Cancer information system utilizing IT

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1. Introduction

    The element of three types, structure, process, and outcome, is necessary to evaluate the quality of the cancer therapy. In the medical physics research field, developments of equipment are equivalent to structure and technology developments (diagnostic method and treatment method, etc.) are equivalent to processes. It is very important to feed back to clinical data as outcome. This time, we introduce cancer information systems utilizing information technology developed by us.

2. Clinical Database System

2.1. NCDB (National Cancer Database, USA)

    In the United States, the National Cancer Database (NCDB) was founded in 1989 as a joint project of the American Cancer Society and the Commission on Cancer (CoC) of the American College of Surgeons (ACoS). The NCDB is a nationwide oncology database for close to 1,600 hospitals in 50 states. The NCDB collects information on about 70% of all newly diagnosed cases of cancer nationwide annually. This database is used as the clinical performance measures and the quality indicator for improvements in the processes and outcomes of cancer care.

2.2. CCDB (Clinical Cancer Database, Japan)

    In Japan, it is necessary to establish an informational system that can collect national data for cancer care. The Clinical Cancer Database (CCDB) has been established on the radiotherapy data as a joint project of the Japanese Society of Therapeutic Radiology and Oncology (JASTRO). The CCDB software has been released on the JASTRO website (http://www.jastro.or.jp/). The CCDB software has consisted of two parts: the common part and the site-specific part (breast, cervix, esophagus, lung, and prostate cancer). The common part database had

the basic items as radiation oncology database. The site-specific part database had the detailed items in each site. The common part database and the site-specific part database were linked by the target disease flag. The CCDB software is updated periodically to incorporate the various opinions of the radiation oncologists. The analysis results of the collected data will be published through the website like the NCDB website. The registration of clinical cancer data will be opened during the current year.

2.3. PCS (Patterns of Care Study, USA and Japan)

The Patterns of Care Study (PCS), started in the 1970's, is a well-known study used for clinical quality assurance (QA) in radiation oncology in the United States. As PCS evolved into Quality Research in Radiation Oncology (QRRO), periodic assessments of radiation oncology have been conducted for evaluation of practice quality on a national basis. In Japan, PCS has been introduced since 1996. The structure, the processes and the outcomes for cancer care using radiotherapy have been investigated by PCS every four years. The Japanese PCS has evaluated the quality of cancer care with radiotherapy and provided evidence of the disparity in quality of radiotherapy among facilities. However, these data are insufficient because PCS is a two-stage cluster sampling survey. The Japanese PCS has performed focusing on the high-accuracy radiotherapy.

3. Facility Information Profile System

The JASTRO has conducted national structure surveys every 2 years since 1990. The questionnaire dealt with the number of treatment machines by type, the number of personnel by category, and the number of patients by type, site, and treatment modality. In 2009, web-based registry system was developed as a joint project of the JASTRO and this survey was performed every year since 2010. The response rate was 700 of 770 active facilities (90.9%). These data were used as facility information profile.

4. Online QA System

In the United States, the Advanced Technology Consortium (ATC) was founded in 1989 supported by a National Cancer Institute (NCI). This effort includes radiation therapy QA, image and radiation therapy digital data management, and

clinical research and developmental efforts. As Japan had no consortium like the ATC, we developed the online QA system. This system provided the following features.

✓ Anonymization and encryption of radiation treatment planning (RTP) data
✓ Data collection (Online/Offline)
✓ Monte Carlo Verification System (*Developed*)
✓ Making a database of radiation treatment data
✓ Web site (data browsing)

This system can evaluate detailed multi-center RTP data.

5. Conclusion

The cancer information system consisting of the CCDB, the Japanese PCS, and the online QA system was developed (Fig.). The data center has collected the RTP data, the clinical data of radiotherapy, and structure data from the participating facilities. Also the data center has published the analysis results through the Internet. This system makes it possible to make the international comparison.
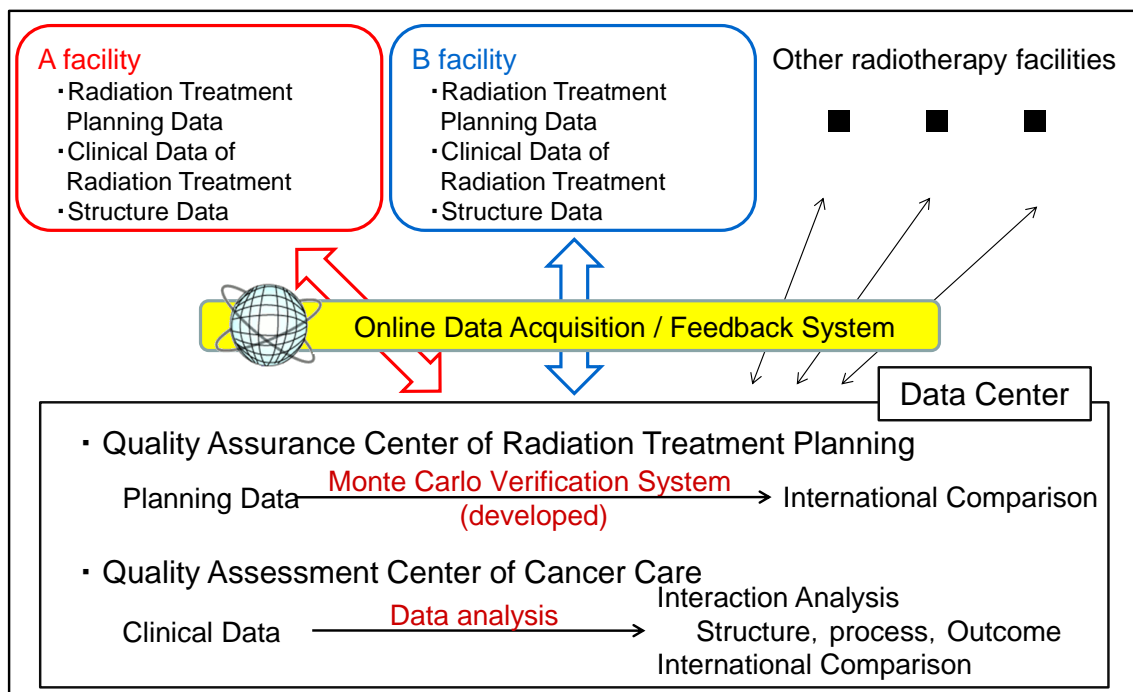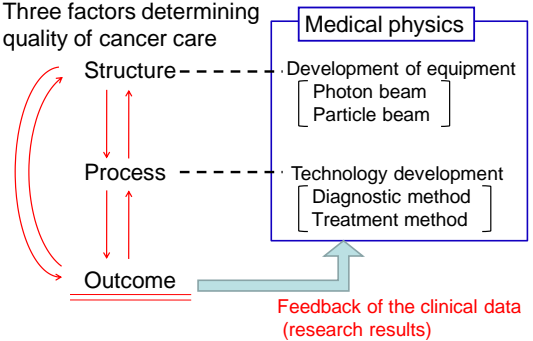

Fig. Cancer Information System

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Importance of Cancer Care Data

Three factors determining quality of cancer care

Structure

Process

Outcome

Medical physics

- Development of equipment
  - Photon beam
  - Particle beam
- Technology development
  - Diagnostic method
  - Treatment method

Feedback of the clinical data
(research results)

Contents

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  ➢ NCDB (National Cancer Database, USA)
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  ➢ PCS (Patterns of Care Study, USA and Japan)

☐ Facility Information Profile System
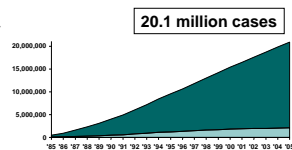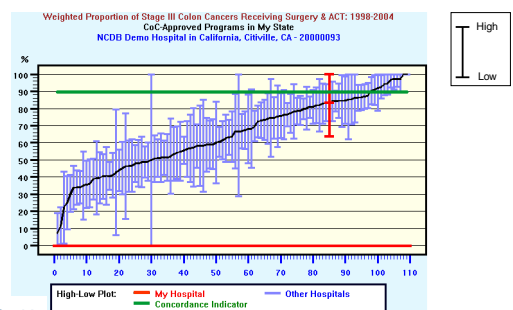
☐ Online QA System

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  ➢ NCDB (National Cancer Database, USA)
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☐ Online QA System

In USA: National Cancer Database

☐ What is the NCDB?
  ➢ A joint project of the American Cancer Society and the Commission on Cancer (CoC) of the American College of Surgeons (ACoS).
  ➢ A nationwide oncology database for close to 1,600 hospitals in 50 states.
  ➢ About 70% of all newly diagnosed cases of cancer nationwide annually.

20.1 million cases

20,000,000
15,000,000
10,000,000
5,000,000

'85 '86 '87 '88 '89 '90 '91 '92 '93 '94 '95 '96 '97 '98 '99 '00 '01 '02 '03 '04 '05

☐ Clinical Duplicates ■ Analytic Cases

Commission on Cancer

Data Feedback Example (NCDB)

Weighted Proportion of Stage III Colon Cancers Receiving Surgery & ACT: 1998-2004
CoC-Approved Programs in My State
NCDB Demo Hospital in California, Citiville, CA - 20000093

High

Low

High-Low Plot: — My Hospital — Other Hospitals
— Concordance Indicator

Commission on Cancer

Clinical Cancer Database (CCDB)

❑ Data management
- Clinical cancer data collection and analysis
- Data: Structure, Process, Outcome
- Evaluation of quality of cancer care

❑ Publication of the database software
- JASTRO Homepage (http://www.jastro.or.jp/)
- Double-layered structure
  - ✓ Common part
  - ✓ Site-specific part
    Breast. Cervix, Esophagus, Lung, Prostate

CCDB Structure

Common part

Linkage by target disease flag
Reciprocal data-sharing (common data items)

Breast | Cervix | Esophagus | Lung | Prostate
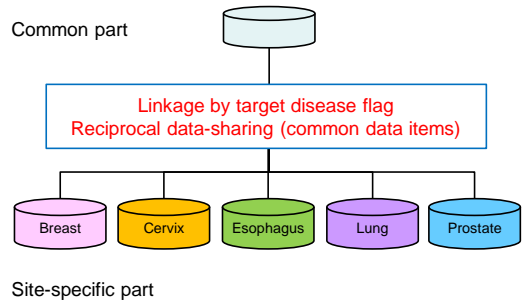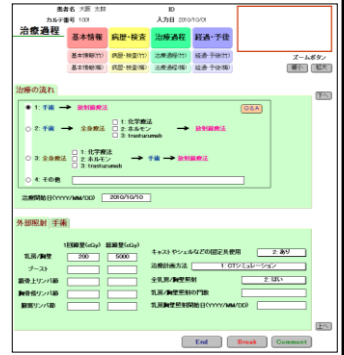
Site-specific part

Common Part DB

- FileMaker
- Basic items as radiation oncology database
- Number of items: 71
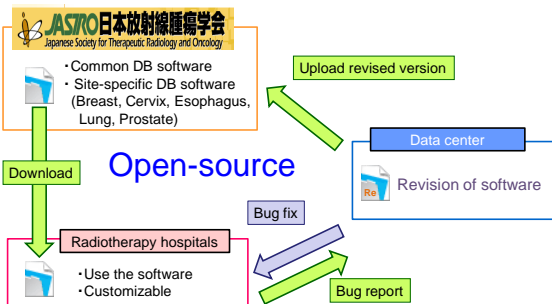- Data import / export

Site-specific Part DB

- FileMaker
- Detailed items
- Number of items: 200~300
- Available as each department DB (Breast. Cervix, Esophagus, Lung, Prostate)

CCDB Development Cycle

- Common DB software
- Site-specific DB software (Breast, Cervix, Esophagus, Lung, Prostate)

Open-source

Download

Radiotherapy hospitals
- Use the software
- Customizable

Upload revised version

Data center

Re Revision of software

Bug fix

Bug report

Data Feedback

Web page (image)

ID
Password
log in | log out

Analysis item
Total dose
Age
cT
Go

Survey year
- 2009
- 2010
- 2011
- 2012
- ALL

Site
- Breast
- Cervix
- Esophagus
- Lung
- Prostate

Total dose (cGy)	My data	National data
< 6000	3 (7.0%)	328 (2.0%)
6000 >=, < 6500	12 (27.9%)	2,337 (14.4%)
6500 >=, < 7000	18 (41.9%)	5,125 (31.6%)
7000 >=	10 (23.2%)	8,446 (52.0%)
Total	43	16,236

PCS (Patterns of Care Study)

□ Over view
- ➢ Clinical Performance Measures / Quality Indicators
- ➢ Data: Structure, Process, Outcome
- ➢ Two-stage cluster sampling (facilities and cases)

- ➢ USA… Current
  QRRO（The Quality Research in Radiation Oncology）

- ➢ Japan… Current
  Quality evaluation of high-accuracy radiotherapy
  → Special study

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□ Online QA System

Facility Information Profile System

□ Structure survey of radiation oncology in Japan
- ➢ Joint survey with JASTRO
- ➢ Web based registry system
- ➢ Results showed equipment and personnel information in 700 facilities nationwide (2009)

□ Cooperation with CCDB
- ➢ We used data as FIPS of CCDB
- ➢ Comparison of FIPS with process and outcome will be possible.
- ➢ Important information for medical policy making.

FIPS Web Registration Screen

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Online QA System

□ Multi-center radiotherapy treatment planning
- ➢ U.S.A.: Advanced Technology Consortium（ATC）
- ➢ Development of communication infrastructure in Japan

□ Online QA System
- ➢ Anonymization and encryption of radiation treatment planning data
- ➢ Data collection (Online/Offline)
- ➢ Monte Carlo Verification System (*Developed*)
- ➢ Making a database of radiation treatment data
- ➢ Web site (data browsing)

Overview of Online QA System

Web site

Make a database

SQL Server

Imaging devices (DICOM)   RTPS (DICOM-RT)

Radiation Treatment Planning Data

Delete personal data
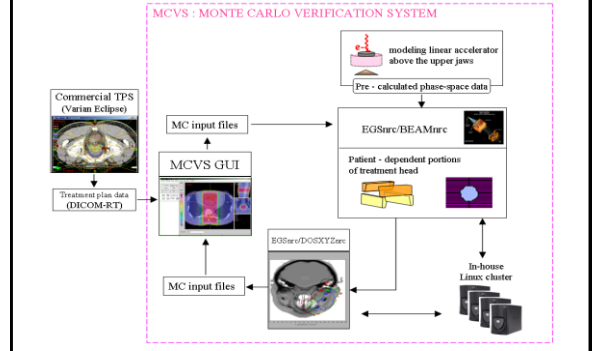
Internet

Online SSL encryption

Offline Mailing data CD

Radiotherapy hospitals

· Recalculation of DVH
· Verification of treatment planning

Monte Carlo Verification System

Data center

Monte Carlo Verification System

MCVS : MONTE CARLO VERIFICATION SYSTEM

Commercial TPS (Varian Eclipse)

Treatment plan data (DICOM-RT)

MC input files

MCVS GUI

modeling linear accelerator above the upper jaws

Pre - calculated phase-space data

EGSnrc/BEAMnrc

Patient - dependent portions of treatment head

EGSnrc/DOSXYZnrc

MC input files

In-house Linux cluster

Cancer Information System

A facility
· Radiation Treatment Planning Data
· Clinical Data of Radiation Treatment
· Structure Data

B facility
· Radiation Treatment Planning Data
· Clinical Data of Radiation Treatment
· Structure Data

Other radiotherapy facilities

Online Data Acquisition / Feedback System

Data Center

· Quality Assurance Center of Radiation Treatment Planning

Planning Data — Monte Carlo Verification System (developed) → International Comparison

· Quality Assessment Center of Cancer Care

Clinical Data — Data analysis →
Interaction Analysis
Structure, process, Outcome
International Comparison