

*Social Innovation 2014/
Smart City Week 2014
Oct. 29 PACIFICO Yokohama*



Life Innovation and Future Health Care Systems

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Association of Medical Science
Professor (Pharmacology)

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1. Introduction . . . What is Human Well-Being?
2. Humans and Sophistication of Medical Science and Service
3. Life Innovation: Influence and Problems
 - Development of life science (understanding of life phenomena)
 - Improvement in medical service and health care
 - Economic effect, industry creation
 - Social influence (the advent of longevity society)
4. Activities of Yokohama, Kawasaki, and Kanagawa (Special Zones for Life Innovation)
5. Activities of Yokohama City Univ.
6. Conclusion: For Achievement of True Well-Being in Human Society

■ What Do We live for?

- States of well-being, happiness

■ Circumstances in Which Living Things Including Humans are Placed

- Environment called the earth
- Coexistence of various species
- Evolution and extinction, environmental change, and adaptation through a very long time

■ Dramatic Change of the Environment in Which Humans are Placed

→ Onset of Various Problems

- Declining birth rates
- Aging
- Lifestyle related diseases
- Dementia
- Educational inequality

■ What are the Sources of Human Sense of Well-Being?

- To receive affection, give affection
- To be affected by something
- To attain something
- To obtain something that satisfies the person's thirst

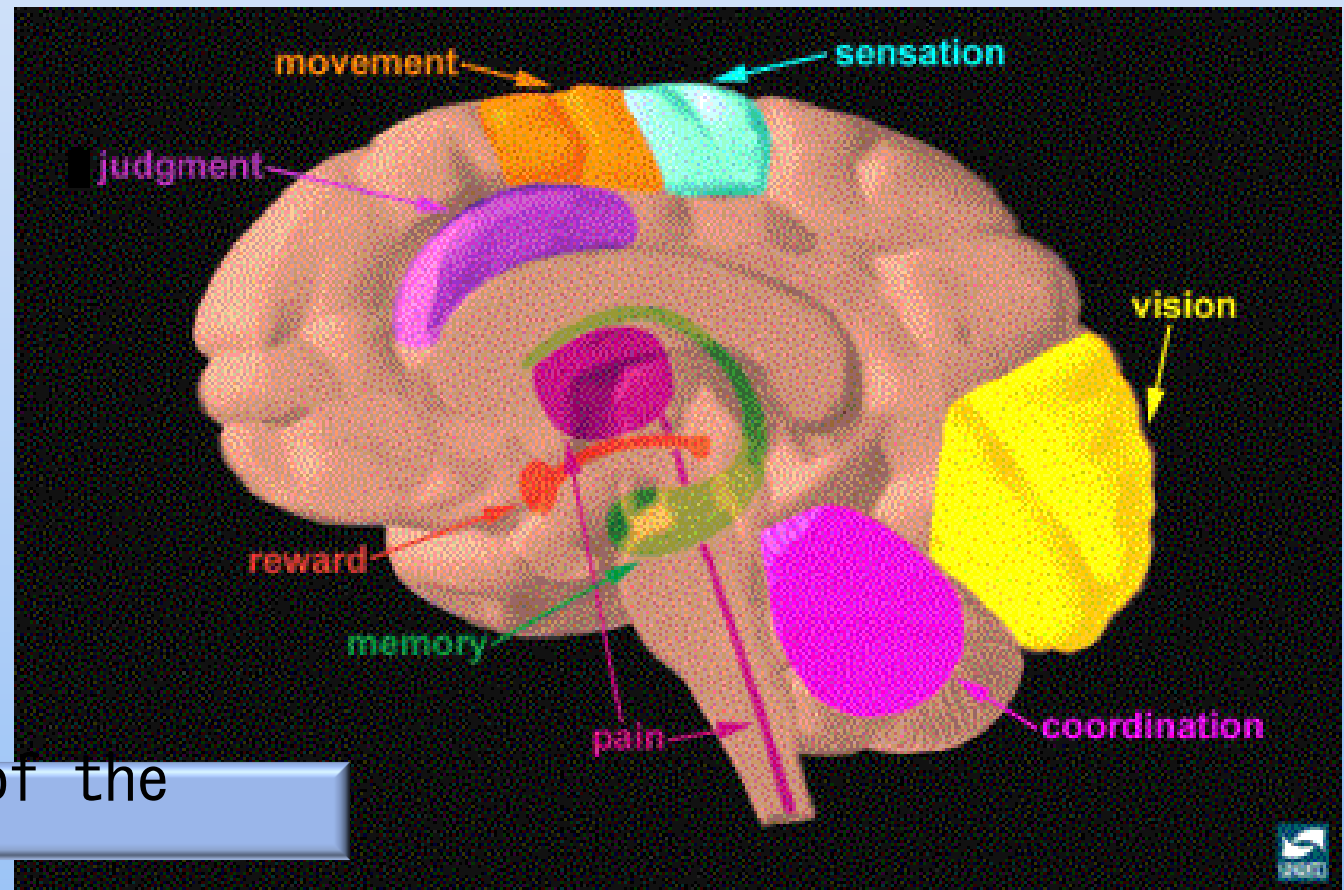
■ Moments or Situations That Make People Happy

- Situations in which the person can work
- The moment when the person has feeling that the work is helpful for other humans
- Situations in which the person can exercise one's body, sweat, drink water, eat delicious food, and sleep
- The moment when the person obtains something that he/her has wanted

Nature of human desire

- Desire induces further desire.
- Desire is placed under a certain restriction and constraint.

The theme of medicine has been relief from pain and agony
...Standpoints of providers and beneficiaries of medicine



Functions of the
brain



- Increase of medical knowledge
- Potential of medical service and expansion of needs
- Ethical problems
- Economic cost problems
- From investigation of disease mechanisms to prevention of diseases
- Aging and lifestyle related diseases
- Globalization and problems of infectious diseases

Is it sufficient for society to leave medical service to doctors, nurses, and pharmacists ?

- General public's little consciousness about their role in medical service
← Medical service is the service that are provided, that the public cannot protect or create.
- Whole society's effort is vital.
- The object is not medical cost reduction, but maintenance and improvement of good health, disease prevention, recovery, and social rehabilitation from diseases.

Establishment of outcome objectives

- The degree of contribution to human health
 - ...Wrong objectives spoil all.
- Measurement, collection, disclosure of the outcome

Appropriate incentives

To guide people to better direction

Each person should live paying attention to his/her health

Looking after his/her own affairs, talking to each other, helping each other

Two barriers in and outside of medical service

The barrier made by medical workers

The barrier made by people outside medical industry

Potential of medical industry

Medical industry latently has strong needs for outside human resources. New players are certainly able to find positions in which they can show their strength as long as they understand the industry's internal needs.

New players from outside must also strive to exercise their abilities in order to precisely understand the internal needs and show their strength in medical industry.

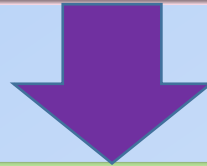
(In fact, we do not need much money to live a long healthy life, Kazuhisa Takeuchi, Yuji Yamamoto, Discover Revolutions)



Friendly competition of persons who are willing to dedicate to health care

Three paradigm shifts in medical services community

- (i) From medical treatment to health care (understanding of the value and importance of preventive care)
- (ii) From provision to cooperation (care teams led by family doctors)
- (iii) From hospitals to local communities



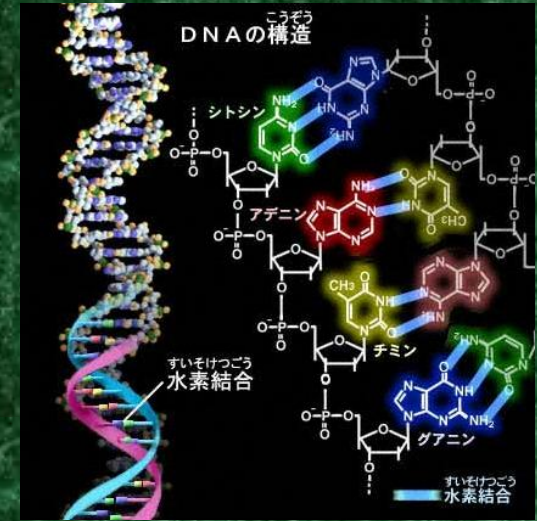
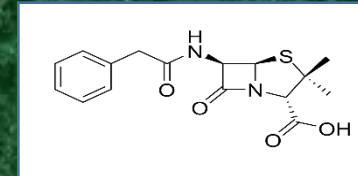
Beneficiaries' contributions to medical service

- Improvement of medical literacy
- Maximization of the value of care

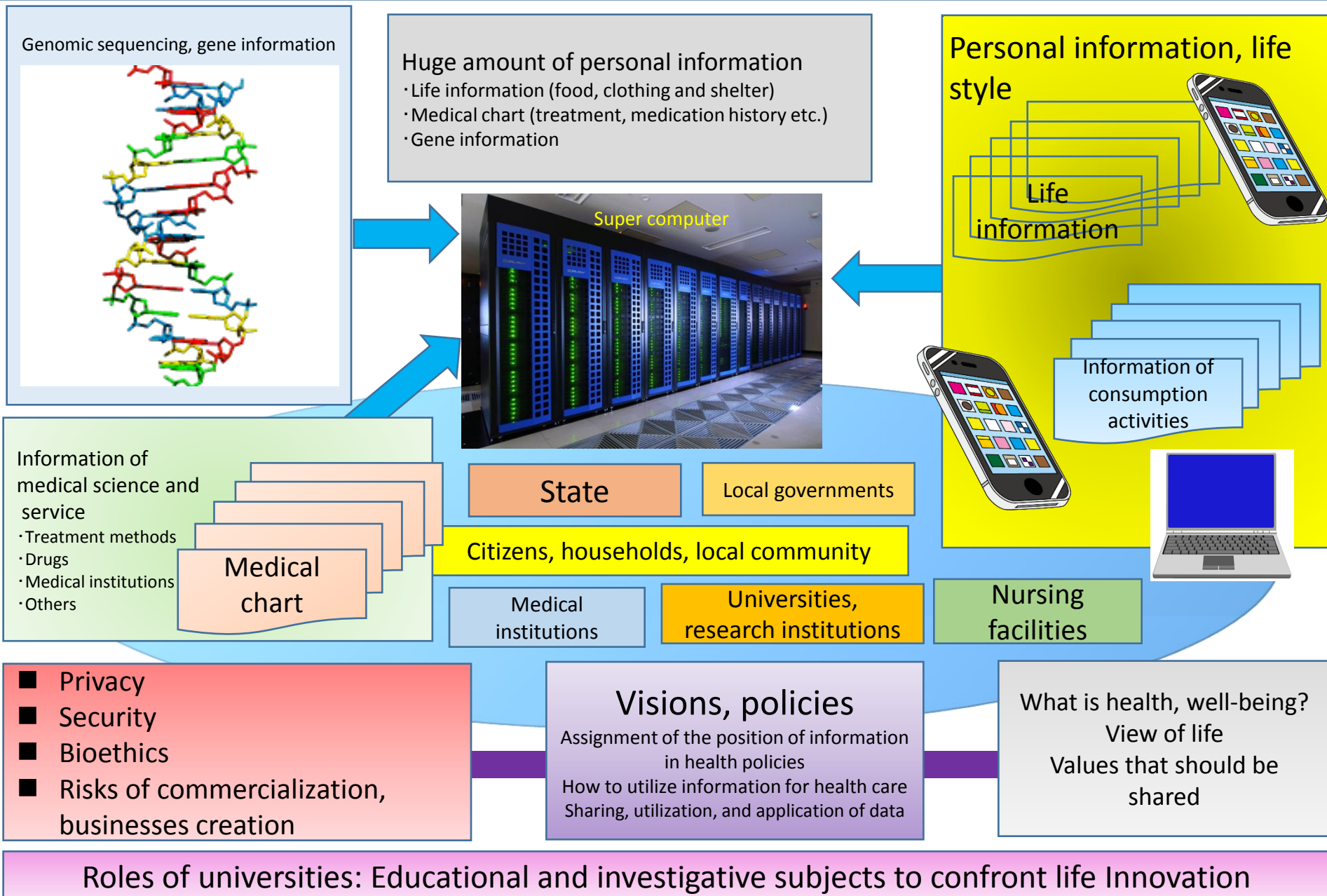
3. Life Innovation(1): History

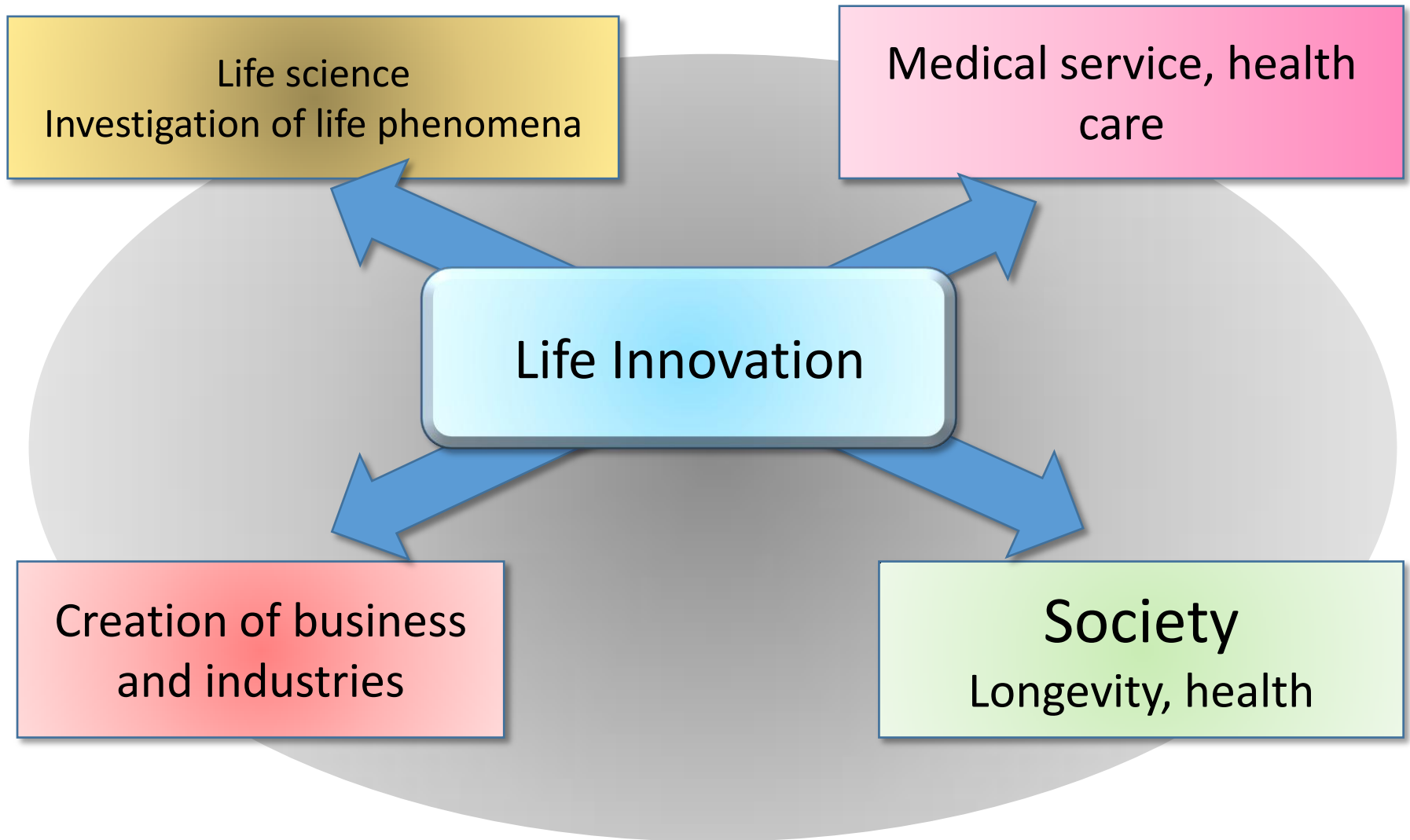
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1769	Steam engine Scotland
1796	Vaccination The UK
1802	Powdered milk Russia
1818	Blood transfusion The UK
1886	Automobile Germany
1895	Discovery of X-ray Germany
1928	Discovery of penicillin The UK
1953	Elucidation of DNA The USA
1959	External fertilization The USA
1971	Genetic recombination The USA
1996	Birth of a cloned sheep The UK
2003	Completion of the human genome analysis The USA
2006	Creation of iPS cells (induced pluripotent stem cell) Japan
2014	Smart City Week



3. Life Innovation (2): The Wave of Big Data and Health, Healthcare

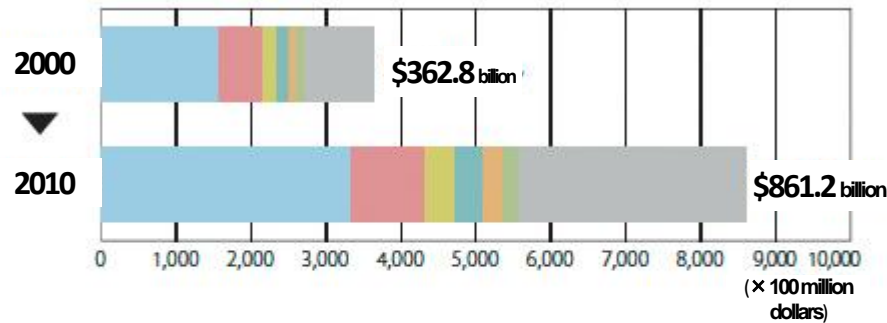




3. Life Innovation (4): Pharmaceutical Industry

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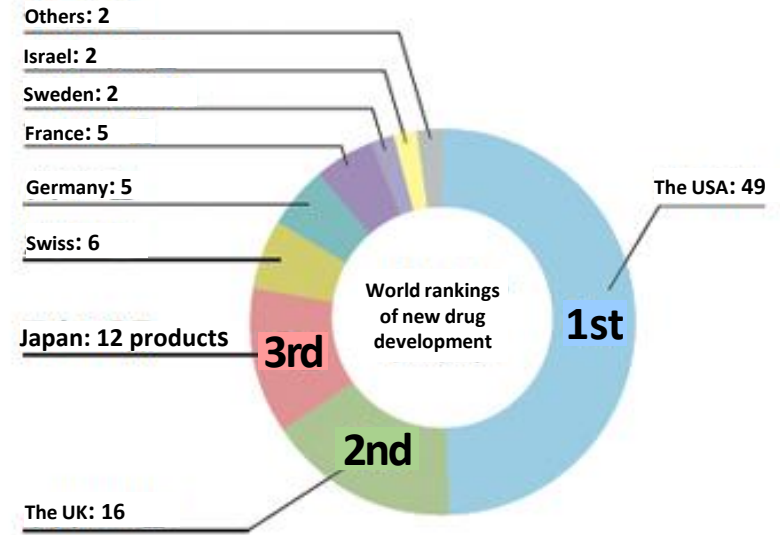
Global pharmaceutical market



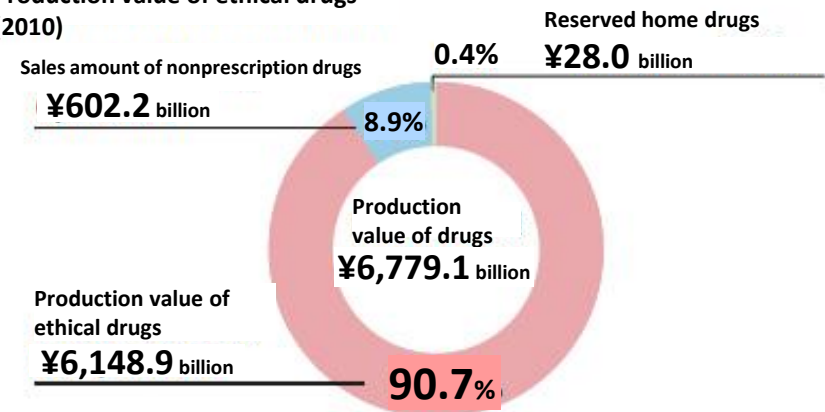
Changes of shares in the pharmaceutical market

	North America	Japan	Germany	France	Italy	The UK	Others
2000	43.0%	15.9%	4.8%	4.6%	3.0%	3.1%	25.6%
2010	38.6%	11.2%	4.7%	4.5%	3.1%	2.4%	35.6%

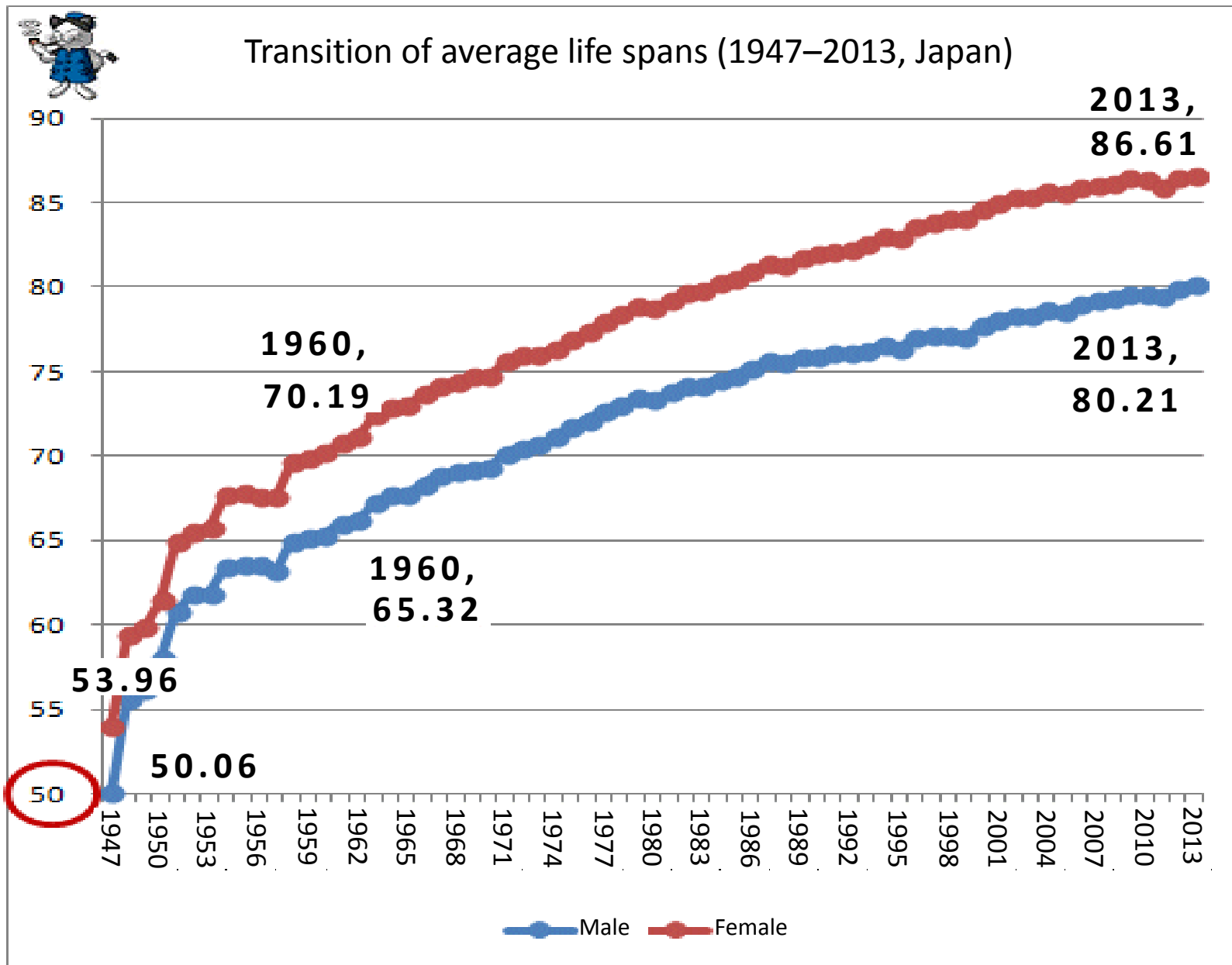
Top 100 sales of drug products in the global market in 2008 (excepting one diagnostic drug)

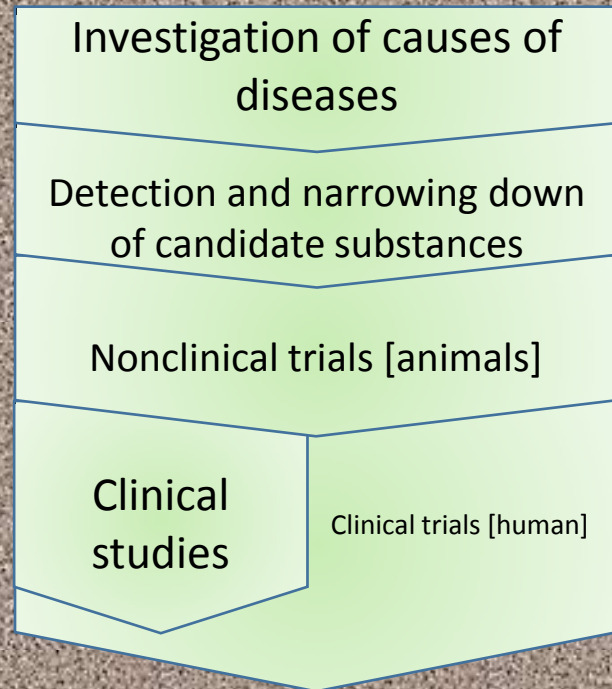


Production value of ethical drugs (2010)



Source: Japan Pharmaceutical Manufacturers Association (JPMA)





(i) Promotion of new business creation,
promotion of development of treatment
methods

Selection and concentration

(ii) Promotion of clinical studies
**High quality data required for
approval**

(iii) Promotion of approval review
**Establishment of evaluation
techniques to evaluate efficacy,
safety, and quality**

(iv) Appropriate evaluation of new
technologies
**In consideration of cost-
effectiveness**

To lead Life Innovation

**Advanced research
ability**

**Cooperation with
local communities**

To utilize life Innovation for
achievement of true well-
being in human society

**Fused studies, Fused
education**



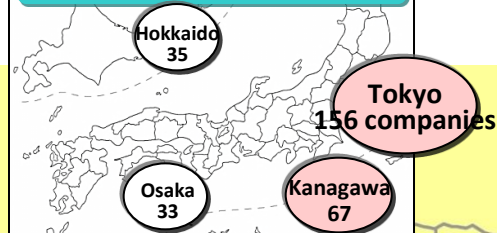
Keihin Coastal Area Life Innovation

Comprehensive Special Zones for International Competitiveness Development

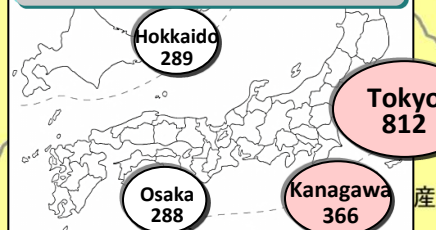
Material source: Kanagawa Prefecture, City of Yokohama, Kawasaki

- The industrial structure of Keihin coastal area which had led Japanese economy has changed.
- The area promotes creation and development of new industries with life science institutions such as companies, universities, and research institutions located in the area.

Top 4 aggregations of bio-venture companies
(by prefecture)



Top 4 aggregations of academic, development, research institutions
(by prefecture)



Shin-Kawasaki Sozo no Mori zone
● 4-University Nano/Micro Fabrication Consortium
Keio Univ., Waseda Univ., TIT, Univ. of Tokyo

★ **Haneda Airport**
Internationalized in Oct. 2010

Tonomachi International Strategic Base (KING SKYFRONT)
CIEA Regenerative Medicine and New Drug Development Research Center
Health and Safety Research Center (tentative name)
Kawasaki Municipal Hospital



Suehiro Base (Yokohama Science Frontier)

RIKEN (Yokohama)

- Research of genome medical science
- Research of allergy and immunology
- Research of Omics science etc.



Yokohama City Univ. Tsurumi Campus
○ Graduate School of Nanobioscience

Yokohama Bio Industry Center
○ Rental study and development facilities for biotechnology companies



Yokohama Biopharmaceutical Research and Development Center
○ Contract manufacturing facilities for trial drugs and drug substances that meet GMP standards



Minatomirai Base

PACIFICO Yokohama

Exhibitions, business talks of BioJapan, Medtec, etc., meetings of medical science and services society

BioJapan 2011
World Business Forum

MEDTEC Japan

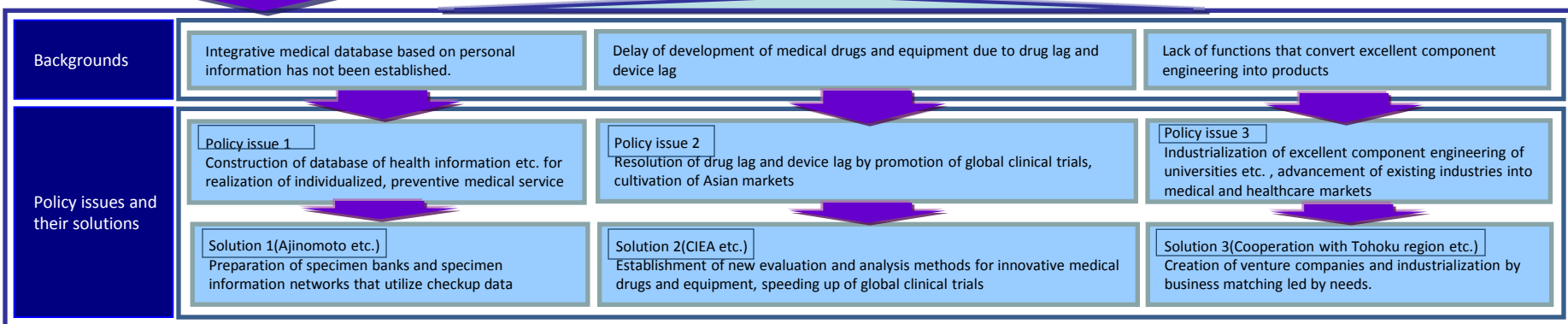
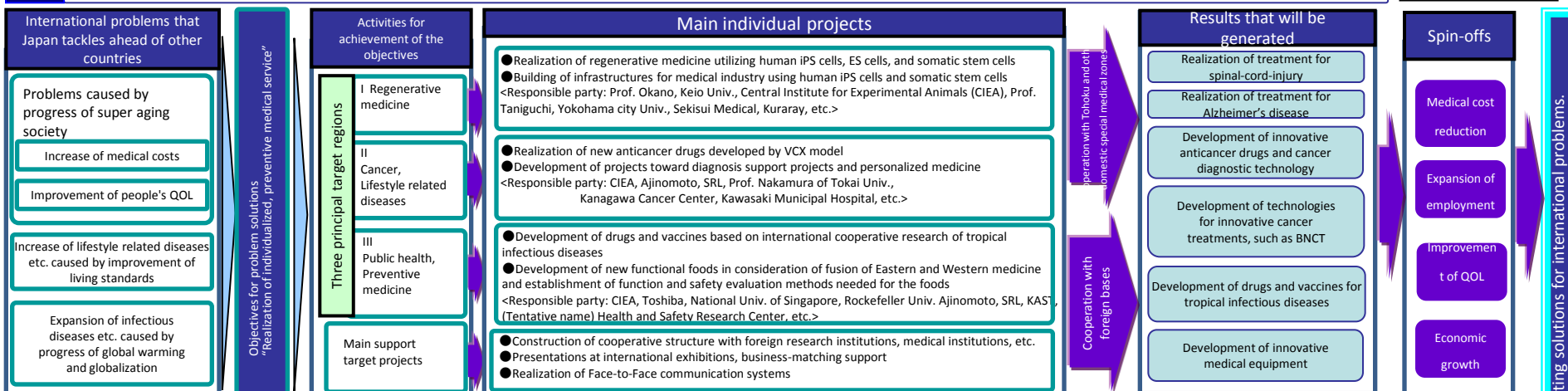
Fukuura Base

Yokohama city Univ.
School of Medicine, Hospital
Advanced Medical Research Center

(iii) The Outlines of Keihin Coastal Area Life Innovation Comprehensive Special Zones for International Competitiveness Development

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Achievement objective Development and manufacture of innovative pharmaceuticals and medical equipment by global companies adapted to individualized, preventive medical service age, and creation of healthcare industries.



The advantages Keihin Coastal Area possesses

<Domestic and international networks>

Haneda Airport, TIACI

FDA, Stanford Univ., Karolinska Institute, Biopolis, etc.

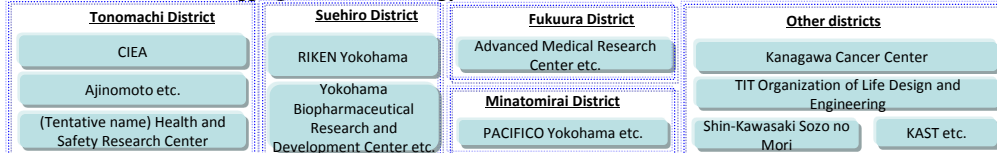
<Aggregation of human resources and information technology>

The metropolitan population of 37 million

35 universities and graduate schools that have science and engineering departments,

46 thousands workers in academic organizations (Kanagawa prefecture)

<Aggregation of technology infrastructure and common infrastructure>



<Aggregation of industries>

Pharmaceutical companies (Takeda Pharmaceutical Company, Chugai Pharmaceutical, etc.)

New comer companies to medical markets (Ajinomoto, Fuji Film Corporation, etc.)

ICT companies (Fujitsu, NEC, Toshiba, Canon, etc.)

Small to medium companies that have high-level manufacturing know-how

Utilization of comprehensive special zone system

<Deregulation>

- Preferential measure for simplification of procedure for clinical studies using human stem cells
- Preferential measure concerning for emigration and immigration of foreign doctors, researchers, and their families, etc.

<Support measures on taxation, finance, and monetary>

- Tax system for promotion of capital investment in comprehensive special zones for international competitiveness development
- Tax system for improvement of environment for projects in comprehensive special zones for international competitiveness development
- Foundation of angel tax system for corporate investors etc.

The special zones lead sustainable development of Japanese economy while contributing solutions for international problems.

Why is it Life Innovation?

- The realization of Life Innovation is a field where Japan can exercise its leadership in Asia.

Why is it in Keihin Coastal Area?

- The area is an important transportation hub adjoining Haneda airport.
- Human resources, information, technologies, and industries are aggregated in the area.
- It has unique local resources such as CIEA, Ajinomoto, and RIKEN.

Implementation of the tasks utilizing the strengths

- Implementation of achievement objectives and three problem solutions

- Construction of databases
- Promotion of new evaluation methods for global clinical trials
- Creation of venture companies

Introduction of comprehensive special zone

Utilization of deregulation

- Preparation of challenging environment for companies by introduction of deregulation and favorable tax systems without dependence on subsidies

- Preferential measures concerning specific health examination and specific health guidance
- Preferential measures etc. for cooperative clinical trials between doctors and companies in approval process of medical equipment

- Establishment of international standards
- Cultivation of Asian markets which are growing rapidly
- Industrialization of technology seeds that have global superiority

- Life innovation contributes solutions for problems of the whole human race and leads Japanese economic growth.

5. Activities of Yokohama City Univ.(1)

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North American bases, partner research institutions

Yokohama City Univ. California Office

UC San Diego, Sanford Burnham Medical Research Institute, Univ. of Texas MD Anderson Cancer Center, The Scripps Research Institute, Johns Hopkins Univ., Yale Univ., Univ. of Iowa, Univ. of Washington



Activities are conducted centering on the field of cancer research and Life Innovation.

National
Strategic
Special Zones

Promotion of
translational research



Advanced Medical Research
Center

International problems Japan tackles ahead of
other countries

Conquest of valley of death between basic
research and application

Problems caused by progress of super
aging society

- Increase of medical costs
- Improvement of people's QOL

Increase of lifestyle related diseases etc.
caused by improvement of living standards

Expansion of infectious diseases etc.
caused by progress of global warming and
globalization

Creation of Life Innovation
Regulatory science



I Regenerative medicine

II Cancer, Lifestyle related
diseases

III Public health, Preventive
medicine

Economic and social problems

Medical
settings are
stages for
fusion.



Structural Biology

1. Supercomputer

CRAY XE6 5,760 cores

5.6 TB memory CRAY Gemini/3DTorus

52.9 TFLOPS(R_{peak}), 39.85 TFLOPS(R_{max})

2. X-ray Crystallographic Analysis System

Rotating Anode X-ray Generators: 4 systems

Diffraction Detectors: 7 systems

4. NMR

900 MHz Solid State

800 MHz with Cryo Probe

700 MHz with Flow Type Cryo Probe

600 MHz with Cryoprobe

500 MHz with Cryo Probe: 2 systems

3. MS

(1) ESI-Q-TOF: 2 systems

(2) MALDI-TOF: 2 systems

(3) ESI-ion trap: 1 system

(4) Ion Mobility MS: 1 system

Medical Life Science is based on Structural Biology.

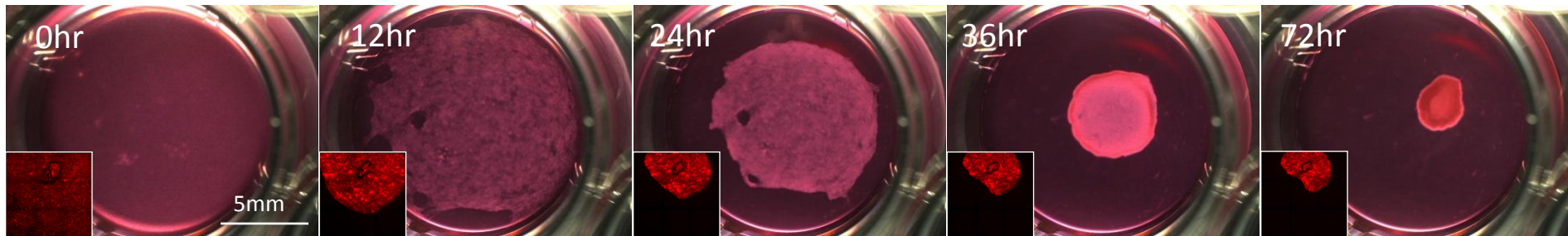
Proteins, RNA and DNA carry out most of the functions of cells, and by folded into specific **three-dimensional shapes** they are able to perform these functions.

Biomolecules are too small to see in detail. The methods that structural biologists use to determine their structures involve measurements on vast numbers of identical molecules at the same time.

Liver regeneration using iPS cells

Takebe, Taniguchi, et al.

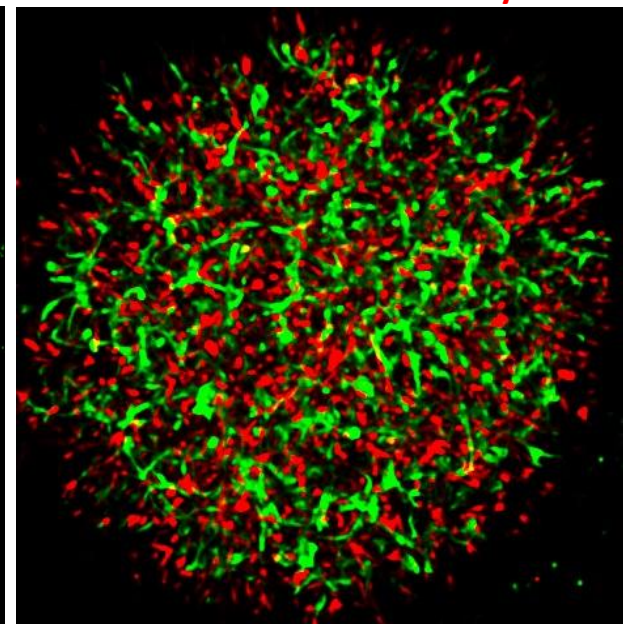
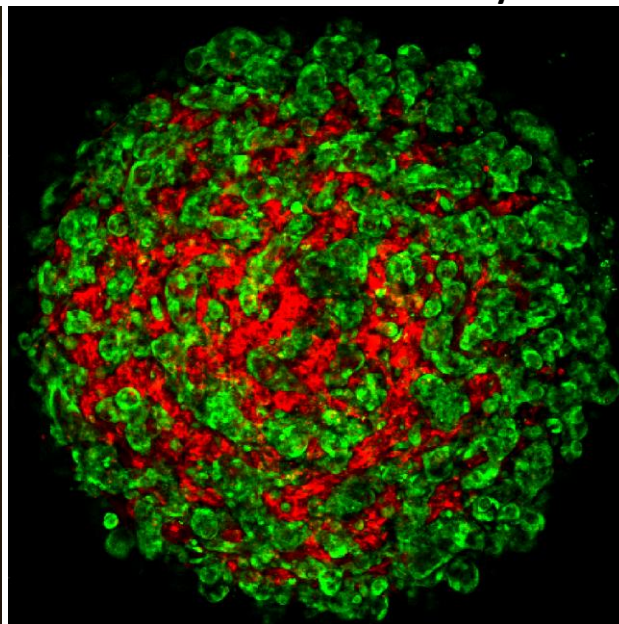
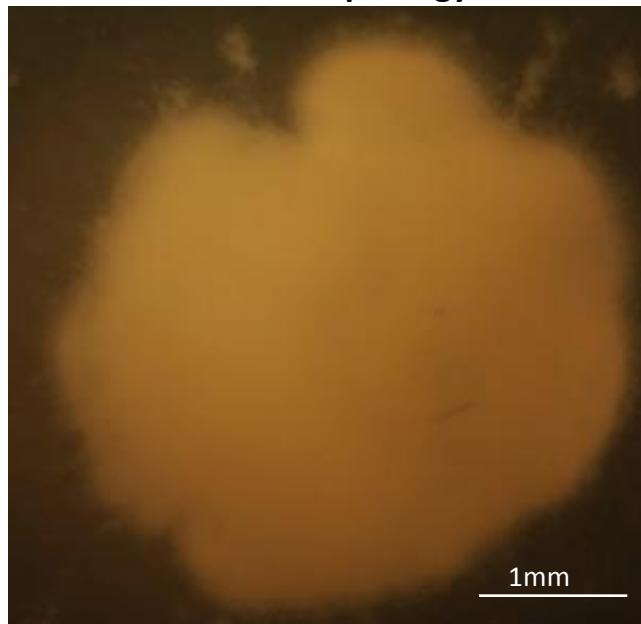
Self-organization of three-dimensional liver bud from human iPS *in vitro*



Gross morphology

hiPSC Endothelial Mesenchymal

hiPSC Endothelial Mesenchymal



T Takebe, et al. **Nature** 499 (7459), 481-484, 2013. (7th May 2013 Accepted)

WO Patent 2,013,047,639:METHOD FOR PRODUCING TISSUE AND ORGAN.



7 collaborative laboratories for biobank, clinical research promotion, proteomics and cellomics, and 4 company's offices for industry-academia collaboration.

AMRC will function more efficiently and effectively after construction of the building.

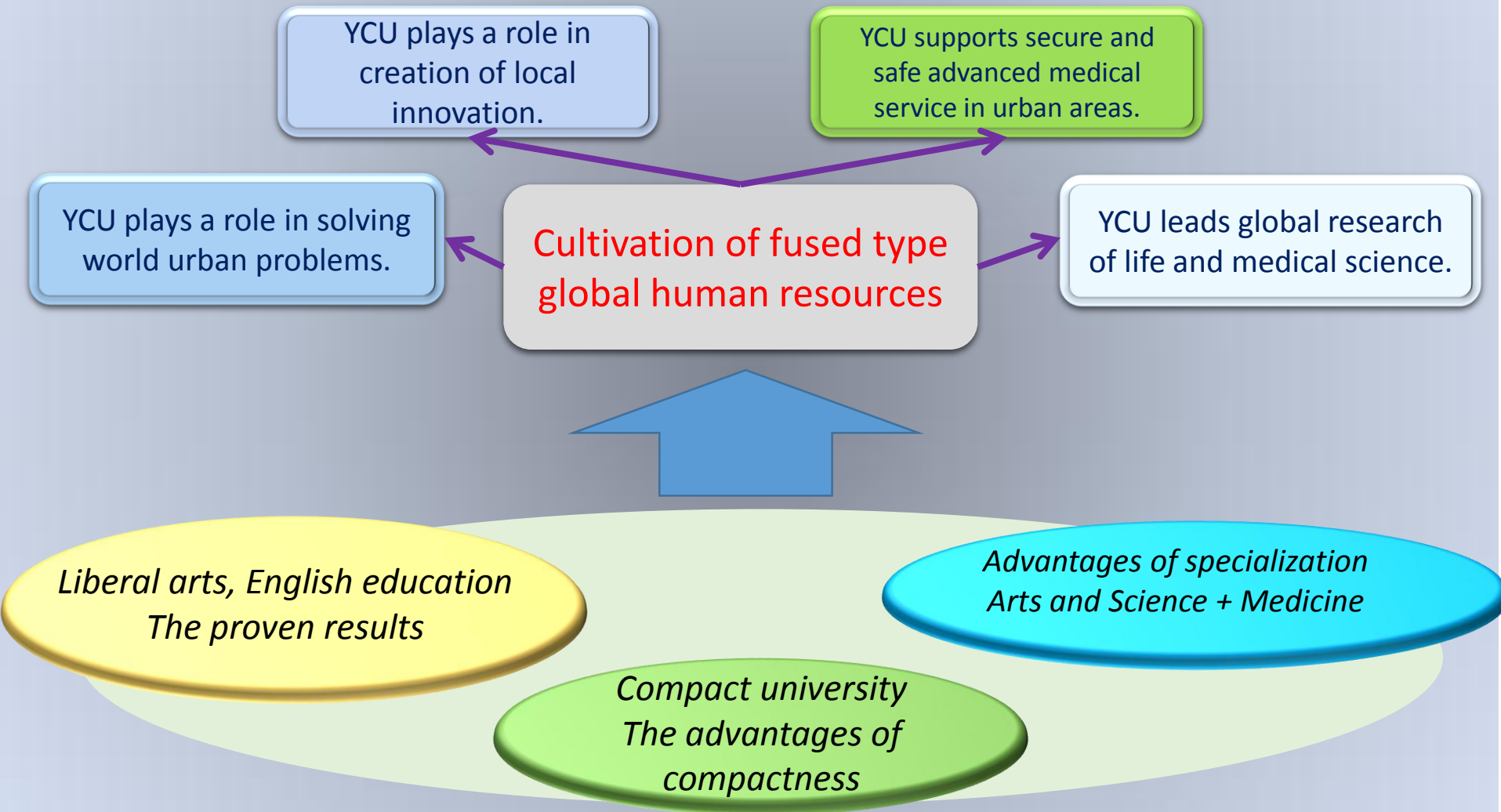
Kanagawa Prefecture (commissioned projects) “Kanagawa growth industries innovation project”

- **Development of DDS carriers for cancer treatment that directly target cancer cells, development of synthesis technology of compounds for drugs that used for rare disease treatments Kanto Bureau of Economy, Trade and Industry (commissioned projects)**
- **“Project of problem solving type development of medical equipment (Keihin Coastal Area Life Innovation Comprehensive Special Zones for International Competitiveness Development)”**
- **Development of prototype pre-operation supportive devices for laparoscopic operations, Development of prototype ultrasonic imaging devices**
- **Development of human cartilage devices used for treatments such as regenerative medicine that uses three-dimensional cell culture**
- **Development of prototype bioartificial renal tubule devices that are created using human renal tubule cells**
- **Development of health monitoring devices with minimally invasive needles**

Globalized activities

Advancement of development of medical drugs and equipment in cooperation with National Institute of Health Sciences, Pharmaceuticals and Medical Devices Agency, Yokohama National Univ., Tokyo Institution of Technology, and foreign medical bases

- Construction of clinical study network systems in Yokohama City and Kanagawa Prefecture
- Support services of Key Support for Life Innovation (NPO)
- Increase of global clinical trials that utilize the organization's support



Is current trend is based on an easy idea that medical service is a growth industry ?

- Medical service protects human life and living.
- Who is medical service for ?
- Workers in the medical settings have no scope for new activities.
- Systems by which whole society tackles medical problems are required instead of confrontational structure between patients and doctors
- Similarity to environmental problems

In this age, medical service should be comprehensively recognized as an important social system.

Life Innovation is nothing short of social innovation.

Creating Shared Value:

Policies and operating practices that enhance the competitiveness of a company while simultaneously advancing the economic and social conditions in the communities in which it operates.

- Michael • E • Porter

Importance of idea creation freed from restriction of conventional framework

- Methods of problem presentation
- Roles and tasks of the media (analyses of backgrounds, places for discussion)
- Learning from the world, providing information from Japan

Small individual activities

- Advance activities coming up with constructive ideas for each detailed problem without missing the aimed visions.
- Accumulation of small activities produces great waves.

- **Share values and objectives.**
 - **Public debate places are required.**
-
- **Education and awareness will change the world.**

Thank you for your kind attention.

<http://www-user.yokohamacu.ac.jp/~pharmac/index.html>

[→http://www.yokohama-cu.ac.jp/kifu/](http://www.yokohama-cu.ac.jp/kifu/)