

A Scheduling System for the Patient Treatment on a Heavy-ion Radiotherapy.

Hinako Toyama, Kouichi Shibayama, Syusuke Kanatsu, Toshitaka Kuroiwa, Hideo Watanabe, Mitsuji Wakaisami, Hiroshi Tsuji, Masahiro Endo and Hirohiko Tsujii

Research Center of Charged Particle Therapy, National Institute of Radiological Sciences, JAPAN
e-mail: hinako@nirs.go.jp

ABSTRACT

We have developed a scheduling system for heavy ion radiotherapy considering the condition of three treatment rooms and treatment planning for each patient. This system consists of a database (patient information, treatment method and machine schedule), a schedule for radiotherapy and WEB server. All operation of this system, such as data input, to change and to view the schedule, are performed by using a WEB browser. In order to protect personal information for the patients, access privilege to each information are limited by according to the occupational category. This system is connected with a hospital central information management system (AMIDAS) and an irradiation-managing computer for the heavy ion radiotherapy. A basic information for the patient is got from AMIDAS and the daily schedule sends to the treatment control computer at each treatment room through the irradiation-managing computer every morning. The daily, weekly, monthly schedules in the treatment room and the treatment condition of each patient are shared on the WEB browser with the all participants of the heavy ion therapy. This system could be useful to save a time to generate a treatment schedule and to inform us the most up-to-date treatment schedule and the related information at the same time.

Keywords: Heavy-ion Therapy, Treatment Scheduler, WEB Server, Hospital information system, Database

1. INTRODUCTION

More than one thousand of patients with cancer have received carbon-ion therapy as clinical trial since 1994 at the hospital in our institute. Conventionally, a schedule of carbon-ion therapy was making manually in each process of machine running time, patient assignment and treatment planning on the papers, which were distributed to the participants whenever any changes occurred in the schedule. The purposes of this study are to make a schedule on the computer system and all participants are able to access easily to the schedule in which any changes are reflected any time and share the same information each other. Cooperation among the systems in the hospital has been also tried and the common information is shared between systems and also among doctors, nurses, technologists and paramedical scientists. And we have also tried to register the record of carbon-ion therapy into the central information management system automatically in order to correspond a electric patient record.

2. MATERIALS AND METHODS

2.1. System configuration

A hardware system is consist of a unix server with four CPUs, a raid disk for data storage and system backup and a network with gateway for remote access from the maintenance company as shown in Fig. 1.

2.2. Software configuration of the scheduling system.

The scheduler consists of the following four processes. 1: to reserve the treatment "frame" on the machine running time

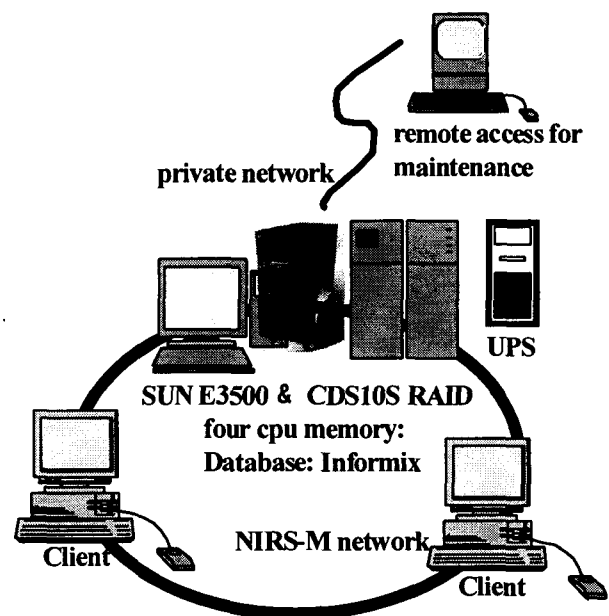


Fig. 1 System configuration of the heavy-ion therapy scheduler, consisting of a Unix server with raid and UPS, client PCs and a network with remote access gateway for remote maintenance

table. 2: to assign the patient to the “frame” according to the fraction times (4, 5, 9, 12, 16, 20). 3: to input treatment conditions for each patient and 4: to book the treatment room in the assigned “frame” according to the employing beam energy and direction, treatment position and the other condition such as use of respiratory gate.

2.3. Cooperation with other systems in the hospital.

In our hospital, there are four major computer systems (AMIDAS, Order entry system, Radiotherapy planning Database and this scheduler). These systems are connected each other as shown in Fig. 2. Basic information of a patient and most entry of clinical study and clinical treatment are managed in the order entry system. The results of the study and treatment, patient’s clinical record are saved into AMIDAS. In the scheduler, a basic information for the patient is got from AMIDAS and the daily schedule sends to the treatment control computer at each treatment room through the irradiation-managing computer every morning. A carbon-ion therapy is performed by using the date getting from the scheduler and the radiotherapy planning system. The status of the treatment, such as “under treatment”, “completion of treatment” and so on, is received from the irradiation managing computer and transfers to the AMIDAS.

3. RESULTS

3.1 Access control

In order to protect personal information for the patients, access privilege to each information are limited by according to the occupational category. All participants in radiotherapy are able to look all information, but only some technologist or some medical doctors having privilege can be able to generate and update the schedule.

3.2 Machine schedule and reservation of the treatment “frame”.

A schedule of running the accelerator for one year (April to March) are determined every year. We divide a year into two terms. A carbon-ion therapy is planned every term. A technologist reserves treatment “frame” over the term according to the machine running time as shown in Fig. 3. Number of patient to be treated per day and No. of fraction are shown in Fig. 3. “S” means start of irradiation, CT means to take CT images for treatment planning. If number of patient a day exceed the arranged number, warning is noticed. In the next process, if a doctor assigns a patient to the “frame”, the name of the patient is displayed as shown in Fig. 3 (Pt-1, Pt-2....).

3.3. Assignment of the patients to the treatment “frame”.

A doctor registers a patient ID to this system and the name, gender and belonging are appeared if the patient is already registered in our hospital. Then the doctor put the more information such as a name of physician in charge, disease name and treatment protocol and assigns the patient to the “frame”.

3.4. Input the parameters for radiotherapy and assignment of the treatment room.

A technologist for radiotherapy planning put the related parameters to a carbon-ion therapy, according to the radiotherapy planning of a patient. A treatment room is assigned to the patient depending on the energy and direction of the carbon-ion beam, treatment position (sitting or decubitus) and existence of patch or multi ports irradiation, shrinkage of radiation field and respiratory gating.

3.5. Weekly and daily schedule for carbon-ion therapy

After setting the parameters for radiotherapy, a patient is assigned to a treatment room and the order of treatment as shown in Fig. 4. A right side table shows a daily schedule at room A. When we click the patient ID, the details of a

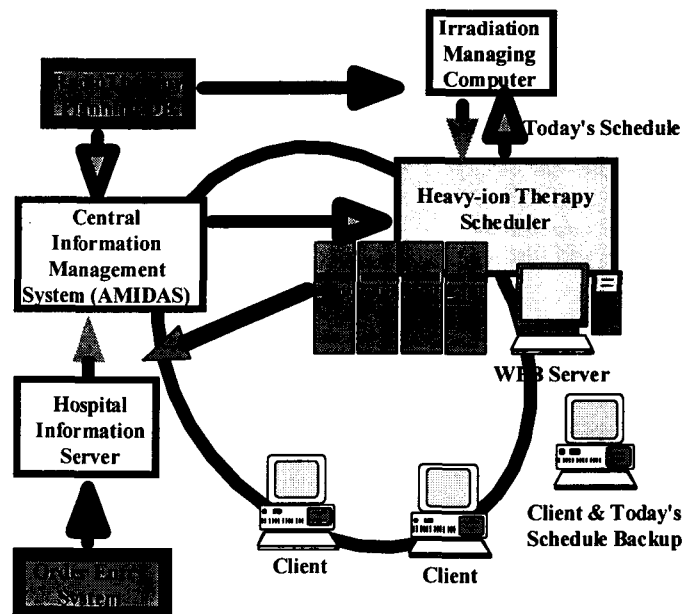


Fig. 2 Cooperation with other systems in our hospital. Basic information and clinical record for a patient in the central information management system

patient and two types of comment are displayed on the browser as shown in the left side of Fig. 4. A common comment is displayed during irradiation and a daily comment is displayed only the dedicated day. After irradiation finished, a color of the patient ID on the display changed into yellow color. When irradiation for all reserved patient is finished or a operator push the finish button, the status of “completion of treatment” is transferred to AMIDAS automatically.

3.6. System maintenance

Most of operation for system maintenance is also done on the WEB browser.

4. DISCUSSIONS

We have been using this system during a half of year. The daily, weekly, monthly schedules in the treatment room and the treatment condition of each patient are shared on the WEB browser with the all participants of the heavy ion therapy. A schedule change occurred in any process is reflected to all process immediately. All data on this system is preserved and is able to be utilize on scheduling in the next term.

5. CONCLUSIONS

This system could be useful to save a time to generate a treatment schedule and to inform us the most up-to-date treatment schedule information at the same time.

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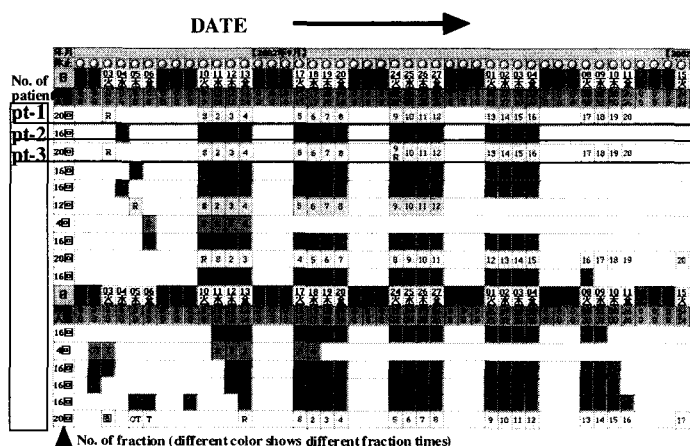


Fig. 3 Machine running days & reserved frames for carbon-ion

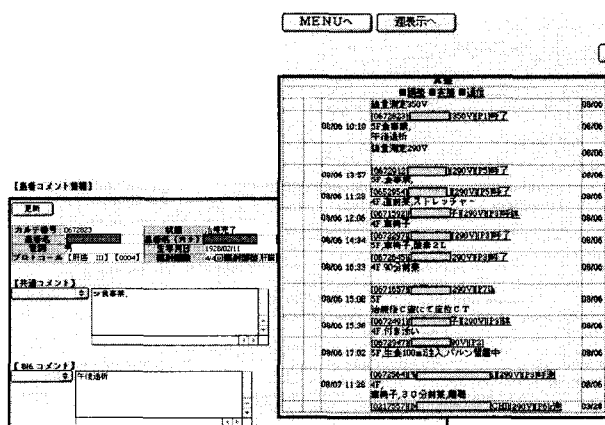


Fig. 4 “Today’s schedule” on Room A & the information and the comment for a patient, which are displayed when we click the patient ID.