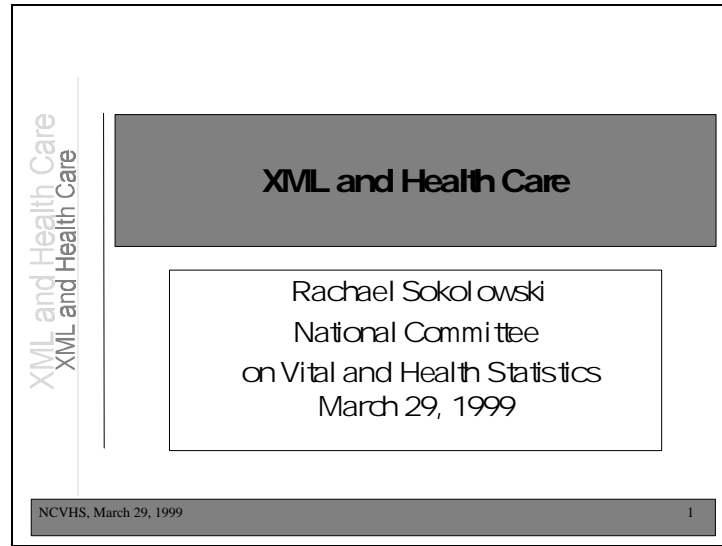


Slide 1



XML and Health Care
XML and Health Care

XML and Health Care

Rachael Sokolowski
National Committee
on Vital and Health Statistics
March 29, 1999

NCVHS, March 29, 1999 1

Rachael Sokolowski
rsokolowski@magnoliatech.com
rsokolowski@itrust.net

Primary affiliation:

President, Magnolia Technologies
Consulting company specializing in SGML and XML for health care and health care publishing.

Secondary affiliation:

Vice President of Research, iTrust
Software development organization, SGML electronic health record and practice management system.

Standards Development Organizations

Co-chair, Health Level 7, HL7 SGML/XML Special Interest Group
Co-chair, ASTM E31.25, "XML DTDs for Health Care"

Slide 2

Outline

XML and Health Care
XML and Health Care

- Health Care Information and XML
- XML Applications in Health Care
- XML Standard Development Efforts
- How XML Compares to Other Technologies for Patient Medical Record Information
- What Needs to Be Done and What Role the Government Might Have

NCVHS, March 29, 19992

Introduction

Recently there has been widespread and increased use of the World Wide Web by the health care industry. The use of Web technologies has not removed the barriers to accessing and exchanging health care information contained in a Patient's Medical Record (PMR). However, there are new opportunities for the representation and exchange of clinical information emerging from the convergence of data processing, communication, and publishing technology, in a new standard for the Web, eXtensible Markup Language (XML).

In the past two years, a growing number of providers, vendors, and standards organizations have begun investigating how XML, a simplified subset of SGML (Standard Generalized Markup Language) designed for Web delivery, can solve problems in health care information systems. XML is a platform, vendor, and application independent technology for describing a document's content and structure.

There are a number of things that must be done for a successful implementation of XML for Patient Medical record Information. This presentation outlines some of these needs.

Slide 3

Health Care Information

XML and Health Care
XML and Health Care

- What is health care information?
- Health care information in the Patient Medical Record is often conveyed in paper documents
- Documents
 - give order to information
 - carry and preserve knowledge
 - have visual clues about information

NCVHS, March 29, 1999 3

No industry stands to benefit more from electronic information than the health care industry. Each year health care information technology becomes more complex and heterogeneous reflecting the dynamic nature of the industry.

The information processing needs of individual health care providers pose increasing challenges for technology solutions. The quality of information processing ultimately effects the quality of patient care itself. Health care has an additional problem when exchanging and processing information: the difficulty in reducing the physician or caregiver's notes to regular, predictable, and discrete data points. That can be kept in a PMR.

Human language, narrative, has been central to medical records. Most of the work on computer-based patient medical records systems has assumed that free form narrative must be replaced by data so that the crucial information contained in the record can be processed by a computer. Until recently, "narrative" and "machine-readable" were mutually exclusive. Electronic documents offer the ability to represent information a form that is human readable and can be processed by a computer.

Slide 4

PMRI is a Composite of Documents

XML and Health Care
XML and Health Care

- The Patient Medical Record is a collection of information
- PMR contains text & other data
- Representation is document centric with regular document types
- The collection has a time sequence

Electronic Health Record (EHR)

NCVHS, March 29, 1999 4

The Patient Medical Record is a collection of information. It is typically a folder of paper documents, collected over time and placed in the folder. Other information outside the folder is routinely used by health care professionals to keep notes, lists of allergies or current medications or chronic problems.

The electronic is a computer-based Patient Medical Record may be generated by many sources such as transcription, scanned from paper, created by and structured reporting software systems. The electronic document may be rendered in many forms such as printed to paper or a computer screen, stored a tables in a database or transformed into other software representations such as messages or transactions.

PMRI ISSUES

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- Large amounts of information and data in electronically inaccessible formats (paper documents)
- No standard processes for collection; variety of sources
- Heterogeneous health care systems and standards
- Multiple formats, no standardization
- Multiple technologies: object-oriented models, word processor files, databases

NCVHS, March 29, 1999 5

Information about patients is critical for delivery of high quality service, but this information exists in representations that make access difficult or impossible. A single point of care, such as a hospital or clinic, may draw patient information from laboratory systems, scheduling and billing systems, imaging systems, and many sources of paper records including records of care from other sites and organizations.

The clinical patient record has been entirely focused on being in a form that is human readable and has ignored the requirements for machine processing. health care information standards, such as HL7 (Health Level 7) and EDI X12 (Electronic Data Interchange), have been almost entirely focused on machine interaction and have ignored the paper-based record. The slow emergence of computer based patient records has led to a classification of information gathered during clinical encounters. This classification is needed as part of the patient record and as a resource for health research and statistics. The classification and coding requirements of these two purposes differ, patient medical records require as much specific detail as possible, where as health statistics require data which are systematically aggregated into categories based on their frequency or their importance for policy.

We need to reach a middle ground. Documents need to be in a form in which humans are able to read and analyze and one in which machines are able to process. XML has the potential to reach this middle ground.

Slide 6

Information Technology Needs

XML and Health Care
XML and Health Care

- Regular and standardized types of health care documents
- Representation of information that can be asked questions:
 - “What symptoms were present?”
 - “What was the final diagnosis?”
 - “What allergies does this patient have?”
- Accomodate different outputs: print, web pages, databases

NCVHS, March 29, 1999 6

There are some easily identifiable requirements for health care information. A set of the types of electronic documents in a PMR needs to be derived. Electronic documents need a standard structural representation of the content so that questions of the information can be asked, and answers easily found. For example:

- Collection and Access: “What was the diagnosis?”
- Quantification: “How many physical exams were performed?”
- Narrative Text: Retain observer’s notation

The information must be published on various different outputs.

Slide 7

Information Technology Needs, 2

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- Information survival through changes in technology
- Timely access to information
- Ability to locate relevant information
- View information in different ways and on different media: in print, as a web page, listen to an audio recording

NCVHS, March 29, 1999 7

Patient Medical Record information needs to be in a form that will exist for the lifetime of a patient and in a form that is likely to survive changes in technology. Health care professionals want to have access to relevant information quickly and when it is needed. Lastly and most importantly, information needs to be correct and be from trusted sources.

Increased Use of the Web

XML and Health Care
XML and Health Care

- Health care industry looking for solutions; has started to use the Web & HTML for information
- Barriers to accessing information have not been removed
- The Web use has created new challenges.
- Enter eXtensible Markup Language (XML), -- a convergence of data processing, communication, & publishing technology as a possible solution

NCVHS, March 29, 1999 8

The vast majority of data exchange in health care is still with proprietary technologies, but there is a rapidly emerging interest in using the Web, and web-based technologies for this purpose. These web technologies are a typically combination of proprietary programmatic interfaces to manipulate the content, structure and style of HTML documents (which are also known as web pages).

HTML was created to describe and display pages of text on a computer screen connected to the World Wide Web. HTML describes how to display the data but does not offer any information about the content of the information so it is an insufficient representation for data generated in clinical settings. Web technologies are a convenient and low cost data capture and distribution mechanism for organizations that are geographically and functionally diverse and are gaining wide use in the health care industry for these reasons. Software components that translate information between HTML, databases and EDI are widely used, but are one-off, proprietary solutions that do not enable widespread information transfer.

The slide is titled "What is XML?" and is part of a presentation on "XML and Health Care". It contains a bulleted list of five points. The footer includes the text "NCVHS, March 29, 1999" and the number "10".

What is XML?

- eXtensible Markup Language
- An activity of the World Wide Web Consortium (W3C)
- Offers new and improved Web applications
- Changes publishing on the Web
- Subset of SGML (Standard Generalized Markup Language) syntax

NCVHS, March 29, 1999 10

The past ten years have seen growing use of text processing markup languages outside of health care that make possible the rigorous specification, processing, and analysis of information in narrative form. These markup languages are based on Standard Generalized Markup Language (SGML). SGML is a meta-language, that is, a language that sets up rules for creating markup languages called applications. HyperText Markup Language (HTML) is an application of SGML.

Recently, a simplified subset of SGML has been specified called eXtensible Markup Language or XML.

In health care, SGML and XML present great promise for allowing exchange and processing of clinical information without sacrificing the precision, nuance, and complexity of human language. While the feasibility of SGML and XML for clinical records is gaining widespread acceptance, this has not been tested in live, clinical contexts supporting multi-faceted exchange of data, text, pictures, and other media.

Reference: Light, Richard, Presenting XML, Sams.net, Indianapolis, IN, 1997, p.343

Slide 11

XML

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XML and Health Care

- XML communicates information in a way that can be understood by humans
- XML communicates information in a way that computer can use the information
- XML facilitates the re-purposing of information in different forms and in different languages
- Allows for vendor-neutral interchange

NCVHS, March 29, 1999 11

Slide 12

XML Example

XML and Health Care
XML and Health Care

```
<?xml version="1.0" ?> ← Prolog
<PRESCRIPTION> ← Start Tag
  <MEDICATION.NAME MED="Amoxil"> Prescribed
    medication: Amoxil
  </MEDICATION.NAME>
  <FORM TYPE="capsule">
    Form: capsule ← Character Data
  </FORM>
  <DOSAGE AMOUNT="25 mg">
    Dosage: 25 mg
  </DOSAGE>
  <RXINSTRUCTIONS FREQUENCY="daily"> daily
  </RXINSTRUCTIONS>
</PRESCRIPTION> ← End Tag
```

NCVHS, March 29, 1999 12

XML documents identify themselves as XML with the first line of the document:

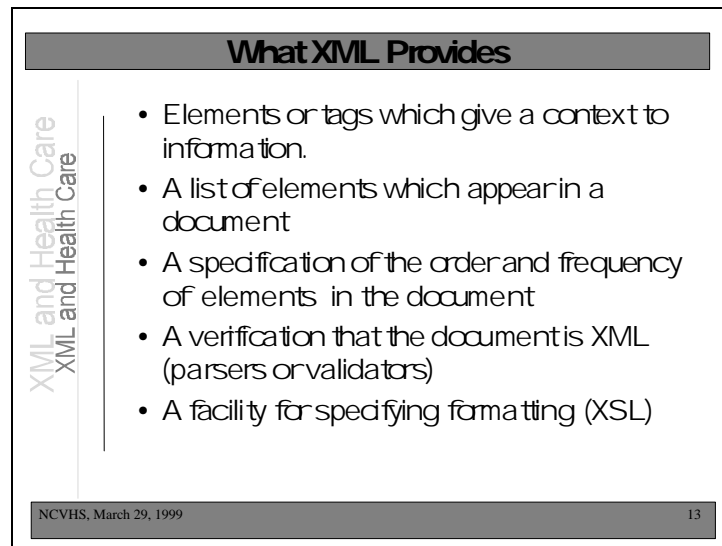
```
<?xml version="1.0" ?>
```

XML adds tags which provide further information about the content of the document. In health care, important or meaningful data can be easily identified by XML markup or tags such as <SUBJECTIVE> and <DIAGNOSIS>. Tags are used to mark the structure of an XML document and to provide context for information. Notice in the above example it can be determined that the family name given here is for a patient and not a provider.

The tags are not “seen” in the published version of the electronic document. In the example above the following could appear in the document:

Prescribed medication: Amoxil **Form:** capsule **Dosage:** 25 mg. daily

Slide 13



XML and Health Care
XML and Health Care

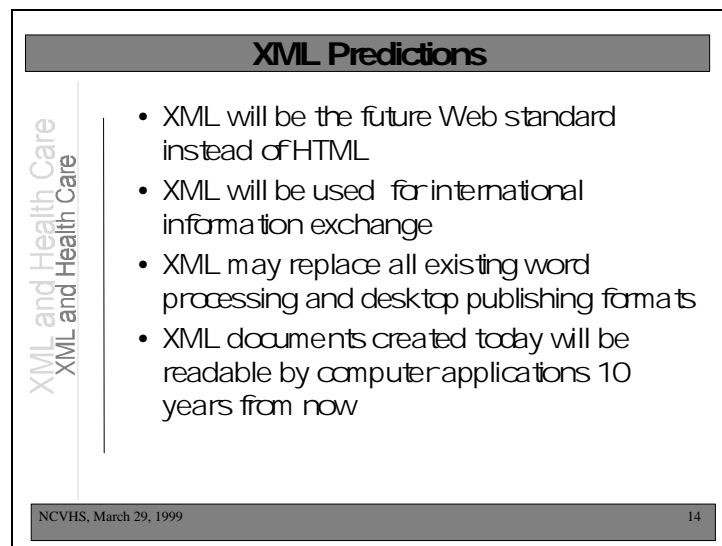
What XML Provides

- Elements or tags which give a context to information.
- A list of elements which appear in a document
- A specification of the order and frequency of elements in the document
- A verification that the document is XML (parsers or validators)
- A facility for specifying formatting (XSL)

NCVHS, March 29, 1999 13

XML provides a mechanism for electronically encoding documents and types of documents. XML documents contain a list of elements or tags which appear in a document, a specification of the order and frequency of elements in the document, a verification that the document is XML and facility for specifying formatting through style sheets.

Slide 14



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XML Predictions

- XML will be the future Web standard instead of HTML
- XML will be used for international information exchange
- XML may replace all existing word processing and desktop publishing formats
- XML documents created today will be readable by computer applications 10 years from now

NCVHS, March 29, 1999 14

XML has the facility to present multiple characters in all foreign languages. XML will be used for international language exchange because it can handle different character sets such as Japanese and Korean. Microsoft is planning to include XML support in April, 1999. Previous DTP that support SGML currently support XML. SGML became a standard in 1986. SGML documents created 13 years ago can still be processed by any SGML-aware application today.

Slide 15

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A few XML Concepts

- Elements (Tags)
- Attributes (Modifiers)
- DTDs (Types of possible documents)
- Stylesheets (How to apply formatting)

NCVHS, March 29, 1999 15

Slide 16

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XML and Health Care

Elements = Tags

- Elements
 - are delimited with start “tags” and end “tags”
 - have unique names
 - provide context
 - do not appear in published versions of the information (paper or web page)

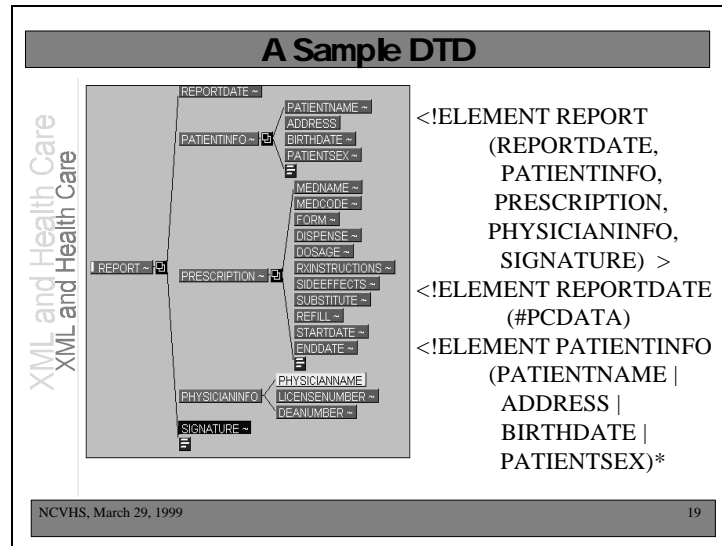
Start tag	Content	End tag
<MEDNAME >	<i>Tylenol</i>	</MEDNAME>

One element

NCVHS, March 29, 1999 16

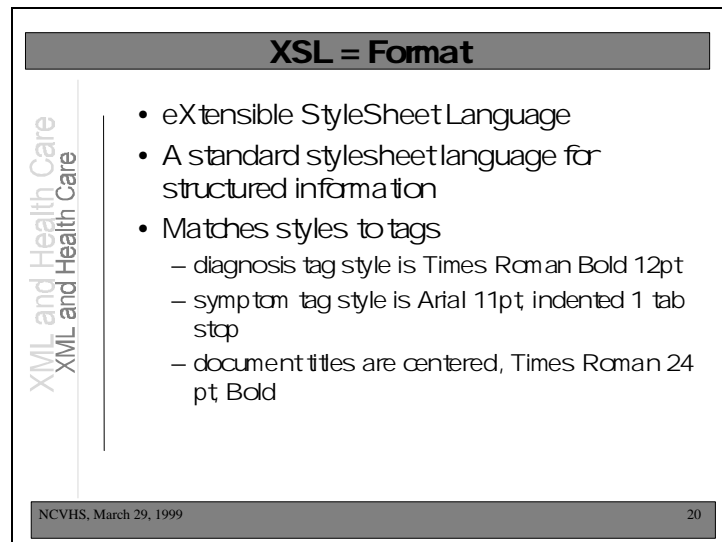
Elements are also known as “tags” and make up the mark-up of the information.

Slide 19



The DTD describes the structure of the document and defines the names of tags it contains. Additionally the DTD declares the order in which the tags occur and how often the tags can appear. A DTD for a prescription might contain structural elements for the medication prescribed, the dosage, the form, the quantity, etc. DTDs can describe documents in a clinical setting, such as a prescription. A prescription has a regular structure as represented in the DTD example: a date is followed by information about the patient, which followed by the actual prescription information, which is then followed by some information about the physician and a signature.

Slide 20




XSL is an acronym for eXtensible StyleSheet Language. It matches styles to tags in XML documents. For instance, the diagnosis tag style is Times Roman Bold 12pt, the symptom tag style is Arial 11pt, indented 1 tab stop and document titles are centered, Times Roman 24 pt, Bold.

Slide 21

XML on the Web

XML and Health Care
XML and Health Care

```
<?xml version="1.0"?>
<patient>
<patientid>123456789</patientid>
<patientname>Jane
  Doe</patientname>
<patientdate.of.birth>May 13,
  1923</patientdate.of.birth>
<patientaddress>123 Main St,
  Anytown, USA
  (home)</patientaddress>
<patientphone>555-345-9876
  (home)</patientphone>
</patient>
```



The screenshot shows a web browser window with the title "Patient Information". The content displayed is: Jane Doe, MRN:123456789, DOB:May 13, 1923, Address:123 Main St., Anytown, USA (home), Phone:555-345-9876 (home).

NCVHS, March 29, 1999 21

An XML document with a stylesheet for a web page, will generate an HTML document for web browsers.


Internet Explorer 5.0 which was released about two weeks ago on March 18, 1999 has support for XML documents with XSL stylesheets.

Slide 22

Patient Information in HTML

XML and Health Care
XML and Health Care

```
<HTML><HEAD><TITLE>
Encounter-Registration
</TITLE> </HEAD>
<BODY bgcolor="#FFFFFF">
<H1>Patient Information </H1>
<P> Jane Doe <BR>
MRN:123456789 <BR>
DOB:May 13, 1923 <BR>
Address:123 Main St., Anytown
  USA (home) <BR>
Phone:555-345-9876 (home)
</BODY></HTML>
```

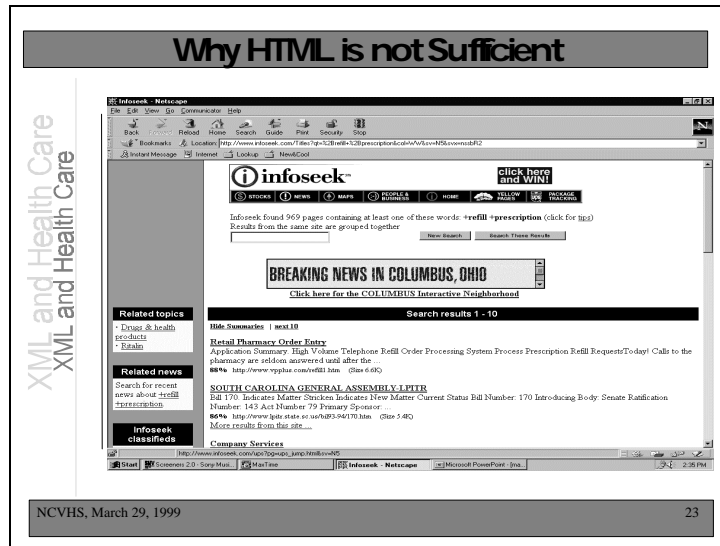


The screenshot shows a web browser window with the title "Patient Information". The content displayed is: Jane Doe, MRN:123456789, DOB:May 13, 1923, Address:123 Main St., Anytown, USA (home), Phone:555-345-9876 (home).

NCVHS, March 29, 1999 22

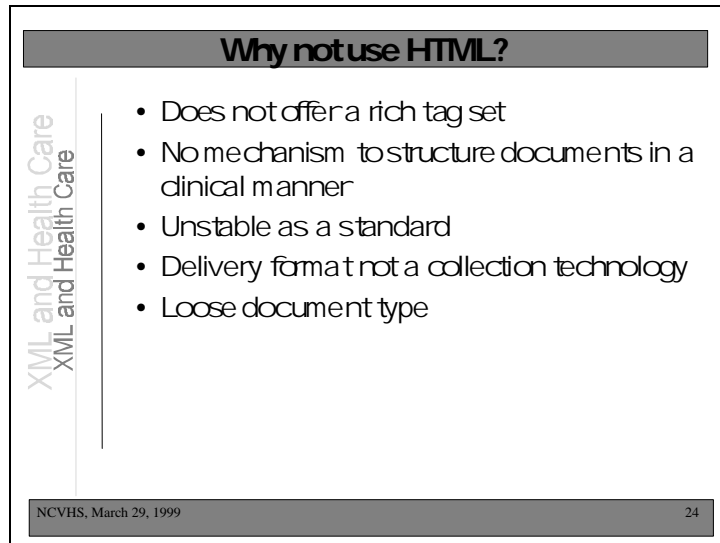
What is the relationship between HTML and XML? HTML is HyperText Markup Language. HTML is a mark-up language for describing web pages and contains tags that describe the format of information. HTML is SGML with a specific DTD. The HTML DTD has tags that are relevant to publishing information to a computer screen. These include headings <H1>, paragraph text <P> and a tags for linking.

Slide 23



This difficulty in finding the context of information becomes especially apparent when surfing the web for information. Since HTML has a limited set of tags, it is difficult to locate specific information in the correct context. I performed the following search looking for “prescription” and “refill”. As can be seen by the search results, my ability to find information about prescription and refills is not necessarily easy. In fact, I was presented with information about the South Carolina General Assembly which has nothing to do with the Patient Medical Record Information I had in mind.

Slide 24



HTML is **not** a technology that meets the needs of information within the Patient Medical Record. The HTML standard or the HTML DTD is not a stable standard. HTML is currently up to HTML version 4.0 and many browser developers add non-standard extensions to HTML to compensate for some of its limitations.

Slide 25

XML DTDs are Important

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- Provide context for narrative text
- Provide document information model
- Agreement on high level structures
- Facility for standardizing formats with stylesheets

NCVHS, March 29, 1999 25

XML DTDs are important for Patient Medical record Information because they will provide context for narrative text, provide a document information model, allow for agreement on high level structures, and they will provide a facility for standardizing formats with stylesheets.

Slide 26

A Premise

XML and Health Care
XML and Health Care

- A set of document types for health care does not exist
- It not known if health care documents have common and identifiable structures but it is generally accepted that some regularity exists
- There is not one standard for describing the tags found in XML health care documents

NCVHS, March 29, 1999 26

A standard set of DTDs for the Patient Medical record does not exist.

Slide 27

The slide is titled "Current XML Standards Work" and is part of a presentation on "XML and Health Care". It lists five current XML standards: HL7, ASTM, CEN, XML-EDI (X12), and CORBAmed. The slide footer includes the text "NCVHS, March 29, 1999" and the number "27".

Current XML Standards Work

XML and Health Care
XML and Health Care

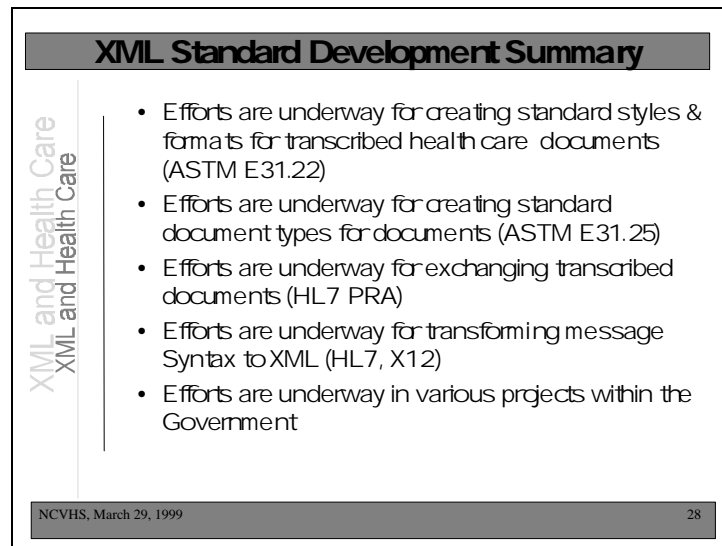
- HL7
- ASTM
- CEN
- XML-EDI (X12)
- CORBAmed

NCVHS, March 29, 1999 27

XML efforts have focused on:

- XML's relationship to object models: (HL7 V3, ASTM, CORBAmed, CEN),
- using XML as a syntax for health care messages and transaction: HL7 X12)
- document exchange (HL7 Patient Record Architecture PRA)
- financial transactions (XML-EDI, X12) and recently
- document types and formats (ASTM).

Slide 28



The slide is titled "XML Standard Development Summary" in a dark grey header. On the left side, there is a vertical label "XML and Health Care" repeated twice. The main content is a bulleted list of five items. At the bottom, there is a footer with the text "NCVHS, March 29, 1999" on the left and the number "28" on the right.

XML Standard Development Summary

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- Efforts are underway for creating standard styles & formats for transcribed health care documents (ASTM E31.22)
- Efforts are underway for creating standard document types for documents (ASTM E31.25)
- Efforts are underway for exchanging transcribed documents (HL7 PRA)
- Efforts are underway for transforming message Syntax to XML (HL7, X12)
- Efforts are underway in various projects within the Government

NCVHS, March 29, 1999 28

The efforts may be summarized as:

Frameworks for information exchange which includes HL7 and XML-EDI. Messages, transactions, and architectures to request and send healthcare information.

Services for healthcare information: CORBAmed, CEN and HL7. Interfaces to find, request, send, filter, and query healthcare information.

Research: CEN. Uses of XML in healthcare and best representations.

Paper-based Forms and Documents: regulatory forms for reporting healthcare information (HCFA, CDC) and documentation produced from the transcription process.

Slide 29

What is needed?

XML and Health Care
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- Standardization of clinical document types in XML DTDs and in future versions of DTDs as specified by the W3C
- Acceleration of the future DTD syntax specification process
- Standardization in XML of Government forms (HCFA 1500, CDC Surveillance forms)
- Common set of XML tags and attributes for clinical information
- Development of XML stylesheets

NCVHS, March 29, 1999 29

Efforts to create DTDs and stylesheets for the documents in the Patient Medical Record are newly formed activities of ASTM and not much progress has been made in their short lifetimes. The new DTD syntax specified by the W3C will greatly impact the future of structuring XML document and the rules about constructing documents. Additionally, DTDs for common forms from the government should be available. There is a need for standardization among tag names. Different standards may create their own tag names and HL7 tag names might differ from ASTM. At the very least, a facility needs to be provided for mapping XML tags to different coding systems and to other tag names that mean the same thing.

Slide 30

Role of the Government

XML and Health Care
XML and Health Care

- Resources to accelerate the ASTM E31.25 Effort
- Resources to accelerate the future DTD syntax specification process
- Creation of DTDs for standard Government Forms (HCFA 1500, CDC Surveillance etc.)
- An organization that facilitates communication among the various XML efforts (HL7, ASTM, XML-EDI) for a common PMR XML knowledge source
- An oversight organization that is a repository and information provider for DTDs, tag names and stylesheets, code mappings
- A facility for verifying that PMRI documents conform to the standard

NCVHS, March 29, 1999 30