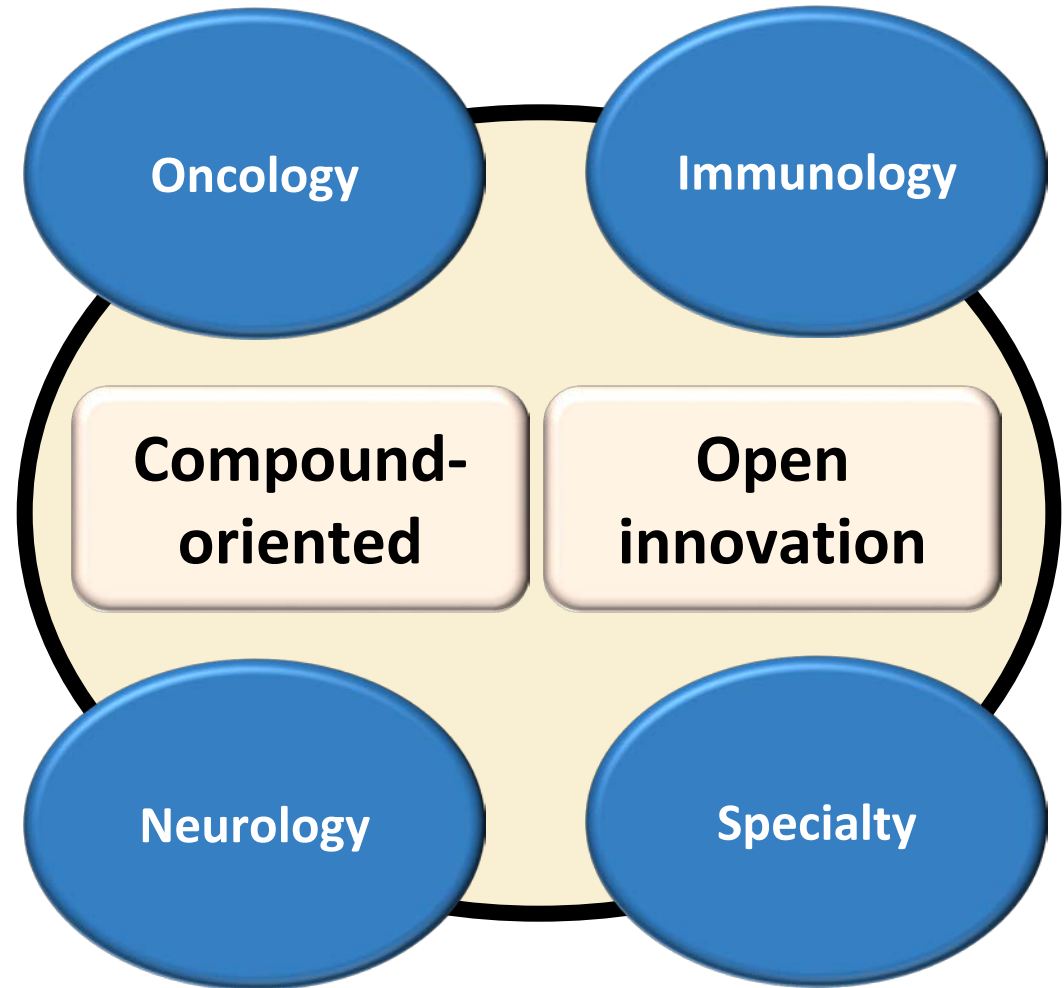


Ono's Initiatives in Drug Discovery

May 10, 2019

Reviewed Drug Discovery Strategy

- Creating compounds with **unique pharmacological actions** by utilizing the in-house library and open innovation (compound-oriented)
- +
● Enhancing the **disease expertise** by focusing on the prioritized areas with high unmet needs
- ↓
● Creating **unique and innovative new drugs** by linking the unique compounds with disease expertise



Drug Discovery in Four Priority Areas

Reinforce the competitiveness in drug discovery by accumulating and utilizing disease know-how

Research Center of Oncology

As a pioneer in immuno-oncology, aiming to create “another OPDIVO” with unique targets and new technologies by incorporating latest science.

Research Center of Immunology

As a pioneer in immuno-oncology, aiming to become a biologic research center to create new innovations through novel antibody technologies and unique targets.

Research Center of Neurology

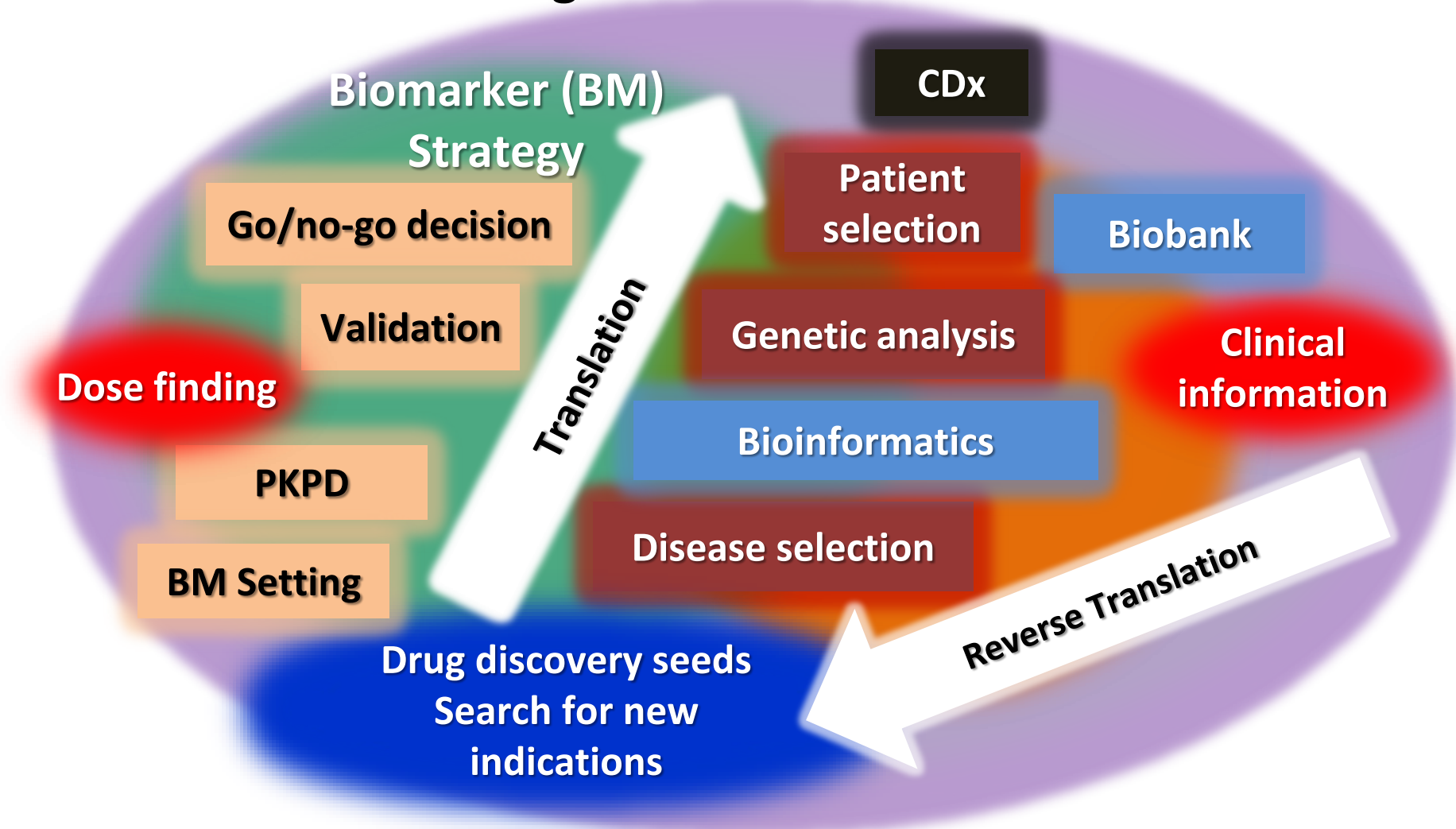
From the highly unique research focusing on glial cells, aiming to create drug products with medical impacts in neurological and psychiatric diseases with high unmet needs.

Research Center of Specialty Products

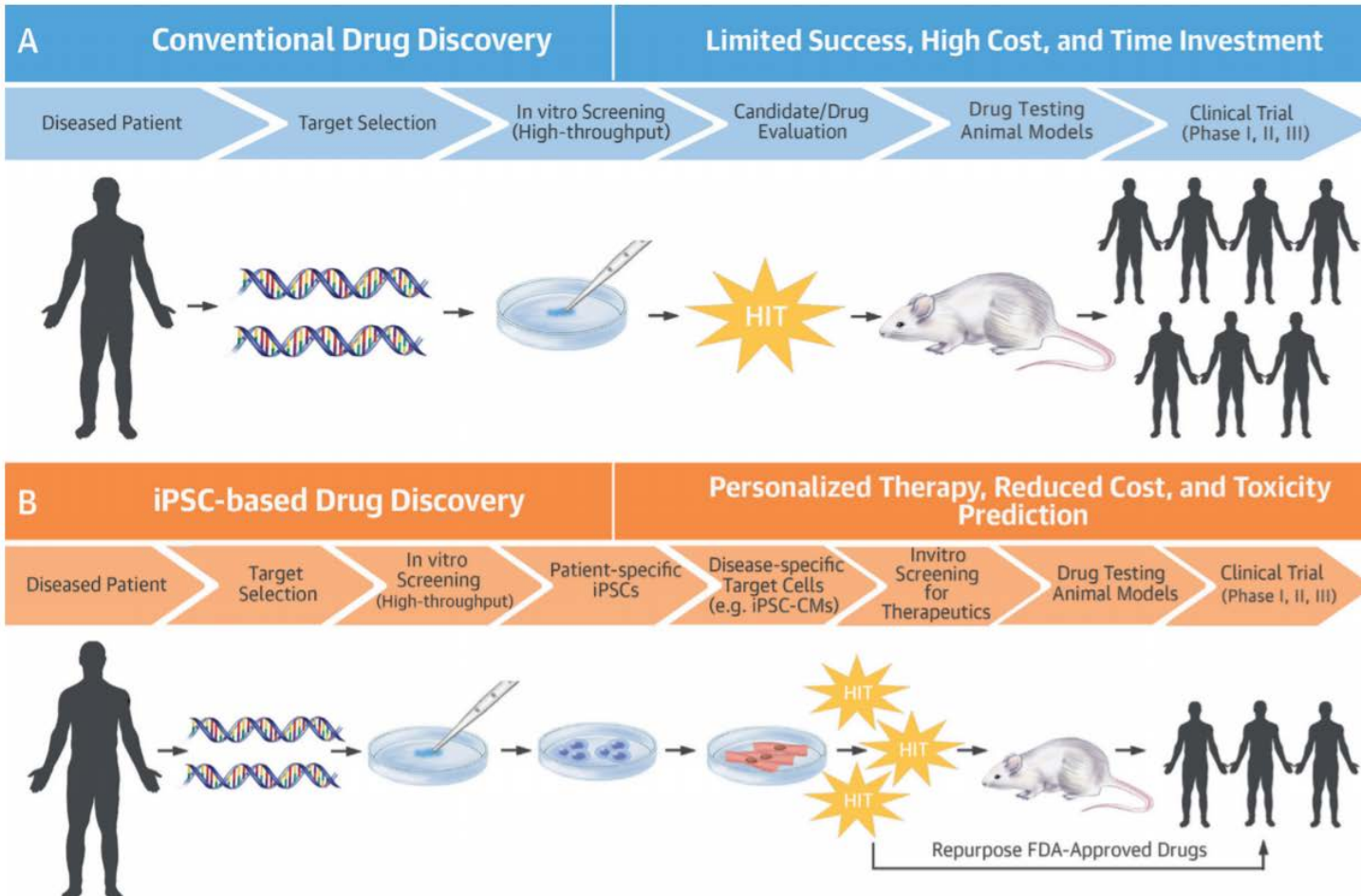
Regardless of indications, aiming to create specialty products that are expected to have great impacts on the diseases with high unmet medical needs.

Translational Research to Increase Clinical Likelihood

Increasing the likelihood of drug discovery concepts by utilizing human data and human genetic information.



Use of iPS Cells in Drug Discovery



Advantages of iPS cells

Patient-derived cells enable us to monitor the cells under disease condition and drug reactions.

Applications

- ✓ Efficacy evaluation (exploration of candidate indications)
- ✓ Toxicity evaluation
- ✓ Target screening
- ✓ MoA Analysis
- ✓ BM exploration

J American College of Cardiology, 2016:2161-76

iPS cell-based drug discovery projects are in operation in neurology and cardiovascular areas.

Research Alliance/Drug Discovery Alliance

	Number of research alliances		Total
	Japan	Outside Japan	
Number of collaborations As of the end of March 2019	185	120	305
Number of newly initiated collaborations in FY2018			85



Ono Pharma UK Ltd.



Minase Research Institute
Tsukuba Research Institute
Fukui Research Institute



Ono Pharma USA, Inc.

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REPAIR
THERAPEUTICS

Fate
THERAPEUTICS

twoAR



Ligand

Cyclenium
pharma

NUMAB
Drug Innovators

neurimmune
Promised antibody therapeutics

VECT-HORUS
BREAKING BARRIERS

THE UNIVERSITY OF TOKYO

Incorporation of Latest Science and KOL Networks in the United States and Europe

Ono Pharma Foundation in the US



Grant program to support the researchers potentially create innovation

Ono Pharma Foundation carries out the Ono Pharma Breakthrough Science Initiative Awards Program ("Ono Initiative"), a competitive awards program to support scientific research projects throughout the United States. Ono Initiative is the embodiment of our commitment to accelerate open innovation by supporting high-risk and high-reward science research projects, which have potential to lead to science discoveries/solutions and, possible, based on further research, to breakthrough treatments for patients.

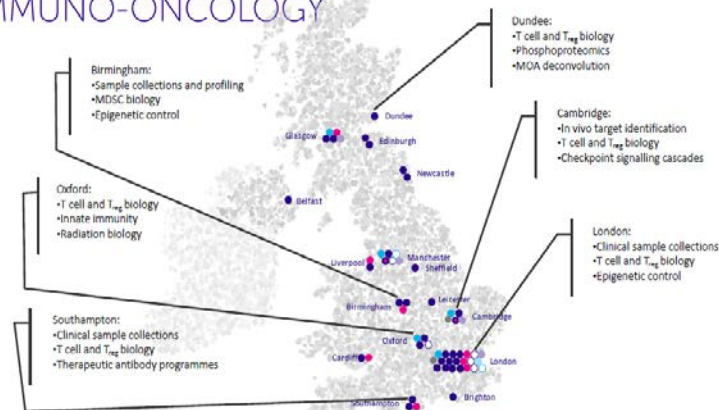
Strategic Drug Discovery Alliance on Novel Targets for Cancer Immunotherapy



Non-profit organizations in the UK with world-class researcher networks and drug discovery capacity



ACADEMIC CENTRES OF EXCELLENCE FOR IMMUNO-ONCOLOGY



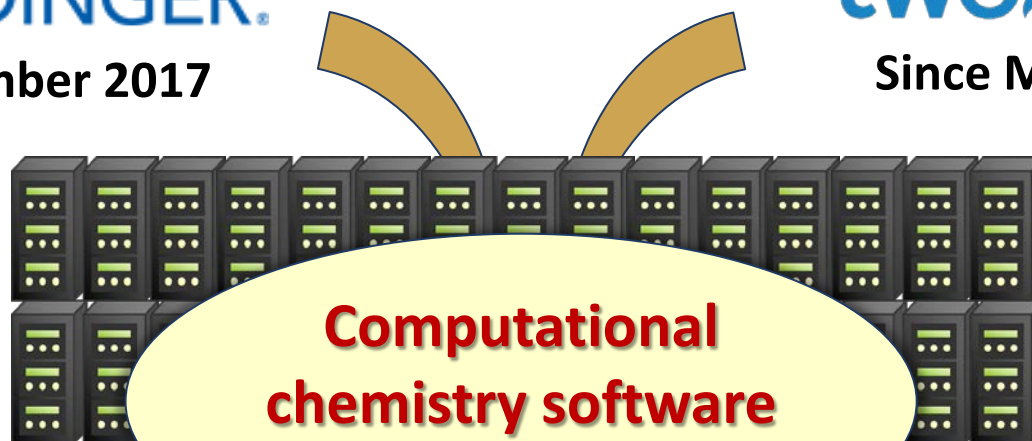
Use of AI Drug Discovery

SCHRÖDINGER.

Since December 2017

twoAR

Since March 2019



**Computational
chemistry software
Artificial intelligence**

**Chemical structure
design by
computational
chemistry**

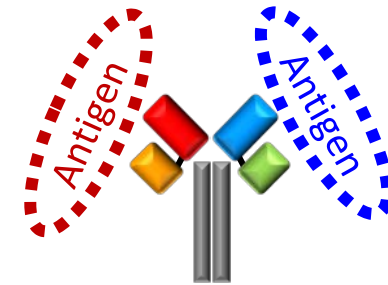
**Searching for new
targets from big data
analysis with AI**

**Exploration in the
neurology area**

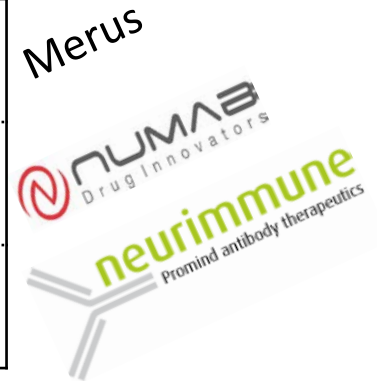
Application of Novel Modalities

Antibody technology

Merus (NL)	Bispecific antibodies (Abs) in the area of autoimmune diseases	April 2014
Numab (CH)	Bispecific Abs in immuno-oncology area	March 2017
Neurimmune (CH)	Human Abs in neurology area	November 2017



Bispecific antibody



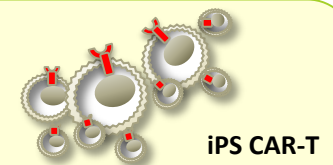
iPS-derived CAR-T Cells: Cancer-killing T cells with forcefully expressed chimeric antigen receptors



Drug discovery alliance for cellular immunotherapies (Since September 2018)

Target Product Profile

- Mass-producible uniform cells.
- Can be administered to anyone.
- Has a sustained effect (prevents recurrence).
- Has improved safety.



To create post-Opdivo innovative new drugs

New drugs with medical impacts on unmet needs

**Translational research
(use of human specimen data and genetic information)**

Our own unique drug discovery know-how (lipids, immuno-oncology, etc.)

Accumulation of disease knowledge

Cutting-edge external technology (AI, Abs, cellular technology, etc.)

Unique drug seeds

World-leading academia/KOL networks