

FUJI-Scheduler : Outpatient-Test-Order-Management Function for Order Entry System

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Abstract— The computerization of medical institutions as part of the social infrastructure is one of the priority elements referred to in the government's e-Japan Strategy. The computerization of patient data is currently making progress, and these are being accumulated by medical institutions as massive volumes of patient data. In order to use these records effectively, therefore, medical institutions require the capability to represent patient records in a variety of different forms that aid in understanding the information, the capability to share patient records among multiple medical institutions, the capability to support the systematic and effective provision of medical care, and other such functionality. In this paper, the clinical planning for the outpatient medical care of chronic disease patients and the data representation for EPR system are investigated. This paper also describes the order entry system that incorporates FUJI-Scheduler that supports formulating test order schedule and the function that efficiently represents the past test order data and the future test order data. This system is able to create annual test schedules for each patient and automatically create test orders using the plan. It also provides a new user interface that reduces the workload of the people who create the plans. This system is presently being operated on an experimental basis.

I. INTRODUCTION

THE amount of medical records of patients has vastly been increasing. In paper-based management, the medical records present difficulties in keeping well-organized data, and in reviewing patients' history and treatment. This is one of the problems of medical services dace, which can be solved through the use of information technology. The Japanese government, in the e-Japan Strategy, aims to establish medical information as part of the social infrastructure, improve safety, and provide a uniform quality of medical care. The outcome of computerizing medical information will be the capability to utilize a variety of different data representation methods more easily than with paper-based medical records. The Query Clinical Information System (QCIS) has endeavored to present patient data from three viewpoints, and LifeLines has endeavored to provide visualization [1][2].

We have conducted research and development of

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electronic patient record (EPR) system, focusing on medical care and computerization with regard to chronic disease patients with lifestyle-related diseases and other such conditions. In this paper, the clinical planning for chronic disease patients and the data representation of EPR system are investigated. This paper also describes the order entry system developed based on those investigations. This system allows the support for formulating test plans and the efficient representation of past data to be put into practice.

II. CLINICAL PLANNING FOR OUTPATIENT MEDICAL CARE

The outpatient medical care for chronic diseases is not only to provide treatments, but also to keep conditions from growing worse, to keep conditions stable over time, to quickly grasp changes in conditions, and so on. There is a need to checkup tests, drug therapy, lifestyle therapeutic recommendations for chronic disease outpatient. These are continuous long-term medical care. It is effective for chronic disease outpatient to create long-term medical care plans in advance.

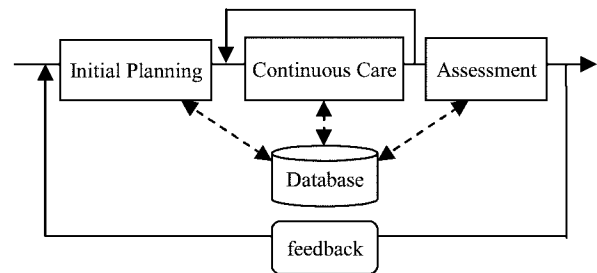


Fig. 1 Medical care loop for chronic disease outpatient

In providing efficient outpatient medical care for chronic diseases, it is effective to create a long term (one year) medical care plan for each patient and provide continuous medical care based on the plan. As shown in Fig.1, such medical care plan can be expressed as a medical care process consisted of initial planning, continuous medical care and assessment.

In the initial planning block, such data as changes in patient conditions and test results are comprehensively diagnosed in order to prepare an annual medical care plan for the patient. This contributes to the safety of medical care by preventing redundant testing and lack in test items, as well as early detection of side effect of the medicine. In the continuous medical care block, each medical care based on

the annual medical care plan is conducted and the plan is modified due to the patient condition if necessary. In the assessment block, the differences of the activity between the annual plan and continuous medical care are investigated and reflected in the next planning.

III. DATA REPRESENTATION IN EPR SYSTEM

The EPR system provides the systematic collection, storage and representation of clinical information. It is important for the EPR system to reorganize and represent a large volume of clinical information efficiently. The following functions are required for the EPR system user interface:

- To provide efficient and flexible data representation
- To improve data entry workload
- To utilize screen area effectively

The source data, that is stored in database, is time series data. However, the medical doctor analyzes the patient records from a variety of different viewpoints in order to grasp the variety of information. We consider data representation method for order data.

To begin with consideration, we classify view style of order data into six categories such as View of Plain Text, View of Outline, View of Consolidation, View of Table, View of Time Line and View of Tree. View of Plain Text displays chronological character based order history. This simple view is used to the ordinary system and overwhelms physicians with a large volume of data. View of Outline displays event summaries of each care such as activity date, doctor, treatment title and so on. View of Consolidation displays the extracted data which are consolidated to reduce the semantic redundancy of order history. View of Table displays order items arranging them in columns. View of Time Line displays lines and icons which keep the overview of the entire order history. LifeLine is based on View of Time Line. View of Tree displays hierarchical structured data. OpenSDE is based on View of Tree[3][4].

Next consideration, we give attention to time-related data such as past data, current data and future data. We consider that there are differences in user demands for the view style of order data among them. In the data representation of past data, displaying the progress of medical care and detecting the contextual information (diversity, continuity and regularity) existing among the data issued in the different days are necessary. In the representation of current data (in other words, medical care data entry), controlling terminology and an efficient data entry system are necessary. In the representation of future data (in other words, schedule management), support for creating medical care schedule, display system and automatic order creation system based on the medical care schedule are necessary.

IV. SYSTEM ARCHITECTURE

We have developed an order entry system for outpatients which includes improved clinical planning for outpatients and improved data representation method. The feature of this system is in the doctor office system and the schedule system. As shown in Fig.2, the doctor office system includes SAKURA-Viewer and FUJI-Scheduler in addition to the ordinary order entry function and Graph-viewer. SAKURA-Viewer can represent past data efficiently. FUJI-Scheduler is the outpatient test order management function which is also put into practice.

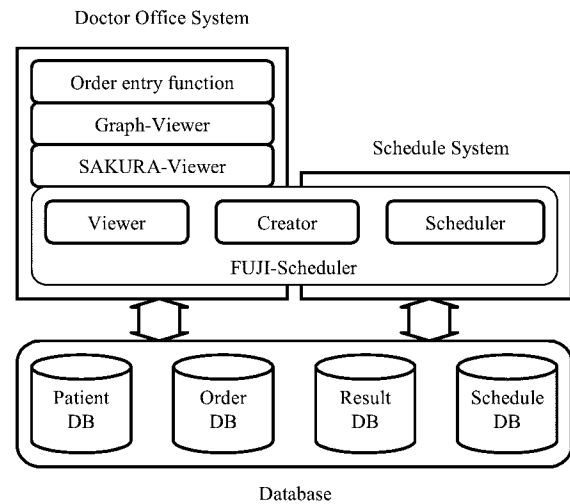


Fig. 2 System architecture

V. SAKURA-VIEWER

The representation of patient records from a variety of different viewpoints assists medical doctors in understanding patient records. It also promotes the efficiency of collaborative work within medical institutions. We have been conducting research and development on SAKURA-Viewer to provide functions in support of the efficient representation of patient records. This viewer is intended to represent order history in space efficient. As shown in Fig.3, this viewer represents the order history from the two viewpoints such as the View of Outline and the View of Consolidation. The order histories of chronic disease patients tend to be composed largely of regular prescriptions and regular tests, so that the same data content appears many times. This viewer makes it possible to significantly reduce the recording of regular prescriptions and regular tests, which make up a large part of the volume of an order history. Meanwhile, the viewer also features the capability to retain information on the progress of time. The viewer adopts button objects as the basic data display unit. This feature allows the displayed data to be used directly as input data. We have also provided SAKURA-Viewer with expanded functionality so that it can represent order histories that have been obtained by medical cooperation with other medical institutions [5][6][7].

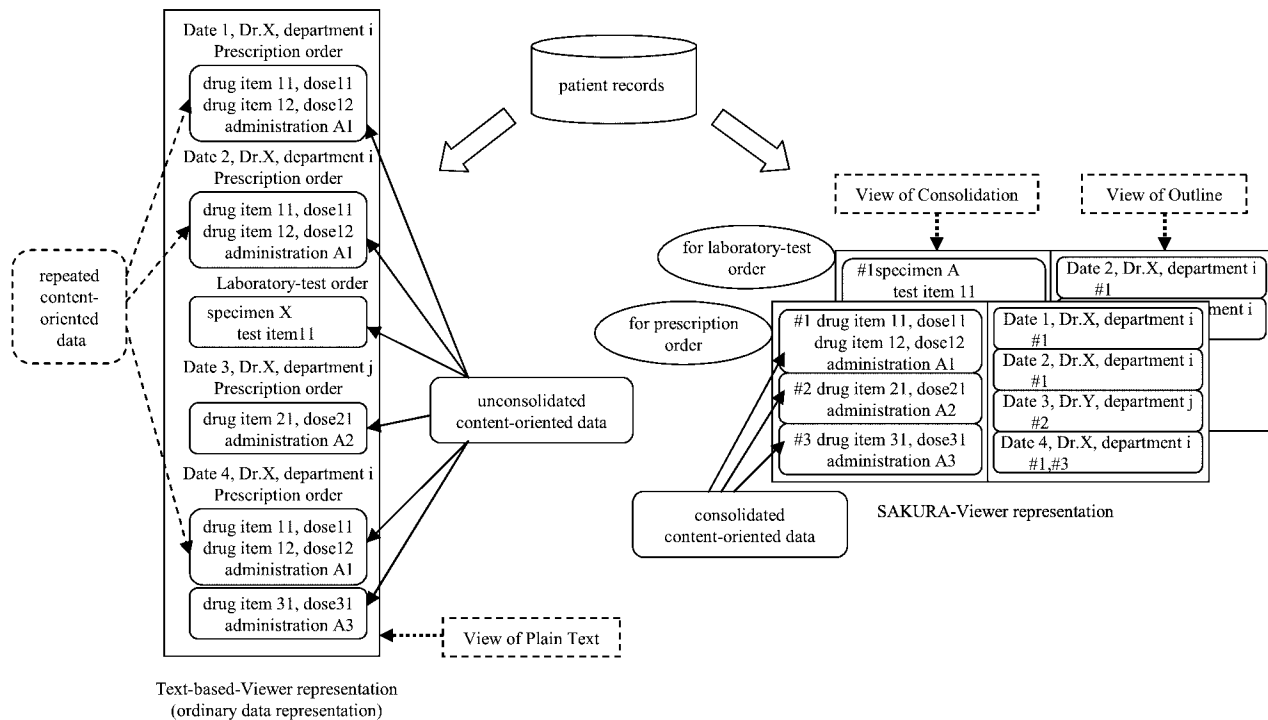


Fig. 3 Overview of SAKURA-Viewer data representation characteristics

VI. FUJI-SCHEDULER

FUJI-Scheduler supports medical care for chronic disease outpatients whose test items and their interval vary from patient to patient. FUJI-Scheduler manages the test schedule and the test order history. Further, FUJI-Scheduler reduces user's workload to create annual test schedule and to create test order. Its main functions are as follows:

- Managing the test items and their interval for each patient
- Displaying test history, test schedule and others
- Providing a user interface suitable for the characteristics of data
- Creating test order using the schedule database automatically

FUJI-Scheduler consists of Viewer, Scheduler and Creator. Viewer and Creator are implemented in the doctor office system and Scheduler is implemented in the Schedule system.

A. Viewer

Viewer has functions that visualize test order history, test schedule and others, and implements these functions in the doctor office system. Viewer displays the past data and the future data on the same screen. The past data are the test order history and the test schedule history. The future data is the planning test schedule. It enables the user to grasp the

discrepancies between the scheduled test items and ordered test items easily. Viewer data presentation method has been put into practice by expanding the idea of "View of Table" as shown in Fig.4. In particular this function displays the cases with seven categories such as "scheduled & completed", "no schedule & completed", "scheduled & canceled", "scheduled & not completed".

Year	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06	07	08
HbA1c	@	-	@	@	@	@	@	-	@	@	+	+	+	+	+	+	+
Glucose	@	-	@	@	@	@	@	-	@	@	+	+	+	+	+	+	+
Cr			@			@			@			+			+		

Test order history: 04 to 12
 Test schedule history: 01 to 12
 Planning test schedule: 01 to 08
 now: 01

View of Table

@: scheduled & completed
 -: scheduled & canceled
 +: scheduled & not completed

Fig. 4 Data representation style of FUJI-Scheduler

B. Scheduler

Scheduler includes Viewer's functions, data entry function to create a test schedule for each patient, and others. Scheduler

implements various data entry methods. This has enabled the annual test plan to be patient-centered, and the workload of input operation has been reduced. The advantages of this scheduler are as follows.

- Enables to create and store long term medical care plan for each patient
- Enables to take appropriate actions due to the change in disorder of a patient
- Enables to feedback past patient data

The schedule template function is one of the data entry function. It provides next annual medical care plan based on the past order history and the schedule history. With this function it is enabled to create an annual medical care plan for each patient. And the function can also contribute to the efficiency of creating plan data.

The test schedule document issuance function prints out documents that explain the substance and implementation status of the plan to the patient. These documents are not only stored at the medical institution, but can be used when giving patients explanations of their medical care plans and the course of their medical care over time.

C. Creator

Creator creates automatically test order using schedule database. This function help to minimize the occurrences of test item-omission errors. The automatic order creation algorithm is shown in Fig. 5. This algorithm can be summarized as follows:

- It validates test schedule only for the attending physician.
- It easily creates actual test order and adjusts test schedule.
- It requires data validation for each order creation.

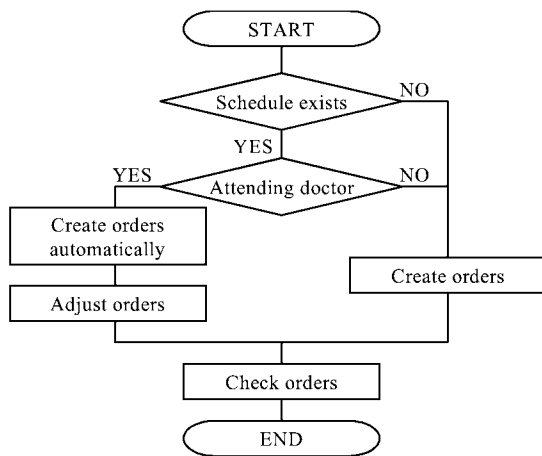


Fig. 5 Overview of automatic order creation algorithm

VII. CONCLUSION

The FUJI-Scheduler and SAKURA-Viewer described in this paper were actualized by incorporating them in the EPR system. This order entry system is currently being operated on an experimental basis at medical offices devoted primarily to internal medicine.

FUJI-Scheduler has been effective in improving the efficiency of medical care for lifestyle-related diseases and other such chronic conditions. Annual test schedule for each patient are created by physicians. Schedule for periodic test items such as blood chemistry and long interval test items such as physiological tests can now be examined patient by patient. The explanation of annual test schedule and their compliance are integrated with nutritional guidance, instruction on medication, exercise guidance, test result explanation and so on.

In addition, the automatic order creation function based on the annual plan has made it possible to reduce the workload of medical doctors. The effect of preventing omission-error and other such errors is also contributing to the increased safety of medical care. Finally, it can be said that FUJI-Scheduler is one of the effective usage methods of patient records.

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