Clinical Path Modeling in XML for Benchmark Test of Medication

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Abstract

Many hospitals have introduced Clinical Path (CP) to improve the medical procedure in Japan. CP is a kind of care managing and checking lists for certain diseases and is a useful tool for hospital management. By utilization of CP, hospitals can reduce duration of hospitalization, variation in care of patients, increase of hospital revenue. At present CPs are made by each hospitals and they have no standard in their format. Benchmark test between CPs of different hospitals is an important challenge for evaluation of medical practices. However, formats for CPs are not standardized, so the benchmark test of CPs is not so easy. To start benchmark test of CPs, we remark medication in CP and introduce a description rule about medication in XML. Based on this rule, we developed a prototype system enables to compare and show the difference of medications in CPs prescribed between plural numbers of hospitals.

Keywords:

Clinical Path, benchmark test, XML, medication

Introduction

Diagnosis Related Group/Prospective Payment System (DRG/PPS) was introduced to reduce soaring medical payments in US In 1983 [1]. So each hospital adopt various ways of management. In 1986 Zander developed Clinical path as a nursing administration method applying PERT and Gantt Chart those are production process management tool [2]. A CP is a nursing check list defined for each disease, it has an effect that reduce the duration of hospitalization, decrease variation of medical care. In Japan CPs have been introduced [3] but they have no standard format. It is urgent to reduce soaring medical costs and to improve medical efficiency and they are achieved by competition obtained by evaluation of quality of each hospital [4]. CPs provide accumulated know-how of specific disease. Therefore it is very significant to compare CPs between hospitals and pursue better medical care. We focus on medication described in CP. We described CPs in XML and implemented a system so that it makes qualitative and quantitative comparison of medication between hospitals with referring drug database. This system extracts therapeutic category and drug prices from XML documents and shows them to compare with each other.

Materials and Method

Clinical Path

A CP is defined 2-dimeisional table, which contains procedure and sequences of clinical practice related to many medical professions.

In horizontal axis shows progress of care, and vertical axis shows category of intervention and care. Physicians and co medical people check when they perform care category item described in the table.

Figu1 - General format of Clinical Path

XML Model of Clinical Path

The medical staffs concerning CPs are accumulating much data. In order to analyze the data of CPs, it is better to digitize CPs contents. CPs always have been renewed by the introduction of new medical technology and case studies, therefore to define a CP's structure flexible modeling is desired.

We have modeled CP based on semi-structured data model, and implemented an electronic CP as a Web application [5-6]. We are developing of electronic CPs described in XML.

We show certain parts of drug injection of a CP described in XML in Fig.2. We attempted to implement a system that can compare a number of CPs in this article. This system is written in Java™ and it is a web application.

```
<?XML version="1.0" encoding="UTF-8" ?>
-中略-
<!ELEMENT 注射（月日*)>
      <!ELEMENT 月日（フェーズ+)>
      <!ELEMENT 月日（#PCDATA)>
      <!ELEMENT フェーズ（投与条件*)>
      <!ELEMENT 投与条件（投与薬剤)>
      <!ELEMENT 投与薬剤（商品名,規格単位,用法)>
      <!ELEMENT 商品名（#PCDATA)>
      <!ELEMENT 規格単位（規格,単位)>
      <!ELEMENT 規格（#PCDATA)>
      <!ELEMENT 単位（#PCDATA)>
      <!ELEMENT 用法 (((_1 フェーズ投与量|_1 日投与量|_1 回投与量)),(注射方法*),(注射時点*),
                  (注射時間*),(注射速度*),(注射後処置*),(注射回数+)))>
      <!ELEMENT _1 フェーズ投与量（#PCDATA)>
      <!ELEMENT _1 日投与量（#PCDATA)>
      <!ELEMENT _1 回投与量（#PCDATA)>
      <!ELEMENT 投与回数（#PCDATA)>
      <!ELEMENT 投与時点（#PCDATA)>
```

Figure 2 - The DTD of CP described in XML

Comparing Method of Drug Efficacy and Drug Prices

Coding of Drugs

In Japan, the formulation of medical drugs is made by the Medical Information System Development Center (MEDIS) and associated company, but there is no coding rule used by all medical facilities.

In this paper, we define a tentative drug coding based on existing drug coding to build a benchmark test system of medication stated in CPs. Our drug coding is equivalent to therapeutic category and is derived from 'Japanese standard commodity classification' and 'National Health Insurance Drug Price Standard (NHI) code (so called Ministry of Health, Labor, and Welfare's 12 digits code)' which are used in drug package insert. There exist quadruple digits that constitute lower 4 figures of 'Japanese standard commodity classification code' and also constitute upper 4 figures of NHI code. For example we define our standard code of Dormicum™ as '1124' because it is defined as '871124' by the 'Japanese standard commodity classification code' and is defined as '1124401A1028' by NHI code.

Therapeutic category is divided in 3 ranks so we call each of ranks 'major division', 'medium division', and 'minor division'.

For example '1 drugs for neural and sensory organ ' is called as 'major division' and '11 drugs for central nervous system' is called as 'medium division' and '112 hypnotics and sedatives' is called as 'minor division'.

Sequence of Comparison of Medication

The system compares medication of hospitals as follows:

- Describing CPs of each hospital in defined XML format manually.
- The system reads the files and pick up nodes of XML files and gets drug names prescribed in CPs.
- The system refers the standard codes of drugs and retrieves drug names and codes prescribed by a hospital.
- The system extracts prescribed drug from database, and show drug effects and drug prices of each hospitals. The system sorts drugs into three groups, drugs both hospitals adopt, drugs only hospital A adopts, and drugs only hospital B adopts.

Materials

We searched published CPs of inguinal hernia of adult from published books or Web site in Japan, and picked up two CPs.

Results

Function of this system

This system works as follows:

- Drug effects of each hospital are read from database and drugs commonly used or not.
- When drug efficiency is selected (Fig.3), this system can pick up the type of drugs used in each hospital and display the drugs.
- Drug effects of each hospital are read from database and drugs commonly used or not.

Example of Comparison

We tried a benchmark test of published CPs applied to adult inguinal hernia operation focusing on blood substitutes.

We obtained a result that hospital A adopts 'Veen™-F inj.' and hospital B adopts 'SOLDEM™ 3A' as shown in Fig.4.

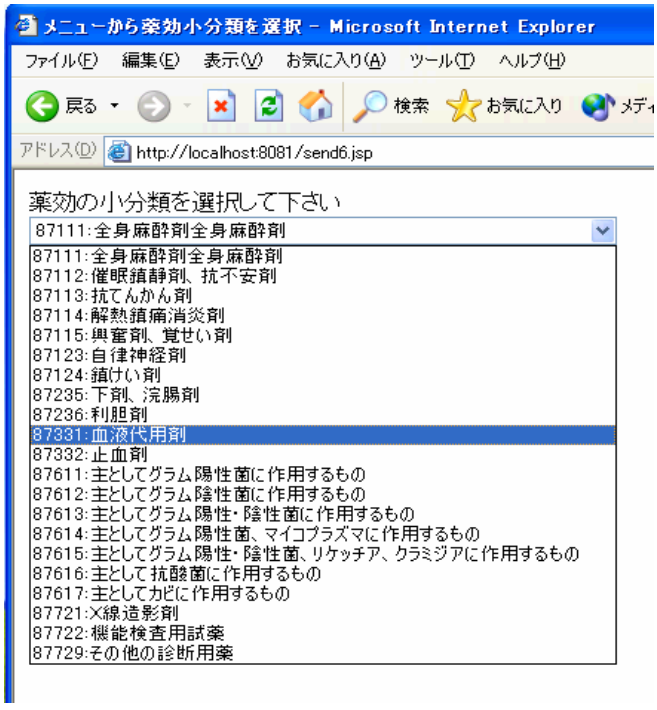

Figure 3 – Picture: Selecting in minor division class

This system also can display all drugs prescribed in CPs. Fig.5 shows all names of drugs medicated by each hospital with their drug prices. These functions enable one can compare plural CPs on Web.

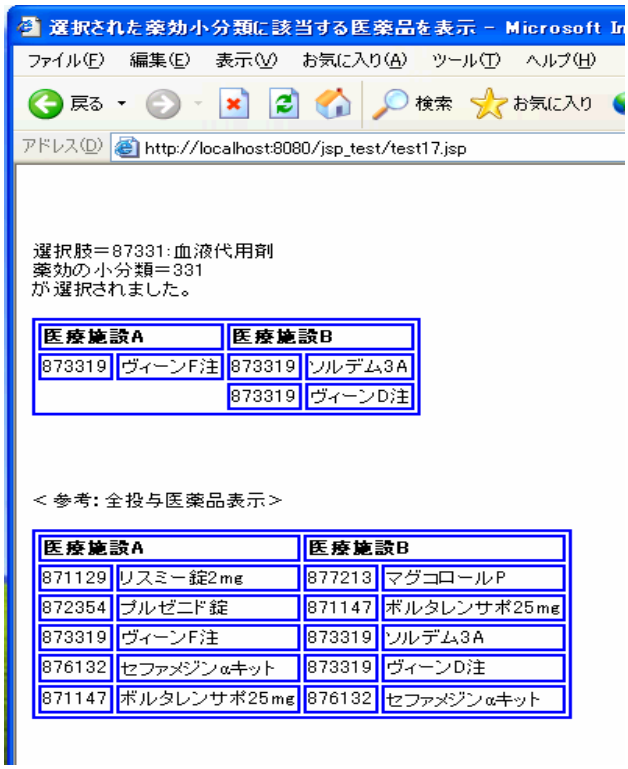

Figure 4 - Picture showing drug efficacy

Figure5 - Listing of medications and drug prices

Discussion

A lot of hospitals introduce CP for quality control of medical services, and CP is hoped as a new method bringing efficiency and improvement in quality of medicine in Japan [4]. If many hospitals are networked and CPs hospitals are compared with each other, medical staffs obtain better procedure of medical practice. Networking environment is built by the progress of intelligence infrastructure represented by Internet. It is said that progress of coding and structuring of description of CP will provide improvement and trust to medical care [4]. MEDIS begins to provide a service that people can refer to many CPs on a Web site [7]. However people cannot compare CPs with each other in qualitatively and quantitatively due to the lack of description of CPs. To address this issue we made a description rule of medication part of CP in XML, and developed a system that enables comparison of CPs.

Issues should be resolved are as followings:

- Precise definition of XML description not only of medication but also of tests or cares stated in CPs.
- Automated calculation of costs of medical care in CPs.
- Establishment of benchmark test system of CPs used in hospitals attached on network.

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