Validation of an XML-Based Process to Automatically Web-Enable Clinical Practice Guidelines: Experience with the Smoking Cessation Guideline

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Objectives. *To validate the ease by which a Clinical Practice Guideline (CPG) can be web-enabled using an XML-based semi-automated process.* ***Design and Implementation.*** *An XML DTD for Clinical Practice Guidelines and an MS Word authoring template were created in an earlier project. We took an existing guideline, Bedside Smoking Cessation Intervention, placed it into the MS Word template, converted it into XML, and then to HTML for deployment over the Kaiser Permanent intranet.* ***Conclusions.*** *We were able to use the MS Word authoring template and automatically generate both an XML representation of our guideline, and an HTML representation, which we have deployed on our intranet. The Bedside Smoking Cessation Intervention guideline was automatically merged into the online guidelines collection. Placing it on our intranet allowed for rapid and easy access by physicians and other health care providers throughout the Kaiser Permanente Medical Care Program.*

INTRODUCTION

An implementation approach was developed at Kaiser Permanente that utilizes widely available tools and Internet technology to translate our clinical practice guidelines (CPG) into XML and HTML format[1,2]. We helped validate the ease of use and successful implementation by subjecting our Bedside Smoking Cessation Intervention (BSCI) CPG to this process. This allowed it to be placed on the Kaiser Permanente intranet alongside the other guidelines, all of which are available to any computer nationwide that is connected to Kaiser Permanente's national intranet.

CPGs are systematically developed statements to assist medical decision-making as to appropriate health care for specific clinical conditions[3]. Compliance with clinically valid and scientifically based guidelines may improve patient outcomes[4]. Development of CPGs without attention to implementation may result in little or no appreciable change in physician behavior or patient outcomes. Effective implementation, dissemination and ease of use of CPGs require a multi-modal approach, especially strategies utilizing evolving technology[5-6].

OBJECTIVES

As we enter the 21st century, clinical practice guidelines are having an increasing impact on the standardization and quality of patient care. CPGs represent the state of knowledge, current at the time of their publication. With on-going changes in the state of scientific information and technology, periodic review, updating and rapid revision is necessary in order for the CPGs to be of value in patient care. We needed a way to easily disseminate our CPGs. Preferably one that is easy to use, standardized and easy to revise. Our intranet, and our computerised medical records as currently planned meet these criteria.

BACKGROUND

XML (Extensible Markup Language) (www.w3.org/TR/1998/REC-xml-19980210.html) reduces a document to words in a known context-free grammar through a process of markup. The formal markup specification for a collection of documents is called a Document Type Definition (DTD). Documents are then written to conform to a particular DTD, enabling them to be automatically parsed and validated against that DTD. XML is a proper subset of SGML (Standard Generalized Markup Language, ISO 8879:1986), meaning that all valid XML documents are SGML documents. More information on SGML and XML can be found in the references[7-8].

In January 1997 an XML DTD and corresponding MS Word authoring template were created to

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facilitate automated representation of our CPGs. CPGs, once in the MS Word template, can be automatically converted into XML. From there, they can be automatically converted into HTML for deployment over the web. The web-based search engine understands the XML structure and enables context-sensitive search and retrieval by web users. The Smoking Cessation Intervention (SCI) CPG was used by us to pilot and externally validate the use of this process within the Kaiser Permanente Southern California Medical Care Program (KPSC).

The Smoking Cessation Intervention CPG was first introduced to KPSC in Orange County, California in 1987. A specific CPG for Bedside Smoking Cessation Intervention (BSCI) was developed in 1994. The BSCI was designed to provide high-risk (Coronary Artery Disease and Chronic Obstructive Pulmonary Disease) hospitalized patients with timely bedside intervention and to update KPSC physicians regarding the latest smoking cessation recommendations and literature. It was this CPG that was piloted for external validation. The impact of the SCI program made wide physician access to the guideline desirable. Every physician within KPSC has a computer that allows them instantaneous and at will access via the Kaiser Permanente Intranet. Once successful, the CPG was expanded to include the entire SCI program.

The SCI guideline is a standardized treatment protocol. A summary of the recommendations include:

1. These recommendations are endorsed by the Regional Smoking Task Force, Kaiser Permanente Southern California.
2. Identification and documentation of tobacco use by all adult patients admitted to any hospital service.
3. A physician orders a Bedside Smoking Cessation Intervention on all identified inpatients.
4. Pediatricians may order Bedside Smoking Cessation Intervention for hospitalized children whose parent(s) smoke(s.)
5. Patients should be assessed as to readiness to change, cultural barriers, comprehension, medical history, smoking /nicotine patch history, and sociodemographic factors.
6. Appropriateness for nicotine patch therapy should be based on medical condition, weight (over 100 lb), and smoking history at admission.
7. Dosage of the patch: 14 mg/24 hr for non-high risk patients; 7 mg/24 hr. for CAD in selected patients (i.e. weight < 100 lb.; smokes < 1 pkg. per day).
8. Dosage of Zyban: 150 mg daily pre-discharge in selected patients.
9. Documentation of all smoking cessation educational intervention in the medical chart.
10. Written referral at discharge to Health Education for continued educational intervention , monitoring of medications and medication refills.

The guideline allows easy dissemination of the latest recommendations and literature relating to all aspects of smoking cessation including office advice, referral to educational programs and the use of Nicotine Replacement Therapy (Table A) and Bupropion HCl (Table B).

Table A: Suggestions on the Clinical use of Nicotine Patch

PATIENT SELECTION	Nicotine Replacement Therapy (NRT) is appropriate as a primary "pharmacotherapy" for smoking cessation for designated populations.
PRECAUTIONS	***Cardiovascular Diseases*** - although not an independent risk factor for acute myocardial events, the nicotine patch should be used only after consideration of risk and benefits among particular cardiovascular patients: those in the immediate (within 4 weeks) post myocardial infarction period, those with serious arrhythmias and those with severe or worsening angina pectoris. ***Respiratory Disease*** - The nicotine patch should be considered as part of the treatment for any patient with COPD or lung cancer as soon as the physician feels it is medically appropriate
CRITERIA	Nicotine patch treatment during hospitalization with continuous application immediately post discharge, has been shown to be quite effective in reducing the smokers' tendency to relapse. Physicians should consider individualized nicotine treatment based on the patient's "readiness" to quit, weight (over 100 lb.),

	amount smoked (>1 pkg./day), previous experience with the patch, reason for hospitalization (CAD, surgery, COPD, medical, etc.), history of severe skin reactions to adhesives, and degree of addictiveness.
DOSAGE	The following treatment schedule is suggested as reasonable for most smokers during hospitalization: Brand Dosage Habitrol 14mg./ 24 hr. for non-high risk patients Habitrol 7mg./ 24 hr. for high risk CAD patients ***All Patients using the patch at discharge are to be referred to Health Education for additional outpatient education and monitoring

Table B: Suggestions on the Clinical Use of Zyban (Bupropion HCl) for Smoking Patients

PATIENT SELECTION	Zyban is an appropriate pharamacological adjunct therapy for smoking cessation in selected populations
PRECAUTIONS	Zyban is contraindicated in patients with seizure disorders and in patients treated with Wellbutrin ®, Wellbutrin SR™, or any other medication that contains bupropion as the incidences of seizure is dose dependent. Zyban is contraindicated in patients with a current or prior diagnosis of bulimia or anorexia nervosa. The concurrent administration of Zyban and MAO inhibitor is contraindicated. Zyban is contraindicated in patients who have shown an allergic reaction to bupropion.
CRITERIA	Physicians should consider Zyban therapy in patients who smoke ½ -¾ packs of cigarettes per day; have tried to formally quit smoking > 2 times; have a contraindication to the nicotine patch.
DOSAGE	Suggested maximum dose of Zyban is 150mg/daily pre-discharge. If the 150mg/day is adequately tolerated, the dosage maybe increased to the recommended dose of 150mg BID with continued physician monitoring for adverse reaction(s). **Note:** research has indicated that the use of Zyban plus the nicotine patch (14mg or 7mg) has a higher success rate than with Zyban alone. In the outpatient setting, it is recommended that patients are treated with Zyban for 7-9 weeks.

METHOD

A 'Guideline for Guidelines' was developed, which "simplified the explicit structure and content of CPGs and enabled the automatic translation of the CPG's", written in MS Word format, into documents that can be placed on an Intranet or the Internet. Kaiser Permanente's web-based CPG site went live in March, 1998.

The CPG DTD was defined based on an analysis of existing guideline documents, consultation with our own guideline experts, and an analysis of commonly used XML tags for the representation of typical document components, such as tables and lists.

The CPG template, developed by KPSC in January 1997, allows for uniformity and consistency in content and presentation of CPGs; rapid deployment – wide instant access to approved guidelines; scaleable methodology – development of processes that can be readily adopted by other regions; minimization of human effort – templates and computer program support for all aspects of the process; consistency with existing rules for the structure and content of CPGs; and utilization of a standard file format- documents created by this process can be stored in an application-independent persistent form.

The SCI- CPG used a global subjective judgment methodology consisting of a panel of practitioners drawing on personal knowledge, experience, and judgment. The panel reviewed the literature,

discussed the pros and cons of different interventions and reached a consensus about the appropriate practice.

All CPGs are developed with physician input and approved by every stakeholder group who will be involved in the use or interpretation of the guideline. The multidisciplinary involvement is an essential part of the equation.

RESULTS

The BSCI-CPG document was successfully automatically converted into Web based documents. The CPG was then made available on our intranet. Later the entire SCI-CPG was also automatically converted and a new guideline for Bupropion HCl was added, All of these were taken from MS Word documents.

The conversion of the SCI-CPG into HTML format was an early pilot test of the effectiveness of this innovative system. The SCI-CPG had previously existed as a stand-alone MS Word document. It took ten minutes to move the CPG into the template. From there, the rest of the process to move it into XML and then into HTML was automatic, requiring no human intervention. The Guideline for Guidelines worked and the CPG's are now available online to all physicians in KPSC, right alongside the other CPGs.

The use of XML has enabled the automatic creation of a table of contents, a list of all tables and figures , a context-specific full text index, and an outline of each guideline.

CONCLUSIONS

We found that a CPG could be easily web-enabled by following a process based on the XML standard. This process has enabled us to achieve rapid wide-spread deployment, consistency in content and presentation between this guideline and the others included in the guideline collection, enhanced search and retrieval, and an application-independent persistent format.

We are currently enhancing our CPG DTD. We are examining external CPG representation standards, particularly the Medical Core Metadata set[9], and anticipate that our CPG XML document headers will contain a superset of the Medical Core metadata. We are also pursuing internal national consensus building so that guidelines and other clinical documents developed throughout the organization nationally will share a common representation[10].

Our next challenge will be to document the utilization of the CPGs and their impact on the quality of care. We plan to eventually tie them into our computerized medical records via decision support systems.

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