# Heart Function Prosthetic Device Technology

## Outline of Technology

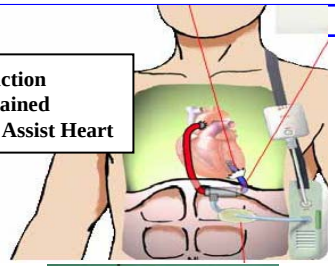
- Implantable cardioverter defibrillation (Ultra ICD) with low voltage enables defibrillation without comas or pain.
- Next generation aspiration and circulatory support system with smaller, more excellent antithrombogenicity and higher permanence.
- Compact implantable artificial heart system would enable long term serious heart failure patients to live at home and be rehabilitated back into society without long term waiting for cardiac transplantation.

## Superiority of Japanese Technology

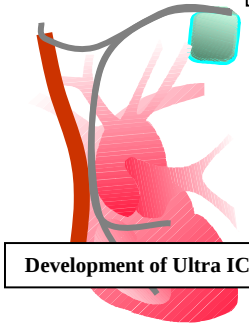
Low voltage defibrillation technology realizing aponia is being developed in Japan and first release in the world

- Epochmaking antithrombogenicity qualification technology at the blood contact surface is effective over the longer term compared to other existing technology.
- Blood pumping technology without a rotating axis in the artificial heart system has high possibility of the smallest and lightest since with the breakthrough low power consumption, permanence and stability.
- The necessary technologies for life support. will be possible to supply domestically

## Impact on Society



**High Function Self-Contained Artificial Assist Heart**



**Development of Ultra ICD**

**Next Generation Aspiration and Circulation Support System**

Improvement of After Life-Saving and QOL

**Cardiovascular Disease Patients (35 million in Japan)**
**(Over 3.5 billion globally)**

Death in Acute Period because of Cardiovascular Disease
(estimated 80 thousand a year in Japan)

Acute Long Term Heart Failure Patients
(estimated 20 million in Japan)

## Required Framework for Technology Development

- Effective cooperative research system and medicine-engineering collaboration beteween universities, national medical care centers and business organizations.
- Cultivation of human resources with knowledge in both medical science and engineering at universities and business organizations.
- Independent research and development system by constant obtaining research funds from collaborative research business organizations and joint ventures.

## Required Reformation in Social System

- Parallel use of insurance for non-approved medical equipment and reinforcement of compensation insurance by expansion of clinical trials under doctors' initiatives and advanced medical treatment evaluation system.
- Establishment of clusters that specialize in medical equipment development and support for organic business-academia collaborations and cultivation of the necessary human resources.
- Enabling of integrated management of research investment from multiple departments, research promotion corporations and business organizations.

# iPS Cell Regeneration Medical Technology

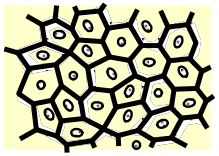
## Outline of Technology

- Innovative technology to acquire artificial iPS cells by resetting differentiated cells.
- iPS cells can be generated without constraint compared to embryonic stem cells (ES cells) that have ethical issues.
- iPS cell can avoid the adverse reaction issue compared to ES cells.

## Superiority of Japanese Technology

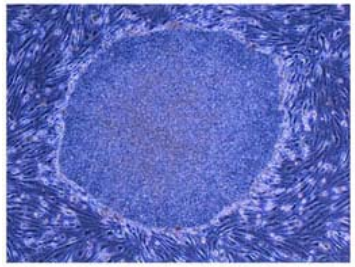
- Announcement of mouse iPS cell establishment by Prof. Yamanaka in August, 2006.
- Announcement of human iPS cell establishment by Prof. Yamanaka in November, 2007.
  (Announcement by Wisconsin University on the same date)
- In Europe chainging from cloned embryo research to iPS cell research.
- Japan has the advantage but international competition is getting serious.

## Impact on Society



**Skin Cell**

**Gene transformation (Low molecular compounder is also expected)**



**Colony of iPS Cell**

**Cornea** → **Visually Deficient Treatment Approx. 200 thousand**

**Nerve Cells** → **Spinal Cord Injury Treatment Approx. 100 thousand**

**β Cell of pancreas** → **Diabetes Treatment Approx. 2280 thousand**

**(Diabetes Medical Cost 1.15 trillion JPY/year)**

**Kidney Cell** → **Chronic Kidney Failure Treatment Approx. 260 thousand**

**(Artificial Dialysis Medical Cost 1.3 trillion JPY/year)**

## Required Framework for Technology Development

- iPS research system all over Japan.
- Strategic patent application system.
- iPS cells supplying system.
- Govermental support sysytem.
- Application system for international patentstrategy .

## Required Reformation in Social System

- Simplification of ES cell research regulation procedure research to accelerate iPS cell research.
- Prompt preparation of guuidline or standard for clinical trial along with on going research.
- Integrated application for research funds.

# Toxicological Evaluation Technology using iPS cells

## Outline of Technology

- Expectation and evaluation technology for side effect of drugs or hazard of chemicals using various cells differentiated from iPS cells considering race, gender, age, and individual differences.
- Expectation technology of effect and side effects of drugs by individual genetically back ground information with application of drug side effect information, gene information and integrated database which contains various cell differentiated from iPS cells reaction to drugs.
- Expecting for elucidaton of rare diseases by generating model cells for them using iPS cells.

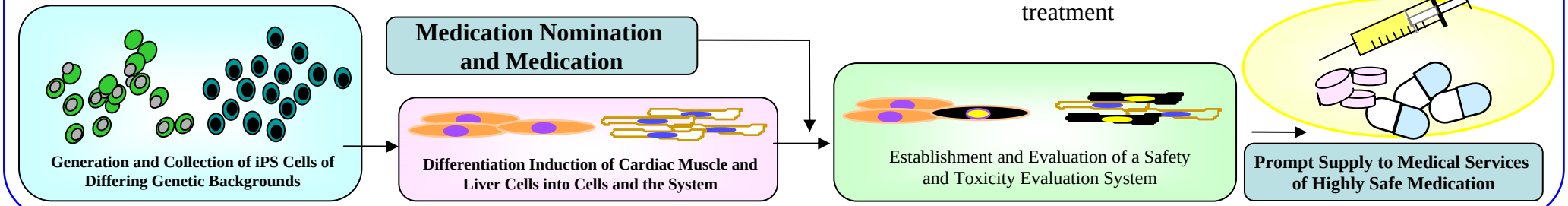
## Superiority of Japanese Technology

- Announcement of iPS cell establishment by Prof. Yamanaka of Kyoto University in November, 2007.
- Japan's molecular toxicity analysis technology for cells (toxicogenomics) and individual to chemical substance (e.g..medication) is global top class.
- The scale of the toxicogenomics database (drug toxicity database and gene expression data at medical base laboratories (Germany) is of global top class.

## Impact on Society

- Enables the side effects of medication under development to be predicted before clinical tests through iPS cell evaluations.
- Enables side effects to be predicted for individual diathesis

- Improved safety of medication
- Can expect medication development periods to be shortened and costs reduced (could be 100 billion JPY) by improving the success rate of developments.
- Realization of tailor made medical treatment




## Required Framework for Technology Development

- Enhanced industry, academic and government system by setting medical base laboratory and national medication and food as the core in promoting technology being introduced by medicine manufacturers.
- System development to broadly apply various iPS cells at research institutions and business organizations.

## Required Reformation in Social System

- Simplification of procedures related to application research regulations for human ES cells in promoting differentiation induction research.
- Promote the acquisition of informed consent when generating iPS cells to being able supply them widely and put in place a safety toxicity estimation evaluation system.

# Vaccine Development Technology for Infectious Disease (Malaria)

## Outline of Technology

- Efficiently and comprehensively generate the malarial parasite protein that was hard to artificially make through use of plant (wheat germ protein synthesis system.)
- Searching for a protein to use in generating a malaria vaccine from various retrieved proteins of malaria parasite and promptly developing a malaria vaccine.

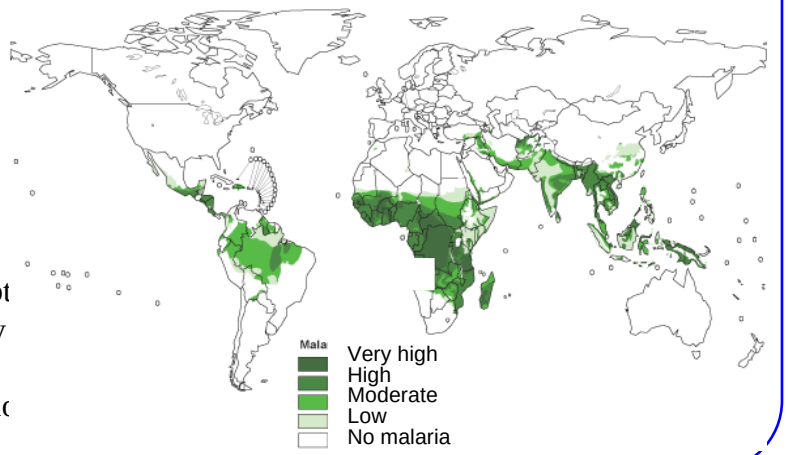
## Superiority of Japanese Technology

- Although many malaria vaccine development is being researched mainly by Europe and US, an effective vaccine is yet to be developed because of a lack of technology for use in acquiring an effective protein for vaccine.
- A wheat germ protein synthesis system was developed in Japan and used to acquire related patents. The realization of efficient generation of proteins such as the malaria parasite protein, which was rather hard to produce.

## Impact on Society

Appearance of drug resistant malaria parasites make exist curative ineffective.


Malaria endemisity




International Contribution by the Malaria Vaccine Development using Technology Originating in Japan

- 40 % of the world's population live in malarial hot
- 300 to 500 million get infected with malaria every
- 1 million die from malaria every year.
- The malaria epidemic areas are expanding with glo

## Required Framework for Technology Development

- Develop bases to produce various malaria parasite proteins and efficiently analyse their functionality as vaccine nominations.
- Develop a mass production system for the proteins to be used in clinical investigations.
- Develop an international implementation structure for clinical investigations.

## Required Reformation in Social System

- Collaboration with international institutions.
- Development of a research scheme in malaria epidemic areas.

# Noncontact Visualizing Analysis Technology (Terahertz)

## Outline of Technology

The development of compact real time analysis equipment through the realization of terahertz sensors using semiconductor device technology will enable food impurity inspections at food handling facilities, security checks at airports, inspections of medical supplies and semiconductors in their production process, monitoring of environmental pollutants in the air and so forth.

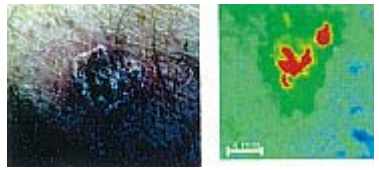
## Superiority of Japanese Technology

- Realization of 1THz oscillation, the world's highest frequency, at normal temperature of a semiconductor device.
- Terahertz pulse generation technology with optical communication technology is unique to Japan.
- The Japanese material spectroscopy database is the largest in the world.

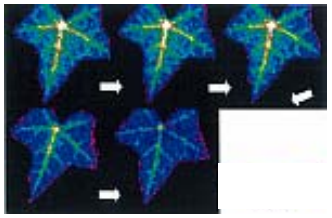
## Impact on Society

- Application in a broad range of fields and generation of related businesses.
  (e.g.) Food security inspections without having to open them, non-destructive inspections of coating thicknesses of medicine in effective administration of medication accurately and revealing foreign objects in pills, label free detection of DNA and proteins, detection of skin and lung cancer, semiconductor wafer evaluations, LSI defect inspections, noncontact acquisition of knives and firearms at airports, closed dangerous material detected in mail, noncontact inspection of cultural assets, agricultural work support such as watering control using water monitors, high speed radio communication, monitoring of contaminants and global warming substances in the air, space observation and so forth.
- Expected market scale will be 169.4 billion JPY in 2010 and 724.7 billion JPY in 2015 (According to Terahertz Technology Trends Research Report.)

Visualization of a Concealed Weapon (Right)



Terahertz Image of Skin Cancer (Right)



Water Inspections of
Crops, Food, Wood, Paper and Skin


IC Card Check

## Required Framework for Technology Development

- Collaboration of industry, academia and the government with NICT, RIKEN and AIST for example at the center in promoting standardization of measurement approaches and the spectroscopy database and research and development of standardized technology.
- International research collaboration system to enable international standardization.

## Required Reformation in Social System

- System to share equipment in public agencies and enhance the acquired data in a library.
- Treatment of the privacy of images recorded in security checks.

# Environmental Tolerance/High Yielding Technology for Chief Crop (wheat and soybeans)

## Outline of Technology

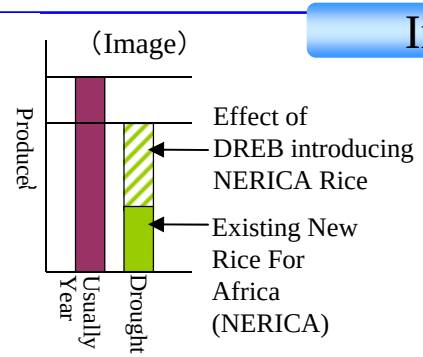
- Improved agricultural crop bred for difficult environments (dry, salt damage, humid environments and so forth) using genome information (rice genome, soybean genome etc.)
- Gene recombination technology (Expressing genes in plants and producing valuable agricultural crops)
- Marker breeding technology (technology to improve breeding quickly by utilizing the gene information of plants)

## Superiority of Japanese Technology

- 55% of the rice genome have been decoded by Japan, a large contribution.
- Japan leads the world in analyzing decoded genomes. (More than 100 patents applied for)
- Japanese basic research of model plants such as arabidopsis thaliana is on a high level in the world.
- Japan first discovered the drought tolerant induction gene in the world.

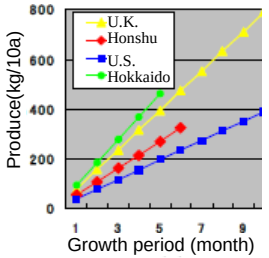
## Impact on Society

Frequent Recent Globally Catastrophic Droughts

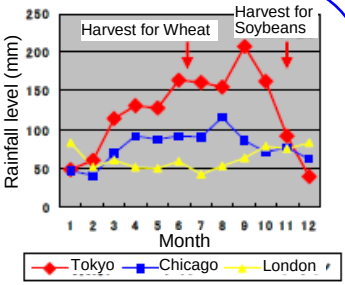



Germinating wheat in the rainy season

Soybeans Submersed in Water




Wheat growth period vs. produce




- Important to develop agricultural crops that can cope with the global climate change (appox. 30% of the growing areas in developing nations face the threat of drought and salt damage)

- Excellent breeds that have twice the yield and that are tolerant to disasters such as droughts are produced by utilization of the dehydration-responsive element-binding protein gene (DREB gene)

Contribution to solution of the International Food Problem

- Wheat and soybeans native to semiarid zones and hence Japan is unplantable agricultural areas for wheat and soybeans because of high humidity.

- Improvements of wheat and soybeans, which are humid-resistant varieties and are harvested before/after rainy season.

Improved Japanese Self-Sufficiency Ratio

## Required Framework for Technology Development

- Enhancement of the genome function analysis system.
- Development and centering of outdoor agricultural fields for cultivating GMO.
- System development to promote public acceptance of GMO.

## Required Reformation in Social System

- Reinforcement of the collaborative relationship with international research organizations
- System improvement to produce able researchers with international expertise, and to accept foreign researchers.