An effective approach for development of regional medical information system using XML technology

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Abstract

The system proposed here accepts XML-documented patient records and transforms them into a common schema through the style sheet. Because we adopted an XML format, the users of this system will easily get the information exchanged among medical facilities. The characteristics of this system include;

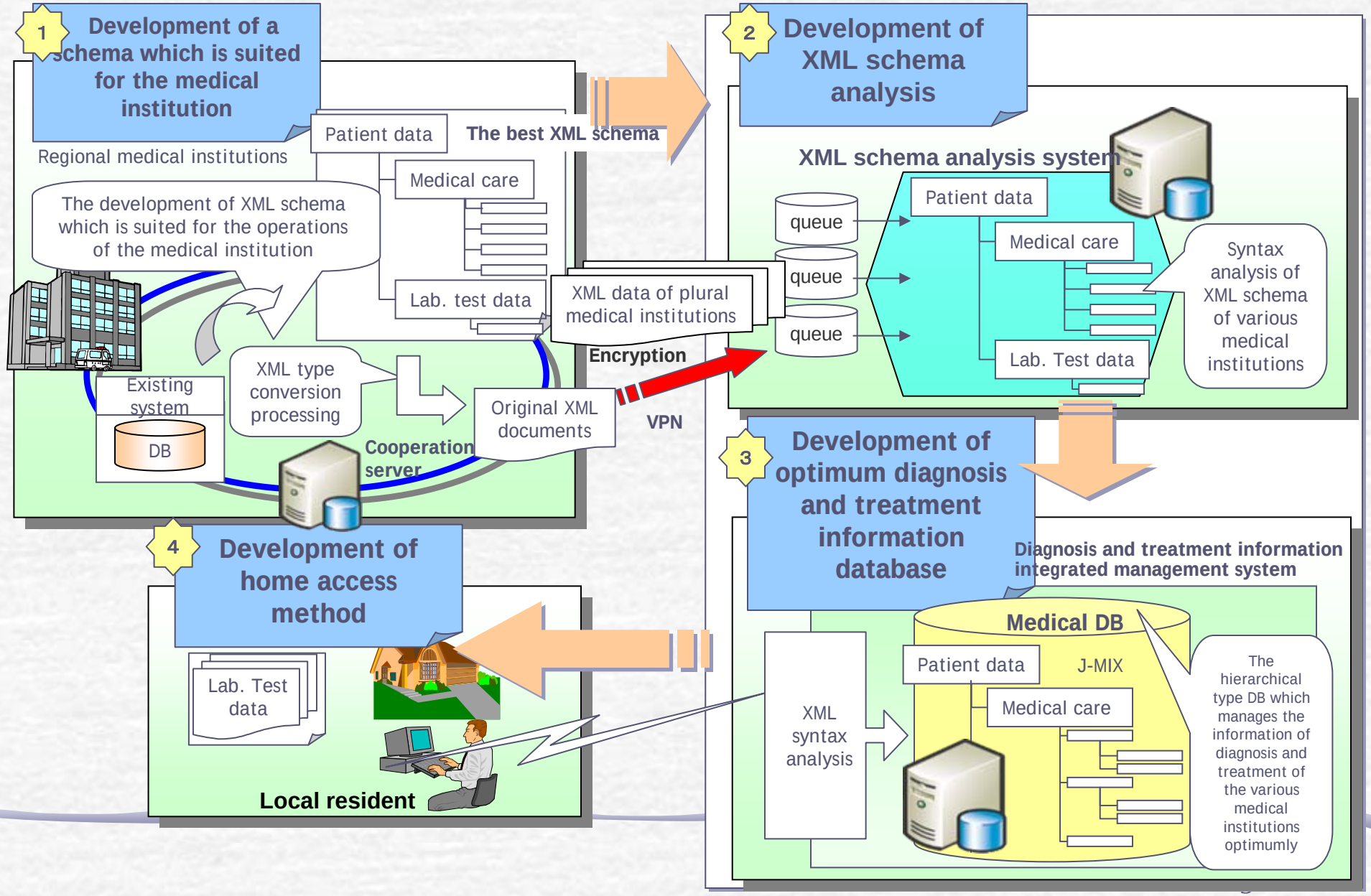
(1) automatic creation of an appropriate structure of database from the XML schema information for each hospital, enabling to store any records of XML format for which XML schema information is known in advance,

(2) facilitation of a dynamic control of information flow by introducing an idea of standardized interface structure,

(3) reduction of the costs at which regional medical information systems are built up and

(4) increase of the number of hospitals sharing this DB of patient records by exploiting a common XML schema.

Development of regional medical information system using XML technology



Methods

1.XML text Viewing and editing

We can create and edit XML files in a text format using the XML Schema design view of XMLspy (released by Altova).

2.Developing XML-to-XML Mappings

To develop an XML-to-XML mapping, what needs to get done is simply to load XML document and XML Schema in MapForce (released by Altova) and to drawn drag connecting lines between the elements or attributes of the source and target.

3.Generating Program Codes

MapForce generates XSLT style-sheets program codes for marshalling medical data from the source to the target content model. All code generated by MapForce can easily be used in XML data transforming.

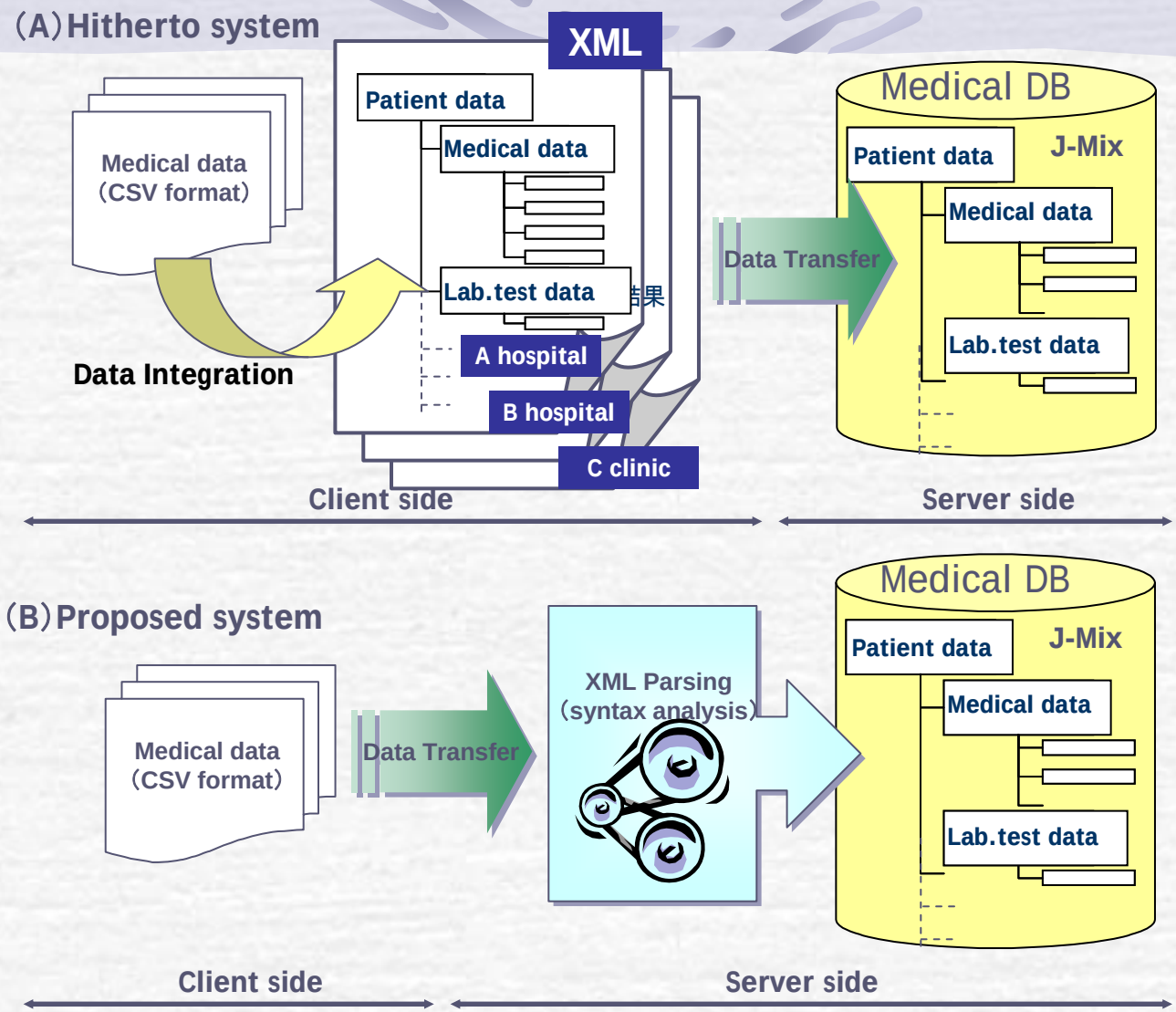
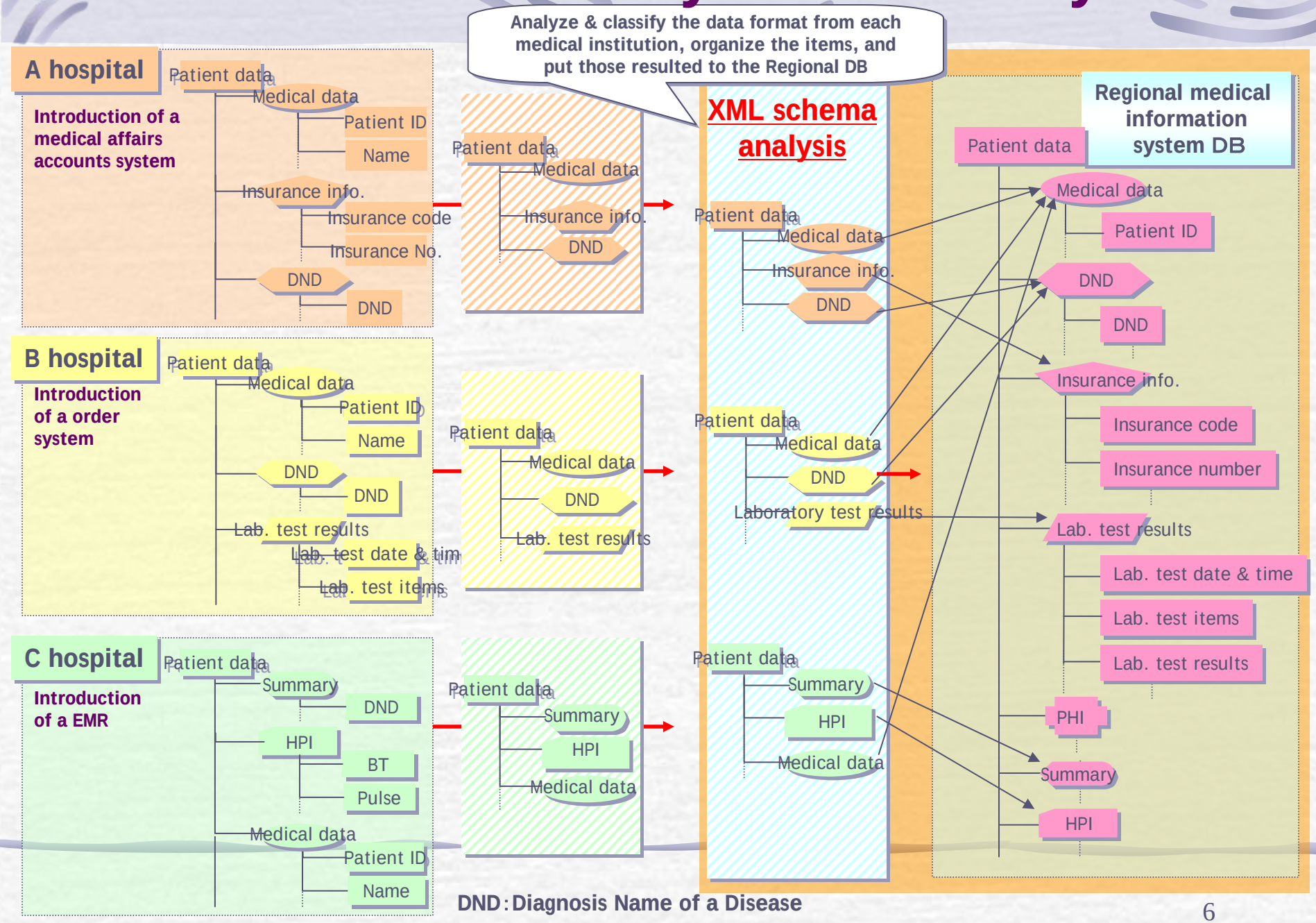
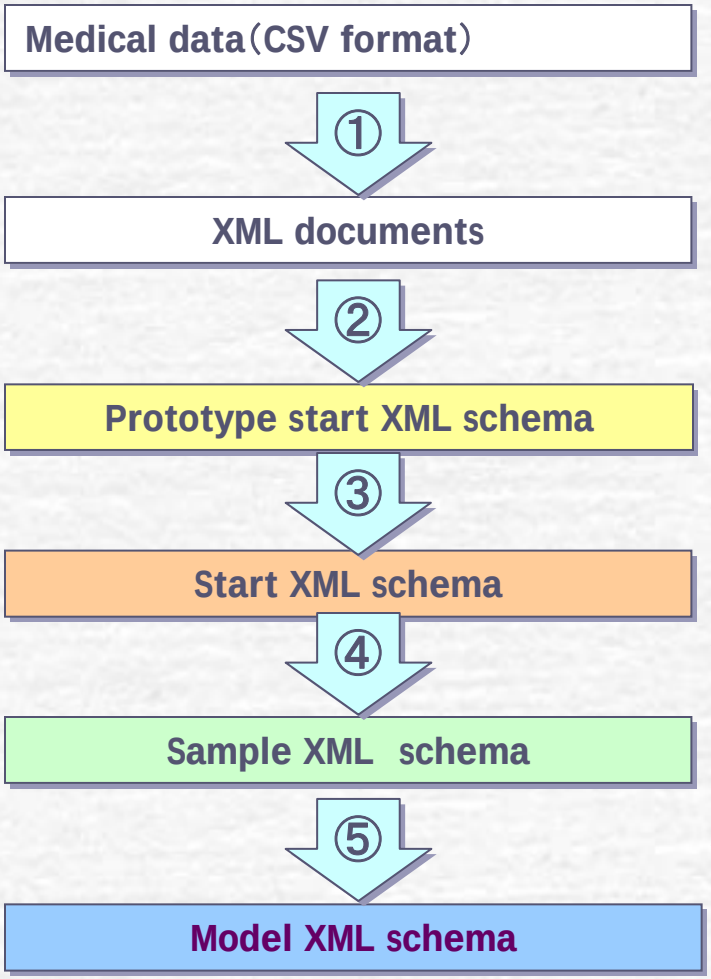


Fig. Comparison between hitherto system and proposed systems.

XML schema analytical summary



DND : Diagnosis Name of a Disease



①described in terms of XML (XML document)

②The medical data were classified into the types of university hospitals, clinics, and National Hospitals.

③Data Modeling (granularity, tag name, structure)

④Data modeling for extracting semantic information (class diagrams) from XML data

⑤Extraction of Conceptual Models from XML Data by User-Defined Rules (normalization in this paper)

Fig. Common XML schema making procedure (developping an XML schema for extracting semantic information from an XML data given).

The procedure which processes each medical institution diagnosis and treatment data with the XML schema (1)

患者基本情報レベル1_0o0o25.csv - メモ帳

ファイル(F) 編集(E) 書式(O) 表示(V) ヘルプ(H)

```
患者番号(外部),患者属性コード,患者属性名称,カナ氏名,漢字氏名,性別,生年月日,国籍・本籍コード,国籍・本
籍名称,電子メールアドレス,コメント,予備
6500001,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,H100515,,,,ニュウインアリ,20020904
6500014,02,,ｱｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,M,S111226,,,,20041012
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6500030,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,M,H071114,,,,20030812
6500043,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,S381020,,,,20040123
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6500069,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,M,S230306,,,,ノウコク,20040305
6500072,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,S510403,,,,20021112
6500085,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,M,S280111,,,,20020729
6500098,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,S450517,,,,20040206
6500102,01,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,S440218,,,,20020729
6500115,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,M,T150513,,,,２７二割,20021016
6500128,01,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,S460628,,,,20020729
6500131,01,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,S381017,,,,20020729
6500144,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,S540919,,,,20020812
6500157,01,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,S560923,,,,20020729
6500160,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,M,S421225,,,,20020730
6500173,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,S241119,,,,20021216
6500186,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,M,S100512,,,,４１・１割,20040826
6500199,01,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,S081120,,,,20020730
6500203,01,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,M,H050312,,,,20020730
6500216,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,H061203,,,,20031110
6500229,01,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,S440515,,,,20020730
6500232,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,M,S550102,,,,20020730
6500245,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,F,S240314,,,,20020730
6500258,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,M,S090206,,,,20021009
6500261,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,M,S270705,,,,20020730
6500274,02,,ｹﾝｺｳ ﾀﾞｲｲﾁ,健康 第一,M,S170205,,,,20021018
```

Altova XMLSPY - [患者基本情報_info_レベル1_2.xml]

ファイル(F) 編集(E) プロジェクト(P) XML(X) DTD/スキーマ(D) スキーマ設計(M) XSL(L) AUTHENTIC(A) 変換(C) 表示(V) ブラウザ(B)

WSDL(S) SOAP(O) ツール(T) ウィンドウ(W) ヘルプ(H)

```
29  <head>
30  <fileName>D:¥WINNT¥test_data¥患者基本情報_info_レベル1_2.csv</fileName>
31  <timeLastAccess>Wed Nov 10 23:57:49 2004</timeLastAccess>
32  <timeCreation>Wed Nov 10 23:57:48 2004</timeCreation>
33  <timeModify>Wed Nov 10 23:56:24 2004</timeModify>
34  <fileSize>400072</fileSize>
35  </head>
36  <record>
37  <患者番号(外部)>6500001</患者番号(外部)>
38  <患者属性コード>02</患者属性コード>
39  <患者属性名称>~</患者属性名称>
40  <カナ氏名>[redacted]</カナ氏名>
41  <漢字氏名>[redacted]</漢字氏名>
42  <性別>F</性別>
43  <生年月日>[redacted]生年月日>
44  <国籍・本籍コード>~</国籍・本籍コード>
45  <国籍・本籍翻訳名></国籍・本籍翻訳名>
46  <電子メールアドレス></電子メールアドレス>
47  <コメント>ニュウインアリ</コメント>
48  <予備>20020904</予備>
49  </record>
50  <record>
51  <患者番号(外部)>6500014</患者番号(外部)>
52  <患者属性コード>02</患者属性コード>
53  <患者属性名称>~</患者属性名称>
54  <カナ氏名>[redacted]</カナ氏名>
55  <漢字氏名>[redacted]朗</漢字氏名>
56  <性別>M</性別>
57  <生年月日>S111226</生年月日>
58  <国籍・本籍コード>~</国籍・本籍コード>
59  <国籍・本籍翻訳名></国籍・本籍翻訳名>
60  <電子メールアドレス></電子メールアドレス>
61  <コメント></コメント>
62  <予備>20041012</予備>
63  </record>
```

このファイルは、整形式ではありません。
Whitespace (Blank, Tab, CR, LF) が必要です。

Recheck

Text | Grid | Schema/WSDL | Authentic | Browser

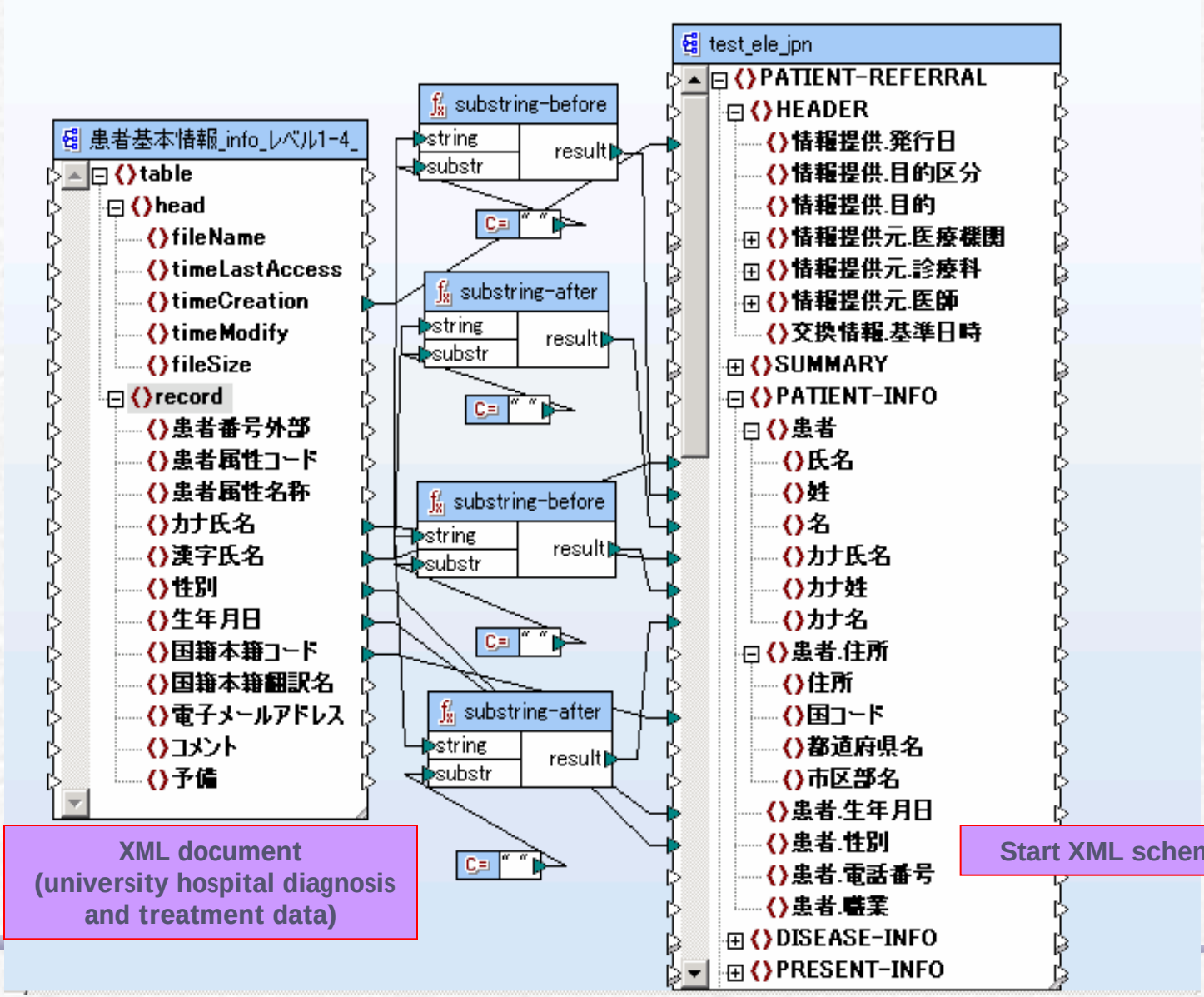
患者基本情報_info_レベル1_2.xml

xmlspy v2004 rel. 4 U Hiroaki Sudo (Nagasaki University) で登録されています (C)1998-2004 Altova GmbH Ln 4, Col 25 NUM

① Outputting patient data with the CSV file format

② Converts the data to the XML document

The procedure which processes each medical institution diagnosis and treatment data with the XML schema (2)



From a prototype start XML schema to a start XML schema

```
1  <?xml version="1.0" encoding="UTF-8"?>
2  <!--
3
4  This file was generated by MAPFORCE 2004
5
6  YOU SHOULD NOT MODIFY THIS FILE, BECAUSE IT WILL BE
7  OVERWRITTEN WHEN YOU RE-RUN XSLT GENERATION.
8
9  Refer to the MAPFORCE 2004 Documentation for further details.
10 http://www.altova.com/mapforce
11
12 -->
13 <xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
14 →  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
15   <xsl:output method="xml" encoding="UTF-8"/>
16   <xsl:param name="NameInstance" select="'D:¥Sample.xml'"/>
17   <xsl:param name="NameInstance2" select="'D:¥Sample2.xml'"/>
18   <xsl:param name="NameInstance3" select="'D:¥Sample3.xml'"/>
19   <xsl:param name="NameInstance4" select="'D:¥Sample4.xml'"/>
20   <xsl:param name="NameInstance5" select="'D:¥Sample5.xml'"/>
21   <xsl:param name="NameInstance6" select="'D:¥Sample6.xml'"/>
22   <xsl:template match="/doc">
23     <xsl:variable name="MainInstance" select="/"/>
24     <PATIENT-REFERRAL>
25       <xsl:attribute name="xsi:noNamespaceSchemaLocation">D:/xml_schema.xsd</xsl:attribute>
26       <xsl:for-each select="recode">
27         <PATIENT-INFO>
28           <患者>
29             <xsl:for-each select="漢字氏名">
30               <氏名>
31                 <xsl:value-of select="."/>
32               </氏名>
33             </xsl:for-each>
34             <xsl:for-each select="カナ氏名">
35               <カナ氏名>
36                 <xsl:value-of select="."/>
37               </カナ氏名>
38             </xsl:for-each>
39           </患者>
40           <患者.住所>
41             <xsl:for-each select="国籍本籍コード">
```

Example of the XSLT code which is obtained by the mapping of medical data elements
(C university hospital)

From a prototype start XML schema to a start XML schema

```
1  <?xml version="1.0" encoding="UTF-8"?>
2  <!--W3C Schema は xmlspy v2004 rel. 4 U (http://www.xmlspy.com) で生成されています-->
3  <xs:schema elementFormDefault="qualified" xmlns:xs="http://www.w3.org/2001/XMLSchema">
4    <xs:element name="T大">
5      <xs:complexType>
6        <xs:sequence>
7          <xs:element name="患者基本情報">
8            <xs:complexType>
9              <xs:sequence>
10               <xs:element name="基本情報レベル">
11                 <xs:complexType>
12                   <xs:sequence>
13                     <xs:element name="基本情報1レベル">
14                       <xs:complexType>
15                         <xs:sequence>
16                           <xs:element name="カナ氏名" type="xs:string"/>
17                           <xs:element name="漢字氏名" type="xs:string"/>
18                           <xs:element name="性別" type="xs:string"/>
19                           <xs:element name="生年月日" type="xs:string"/>
20                           <xs:element name="国籍・本籍コード" type="xs:string"/>
21                         </xs:sequence>
22                       </xs:complexType>
23                     </xs:element>
24                   </xs:sequence>
25                 </xs:complexType>
26               </xs:element>
27               <xs:element name="住所情報レベル">
28                 <xs:complexType>
29                   <xs:sequence>
30                     <xs:element name="郵便番号" type="xs:string"/>
31                     <xs:element name="住所1" type="xs:string"/>
32                     <xs:element name="住所2" type="xs:string"/>
33                     <xs:element name="電話番号1" type="xs:string"/>
34                   </xs:sequence>
35                 </xs:complexType>
36               </xs:element>
37             </xs:sequence>
38           </xs:complexType>
39         </xs:element>
40         <xs:element name="患者病名管理">
```

Portion of the start XML schema which is obtained by converted the prototype start XML schemer with the XSLT code
(C university hospital)

References

[1] Honda M, Yamanobe Y, Nakayama Y, Sudo H, and Yanase K. Development of regional medical information system -using XML technology- (in Japanese). Japan Journal of Medical Informatics 2005: 25(1): 1-5.
[2] Honda M, and Yamanobe Y. On the current problems of user authentication for EMR in HIS, MEDINFO 2004, M.Fieschi et al.(Eds), Amsterdam:IOS Press, 1644, 2004

Acknowledgments

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Contact detail

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