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# Structured Clinical Knowledge and its Application as a Socio-technology – PCAPS

**PCAPS : Patient Condition Adaptive Path System**
**CPC: Clinical Process Chart**

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Waseda University, Professor



## Condition-adaptive intervention

- Healthcare needs to be designed as a "condition-adaptive" service coping with disease specificity, patient individuality and patient condition change.
- Medical interventions is a high-risk practice accompanying human body invasion.
- To assure patient safety, strong medical intervention needs to be followed by around-the-clock patient condition monitoring and immediate intervention when necessary.
- Team activity is highly complex : difficult to rely totally on each individual medical staff member in realizing patient safety and quality assurance.

## Overview of clinical knowledge structuration technology aiming at making healthcare a true socio-technology

| For quality/safety / Form of socio-technology | | Technology | Element |
|---|---|---|---|
| Social common sense | Principles<br>Consensus building | Condition-adaptive intervention model | Conceptual model |
| Knowled-ge infrastru-cture | BOK<br>Knowledge contents | Structure (CPC, US and Master)<br>PCAPS contents<br>Work flow | Condition-adaptive intervention process model<br>Integration system<br>Content development processes<br>Standardization technique |
| | Accessibility<br>Applicability | Distribution of PCAPS contents<br>Provision of software application program | Business model for distribution of PCAPS contents<br>Administrator<br>Builder, Analyzer |
| | New knowledge acquisition method<br>Improvement of knowledge contents | Visualization<br>Analysis<br>Transformation of technical achievements to knowledge | Intervention logic<br>Interpretation of guidelines<br>Interpretation of clinical history records<br>Analysis |
| Applicati on in organiza-tion | Application in healthcare organizations<br>Application in society and region<br>Improvement of method to apply in organizations | Application and implementation of clinical knowledge in hospitals<br>Application in region<br>Regional alliance<br>Improvement of application methodology<br>Feedback for improvement of BOK | Implementation and promotion process<br>Business model for PCAPS implementation<br>Method for improving PCAPS contents |

## Overview of clinical knowledge structuration technology aiming at making healthcare a true socio-technology

| For quality/safety / Form of socio-technology | | Technology | Element |
|---|---|---|---|
| Social common sense | Principles<br>Consensus building | 1. CHARACTERISTICS UNIQUE TO HEALTHCARE<br>Condition-Adaptive Intervention Model | |
| Knowled-ge infrastru-cture | BOK<br>Knowledge contents | 2. KNOWLEDGE INFRASTRUCTURE<br>Structure [standard]<br>Contents [standard] | |
| | Accessibility<br>Applicability | 3. KNOWLEDGE INFRASTRUCTURE<br>Utilization | |
| | New knowledge acquisition method<br>Improvement of knowledge contents | 4. KNOWLEDGE INFRASTRUCTURE<br>New Knowledge Acquisition Method | |
| Applicati on in organiza-tion | Application in healthcare organizations<br>Application in society and region<br>Improvement of method to apply in organizations | 5. APPLICATION IN ORGANIZATION<br>Healthcare Organization<br>Region<br>Society | |

1. CHARACTERISTICS UNIQUE TO HEALTHCARE:

CONDITION-ADAPTIVE INTERVENTION MODEL

**Condition-adaptive intervention model**

**Consensus building**

**PCAPS as a condition-adaptive intervention model**

[Unit = clinical phase]

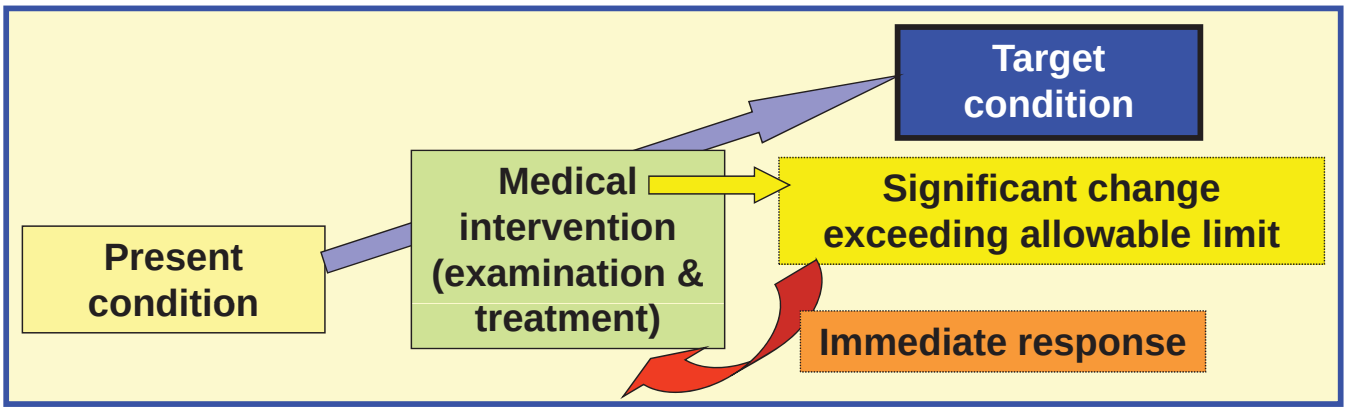
a basic building block for healthcare quality and safety management

[Chain if Unit = clinical process ]

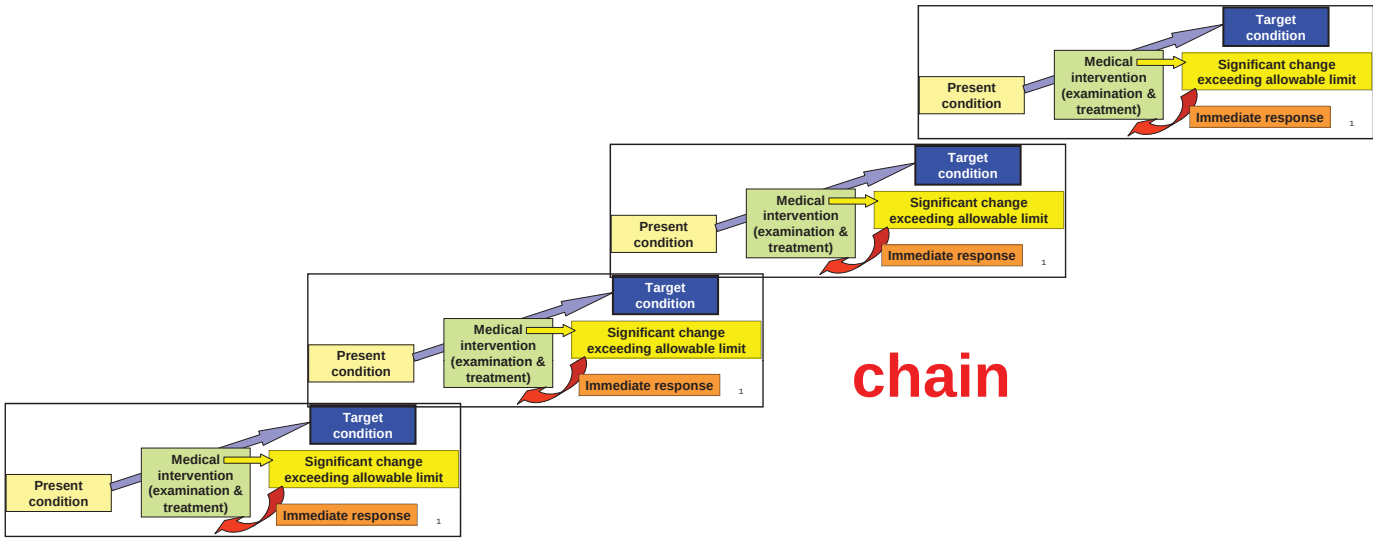
Overhead view of condition-adaptive intervention to transform current patient condition to target condition

# The basic module of Healthcare process

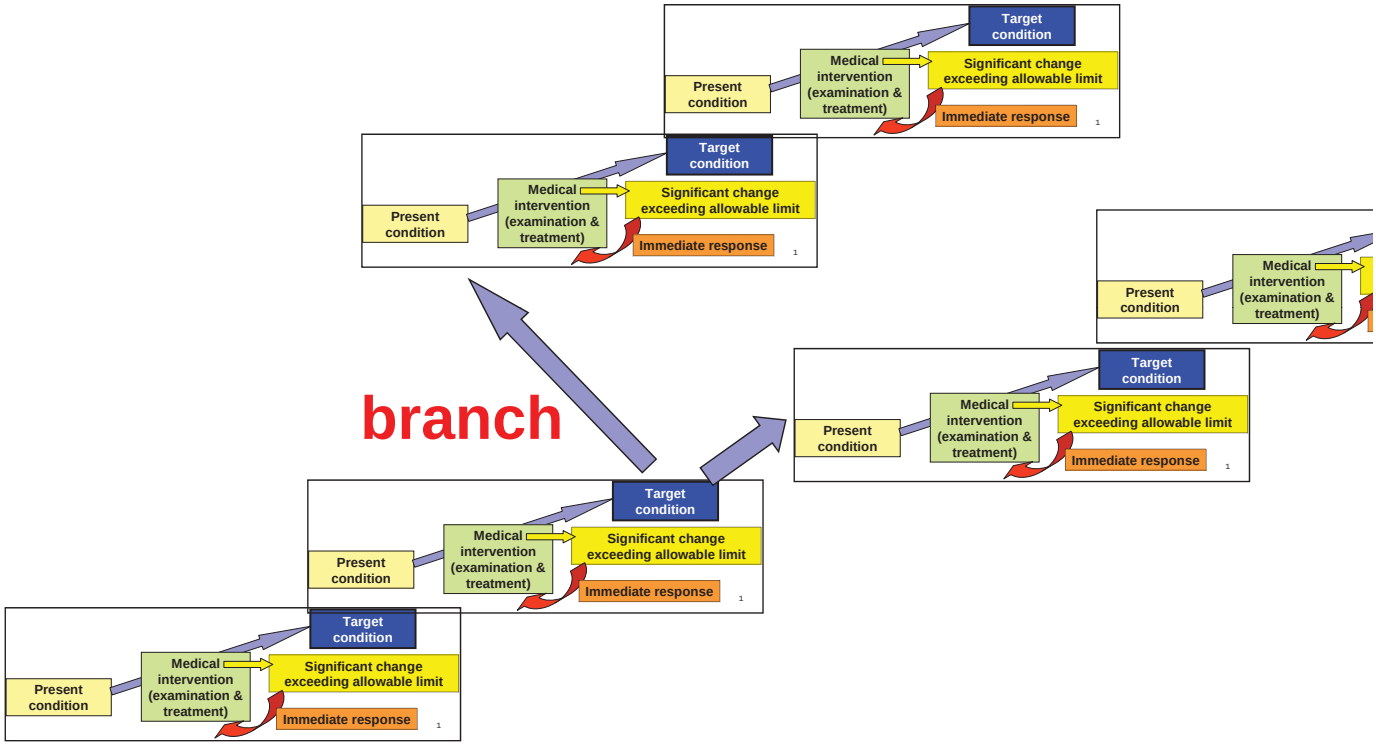
- Analyzed clinical process
- Clarified clinical process module
  - Direction from present condition to target condition
  - Implementation medical intervention
  - Watching significant change of patient
  - Immediately response to the change



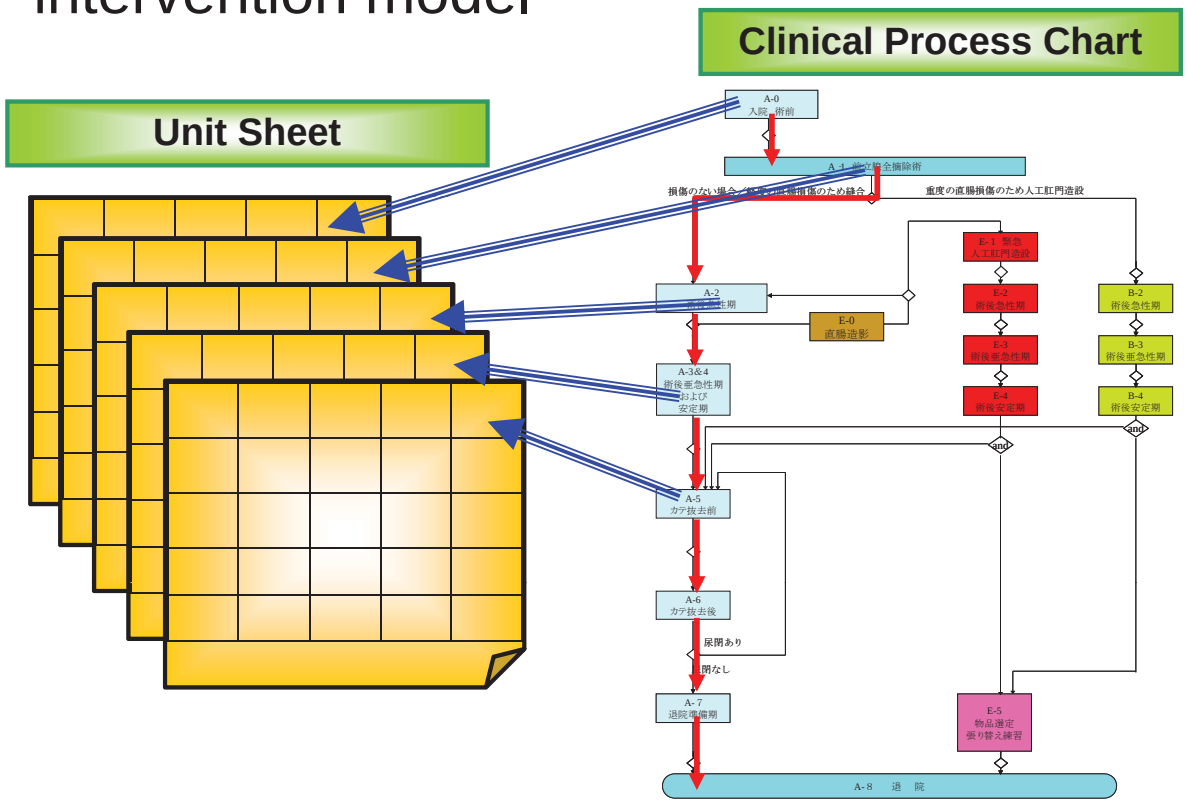
# Healthcare process is described as the module chain




# Healthcare process has branch. There are different conditions for transition.



# PCAPS content applying condition-adaptive intervention model






1. CHARACTERISTICS UNIQUE TO HEALTHCARE:

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**Condition-adaptive intervention model**

**Consensus building**

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[Unit = clinical phase]

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[Chain if Unit = clinical process ]

Overhead view of condition-adaptive intervention to transform current patient condition to target condition

# Consensus building

## (1) Academic consensus building

- In order to build academic consensus, it is necessary to identify justified condition-adaptive medical intervention **by using a scientific technique**.

- In addition, consensus about **better clinical processes** needs to be built in each technical domain.

- Such scientific academic consensus building is essential and useful **for the society**.

- The academic circles should be aware that it is their social mission to propose **a better condition-adaptive medical intervention**.

## (2) Consensus building in team medicine

- **At actual clinical front**, consensus building in healthcare team is important.

- **Neither doctor nor other healthcare specialist alone** can provide healthcare services.

- Team medicine composed of **multiple healthcare specialists** is essential.

- It is important to build consensus about **"better practices (standards)"** among healthcare specialists from different fields as well as from the same field.

1. CHARACTERISTICS UNIQUE TO HEALTHCARE:

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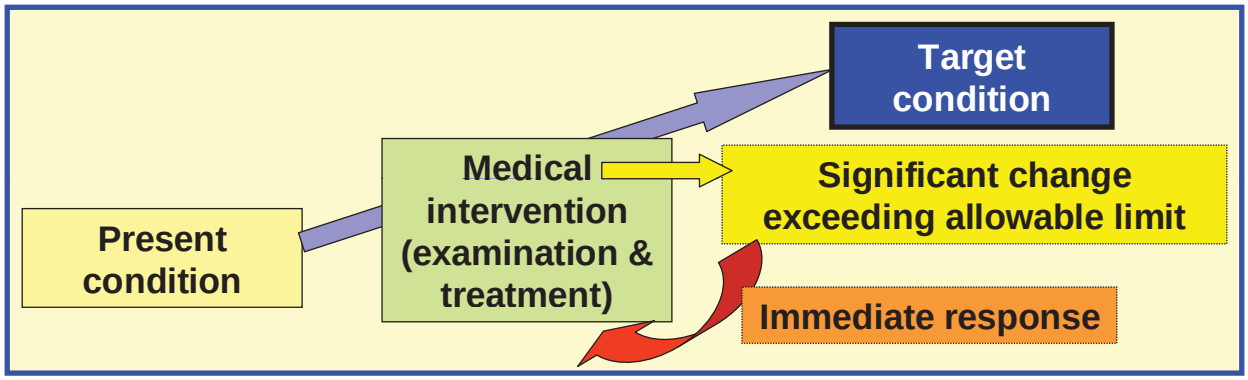
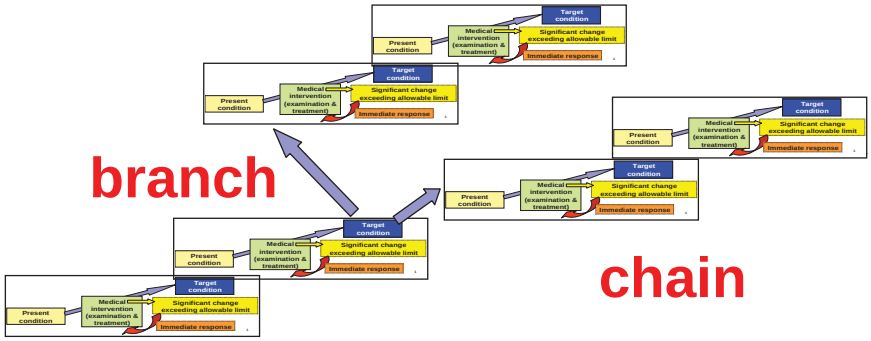
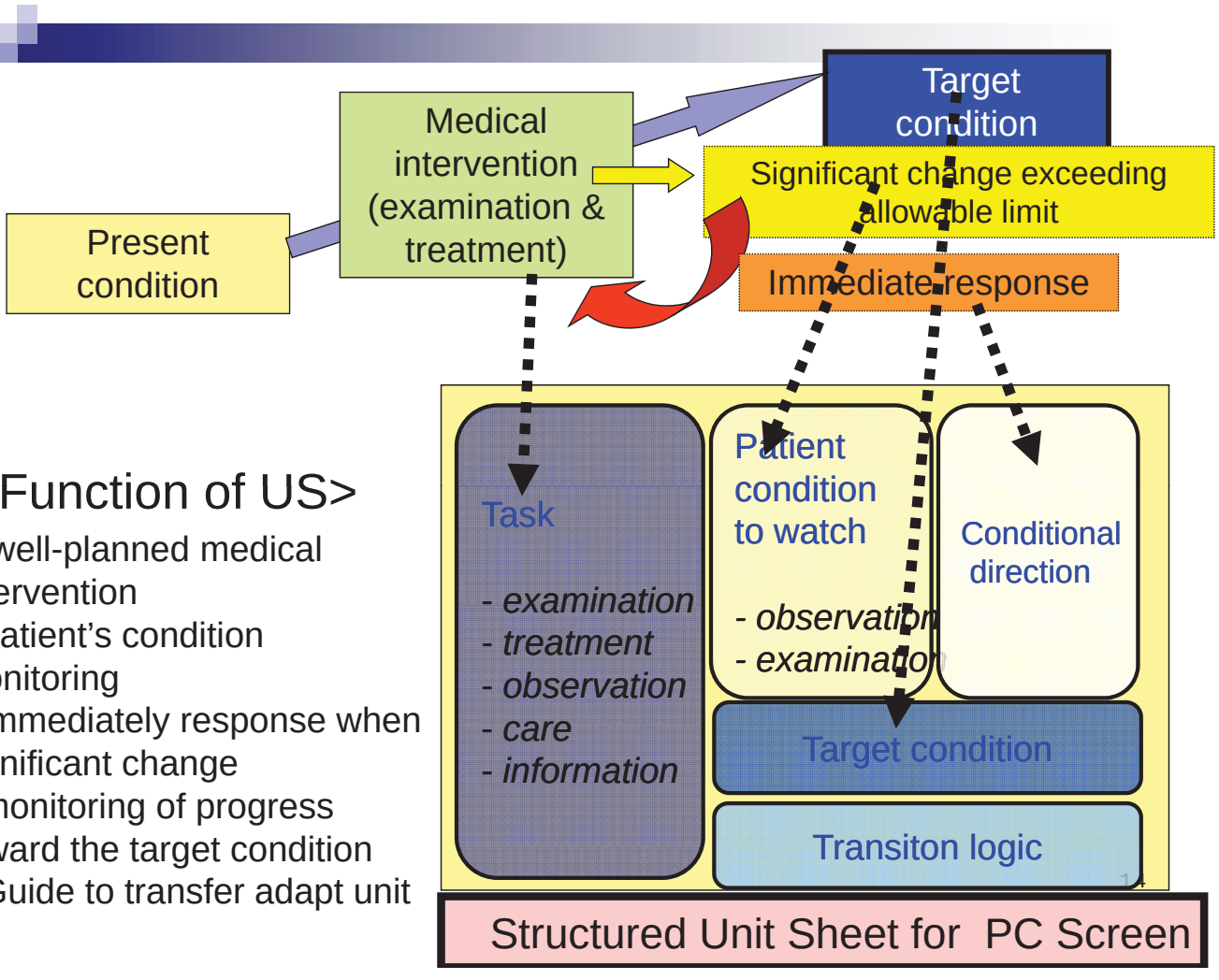
# The basic module of Healthcare process



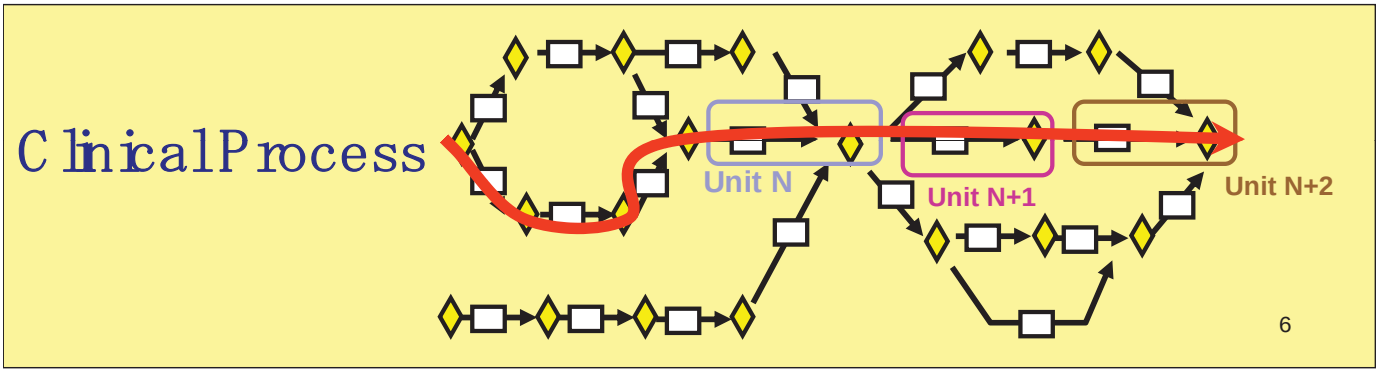



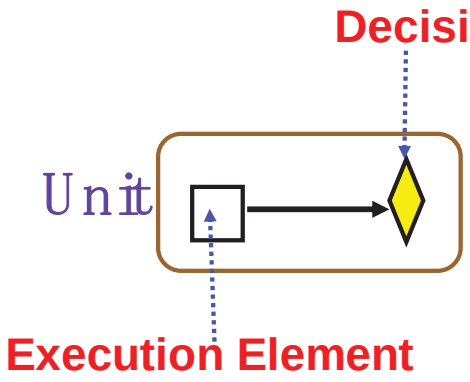

## <Function of US>

- well-planned medical intervention
- patient's condition monitoring
- immediately response when significant change
- monitoring of progress toward the target condition
- Guide to transfer adapt unit

# Conceptual Model of PCAPS

## Patient Condition Adaptive Path System



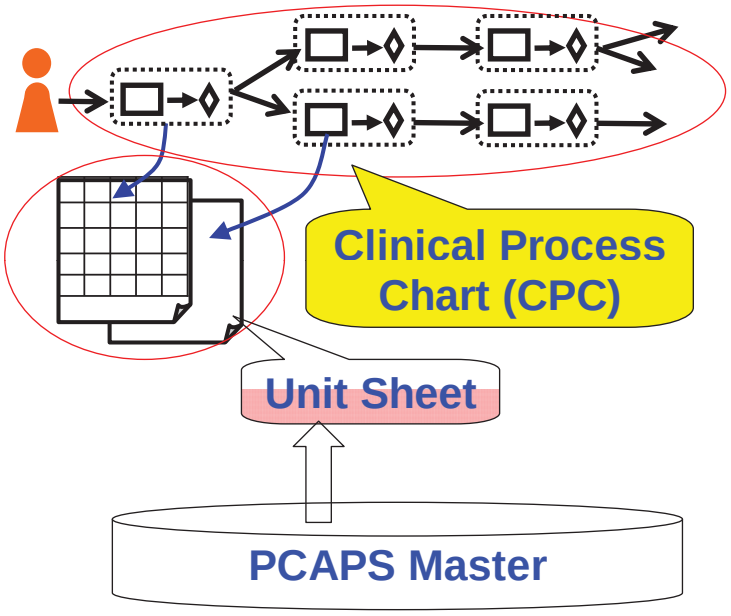




■**Target conditions**
Achieve the target condition?
Adapted to patient's present condition?

■**Transition logic**
Which unit to go next?

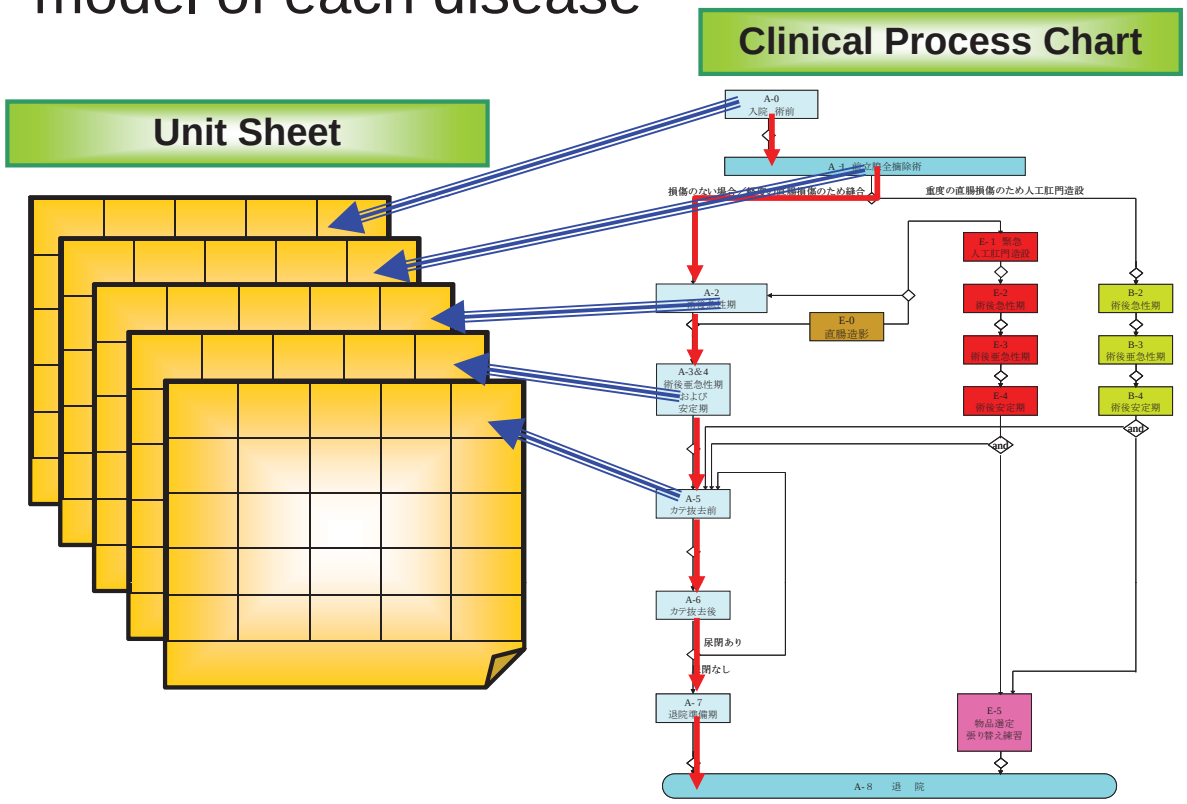
PCAPS-IMT

# Three framework of PCAPS for Clinical knowledge Structuring




**We can develop electronic PCAPS content by this clinical knowledge structuring**

# PCAPS content as tools for clinical process model of each disease






## 2. KNOWLEDGE INFRASTRUCTURE

BOK (Body of Knowledge) = STRUCTURE + CONTENTS

**[Structure] Structured body of clinical knowledge**

**[Contents] Structured knowledge contents**

**[Content development ] Design and systematization of content development processes**

(visualization, structuration and standardization)

**[Content type] Type of PCAPS contents**

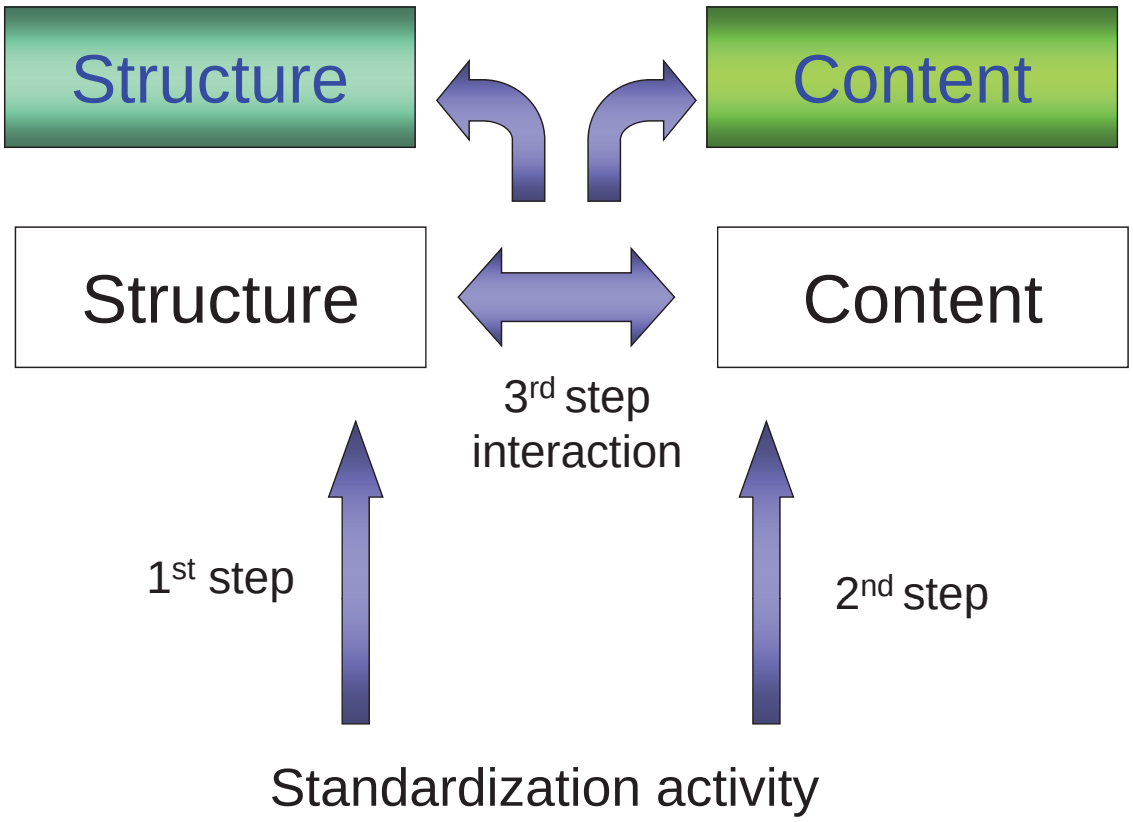
- routine healthcare services : clinical practice
- research and survey :
  - clinical research
  - research and development of industrial product
  - survey to evaluate regional healthcare services
  - survey to evaluate governmental healthcare policies and measures

**[implementation process] Implementation model**

- implementation flow
- detail to use knowledge contents in clinical practices
- tools for operation

**[integration system] Preparation and application of PCAPS contents through PCAPS integration system**

# Standardization process in PCAPS

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# Design and systematization of content development processes (visualization, structuration and standardization)

Step 1: **Initial-version design**
(Domain-specific content development team in PCAPS Study Group)

Step 2:
**Verification**: Group of hospitals carrying out verification / PCAPS secretariat

**Evaluation**: Domain-specific content development team / PCAPS secretariat

**Improvement**: Domain-specific content development team

Step 3: **Approval**

Type 1: Standard Approval Board in PCAPS Study Group

Type 2: Central clinical hospital of each relevant domain

(e.g. National Cancer Center, National Cerebral and Cardiovascular Center)

Type 3: Academic organization

(e.g. academic society, Society of Guideline Evaluation and Improvement Using Society)

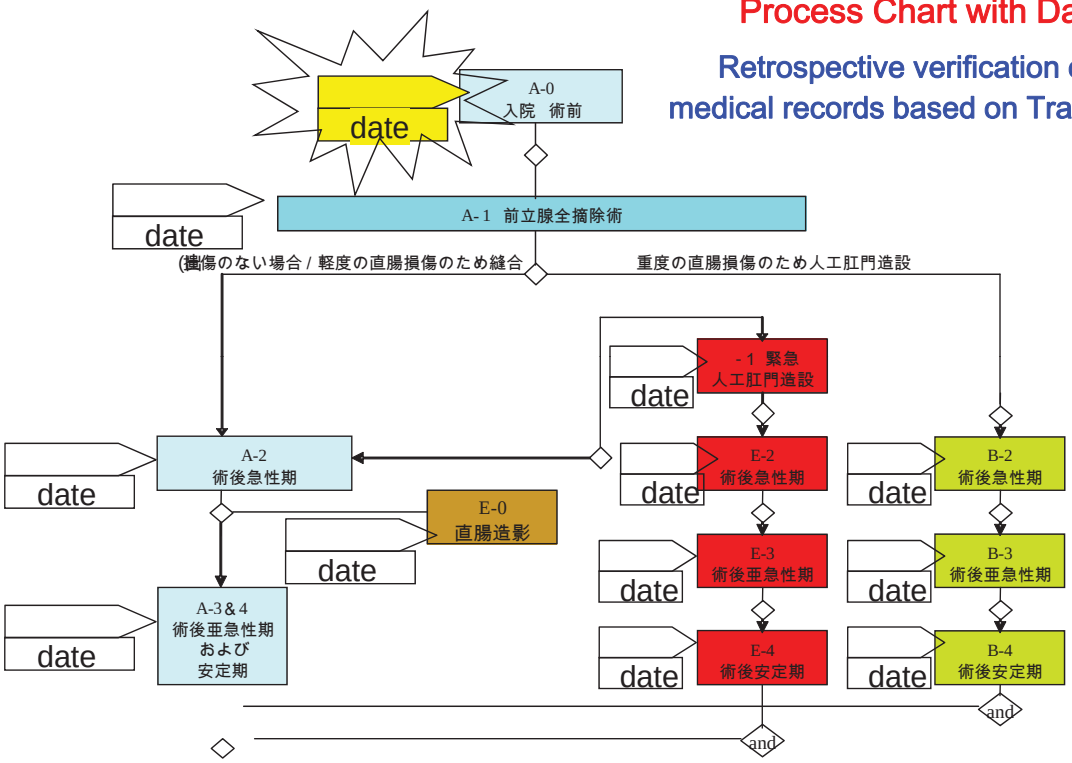


## Prostatectomy

## Verification Sheet

Process Chart with Date Entry

Retrospective verification of patient's medical records based on Transfer Logic List



# Transition Logic List
## ( Prostatectomy )

| Present Unit | Transfer Requirement | Next Unit |
|---|---|---|
| A-0 | Preoperative preparation is completed and no upper Respiratory tract infection (>37.5℃) is observed | A-1 |
| | One of the above two is not achieved | Remain in A-0 |
| A-1 | No rectum damage or slight damage during operation rectum suture) | A-2 |
| | Severe rectum damage and proctostomy | B-2 |
| A-2 | Stable vital sign & body temperature of < 38.0 ℃ | A-3 & 4 |
| | Unstable vital sign or body temperature of 38.1 ~ 38.5℃ | Remain in A-2 |
| | Body temperature of > 38.6℃ | E-0 |
| A-3&4 | Can eat > 50% of normal foods & walk inside of hospital | A-5 |
| | One of the above is not achieved | Remain in A-3&4 |
| A-5 | No leakage at inosculated part of bladder and urethra | A-6 |
| | Leakage at inosculated part of bladder and urethra | Remain in A-5 |
| A-6 | No urinary retention | A-7 |
| | Urinary retention | Move to A-5 after placing cathe |



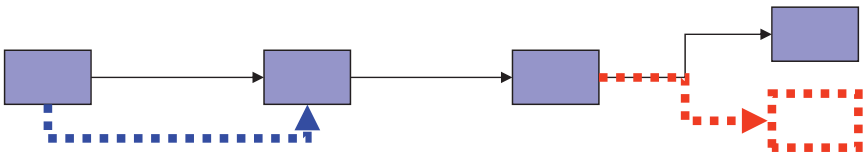


# Verification using medical record of each patient

**Departure**

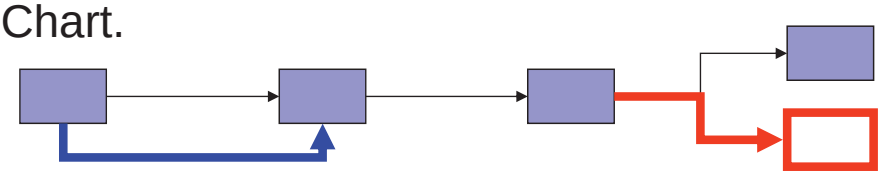
**<cause>**

- Unit-to-unit transfer history on Clinical Process Chart is analyzed to identify “departure” from potential transfer route.



**<improvement>**

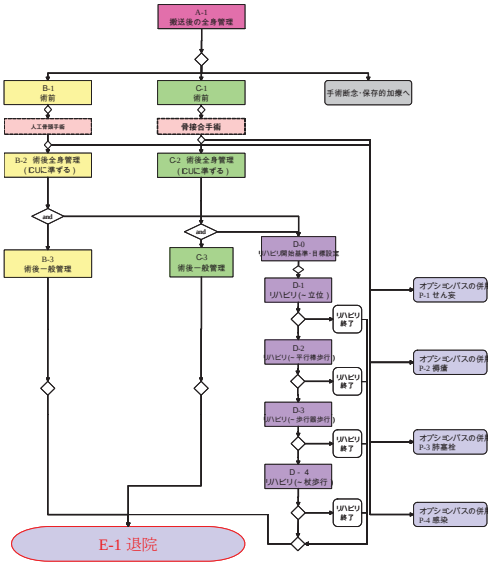
- Analysis of departures and their causes enable medical staff to effectively add new units and routes to Clinical Process Chart.

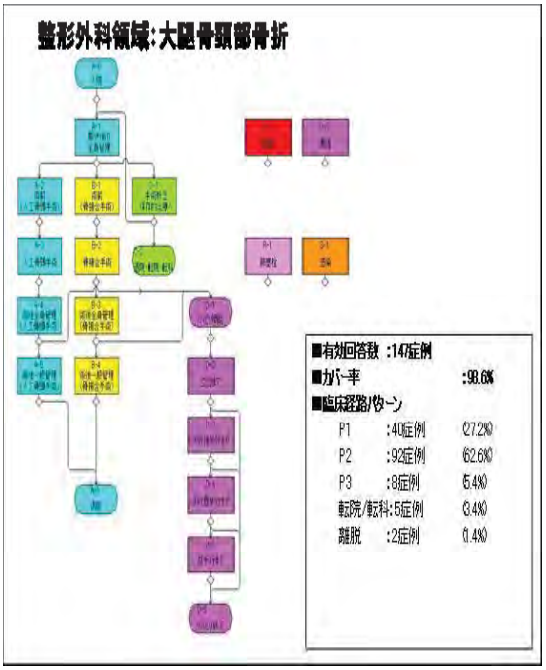


# Verification and Improvement
## <Femoral Neck Fracture>

**2005**
**Coverage ratio**
**50.4%**

**2006**
**Coverage ratio**
**98.6%**




# Verification in 2005

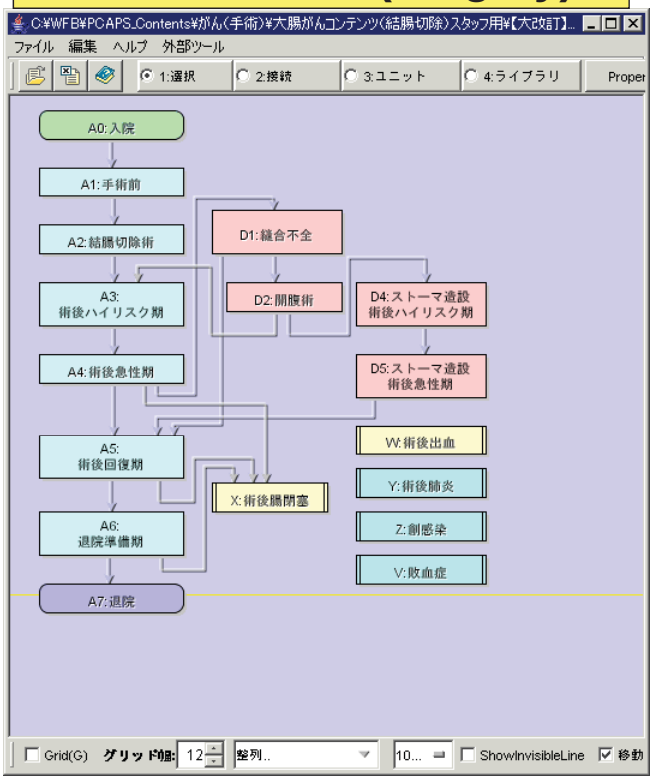
| | Ischemic heart disease | Total prostatectomy | Cerebral infarction | Infant bronchial asthma | Diabetic insulin introduction | Fracture of neck of femur | Total |
|---|---|---|---|---|---|---|---|
| No. of cases | 136 | 137 | 302 | 228 | 80 | 141 | 1024 |
| **No. of hospitals** | 8 | 9 | 7 | 7 | 9 | 7 | |

# Summary of Verifications

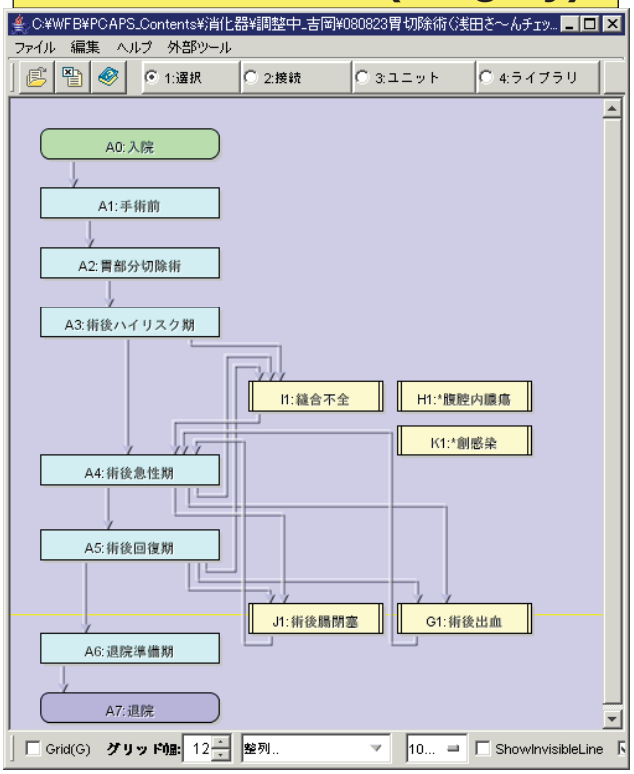
| Item/Year | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|
| No. of hospitals | 55 | 51 | 35 | 44 |
| No. of beds | 20,033 | 18,317 | 15,795 | 2,009 |
| No. of PCAPS contents | 26 | 19 | 32 | 11 |

# Structure type of PCAPS-CPC contents for cancer surgery

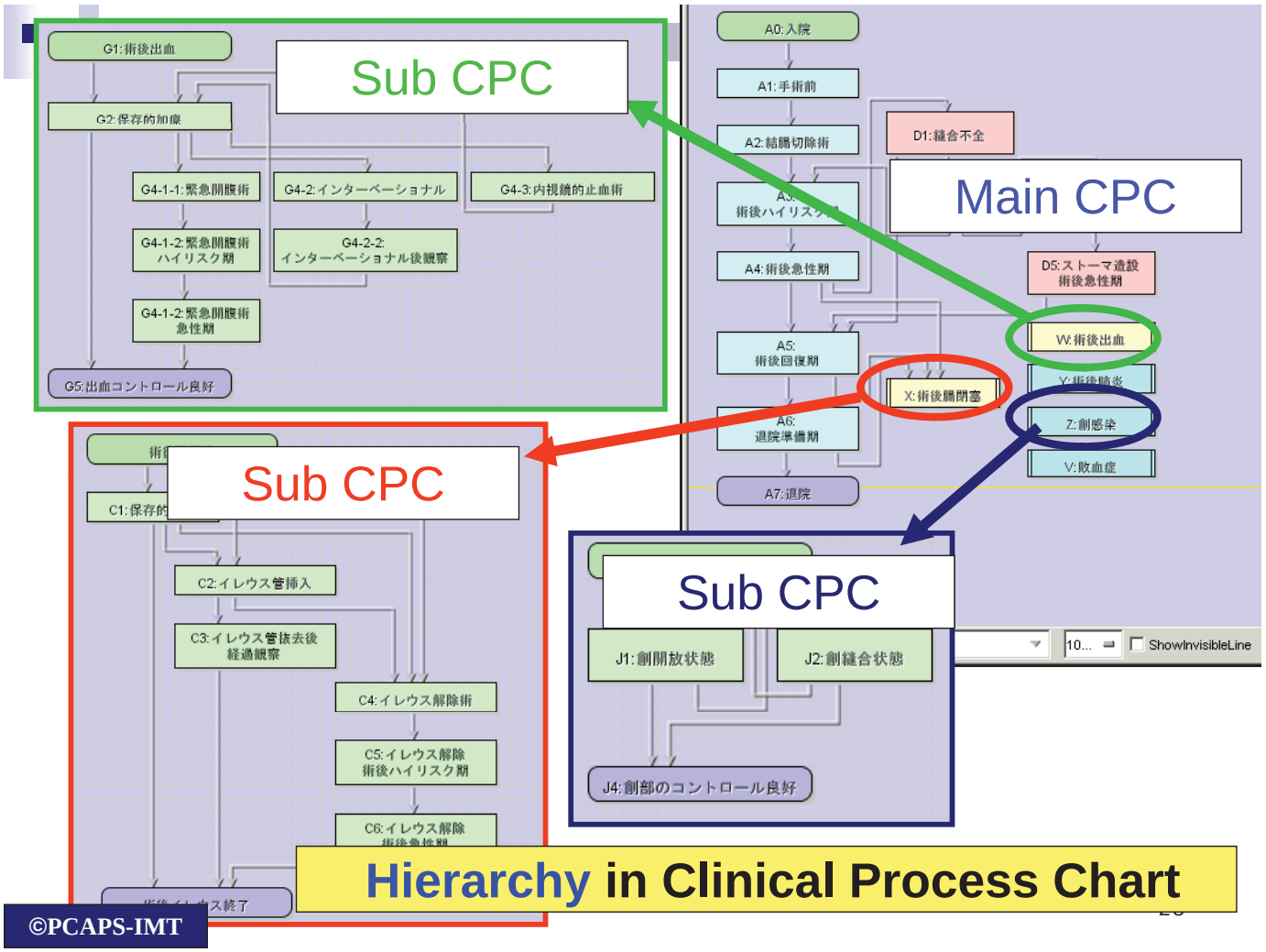
## Colon Cancer (surgery)



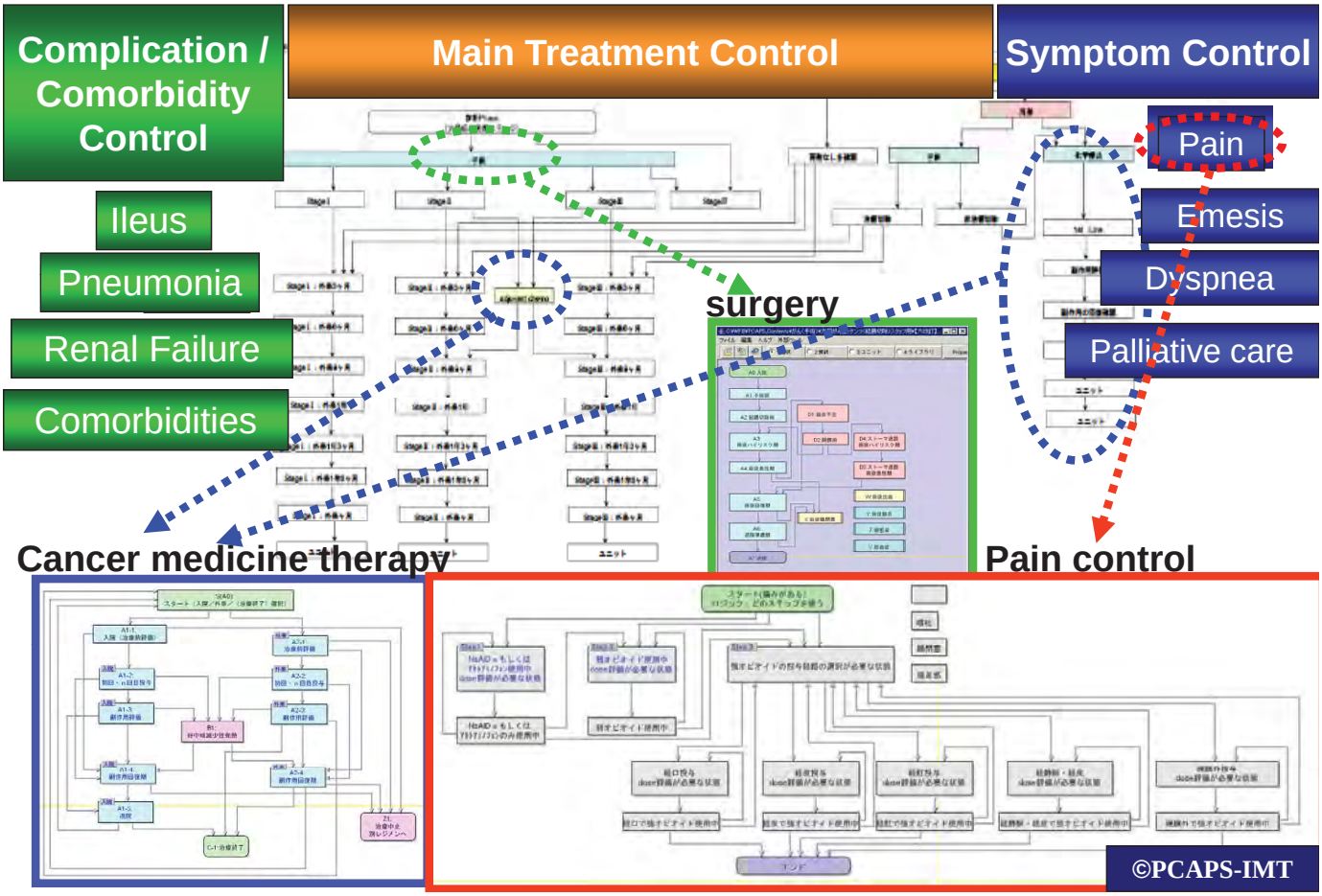

## Gastric Cancer (surgery)





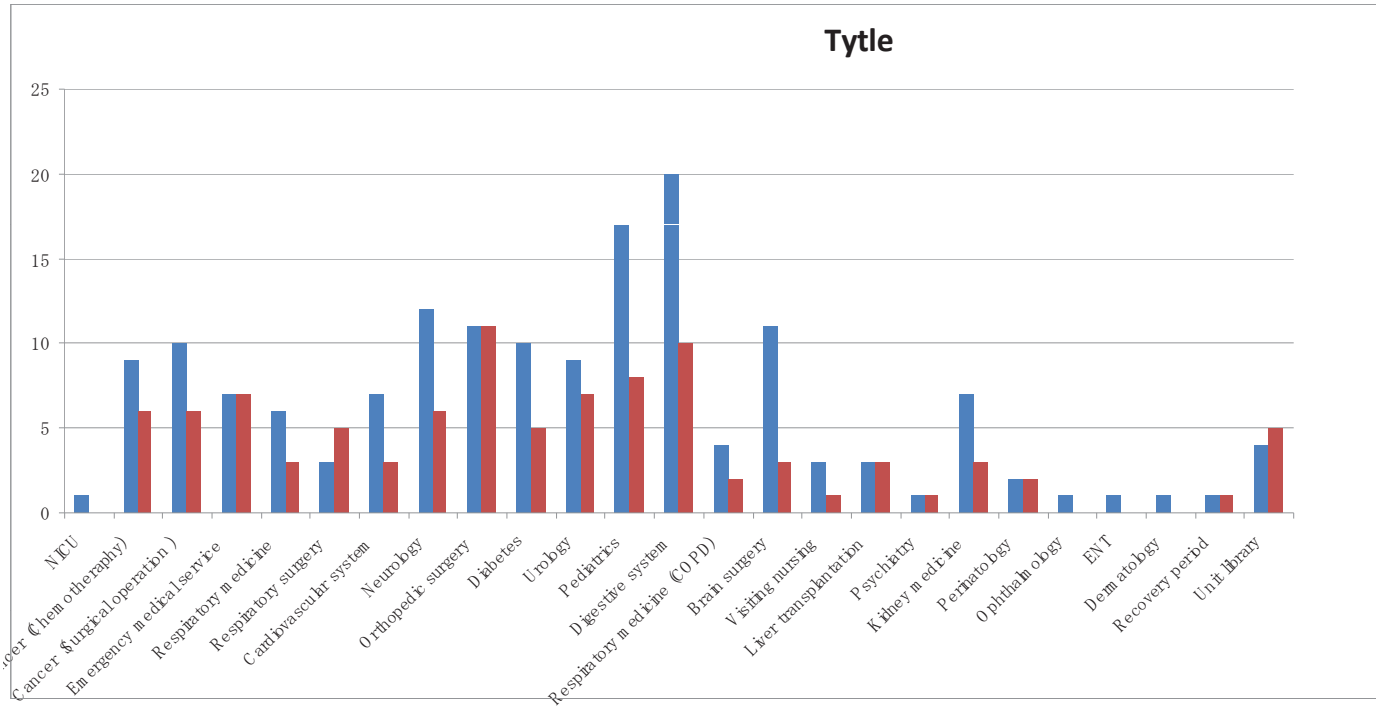
# Hierarchy Structured PCAPS-CPC for Cancer Care




## Progress of PCAPS electronic content development

| | | (A) Plan The number of contents that each domain team initially plans to develop (Some are less important.) | (B) Plan The number of contents that each domain team currently finds it necessary to develop (All of them are important.) | (C) Actual (The number of contents published) =The number of important contents / contents with high patient coverage =The number of contents completed) | Target achievement rate (%) Contents completion rate (C)/(B) | (D) The number of contents verified by clinical process simulation developed based on actual clinical history records of patients (←The number of contents verified) | Target achievement rate (%) Clinical process simulation implementation rate (D)/(C) |
|---|---|---|---|---|---|---|---|
| 1 | NICU | 1 | 1 | 0 | 0.0 | 0 | 0 |
| 2 | Cancer (Chemotheraphy) | 9 | 9 | 6 | 66.7 | 6 | 100.0 |
| 3 | Cancer (Surgical operation) | 10 | 10 | 6 | 60.0 | 5 | 83.3 |
| 4 | Emergency medical service | 7 | 7 | 7 | 100.0 | 7 | 100.0 |
| 5 | Respiratory medicine | 6 | 6 | 3 | 50.0 | 3 | 100.0 |
| 6 | Respiratory surgery | 3 | 3 | 5 | 166.7 | 5 | 100.0 |
| 7 | Cardiovascular system | 7 | 3 | 3 | 100.0 | 3 | 100.0 |
| 8 | Neurology | 12 | 2 | 6 | 300.0 | 6 | 100.0 |
| 9 | Orthopedic surgery | 11 | 11 | 11 | 100.0 | 11 | 100.0 |
| 10 | Diabetes | 10 | 5 | 5 | 100.0 | 3 | 60.0 |
| 11 | Urology | 9 | 9 | 7 | 77.8 | 6 | 85.7 |
| 12 | Pediatrics | 17 | 4 | 8 | 200.0 | 8 | 100.0 |
| 13 | Digestive system | 20 | 20 | 10 | 50.0 | 10 | 100.0 |
| 14 | Respiratory medicine (COPD) | 4 | 4 | 2 | 50.0 | 2 | 100.0 |
| 15 | Brain surgery | 11 | 11 | 3 | 27.3 | 3 | 100.0 |
| 16 | Visiting nursing | 3 | 1 | 1 | 100.0 | 1 | 100.0 |
| 17 | Liver transplantation | 3 | 3 | 3 | 100.0 | 1 | 33.3 |
| 18 | Psychiatry | 1 | 1 | 1 | 100.0 | 1 | 100.0 |
| 19 | Kidney medicine | 7 | 3 | 3 | 100.0 | 3 | 100.0 |
| 20 | Perinatology | 2 | 2 | 2 | 100.0 | 1 | 50.0 |
| 21 | Ophthalmology | 1 | 1 | 0 | (-) | 0 | (-) |
| 22 | ENT | 1 | 1 | 0 | (-) | 0 | (-) |
| 23 | Dermatology | 1 | 1 | 0 | (-) | 0 | (-) |
| 90 | Recovery period | 1 | 1 | 1 | 100.0 | 0 | 0.0 |
| 100 | Unit library | 4 | 4 | 5 | 125.0 | 0 | 0.0 |
| | Total: 25 domains | 161 | 123 | 98 79.7% | | 88 | 80.1% |

# Progress of PCAPS electronic content development






## 3. KNOWLEDGE INFRASTRUCTURE: UTILIZATION

[Assurance of accessibility]

Content distribution business model

- Who is customer?
- What is value of customer?
- How can we design the money cycle in core work, outsourcing and alliance?

[Assurance of applicability]

the PCAPS integration system

- Builder
- Administrator
- Analyzer

# Assurance of accessibility : Content distribution business model

## Expected users (customers) of PCAPS contents

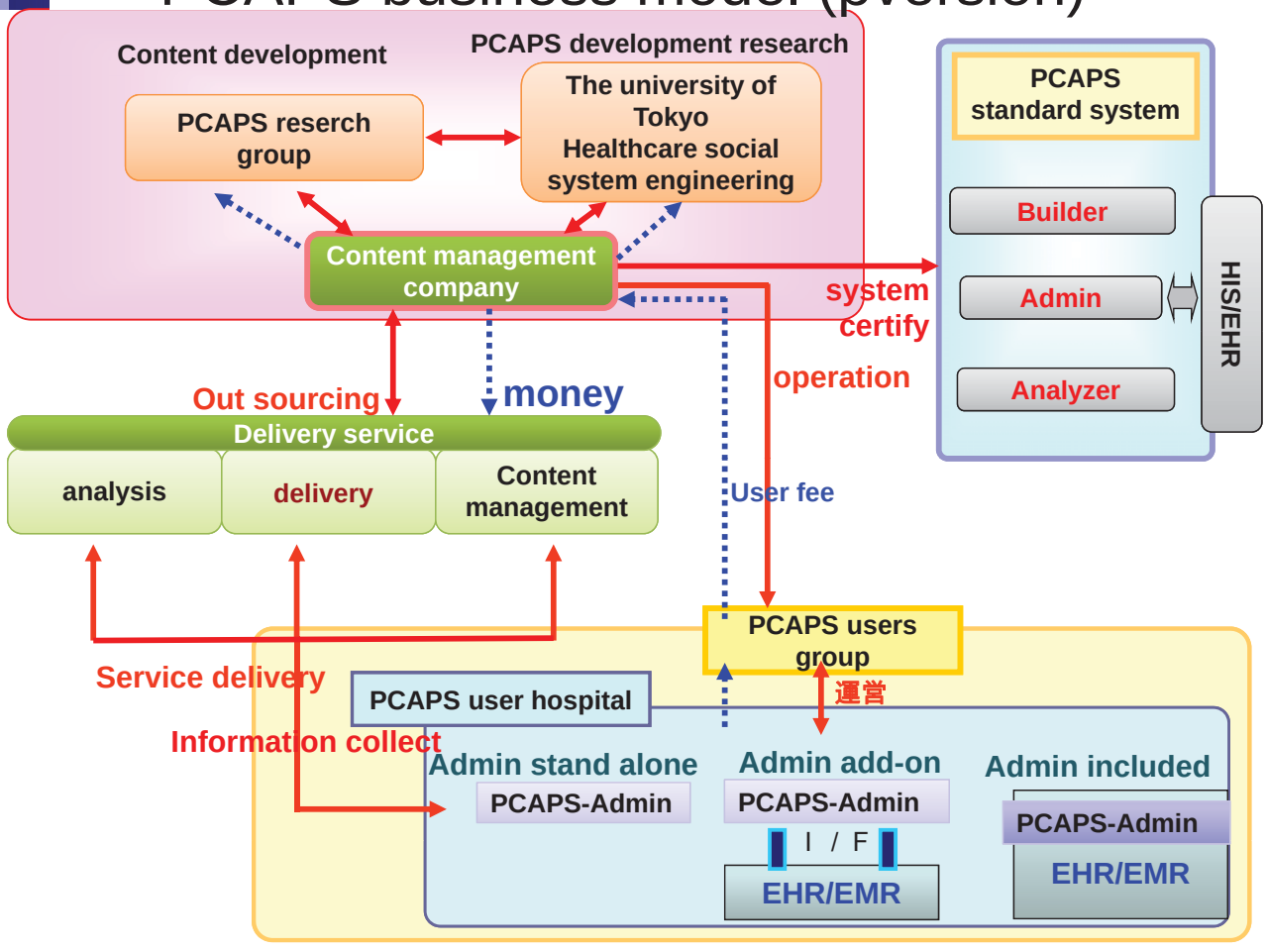
- healthcare staff and hospital
- educational institution and student
- academic organization and researcher
- manufacturer and business organization
- public agency (local and national governments).

## Contents for business use can be categorized as follows:

- Clinical-based contents
- Survey- and research-based contents
- Contents for specific need
  (to be newly developed for each business organization)
- Use of existing contents
  (New contents specifically serving a particular survey)



# PCAPS business model (βversion)



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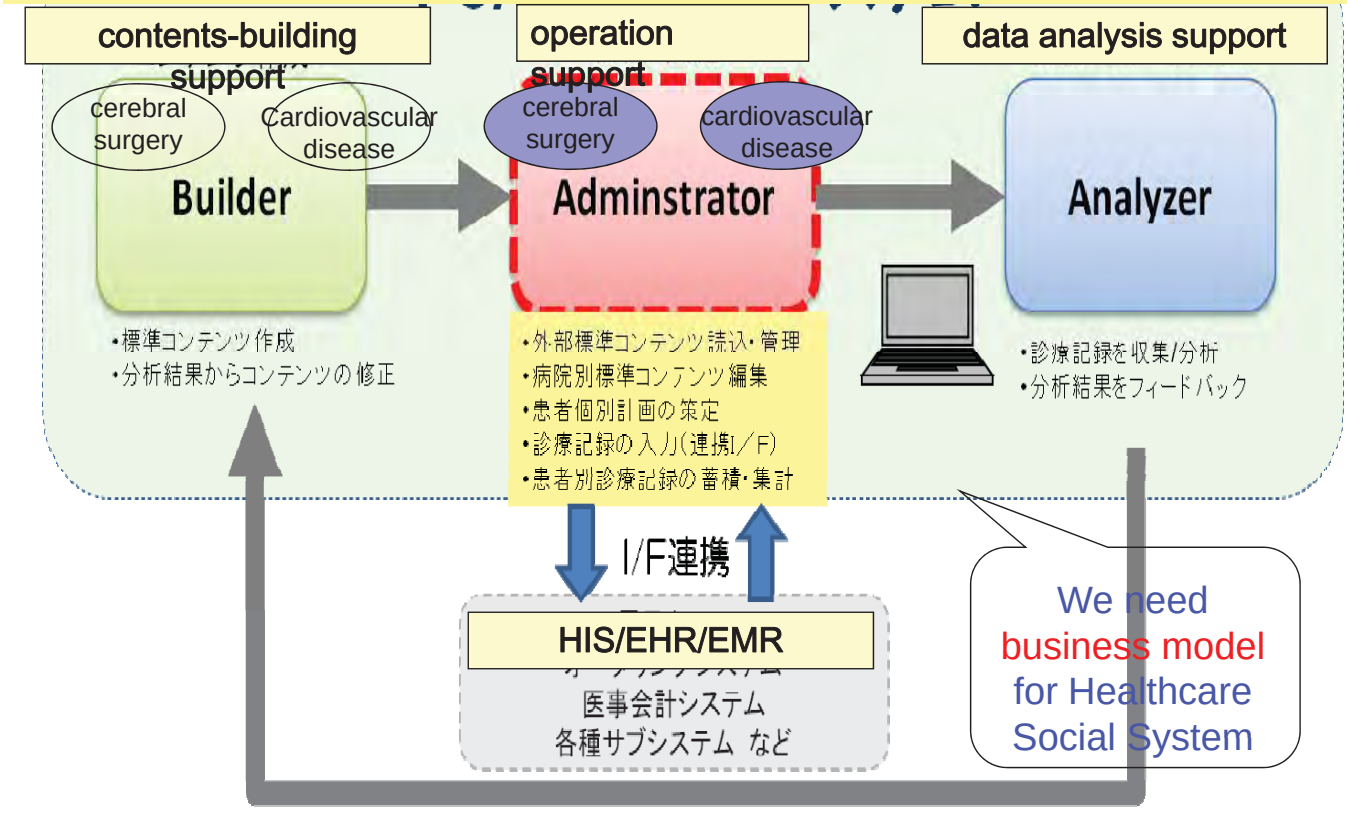
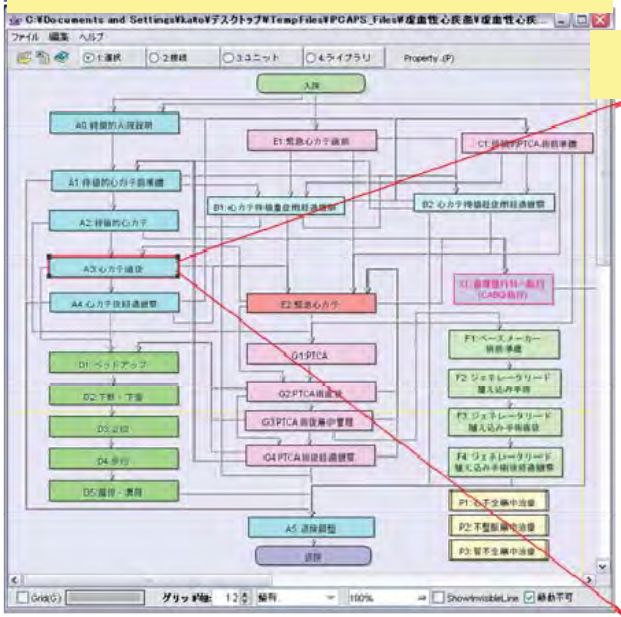
**Improvement of content through PCAPS integration system**

**< PDCA cycle >**



# PCAPS-Builder
## PCAPS content-building support system

### Clinical Process Chart



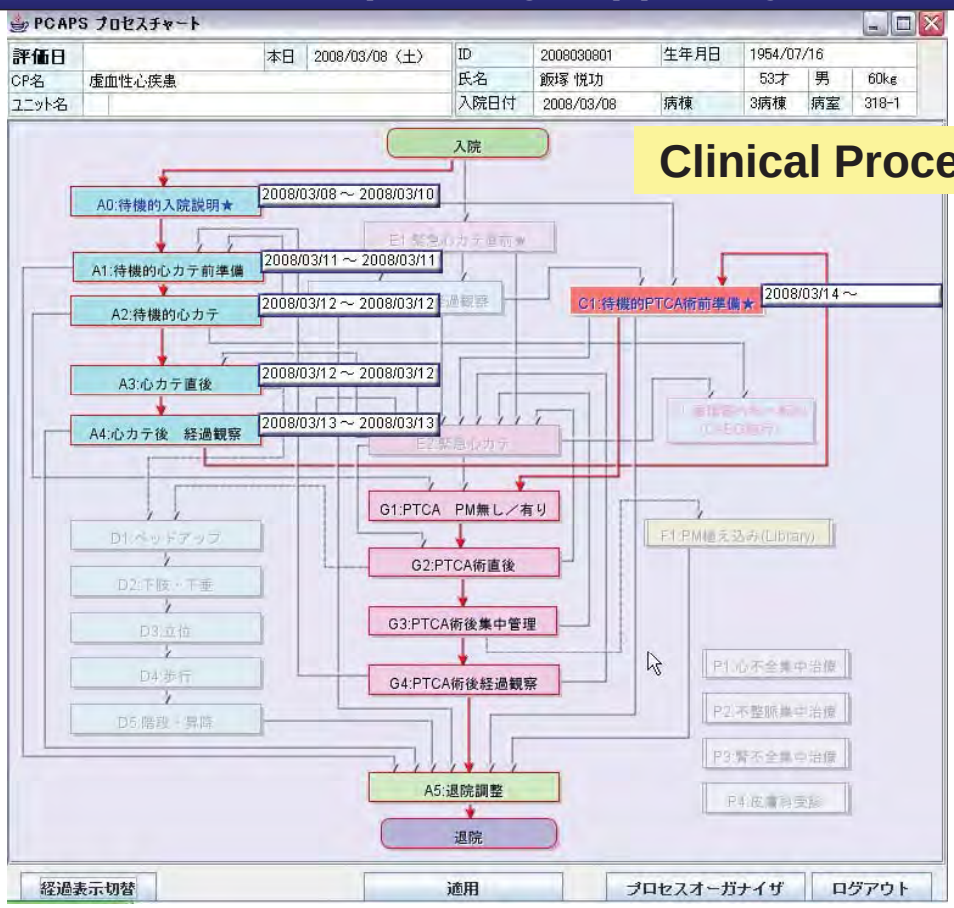
### Unit Sheet





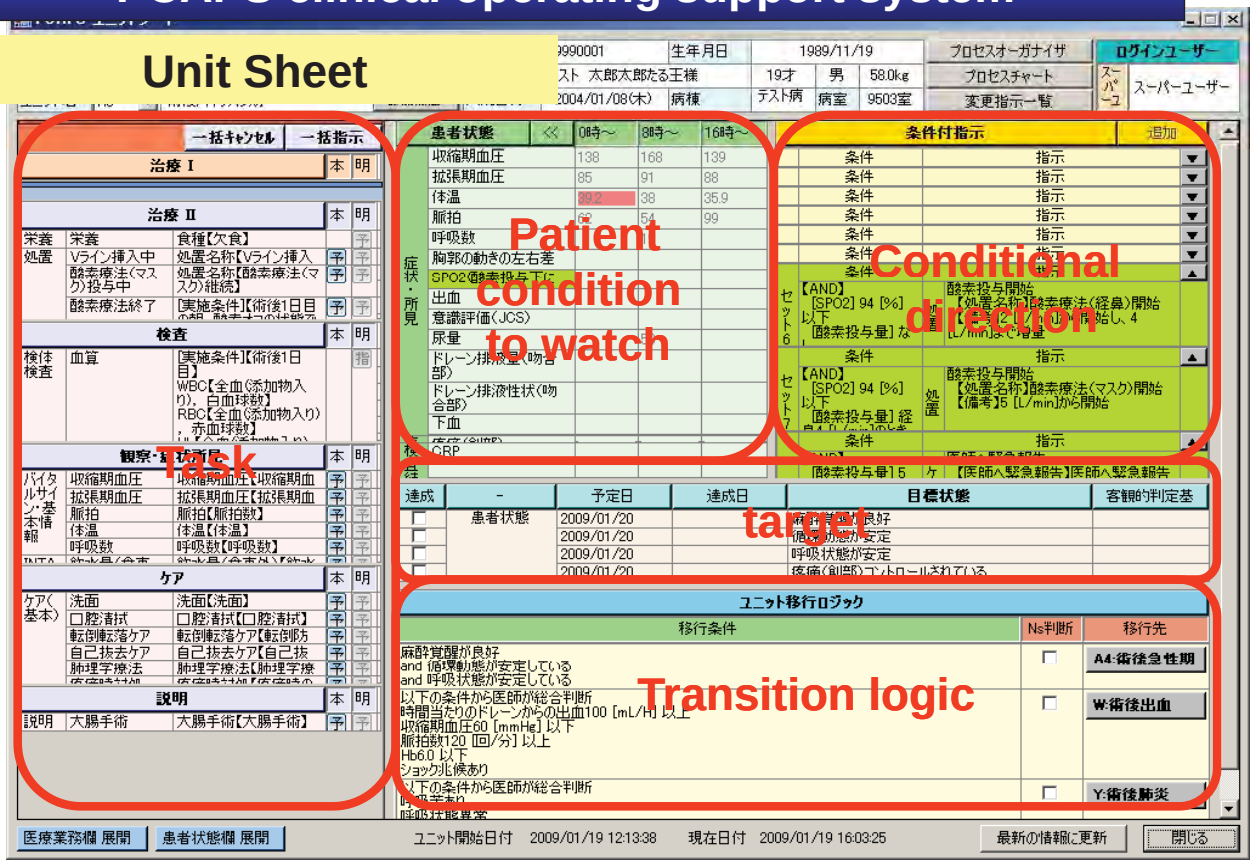
# PCAPS-Administrator
## PCAPS clinical operating support system

### Clinical Process Chart



# PCAPS-Administrator
## PCAPS clinical operating support system

### Unit Sheet





# PCAPS-Administrator
## PCAPS clinical operating support system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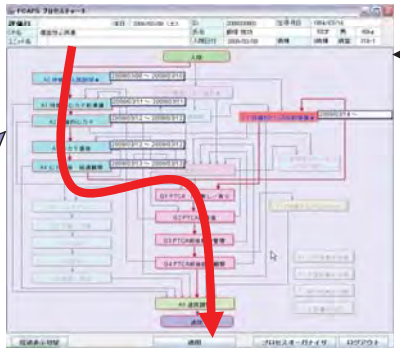
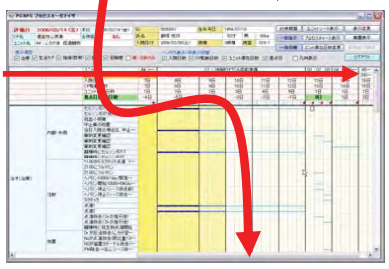
Clinical process chart

Apply to P C A P S content



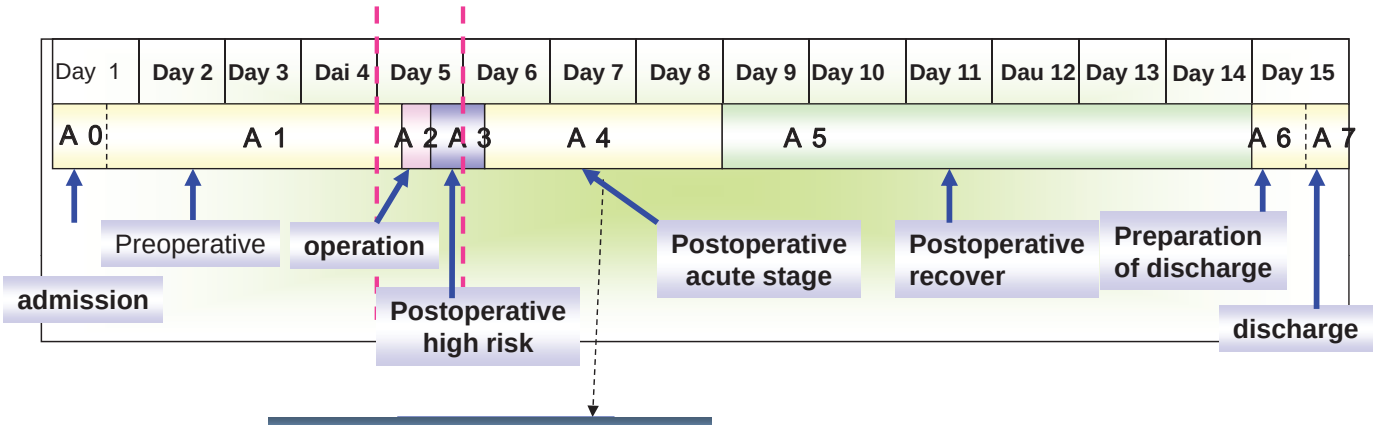
Unit stay date



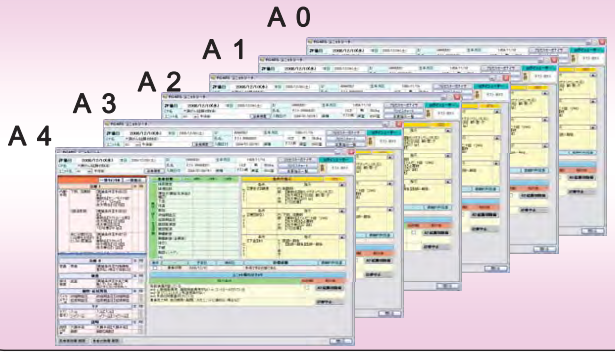
Unit sheets

Process organizer
*overview of schedule

# PCAPS-Administrator
## PCAPS clinical operating support system




### Unit Sheet



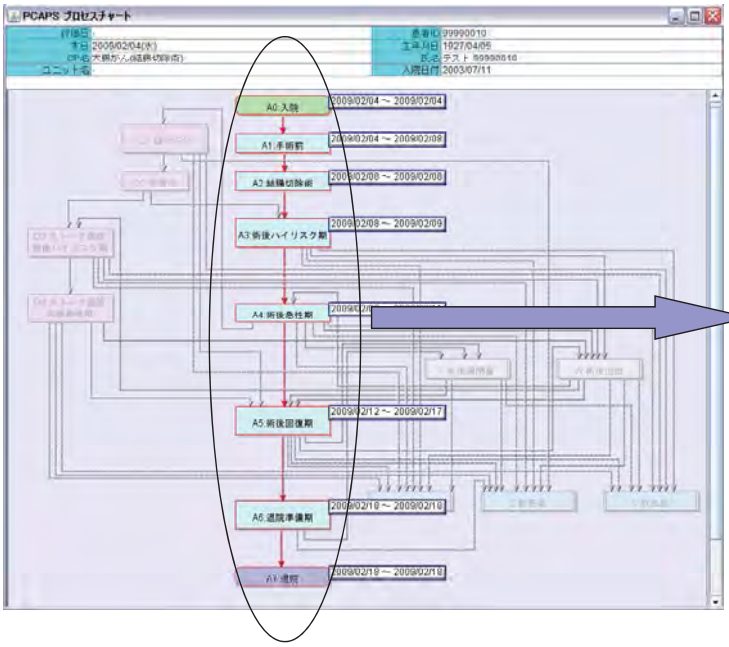

Planning schedule of each unit

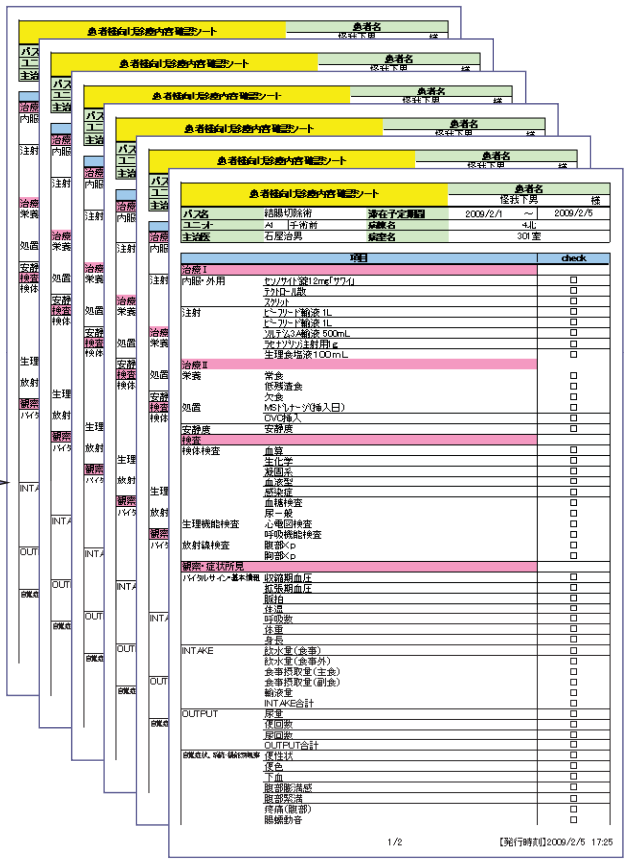
### Process organizer

Planning schedule of each date


# PCAPS-Administrator
## PCAPS clinical operating support system


## Informed consent for patient using PCAPS



# Fact Based Policy making

Rela -PFC
New wo ent safety

Each patient's Clinical plan
(Standard based plan)

Medical Doctor
Edit for the Patient

PCAPS-CPC for
the Patient

Medical Doctor
Select & adaptation

PCAPS-CPCs for the
hospital
(Hospital standard )

Hospital
Catalog & edit

delivery

PCAPS-CPCs
(Standard)

Structured knowledge

Hospital Improvement
clinical Practice
hospital management

Analyze

Structured
summary

store

Order
treatments

implement

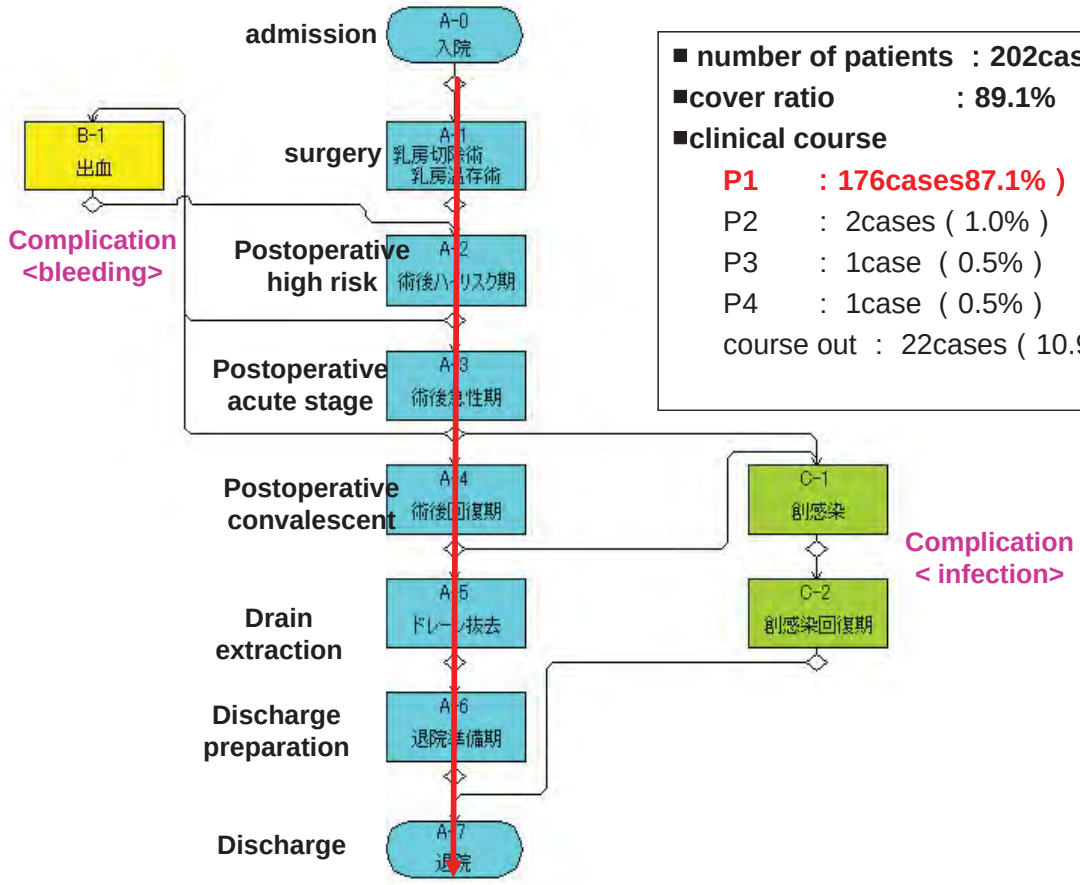
Payment
system

medical
record

refer

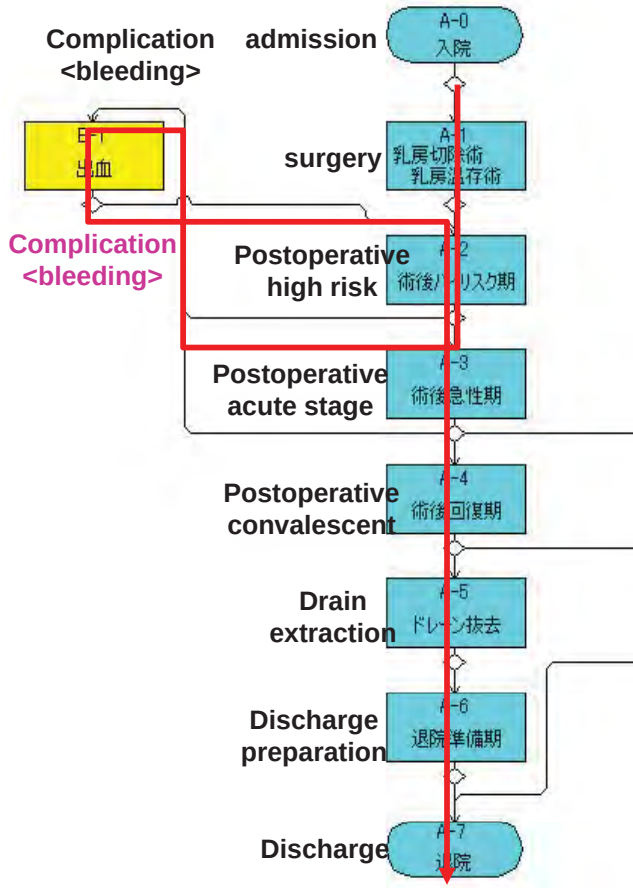
PCAPS-IMT

## Mammary cancer (surgery)




- number of patients : 202cases
- cover ratio : 89.1%
- clinical course
  - P1 : 176cases87.1% )
  - P2 : 2cases ( 1.0% )
  - P3 : 1case ( 0.5% )
  - P4 : 1case ( 0.5% )
  - course out : 22cases ( 10.9% )

# Mammary cancer (surgery)

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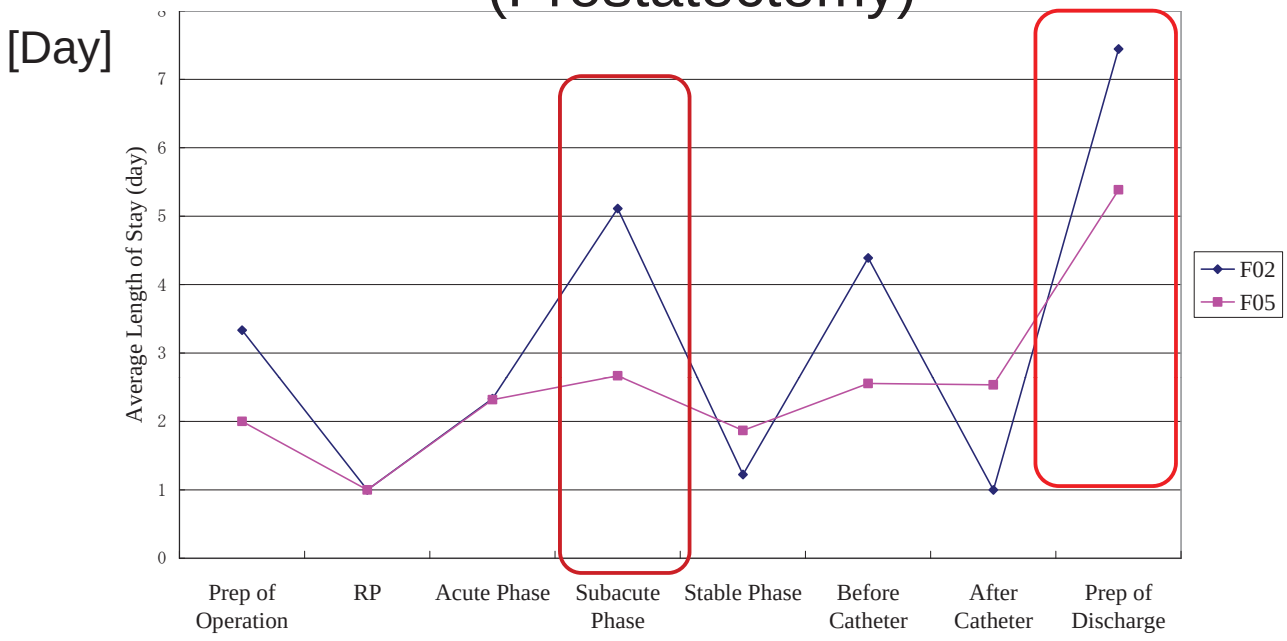
# Comparison of Length of Stay in Each Unit (Prostatectomy)




Length of Stay in Each Unit of Two Hospitals

Stratification by unit is useful to identify causes for difference in length of stay

## 4. KNOWLEDGE INFRASTRUCTURE: NEW KNOWLEDGE ACQUISITION METHOD

[condition adaptive intervention]

intervention logic model

- visualization as intervention logic in clinical practice
- analysis for standardization
- sophistication of condition adaptive intervention

[change management]

enhancement of overall quality of clinical practices

- adding new knowledge in PCAPS content
- publicity

### survey 2008(pediatrics)
### Efficacy of first dose of immunoglobulin (IVIG) in kawasaki disease

- non lowering of feve：15 case (9%)

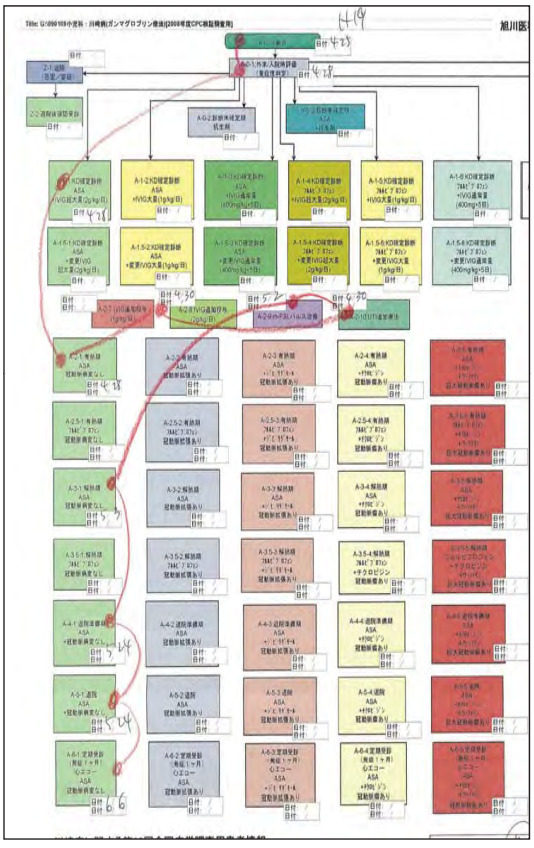
- Add dose ( including adding another therapy)
  - IVIG 2 g /kg 6 cases (40%)
  - IVIG 1 g /kg 8 cases (53%)
  - m-PSL pulse therapy 5 cases (33%)
  - UTI adding theapy 2 cases (13%)

IVIG and another therapy from first dose date to lowering of fever date

- 1 day total 5 cases
  - IVIG2g/kg/day 5cases (100%)

- 2 days total 12 cases
  - IVIG2g/kg/day 6 cases (50%)
  - IVIG1.86g/kg/day 1 cases (8%)
  - IVIG1.2g/kg/day 1cases (8%)
  - IVIG1g/kg/day 1cases (8%)
  - IVIG non dose 3cases (25%)

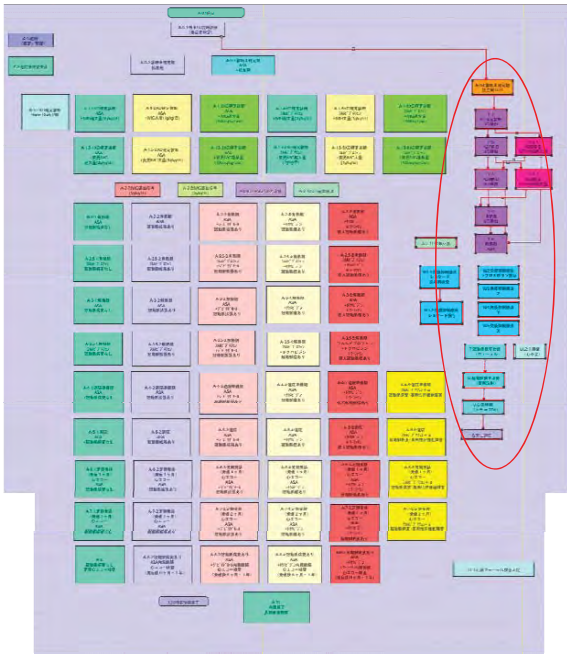
- 3 days total 40 cases
  - IVIG2g/kg/day 30 cases (75%)
  - IVIG1g/kg/day 6 cases (15%)
  - IVIG non dose 4 cases (10%)



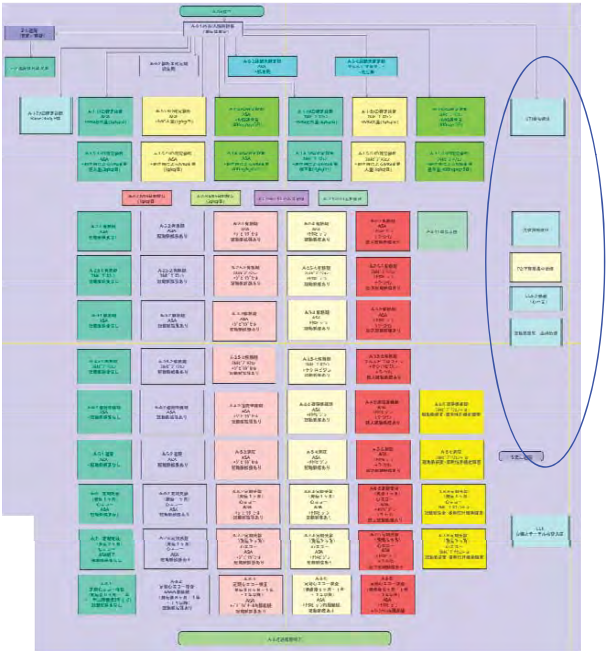
# After survey:

## Improvement of PCAPS clinical process chart

## (new standard after consensus meeting)



**Non efficacy therapy**

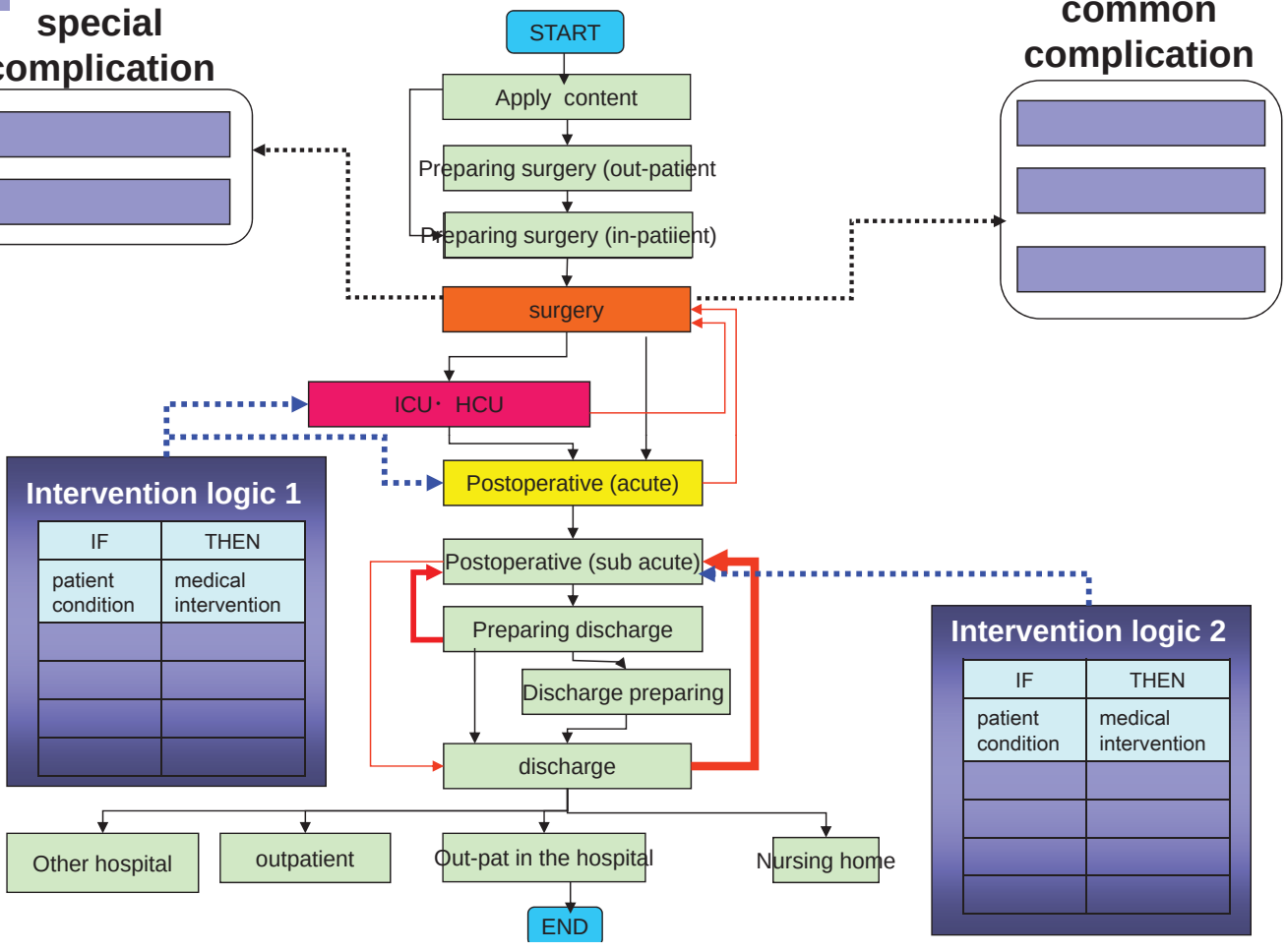


**Adding new therapy**

# General content (surgery type)

**special complication**

**common complication**



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[change management]

enhancement of overall quality of clinical practices

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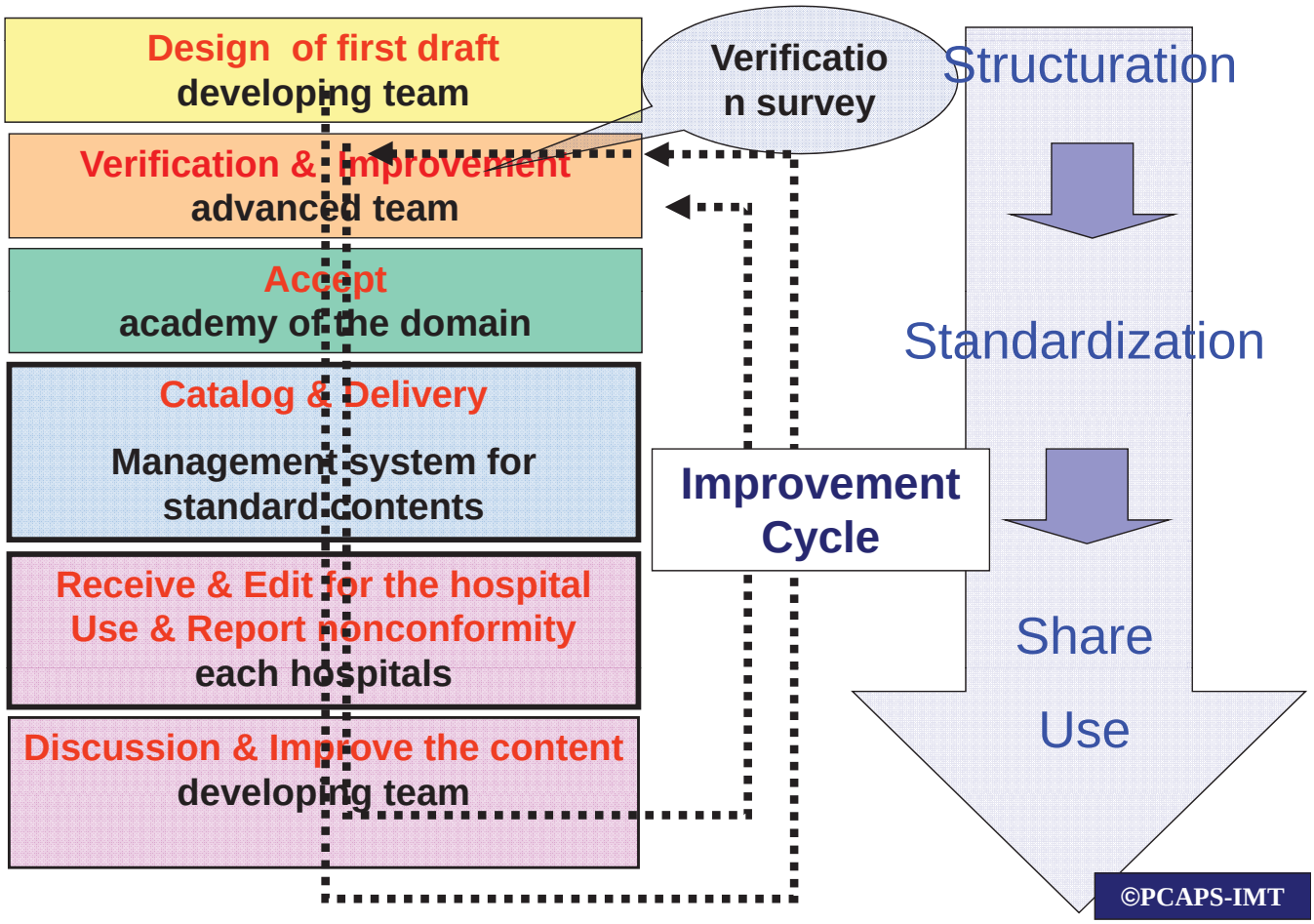
- publicity

## PCAPS contents (2010)

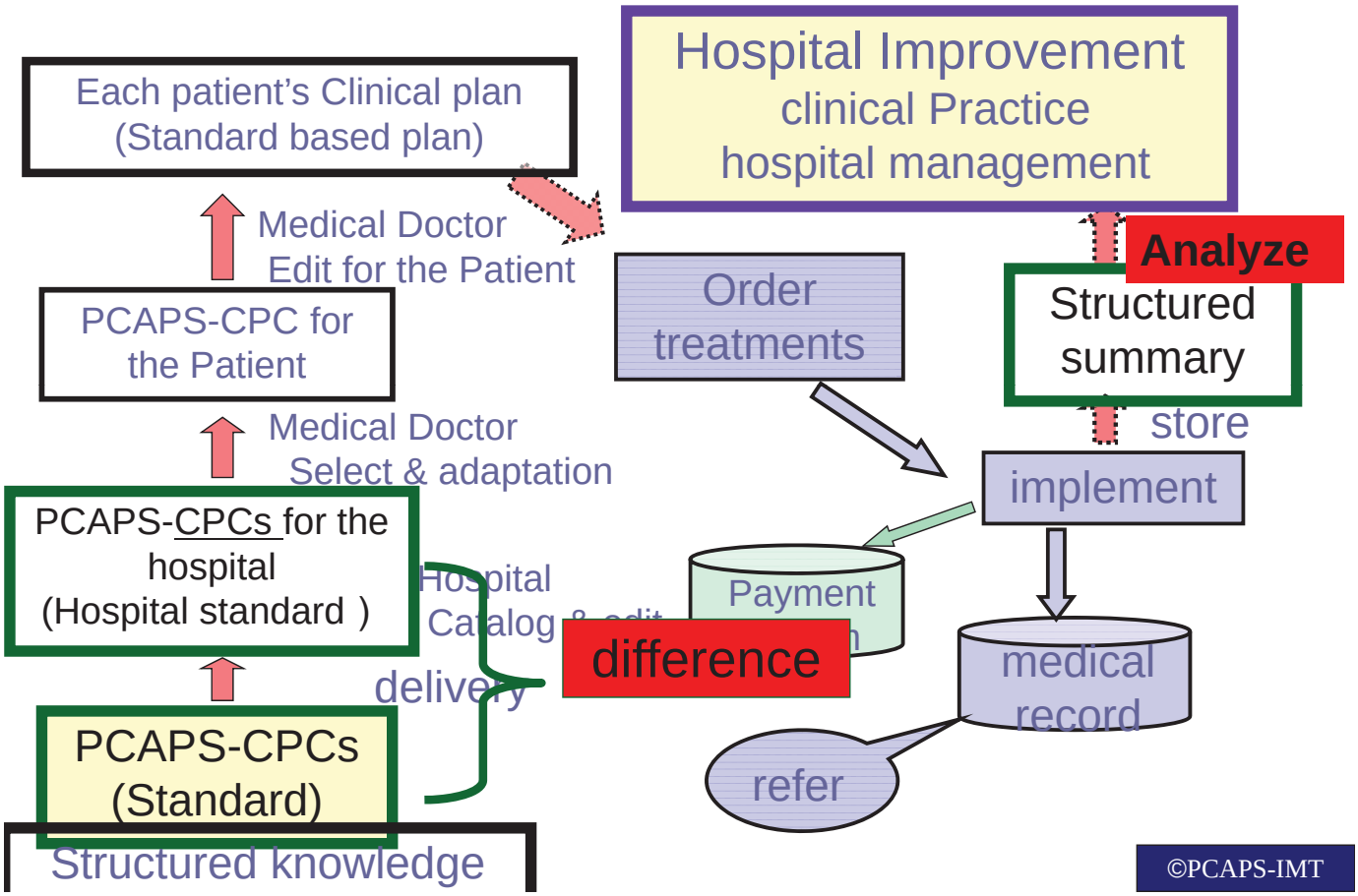
### 21 areas， 101 clinical process charts (electronically CPC)

- cancer (operation)
- cancer (chemotherapy)
- digestive tract internal medicine
- psychiatry department
- home nursing visit
- living donor liver transplantation
- neonatal care
- kidney internal medicine department
- Emergency
- department of respiratory surgery
- respiratory tract medicine
- circulatory organs department
- cerebral surgery
- nerve internal medicine department
- orthopedics department
- Diabetes
- Urology
- pediatrics department
- digestive organs surgery
- orthopedics
- obstetrics and gynecology

## Organized process design to make up social technology.




## Fact Based Policy making



## 5. APPLICATION IN ORGANIZATION

Application in healthcare organization

Application in region and society

Improvement of method to apply PCAPS contents in organization

# Implementing test and start 2011

**The following technical domains are selected:**

Application in acute hospital:
- Surgical operation
- Drug therapeutics
- Cancer treatment

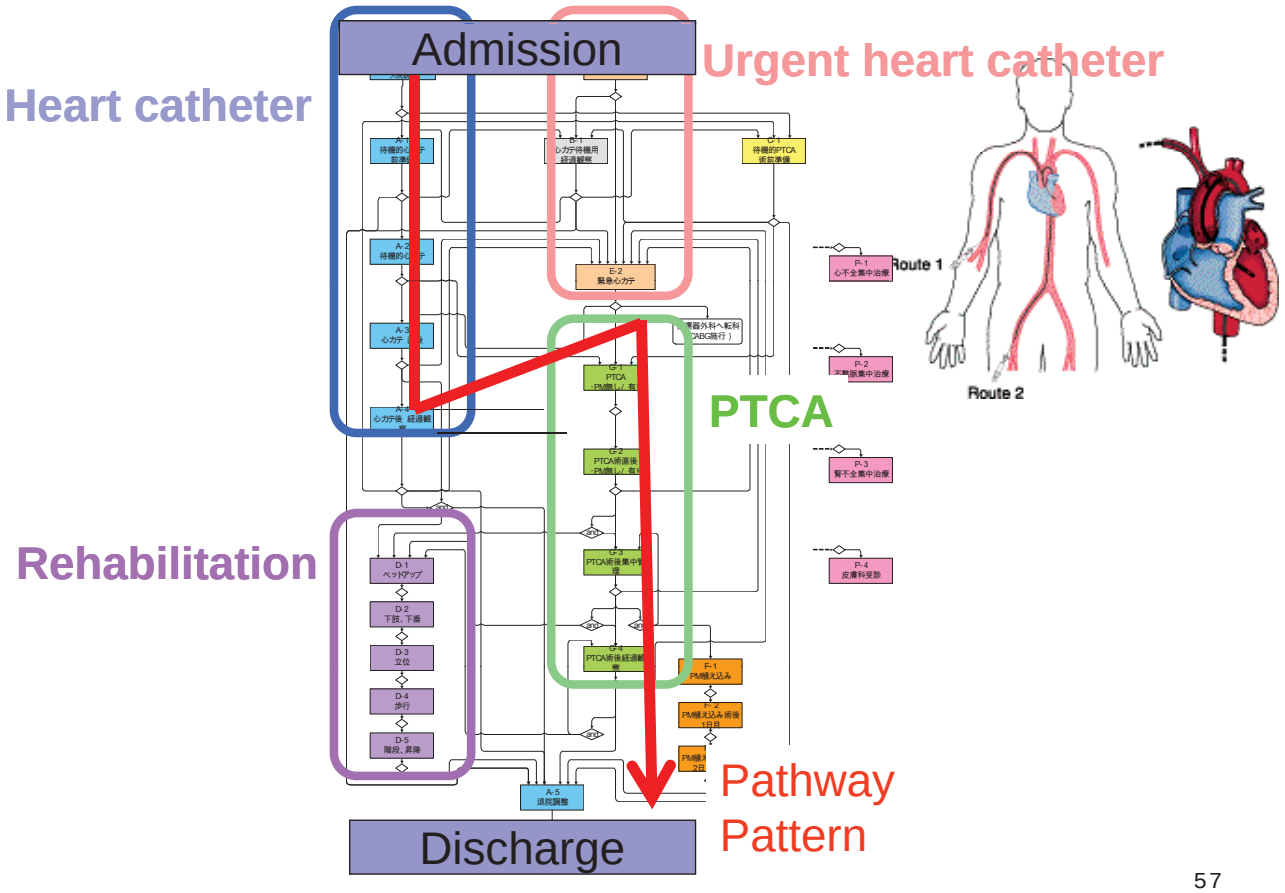
Application in recovery-stage hospital:
- Rehabilitation hospital

Application to perinatal medical care:
- Regional central hospital / clinics

Application to home medical care:
- Nursing station for visiting home

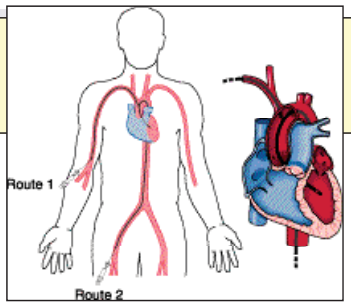
Application to alliance:
- among healthcare specialist teams within a hospital
- among neighboring healthcare service processes
- between low-risk and high-risk healthcare services

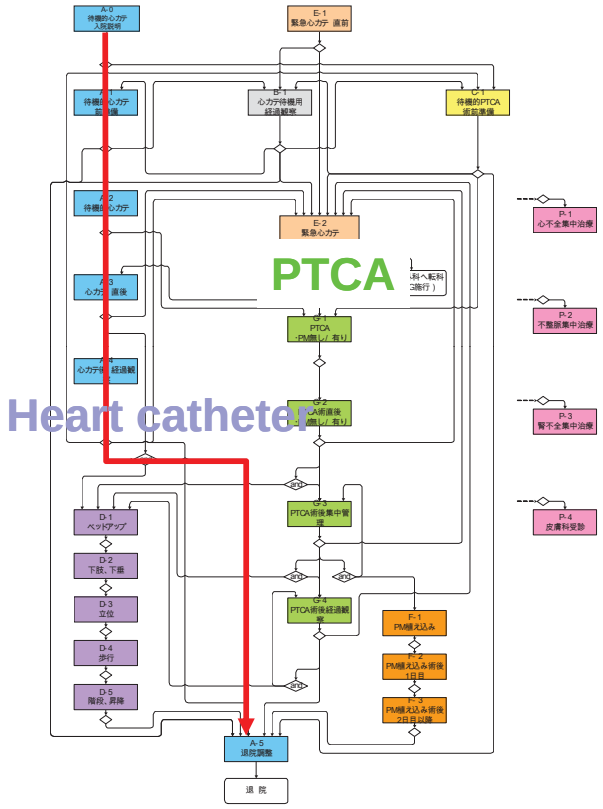
# IHD: Ischemic Heart Disease





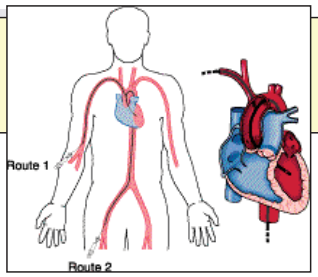

# Ischemic Heart Disease

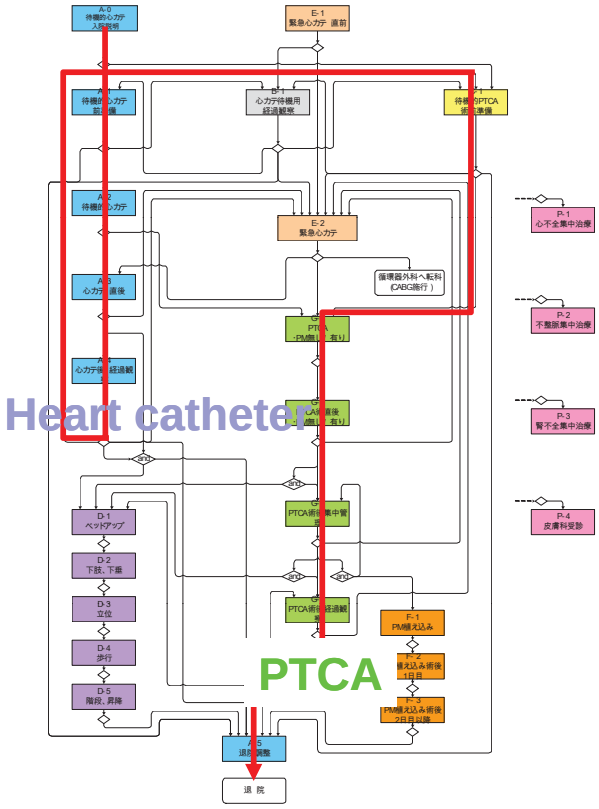



- **No. of valid responses**
  - No. of responses collected ：136例
  - No. of valid responses ：133
- **Type of pathway pattern**
  - **Pattern 1 ： 59 ( 44.4% )**
    *Cardiac catheter→Discharge*
  - Pattern 2 ： 15 ( 11.3% )
    *Cardiac catheter→PTCA→Discharge*
  - Pattern 3 ： 17 ( 12.8% )
    *PTCA→Discharge*
  - Pattern 4 ： 11 ( 8.3% )
    *Emergent cardiac*

# Ischemic heart disease

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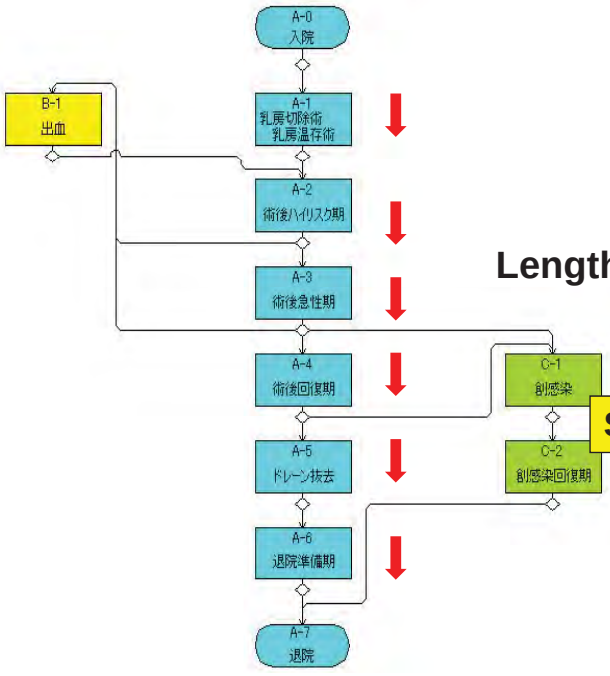
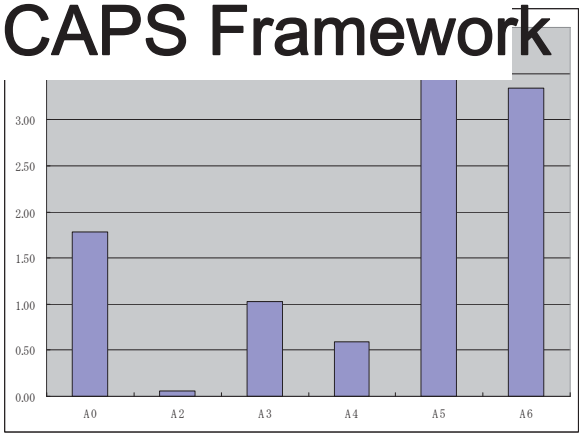
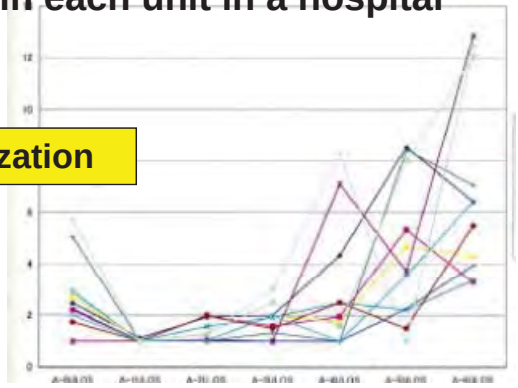
# Analysis Enabled by PCAPS Framework




**Length of stay in each unit in a hospital**

**Standardization**



**Visualization of differences among multiple hospitals**

## 5. APPLICATION IN ORGANIZATION

Application in healthcare organization

Application in region and society

Improvement of method to apply PCAPS contents in organization

# Application in region and society

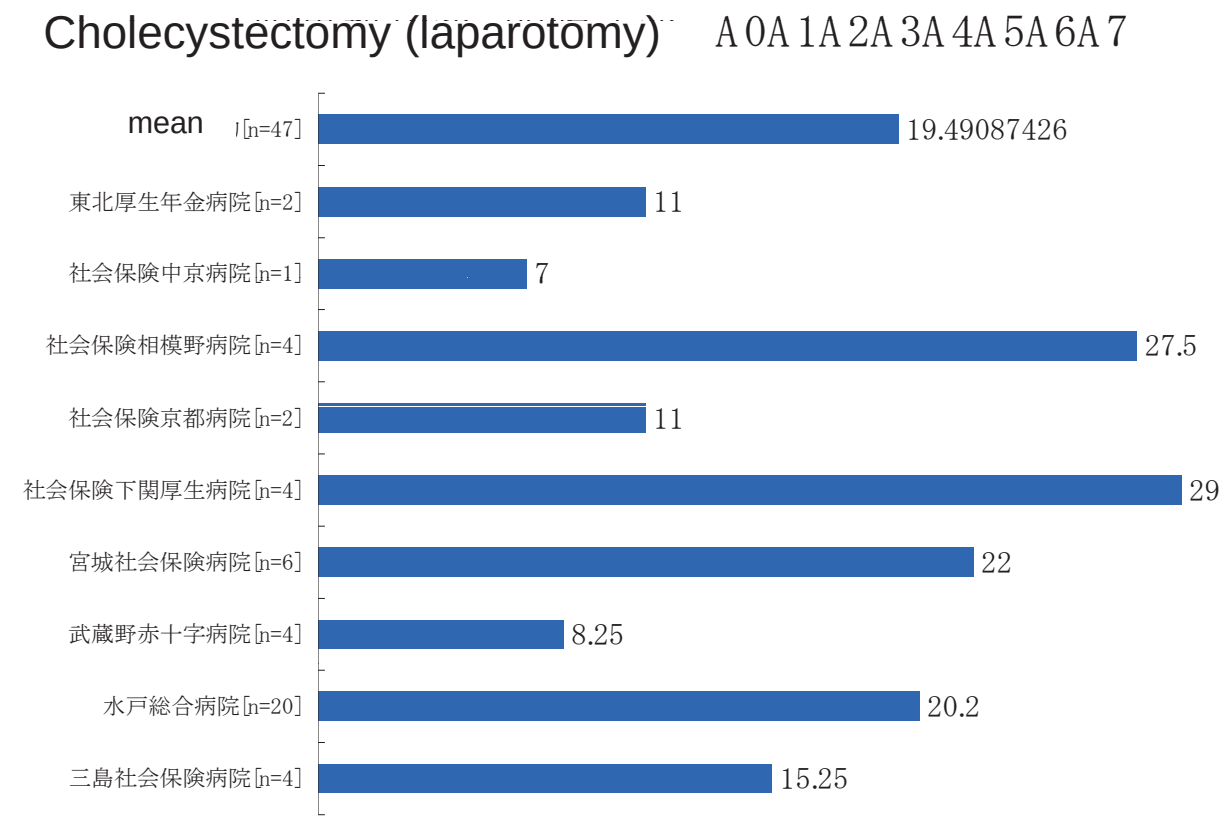
**For regional application, two aspects are considered:**

1) **application to regional healthcare service alliance**
2) **evaluation and improvement of regional healthcare service plan.**

**Application of PCAPS contents will make it possible for each region to collect data to prepare scatter diagram etc. and to identify strength and weakness in regional healthcare services.**

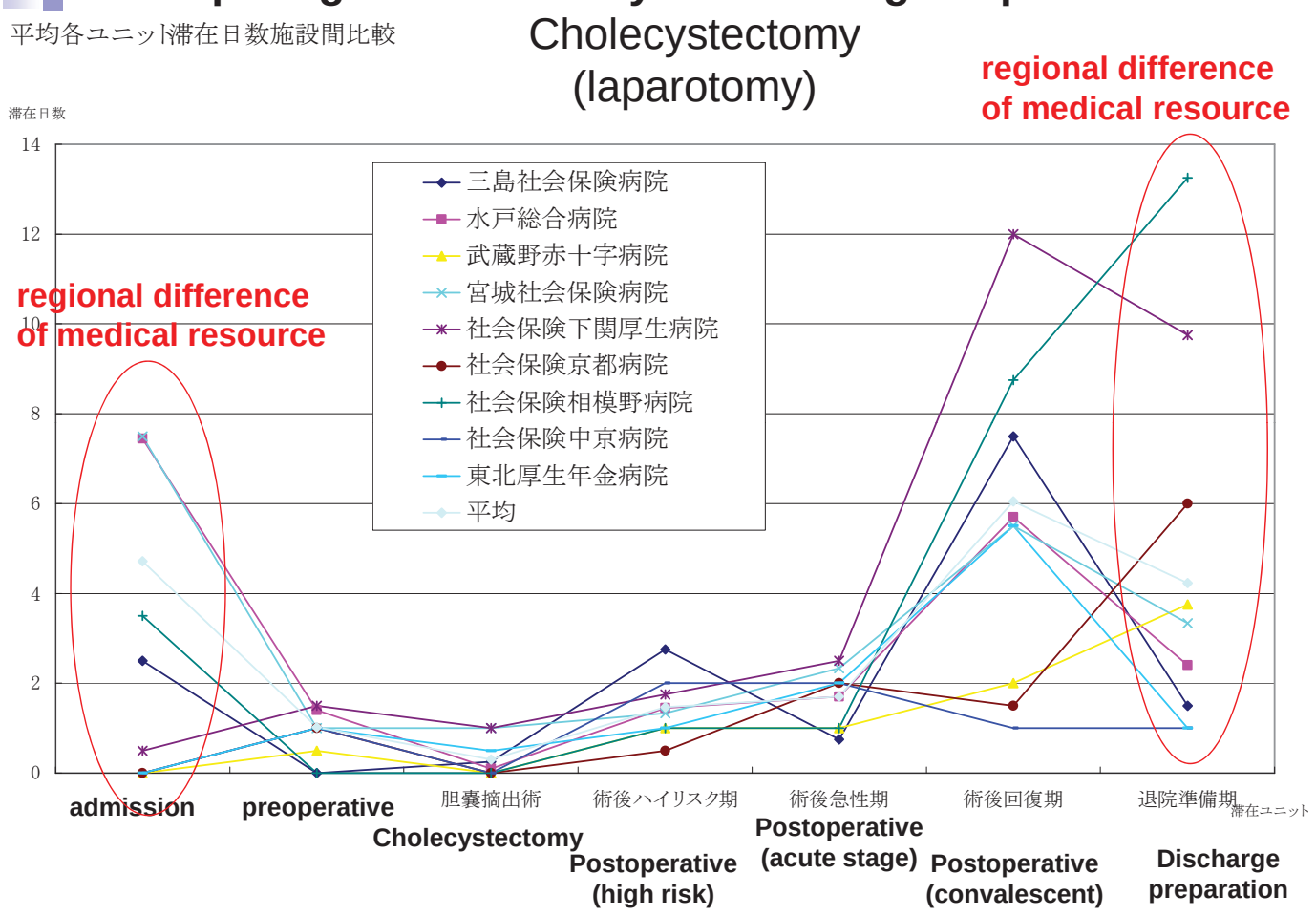
**Through similar procedures, it is also possible to evaluate and improve healthcare service policies and measures implemented by government agencies.**

# Admission date of each hospital

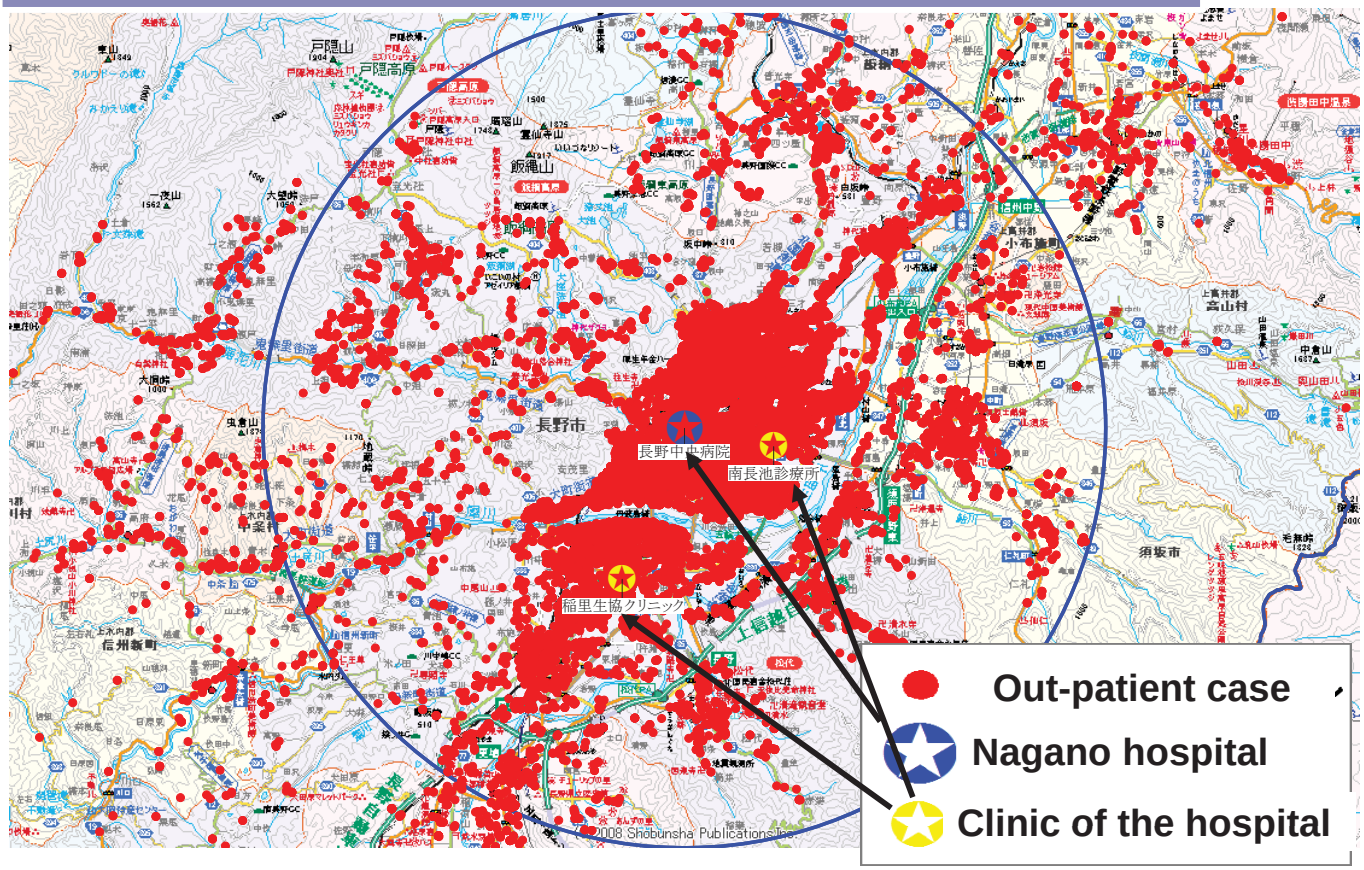



# Comparing Each unit stay date among hospitals

平均各ユニット滞在日数施設間比較



# Distribution of out-patients




## 5. APPLICATION IN ORGANIZATION

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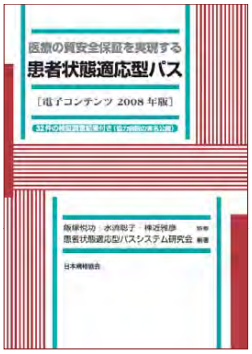
Improvement of method to apply PCAPS contents in organization

As organizations keep using PCAPS contents, method to apply them in organizations is expected to be theorized and further improved.

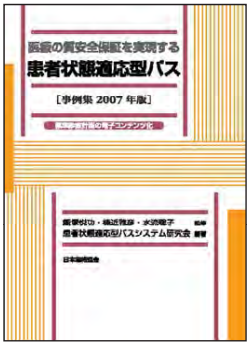
# Publishing PCAPS books from 2006 to 2011


2011

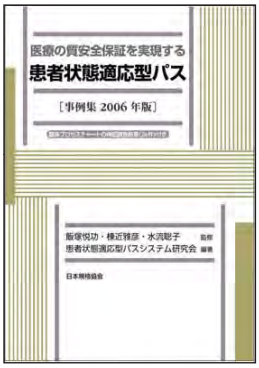

2010



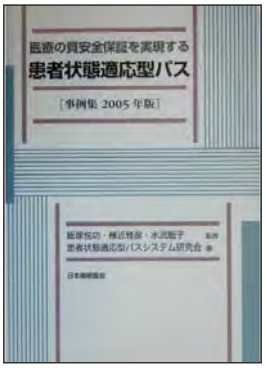

2009




2007




2006




2005

Thank you for your attention